MOL.19961114.0137

CRWMS/M&O

Design Analysis Cover Sheet

Complete only applicable items.

① QA: L

Page: 1 Of: 22

2. DESIGN ANALYSIS TITLE

ESF GROUND SUPPORT - STRUCTURAL STEEL ANALYSIS (SCPB: N/A)

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABEE0000-01717-0200-00003 REV 02

4. TOTAL PAGES

22

5. TOTAL ATTACHMENTS

10

6. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH

I-174, II-62, III-124, IV-3, V-6, VI-9, VII-10, VIII-27, IX-19, X-33

	Printed Name	Signature	Date
7. Originator	Thomas Misiak	M.E. Taylor for	6-26-96
8. Checker	Matthew Gomez	J Salehak for	6-26-96
9. Lead Design Engineer	M. E. Taylor, Jr.	M.E. Taylor Jr	6-26-96
10. QA Manager	H. GRIFFITH	Hyde Griffith	6/26/96
11. Department Manager	J. L. Naaf		6-26-96

12. REMARKS

1. TBV-193-ESF: Seismic design values for steel sets to be verified.
2. TBD-147-ESF: Thermally-induced stresses in the steel sets (or lining) to be determined.
3. TBD-154-RDR: Upgrades (if needed) to linings and ground supports due to a credible explosion and fire will be determined after completion of risk assessment.
4. TBV-069-DD: Rock mass strength estimates for TSw1 and TSw2 (for all rock categories 1-5) are non-qualified and to be verified.
5. TBV-073-DD: Depth of stations analyzed in Reference 5.20 to be verified and may affect rock loads.
6. TBD-146-ESF: Thermal load requirements to be determined later for design of steel sets.

CRWMS/M&O

Design Analysis Revision Record

Complete only applicable items.

①

2. DESIGN ANALYSIS TITLE

ESF GROUND SUPPORT - STRUCTURAL STEEL ANALYSIS

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABEE0000-01717-0200-00003 REV 02

4. Revision No.	5. Description of Revision
02	Main body of analysis: Miscellaneous editorial revisions. Revised sections 4.2, 7.1, 7.7, 8.3 to reflect the ESFDR changes. Revised Section 6.5 to include Software Configuration Management. Revised sections 8.7.3 III.E and 8.7.10 to reflect changes made to the W8 x 31 baseplate offset and finite element analysis. Revised Section 8.5 E to reflect changed tie rod spacing. Attachment III: Deleted pages III-63 and III-64, (replaced by III-65) and pages III-73, III-74, and III-75 (stiffeners not required). Revise page III-60 for hole size. Revised pages III-65, III-67, III-68, III-69, III-70, III-71, and III-72, to reflect the 3/4-inch chamfer of the concrete invert segment curb. Revised page III-76 to delete stiffners. Revised pages III-82, III-83, and III-84, to reflect 3/4-inch chamfer and determine offset based on bearing pressure. Revised page III-102 to reflect changed fillet weld thickness. Revised page III-113 to remove shear tab. Attachment VII: Revised pages VII-3 and VII-4 to reflect changed tie rod hole group spacing and tie rod spacing. Attachment IX: Revised page IX-6 to reflect changed tie rod hole group spacing and tie rod spacing. Revise page IX-16, IX-17, and IX-18 to remove stiffners. Attachment X: Revised entire contents to reflect the 3/4-inch chamfer of the concrete invert segment curb.

1. PURPOSE

1.1 The purpose and objective of this analysis are to expand the level of detail and confirm member sizes for steel sets included in the Ground Support Design Analysis, Reference 5.20. This analysis also provides bounding values and details and defines critical design attributes for alternative configurations of the steel set. One possible configuration for the steel set is presented. This analysis covers the steel set design for the Exploratory Studies Facility (ESF) entire Main Loop 25-foot diameter tunnel.

1.2 This analysis includes design calculations for the following ground support structural members, components, and features. Also included are associated tolerances, design sketches, and computer output data (attachments where calculations are found are in parentheses after each item):

A. Steel Sets (I, III.A and VIII)
B. Steel lagging (III.B)
C. Tie rod and pipe spacer (III.D)
D. Steel set foot plate (III.E)
E. Steel set connection to insert (III.G)
F. Connection between steel set segments (III.G)
G. Inserts (III.C)
H. Steel set foot segments (III.H and III.I)
I. Shim plates (III.K)
J. Steel wedges (III.L)
K. Jacking bracket assembly and bolted connection to steel set (III.C and VI)
L. Tolerances (VII)
M. Summary of Design Sketches (IX)
N. FLAC Computer Output (II)

2. QUALITY ASSURANCE

2.1 The quality assurance (QA) classifications for structural steel ground support in this analysis are presented in QA Classification Analysis of Ground Support Systems, Configuration Item (CI): BABEE0000 (Reference 5.5).

2.2 The following structural steel ground support components are permanent and are classified QA-1 and QA-5:

A. Steel set
B. Steel lagging
C. Tie rod and pipe spacer
D. Steel set foot plate
E. Steel set connection to insert
F. Connection between steel set segments
G. Insert

H. Steel set foot segments
I. Shim plate

2.3 Wedges, blocking, backfill or other materials placed in voids to transfer the rock load to the steel sets are considered to be non-quality affecting. (In commercial tunnels, blocking and wedges are typically made from timber; material strength is not considered to be a critical parameter.) These materials can be thought of as a substitute for rock originally occupying the void space, for which there is no relevant QA classification.

2.4 The following structural component is temporary and is not subject to the requirements of the project QA program: jacking bracket assembly and bolts used for the connection to steel set.

The jacking brackets and connection will be used during installation of steel sets only. Since the brackets have no permanent ground support function, they are not considered important to waste isolation or radiological safety.

3. METHOD

3.1 The steel set is analyzed for two basic conditions:

3.1.1 Installation/jacking process associated with erecting the steel sets after the ground has been excavated by the tunnel boring machine (TBM)—the computer software STAAD-III/ISDS (See Section 6, Use of Computer Software) is used to analyze steel sets and verify size of steel members as noted in Section 3.2.

3.1.2 Long-term rock load condition—the long-term rock load analysis, including utility and seismic loads, was determined in ESF Ground Support Design Analysis (Reference 5.20). The resulting forces and moments were then used for the design of the steel set and components, noted in Section 3.2.

3.2 The steel set and other components listed in Section 1.2 are designed by hand calculations and computer analyses using the results of the ESF Ground Support Design Analysis (Reference 5.20) outputs, installation/jacking loads, and other inputs listed in Section 4.

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

4.1.1 Seismic - Mean Peak Horizontal and Vertical Acceleration = 0.37g (TBV-193-ESF). (Appendix A, Page A-2, Table A-2, Reference 5.16).

4.1.2 Rock Mass Properties (Reference 5.20, Pages 5 through 10) as used in design of lagging (Attachment III.B):

Geologic Unit	**Mean Density**		**Minimum Friction Angle**[(1)]
	Kg/m³	**lb/ft³**	
TCw	2115	132	53°
PTn	1268	80	40°
TSw1	2207	138	41°
TSw2	2257	141	49°

(1) Friction Angles are non-qualified data (TBV-069-DD)

4.1.3 Precast Concrete Dimensions - Drawings (References 5.7 and 5.8). Dimensions used in this analysis were:

- Curb face angle = 31.01° (±) 0.02°
- Invert segment width = 48 in. (1220 mm)
- Curb width = 7 ½ in. (191 mm) (Bearing width = 7 ½ in. - ¾ in. = 6 ¾ in)
- Chamfer ¾ in. (19 mm) on front of curb face
- Notch dimension on back of curb face = ½ in. x 3 in. (13 mm x 76 mm)
- Minimum side cover on bars = 1½ in. (38 mm)
- Base thickness = 28⅛ in. (715 mm)
- Curb rebar is as shown on References 5.7 and 5.8

4.1.4 The configuration of the steel sets was developed through numerous meetings and discussions between the Architect/Engineer (A/E) and Constructor and previous revisions of this analysis. Details were refined to accommodate construction methods and the installation processes.

4.1.5 The dimensions for the jacks used in this analysis for the design of the jacking bracket are from References 5.18 and 5.19 and are as follows (see Attachment VI):

25 ton jack for W8 steel set and 15 ton jack for W6 steel set:

Feature	**25 Ton Jack (W8)**		**15 Ton Jack (W6)**	
	HSR-258T	**HSR-2510T**	**HSR-156T**	**HSR-1510T**
Capacity	25 Ton	25 Ton	15 Ton	15 Ton
Stroke	8¼ in.	10¼ in.	6 in.	10 in.
Closed Height	12¾ in.	14¾ in.	10 11/16 in.	14 11/16 in.
Body Dimension	3⅜ in.	3⅜ in.	2¾ in.	2¾ in.

4.1.6 ESF Tunnel Main Loop maximum grade is 2.567 percent (Reference 5.12).

4.1.7 Not used.

4.1.8 Not used.

4.1.9 ESF Tunnel Main Loop Diameter = 7.62 meters (25 feet) nominal (Reference 5.12).

4.1.10 Force results in steel set from ESF Ground Support Design Analysis (Reference 5.20). Axial forces, moments and shears are provided at various locations (nodes) throughout the steel set. This output from Reference 5.20 has been included as Attachment II to the analysis.

4.1.11 Not used.

4.1.12 Specified Compressive Strength of Concrete f'c = 34.5 MPa (5,000 pounds per square inch [psi] Reference 5.21).

4.2 CRITERIA

The following design criteria, applicable to this analysis, were developed in response to requirements in the Exploratory Studies Facility Design Requirements (ESFDR) document (Reference 5.16).

4.2.1 The permanent and temporary components of the ESF structural steel ground support system shall be designed to withstand the applicable seismic environment specified in Appendix A of the ESFDR. The seismic loads were determined in the analysis of Reference 5.20 (also see Attachment II), and the steel sets were designed (Attachment III) to withstand these loads (ESFDR 3.2.1.2.1.2.A).

4.2.2 ESF non-permanent structural steel ground support items shall be designed for a 25-year maintainable service life. ESF permanent structural steel ground support items shall be designed for a 150-year maintainable service life. These criteria are addressed (see Section 7.1) by the selected design of the steel sets and accessories using exposed carbon steel W-shape bolted ring beams with channel lagging which allow for ease of accessability for maintenance and/or replacement (ESFDR 3.2.1.2.2.A and B).

4.2.3 The ESF structural steel ground support system shall be designed in compliance with the applicable requirements contained in DOE Order 6430.1A. The applicable criteria, i.e., Division 1 (General Requirements), Sections 0111-1 (General), 0111-2 (Loads), 0111-3 (Structural Systems for Buildings and Other Structures), 0111-99 (Special Facilities); Division 5, Sections 0512-1 (Structural Steel for Buildings and Other Structures), and 0532 (Metal Fastenings); and Division 13, Sections 01300-1 (Coverage and Objectives), and 01300-3.2 (Safety Class Items) are addressed throughout this analysis (ESFDR 3.2.1.2.4.C).

4.2.4 Records shall be developed and maintained, including as-built documentation, for location and description of the ESF structural steel ground support systems. This criterion is addressed in Section 7.1 with appropriate requirements for as-built documentation to be furnished by the Constructor included in the construction specification for the steel sets (ESFDR 3.7.1.2.B).

4.2.5 The ESF structural steel ground support system will support the testing requirements. This criterion is addressed (see Sections 7.1 and 7.7) by spacing and configuring the steel sets and lagging to allow access to the rock, as needed, to accommodate testing requirements (ESFDR 3.7.3.1.A).

4.2.6 The ESF structural steel ground support system will be compatible with the excavation methods and equipment. This criterion is addressed (see Section 7.1) by selecting a steel set and lagging system that is compatible with the tail shield configuration of the Tunnel Boring Machine (TBM) (ESFDR 3.7.3.1.D).

4.2.7 The ESF structural steel ground support system shall incorporate the use of noncombustible and heat resistant materials in the design. This criterion is addressed (see Sections 7.1 and 7.7) by specifying carbon steel for all permanent components of the steel set assemblies (ESFDR 3.7.3.1.E).

4.2.8 The ESF structural steel ground support system shall limit the use of selected tracers, fluids, and materials. This criterion is addressed (see Sections 7.1 and 7.7) by limiting the use of cementitious, organic, and combustible materials. Carbon steel is used as the primary ground support material, and the use of wood wedges and blocking is minimized and will be recovered to the extent practical (ESFDR 3.2.1.2.3.B).

4.2.9 The ESF structural steel ground support system shall be designed to permit periodic inspection, monitoring, testing, and maintenance, as necessary to evaluate their readiness and to ensure continued function. In addition, the ESF structural steel ground support system will be designed and installed throughout the main access openings and all alcove transition zones to reduce the potential for deleterious rock movement or fracturing. This criteria is addressed (see Sections 7.1 and 7.7) by the selection of bolted structural steel sets, lagging and accessories for the primary ground support system under the worst case rock load conditions. In addition, Reference 5.20 analyzes the potential for deleterious rock movement or fracturing. Finally, the ground support system, once installed, will be readily accessible for routine observation, maintenance, and/or replacement in whole or in part to ensure continued function (ESFDR 3.7.3.1.F and G).

4.2.10 The ESF structural steel ground support system shall be designed to accommodate anticipated ground conditions utilizing available site data, to have the capability to be supplemented as required when identified through additional site characterization data and analyses, and to have sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions encountered during excavation or identified through in situ monitoring and testing. These criteria are addressed (see Section 7.1) by the selection of bolted structural steel sets, lagging and accessories for the primary ground support system under the worst case rock load conditions as developed in Reference 5.20. In addition, this type of ground support system provides flexibility by allowing adjustment to the supports (or supplementing the supports with additional supports as needed) to accommodate rock conditions encountered (ESFDR 3.7.3.1.I, J, and K).

4.2.11 The ESF structural steel ground support system shall be designed to meet predicted thermal and thermomechanical response of the host rock, surrounding strata, and groundwater system for the site characterization heater tests. This criteria will be addressed when thermal load criteria have been established (TBV-146) as a result of the heater alcove tests. Thermal effects will be incorporated into the Reference 5.20 analysis, and then translated into changes to the design of the steel sets and accessories, if needed (ESFDR 3.7.3.1.L).

4.3 ASSUMPTIONS

4.3.1 Not used.

4.3.2 Not used.

4.3.3 Not used.

4.3.4 Not used.

4.3.5 Not used.

4.3.6 Credible fire and explosion design bases for the repository design are to be determined (TBD-154-RDR). However, the design of the steel sets for the ESF does not preclude the future incorporation of design features which would mitigate the effects of a credible fire or explosion in the repository.

4.4 CODES AND STANDARDS

4.4.1 American Concrete Institute (ACI)

ACI 318-89	Building Code Requirements for Reinforced Concrete (ACI 318-89, Revised 1992) and Commentary (ACI 318R-89, Revised 1992).
ACI 301-89	Specifications for Structural Concrete for Buildings

4.4.2 American Institute of Steel Construction (AISC)

AISC M016-89	AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition (First Revised Printing, January 1991)

4.4.3 American Society of Mechanical Engineers (ASME)

ASME B18.5-90	Round Head Bolts (Inch Series)

4.4.4 American Society for Testing and Materials (ASTM)

ASTM A6/A6M-94a	Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
ASTM A36/ A36M-94	Standard Specification for Carbon Structural Steel
ASTM A53-94	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A307-94	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A325-94	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 kips psi ksi Minimum Tensile Strength
ASTM A490-93	Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A563-94	Standard Specification for Carbon and Alloy Steel Nuts
ASTM F436-93	Standard Specification for Hardened Steel Washers

4.4.5 American Welding Society (AWS)

AWS A5.1-91	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1-94	Structural Welding Code-Steel, Thirteenth Edition

4.4.6 Not used.

4.4.7 Not used.

4.4.8 United States Department of Energy (DOE)

DOE 6430.1A General Design Criteria

5. REFERENCES

5.1 Subsurface Fire Hazard Analysis, BABFAH000-01717-0200-00121 REV 00.

5.2 Impact Review Action Notice, J. Pye to D. Rogers, August 2, 1995.

5.3 Commercial Pantex Sika, Inc. Catalog, Structural Steel Supports, no date.

5.4 Subsurface General Construction, BAB000000-01717-6300-01501 REV 04.

5.5 QA Classification Analysis of Ground Support Systems (CI: BABEE0000), BABEE0000-01717-2200-00001 REV 02.

5.6 Not used.

5.7 Rail Placement Invert Segments - B, Plan & Sections, Drawing BABFCC000-01717-2100-41100 REV 03.

5.8 Rail Placement Invert Segments - A, Plan Sections & Details, Drawing BABFCC000-01717-2100-41099 REV 03.

5.9 Not used.

5.10 *Software Requirements Document for Structural Analysis and Design/Integrated Structural Design System* (STAAD-III/ISDS), Version 4-8 MB, Rev. 16.0, Computer Software Document Number: SRD-02, Revision 0, Computer Software Configuration Item (CSCI) Number 20.93.3002-AAU4-8MB.

5.11 Not used.

5.12 ESF Layout Calculation, BABEAD000-01717-0200-00003 REV 03.

5.13 Not used.

5.14 Not used.

5.15 Retrieval Conditions Evaluation, BCA000000-01717-5705-00003 REV 00.

5.16 Yucca Mountain Site Characterization Project, *Exploratory Studies Facility Design Requirements*, Rev. 02, YMP/CM-0019.

5.17 Beer, F. P. and E. R. Johnston, Jr., Vector Mechanics for Engineers STATICS AND DYNAMICS, McGraw-Hill, NY, 1962.

5.18 Simplex Catalog SC101, Hydraulic and Mechanical Power, 1995.

5.19 TK SIMPLEX Catalog, Hydraulic and Mechanical Jacks for Industry, 1990.

5.20 ESF Ground Support Design Analysis BABEE0000-01717-0200-00002 REV 00 (TBV-069-DD, TBV-073-DD, TBD-146-ESF and TBD-147-ESF).

5.21 Precast Concrete Specification, BABFCC000-01717-6300-03480 REV 00.

5.22 Non-Gassy Mine Classification Analysis, BABE00000-01717-0200-00115 REV 00.

6. USE OF COMPUTER SOFTWARE

6.1 Basis for Computer Use: The steel set (W8 or W6 shape) is a symmetrical arch frame which is a statically indeterminate structure subject to a variety of loading conditions. The general approach to the problem of analysis of statically indeterminate structures with different loading conditions is to utilize the accuracy and speed of the computer to efficiently derive the forces, reactions and moments for the steel set and the size of the W8 or W6 shape using an appropriate indeterminate structural analysis.

6.2 Computer inputs and outputs are presented in Attachments I and II. The steel set W8 or W6 shape is analyzed and initially checked by computer in these attachments. The initial computer check is verified by hand calculation. The permanent attachments and connections are designed by hand calculations (Attachment III) using the maximum axial forces, shears, and moments from the computer analysis output.

6.3 Computer hardware used for this analysis - IBM Compatible 486/33 MHz.

6.4 STAAD-III/ISDS, Version 4-8MB, Rev. 16.0 (Reference 5.10), CSCI No. 20.93-3002-AAu4-8MB, is the computer software used for this analysis. The computer software has been validated, verified, and controlled in accordance with applicable Management and Operating Contractor procedures.

6.5 The computer software used in this analysis is appropriate for this application since the STAAD-III program was specifically selected and validated for the purpose of analyzing and designing the steel sets and accessories. The program was used within the validated range as described in the verification and validation documentation. The program was obtained from Software Configuration Management in accordance with appropriate procedures.

6.6 Attachment II contains results of computer runs presented in Reference 5.20. For FLAC Version 3.22 Verification and Validation (V&V) information, see Reference 5.20.

6.7 In addition to the software noted above (STAAD-III, FLAC), computational support software as defined in Quality Administrative Procedure, QAP-SI-0, *Scientific and Engineering Software*, used in this analysis was Lotus 1-2-3, Release 4 for Windows. The spreadsheet feature of Lotus 1-2-3 was used in Attachment III.I to tabulate and perform repetitive calculations for shear and sliding resistance calculations at the base of the steel sets. User defined formulas, inputs and results are shown in the attachment. Also, WordPerfect Release 5.2+ for Windows was used throughout the analysis to tabulate data (no calculations) and present information.

7. DESIGN ANALYSIS

7.1 INTRODUCTION

Steel sets comprised of wide-flange structural shapes have been selected as an appropriate ground support system (including general configuration and spacing) in the ESF Ground Support Design Analysis (Reference 5.20).

The ESF ground support structural steel analysis is based on two conditions. The first condition is the installation/jacking process associated with erecting the steel sets after the ground has been excavated by the TBM. The second condition is the long term operating conditions for the steel set, which includes the long term rock loading and the various utility service support loads. Of these two conditions, the second (Reference 5.20) establishes the starting point for the analysis of the structural steel.

The circular shape of the steel set is based on the excavated diameter of the tunnel as set by the TBM. Spacing of the steel sets was established (in Reference 5.20) at 1.22 m (4 feet) center to center, nominally, based on construction and equipment limitations associated with the weight and size of the ground support segments and nominal steel set sections commonly associated with a tunnel of this size and the excavation method. Where weaker ground is encountered requiring heavier steel support, the spacing of the steel sets is reduced to 0.61 m (2 feet). With this reduced spacing the steel set configuration would remain the same as that used at 1.22 m (4 feet) spacing, but the lagging span would decrease to provide a stronger support system for the higher rock loads.

The configuration of the steel set used in this analysis was developed during (undocumented) review meetings between the A/E and Constructor and previous revisions of this analysis. A multiple piece set was selected to facilitate handling and erection within the tunnel. The steel set was configured into three large segments (one crown segment and two wall segments) and two small segments, i.e., the foot segments (see Steel Set Detail, Alternate I, Attachment IX). The three large segments provide ground support for the tunnel crown and walls. The two small segments are an extension of the wall segments and have a foot plate on one end that rests on a precast concrete invert foundation. An insert and shims or shims alone are placed between the wall segments and foot (small) segments upper plates during expansion of the steel set. As an alternative steel set configuration (see Steel Set Detail, Alternate III, Attachment IX), the two wall segments are extended and the two foot segments that rest on the precast concrete invert foundation are reduced. Inserts and shims are placed between the wall segments and the foot segment upper plate during the expansion/jacking process.

As shown in Attachment IX, Alternate I consists of a longer foot segment with a jacking bracket near the upper end. A similar jacking bracket is attached to the lower end of the wall segment. The brackets are aligned such that the reaction line of the jacking force passes through the center part of the foot segment base plate, thus eliminating any eccentricity on the foot segment base plate and ensuring stability of this member for personnel safety during the jacking operation. In addition, only shim plates are used between the foot segment and the wall segment.

Alternate III in Attachment IX represents the jacking bracket design as used in the tunnel to date. This configuration requires an insert segment and shim plates between the foot segment and wall segment. The jacking brackets, though similar in design to Alternate I, are aligned such that an eccentric load is applied to the foot segment. To counteract this load and to ensure stability of the foot segment during jacking, a leg was added to the base plate to engage the inner face of the invert segment curb.

The final configurations of the steel set with detailed dimensions as analyzed herein are shown in Attachment IX. The configuration shown will provide relatively unrestricted access to the host rock to accommodate the needs of the testing community. The use of bolted carbon steel sets will also provide a ground support system compatible with the anticipated configuration of the repository. In addition, as shown in this analysis, the steel set system will control the configuration and stability of the opening, will protect personnel and equipment against potential falls of loose rock, will reduce the potential for deleterious rock movement or fracturing, and will be compatible with the excavation methods and equipment (TBM).

The tunnel is judged to not be a corrosive environment because of the generally dry conditions (Reference 5.15, Section 6.3.2.2), therefore corrosion allowance beyond reserve capacity of the steel members is not considered necessary.

Although individual steel sets cannot be guaranteed to last for the design life of 150 years they have been designed for a "maintainable life" of 150 years. This means that steel sets exhibiting obvious signs of deterioration or distress can accommodate removal and replacement either with other steel sets of like kind or with other means of ground support. Similarly, the steel sets as presently designed do not preclude future methods of rock support for repository loads, e.g., a concrete lining with steel sets remaining in place as non-functioning members.

It should be noted that the detailed configuration of the steel sets and accessories as presented in this analysis represent only a few of the many acceptable alternatives that could be considered for steel sets to be used in the ESF. The Constructor will be encouraged to develop and submit alternative details to facilitate construction, which will be subject to A/E approval, as long as the critical attributes as identified in Section 8.5 are met. In addition, the construction specifications will require that the Constructor develop and maintain records, including as-built documentation, for location and description of all structural support systems, e.g., steel sets.

7.2 STEEL SET JACKING

The purpose of jacking the steel set is to bring the profile of the steel set and lagging into positive contact with the excavated profile to support rock loads resulting from the excavation process. The steel set was analyzed to establish the maximum jack forces for the jacking operation based on the jacking bracket configuration as depicted in Attachment IX. A (STAAD-III) computer analysis was performed to determine the effects of various jacking forces: 50^T, 30^T, 25^T, 20^T, and 15^T on the steel set and what the resulting stress ratios were for these forces using the AISC code check option of the STAAD-III software. Simultaneous jacking and one-sided jacking were analyzed to determine the governing condition. The computer input files and output results for jacking conditions are presented in Attachment I for the W8 x 31 and in Attachment VIII for the W6 x 20. The explanations of the loading conditions including loading points in the model, loading values and location of supports are presented in detail in Attachment I.

The jacking analysis used a structural model of the steel set with joints and members that accurately describe the steel set configuration as presented in Attachment IX. Supports/contact points were modeled to reflect the steel set's behavior during the jacking process. At the initial stage of the jacking operation, the steel set starts to make contact with the tunnel walls that provide horizontal support for the steel set from the bottom to about the spring line level. The distance between these horizontal supports is modeled to be at each fifth node (about 6 feet, engineering judgement based on observed field conditions), which conservatively reflects the positive contact requirements for steel set installation. No vertical support is provided below the spring line due to the fact that the steel set is moving upward during the jacking operation and only supports above the spring line could restrain this movement. As the jacking force increases, more contact is made at about mid distance between the spring line and the crown where the support has a horizontal as well as a vertical component. In the final stage, the crown makes contact with the steel set providing the vertical restraint required, which is represented in the model by two vertical supports close to and symmetric about the crown.

The self weight of the steel set was increased in the analysis to account for the additional weight of lagging and other components. No frictional forces were considered as part of the jacking analysis to ensure that the results were conservative and maximum stress for design could be obtained. The relative conservatism of the results is indicated by comparing preliminary strain gage data from the steel sets to design stresses (see Attachment IV).

7.3 LONG-TERM ROCK LOADING AND UTILITY SERVICES

The long-term rock loading analysis results (including utility and seismic loads) are included in Attachment II and were determined in Reference 5.20.

7.4 DESIGN SELECTION PROCESS

The analyses to support the design selection/confirmation process for the structural members, components, and attachments (outlined in Section 1.2) are presented in detail in Attachments I, III, and VIII. Calculations for all structural members, components, and attachments are presented under appropriate headings (with a reference to representative subsection in Section 1.2) in those attachments. A summary of the conclusions from all attachments are found in Section 8.7.

7.5 BOLTED CONNECTIONS

Requirements for bolted connections using ASTM A307 (as a minimum) are provided below:

> The bolted connections in this analysis were determined to be not slip-critical based on the fact that there is little impact, vibration, repetitive loads, load reversals, or high tensile forces in the steel set connections that would tend to reduce the friction between the joint plates (AISC M016, p. 5-270, Paragraph 5[a]). For this reason, torquing of the bolts will not be necessary beyond what AISC refers to as a "snug tight" condition.
>
> A307 bolts will be installed to a snug tight condition in accordance with AISC (Codes and Standards 4.4.2). In AISC, p. 5-303, "snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. In actuality, snug tight is a degree of tightness, which will vary from joint to joint depending upon the thickness and degree of parallelism of the connected material. In most joints the plies will pull together; however, in some joints, it may not be possible at snug tight to have contact throughout the faying surface area."
>
> In the AISC Commentary to Specifications for Joints Using ASTM A325 and A490 bolts, a discussion is presented on why separate installation procedures are now provided for bolts that are not within the slip critical or direct tension category. "The intent in making this change is to improve the quality of bolted steel construction and reduce the frequency of costly controversies by focusing attention, both during the installation and tensioning phase and during inspection, on the true slip-critical connections rather than diluting the effort through the requirement for costly tensioning and tension testing of the great many connections where such effort serves no useful purpose. The requirement for identification of connections on the drawings may be satisfied either by identifying the slip-critical and direct tension connections which must be fully tightened and inspected or by identifying the connections which need be tightened only to the snug tight condition."

Quotations found in the preceding two paragraphs are extracted directly from AISC p. 5-273, Paragraph 8.(c) and p. 5-303 for joints not within the slip-critical range nor subject to tension loads, respectively. The steel set is designed to be in ring compression, therefore, the load transferred at the joint is primarily a compressive force. As the full rock load develops, this compression load will tend to force the plates into contact.

AISC Section M4. Erection, Paragraph 4, p. 5-90 states: "Lack of contact bearing not exceeding a gap of 1/16-in., regardless of the type of connection used (partial-penetration, groove-welded or bolted), shall be acceptable. If the gap exceeds 1/16-in., but is less than 1/4-in., and if an engineering investigation shows sufficient contact area does not exist, the gap shall be packed with non-tapered steel shims. Shims may be of mild steel, regardless of the grade of the main material."

Engineering judgment indicates that, where gaps may exist in steel set segment connections, a minimal ring compressive force will occur. As the rock loading increases, sufficient contact will develop between the plates of the steel set joints to adequately transfer the ring compressive force. As the design compressive force is attained, the plates may come together as noted above. Snug tightness shall be in accordance with AISC, p. 5-303 except that gaps between connection plates and between connection plates and shims may exceed 1/16-in. if plates or plates and shims make contact at any point in the connection plane. Bolted steel set joints are compression connections with only minor moment and shear loads. While they are considered critical to the performance of the set, the relatively low loading in comparison to the size of bolts selected reduces the need for special testing to verify material characteristics of the bolts.

The field drilling of holes larger than 5/16-in. in the steel set members for bolting of miscellaneous connections on steel sets shall be in accordance with AISC Sections J3.1 and J3.5, and will be subject to A/E approval.

7.6 WELDED CONNECTIONS

To ensure the adequacy of welded connections, welding shall be performed in accordance with the requirements of AWS D1.1 using E70XX 70 ksi tensile strength (minimum) electrodes. Welders and weld procedures shall be qualified for the electrode(s) used in accordance with AWS D1.1, Section 5.

The member welds shown in the details of Attachment IX experience relatively low shear stress. Additional weld lengths are provided for connection stability. The flange welds on the W-shapes at connecting plates are provided to ensure that the connection plate and the W-shape work together effectively under both static and seismic load conditions, even though the jacking loads, in most cases, result in the worst case shears at the joints. Welded connections of plates and W-shapes are subject to only minor shear loads due to long term rock load or jacking. While the welds are considered critical to the performance of the set, the amount of welding specified herein, in relation to the minor loading resisted by the welds, reduces the need for special inspections and/or tests to verify the weld filler material characteristics.

7.7 CREDIBLE FIRE AND EXPLOSION

The ground support system (steel sets) has not been designed for credible fire or explosion loads during construction or operation of the ESF. This approach is based on the Subsurface Fire Hazard Analysis (Reference 5.1) which concludes that the potential for an explosion in the ESF is extremely unlikely. In addition, loss prevention and/or life safety concerns due to a credible fire during construction and operation of the ESF would be met by the (current and future) design of the fire suppression and alarm systems; the non-combustible nature of the ground support system; a ventilation system designed to meet life safety objectives; and the provision of refuge chambers. The ESF Design Basis Fire (DBF) is in the TBM itself (Reference 5.1), well ahead of the steel sets. If incorporated into the repository design, fire or explosion damage to the steel sets (if credible) would be localized, of short duration, and, at worst, might result in deformation of the steel sets and lagging but not total collapse of the tunnel. Repair and/or replacement of the steel sets may be needed, but would be relatively uncomplicated.

If a fire should occur in the ESF, it would be localized and of fairly short duration due to the fire suppression and alarm systems in place (see Section 4.3.6, above). AISC M016 (page 6-3) notes that the average temperature reading for steel members exposed to fire should not exceed 1000° F for columns and 1100° F for beams without considering insulating protection for the steel. Fire exposure of severity and duration sufficient to raise exposure temperatures above these limits would seriously impair the ability of the steel members to sustain loads. Although exposure temperatures could conceivably exceed the above limits during a fire, it is judged that fire-proofing of the steel sets and lagging is not required. Fire proofing would be costly, could interfere with the in situ site characterization testing, would obscure the ground support system thus preventing periodic inspection and maintenance, could interfere with incorporating the ground support system into the eventual repository, and would introduce additional undesirable cementitious materials into the ESF environment. In addition, should a fire occur in the ESF or in the repository, resulting in high exposure temperatures to the steel members and subsequent degradation of the steel sets or even localized (though unlikely) failure of the support system, the debris could (as noted above) be cleared and the ground support systems replaced within a reasonably short period of time, thus minimizing the impact on the ESF construction/operational activities and on the repository functions.

8. CONCLUSIONS

8.1 The ESF ground support steel set configuration and details analyzed herein are summarized in Attachment IX. The steel set member sizes and spacing used in the ESF ground support are presented in Table 14 of Reference 5.20.

8.2 Based on the jacking configuration presented in Attachment III.C, the maximum jack load/force on the W8 x 31 is 27 tons (Attachment I) and on the W6 x 20 is 17 tons (Attachment VIII). The jacking load may be applied to both sides of the steel set simultaneously or to only one side of the steel set.

8.3 The steel sets are adequate for use in the construction of a stable, functional opening with a 150 year maintainable life (see Section 7.1).

8.4 The installation tolerances for the steel sets along the longitudinal direction of the tunnel are presented in Attachment VII. The established tolerances contribute no significant decrease to the capacity of the steel sets or components.

8.5 As noted in previous sections, the results of this analysis present only a few of the many acceptable methods that could be used for steel sets in the ESF. The Constructor will be encouraged to develop and submit alternative solutions for A/E approval as long as minimum critical design attributes are met. For the purposes of this analysis critical design attributes are defined as those important design, material, and performance attributes as delineated herein that require verification to provide reasonable assurance that the item will perform its intended safety function. From these critical design attributes, (1) "critical characteristics" of the items are selected and verified through material dedication (separate analysis), and (2) identifiable and measurable or qualitative critical performance attributes necessary for the item to function as intended will be defined for development of installation and inspection requirements.

The Constructor shall incorporate the following minimum critical design attributes into alternative solutions submitted.

A. Member Sizes and Material Properties

The steel set members and materials shall be of the following (members or materials of equal or greater strength may be substituted):

1. Steel set ring beam members shall be either W8 x 31 or W6 x 20, consistent with rock conditions shown in Table 14 of Reference 5.20, with material properties conforming to ASTM A36.

2. Steel lagging shall be C8 x 11.5, with material properties conforming to ASTM A36.

B. Steel Set Configuration

The bend radius of the steel set shall be of uniform contour, shall facilitate placement, and shall be compatible with the nominal 25 feet - 0 in. diameter of the tunnel such that the set engages or contacts the rock perimeter (via the lagging when expanded or blocked into the final configuration) to the extent practical (i.e., consistent with standard industry practice).

1. The steel sets shall be founded on the curbs of the concrete invert segments (see Attachment III.E).

2. The steel sets shall be spaced based on the rock conditions encountered, either 2 feet, 4 feet, or 6 feet nominal (see Table 14 in Reference 5.20).

3. The quantity and location of steel set joints shall be determined by the Constructor, subject to A/E approval of shop drawings.

C. Lagging

Lagging shall be configured such that it can transfer the rock loads to the steel set ring beam.

Lagging details are shown in Attachment III.B.

D. Not used.

E. Tie Rods

Since the tie rods are primarily designed to carry tension loads, they shall be provided with a compression brace (pipe spacer) capable of maintaining the steel set spacing. Tie rod general arrangement will be as shown in Attachment III.D with the following critical attributes:

1. 35° maximum angle between tie rods (± 1")
2. 7° maximum from foot segment base plate
3. Locate at ½" inside of centerline of W-shape (+/-) ⅜ in.

F. Jacking/Expansion of Steel Sets

The steel sets shall be jacked into final position using hydraulic jacks or other means that will provide reasonably uniform expansion of the steel set against the tunnel walls and crown to provide positive contact to the extent practical, i.e., consistent with standard industry practice. The jacking process shall not overstress the steel set. The jacking brackets shown in Attachment III.C represent one jacking method that will work, but should not constrain the Constructor from developing other systems for expanding the steel sets that meet the requirements of this paragraph.

G. Connections

Connections and connecting components (plates, nuts, bolts, shims) shall be sufficient to provide continuity in the entire steel set when loaded (primarily) in ring compression.

Steel set joint connection details shall be as shown in Attachment III.G.

8.6 The ESF has been determined to be a nongassy tunnel (Reference 5.22), and therefore explosion from methane or other explosive gasses are not credible events. The Importance to Safety Ground Support and Lining items classified QA-1 and QA-5 begin their intended radiological safety function at the beginning of the repository phase when waste packages are placed. Therefore, the use of explosives during the construction of the ESF has no impact on the design of steel sets to perform their intended safety function. The use, the amounts transported and stored, and the logistics and associated risk assessment of explosives in the potential repository have yet to be determined. Design for effects of explosions cannot proceed without the above determination being performed (TBD-154-RDR). However, current design does not preclude the installation of reinforcement to allow the linings and ground support to meet credible fire and explosion criteria developed and analyzed during Repository design.

8.7 SUMMARY OF CONCLUSIONS FROM ATTACHMENTS

8.7.1 Attachment I

- W8 x 31 selected is confirmed as an acceptable steel set member size for up to a 27 ton jack load
- Jacking centerline to be maximum of 6 in. from W8 X-X axis, based on the configuration used in Attachment III.C and shown in Attachment IX.
- One-sided jacking is acceptable.

8.7.2 Attachment II

- Output results from FLAC analysis (Reference 5.20), no conclusions.

8.7.3 Attachment III

- III.A: W8 x 31 steel set is adequate for up to a 27 ton jacking force and for rock loads, utility load, and seismic loads.
- III.B: C8 x 11.5 lagging is adequate for rock loads plus seismic loads.
- III.C: Jacking bracket assembly as shown is adequate for up to a 27 ton jack load for W8 x 31 and up to a 17 ton jack load for W6 x 20.
- III.D: ¾-in. diameter tie rod spaced at 35° (in combination with 1½-in. diameter pipe spacer) is sufficient to laterally brace the steel sets.
- III.E: Steel set foot plate as shown is adequate for the average axial load in the steel set. Maximum offset allowed is 1 inch.
- III.F: Steel set foot segment as shown is adequate for up to a 27 ton jack load for W8 x 31 and up to a 17 ton jack load for W6 x 20.
- III.G: Steel set splice connection as shown is adequate.

- III.H: Steel set foot segment (2 alternatives) are stable under 27 ton (max.) jack load for W8 x 31 and 17 ton (max.) jack load for W6 x 20.

- III.I: Not used.

- III.J: Not used.

- III.K: Shim plate thicknesses and configuration as shown are adequate.

- III.L: Steel wedge as shown is adequate for blocking of steel set.

8.7.4 Attachment IV

- Impact Review Action Notice (no conclusions).

8.7.5 Attachment V

- CPS Structural Steel Supports Catalog (no conclusions).

8.7.6 Attachment VI

- Catalog cuts from jack manufacturer's catalog (no conclusions)

- Record of telephone conversation, definition of snug tight on bolts. Tension in bolt is negligible for snug tight condition.

8.7.7 Attachment VII

- Mill tolerances per AISC M016 and ASTM A6.

- Bending tolerances (see Attachment).

- Installation tolerances (see Attachment).

- Steel set is adequate to accommodate cumulative offset tolerances.

8.7.8 Attachment VIII

- W6 x 20 steel set is adequate for 17 ton jacking force (15 ton nominal) but not adequate for 20 ton jacking force.

- Jacking centerline to be maximum of 5 in. from W6 X-X axis.

8.7.9 Attachment IX

- Proposed design of steel sets components and accessories shall be as shown on the sketches of this attachment. However, Constructor may modify the following items (with A/E approval of shop drawings):

  - Steel set configuration (Pages IX-3, 4, 5, & 16)
  - Steel set joint locations (Pages IX-3 & 4)
  - Jacking brackets (Pages IX-3, 4, 5, 8, 13, 16, 17, 18, & 19)
  - Inserts (Page IX-4, IX-16)
  - Materials (Page IX-1)
  - Connections (Page IX-11 & 15)
  - Details (Pages IX-6, 9, 12, 14, 15 & 17)

8.7.10 Attachment X

- W8x31 baseplate is within the design limit stress (27 ksi, or 36 ksi with 1/3 allowable increase for seismic loading).

9. ATTACHMENTS

There are 10 attachments to this analysis.

ATTACHMENT	DESCRIPTION
I	Jacking Load Analysis
II	Rock Long-Term Load Computer Analysis Results
III	Steel Set Member and Components Design
IV	Impact Review Action Notice
V	CPS Structural Steel Supports Catalog
VI	Miscellaneous Reference Data
VII	Miscellaneous Shop Fabrication Tolerances and Steel Set Installation Tolerances
VIII	Structural Steel Set Using W6 x 20
IX	Summary of Design Sketches
X	Finite Element Analysis for W8x31 Baseplate

ATTACHMENT I

Jacking load analysis

TWO SIDED JACKING WITH VARIOUS SIZE JACKS APPLIED EQUALLY ON EACH SIDE

STLRV2 - Two sided jacking with 50 Ton, 30 Ton and 25 Ton jacking load applied at 47

TWO SIDED JACKING WITH 25 TON JACKING LOADS

STLRV3A - Jacking loads applied at 49°.

STLRV3D - Jacking loads applied at 51

STLRV3B - Jacking loads applied at 47° and member end moments released at splice locations.
STLRV3C - Jacking loads applied at 49° and member end moments released at the splice locations.
STLRV3A1 - Jacking loads applied at 47 with rock engagement at most joints (near the completion of the jacking process).
STLRV3A2 - Jacking loads applied at 47 with rock engagement at all joints (near the completion of the jacking process).

ONE SIDED JACKING WITH A 25 TON JACKING LOAD

STLRV4 - Jacking load applied at 47°.
STLRV4A - Jacking load applied at 49°.
STLRV4B - Jacking load applied at 51

STLRV4C - Jacking load applied at 47 , with member end moments released at the splice location.

ATTACHMENT I

PURPOSE AND DESCRIPTION

The purpose for the computer analyses in this attachment is to determine the jack size to be used for the W8X31 steel sets, and then evaluate the W8X31 shape for stresses from the jacking process using the selected jack capacity under different jack loading conditions and jacking settings.

Computer analysis STLRV2 for jack capacities of 50, 30 and 25 tons was executed. Based on this computer analysis and hand calculations in Attachment III pages III-25 through III-27, a maximum size jack of 27 Tons was selected for the jacking operation.

With the jacking force established, the location of jacking loads were varied to simulate the angle range that the jacking forces may be applied to the steel set during the jacking process. Computer analyses were performed with the jacking force applied at 47, 49 and 51 degrees. The 47 and 49 degrees correspond to two different jacks that can be used (see the jack information sheet in this attachment, which is based on the attachment VI tables), and the 51 degree is based on the possibility of using a crown segment based on an angle of 84 degrees arc length instead of the typical 90 degrees. The 51 degrees angle is also the angle that defines the jacking load position when no insert is used. Comparing the analyses: STLRV2, STLRV3A and STLRV3D for two side jacking, and the analyses: STLRV4, STLRV4A and STLRV4B for one side jacking, the conclusions are: (1). There is no difference between the stresses in the steel set caused by two side jacking and one side jacking (hence no further computer analyses for one side jacking are required), and (2). that the jacking at 47 degrees produces higher stresses in the steel set that the jacking force applied at 49 or 51 degrees, hence all the other analyses were performed with jacking force at 47 degrees. The difference between the stresses obtained from varying the angle is typically less than 2%, (4% overall), (see Summary of Computer Analyses for Jacking Loads for comparison). No other analyses were performed with jacking force application below 47 degrees because the small difference expected between the resulting stresses, if the jack was to be applied at a lower point.

In addition to the varying the angle of the jacking force application, computer analyses were performed to simulate the boundary conditions of the splice connections during the jacking process. Depending on when the bolts in the splice connection are tightened the connection may or may not be capable of transmitting moment across the splice during the jacking process. These two conditions were evaluated and the results from the various computer analyses revealed that if the bolts are not tightened, slightly higher stress levels are induced in the W8X31 steel set member when the splice connection acts as a pin connection (capable only of taking shear) , versus the bolts being tightened and the connection being capable of transmitting moment through the splice prior to starting the jacking process. Note computer analyses STLRV2, 3A, and 4, versus the corresponding computer analyses STLRV3B, 3C and 4C.

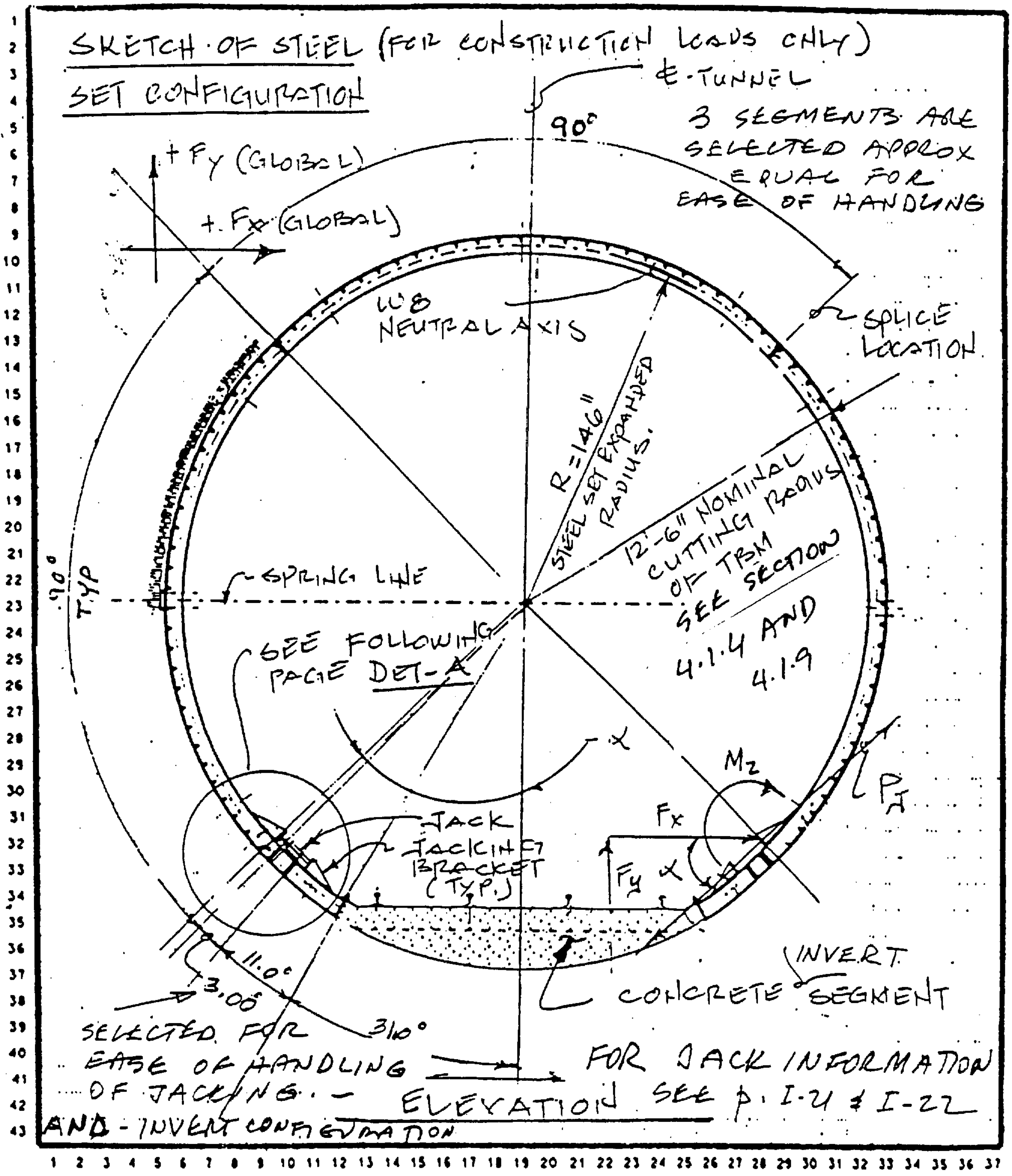
The initial contact\support points of the steel sets to the rock, is assumed to be at maximum 5 nodes which corresponds to approximately 6 ft. This is a conservative assumption, as compared to making positive contact with the rock in the tunnel crown and walls, as a result of 25 Ton jacking force. (See section 4.3.4)

Additional computer analyses were performed to simulate the jacking process as the steel set restraint changes from initial contact/support points with the excavated profile (as described in the above paragraph) to partial, and then full engagement with the rock. See computer analyses STLRV3A1 and A2.

The transition from the initial horizontal contact points below the spring line at each 4 nodes to the full engagement of the steel set by the rock, will occur during the jacking process as the steel set moves upward into the excavated profile of the tunnel and additional supports are provided by the rock. As the steel set is brought in contact with more points of the excavated profile's walls and crown , additional horizontal and vertical supports between the steel sets and the rock will be engaged above the spring line, further restraining the movement of the steel set. No vertical supports are provided below the spring line due to the fact that the steel set is moving upward during the jacking operation and only supports above the spring line can restrain this vertical movement. (For supports layouts see page I-21 and individual computer inputs). In the final stage, additional intermediate points make contact, providing full or almost full support.

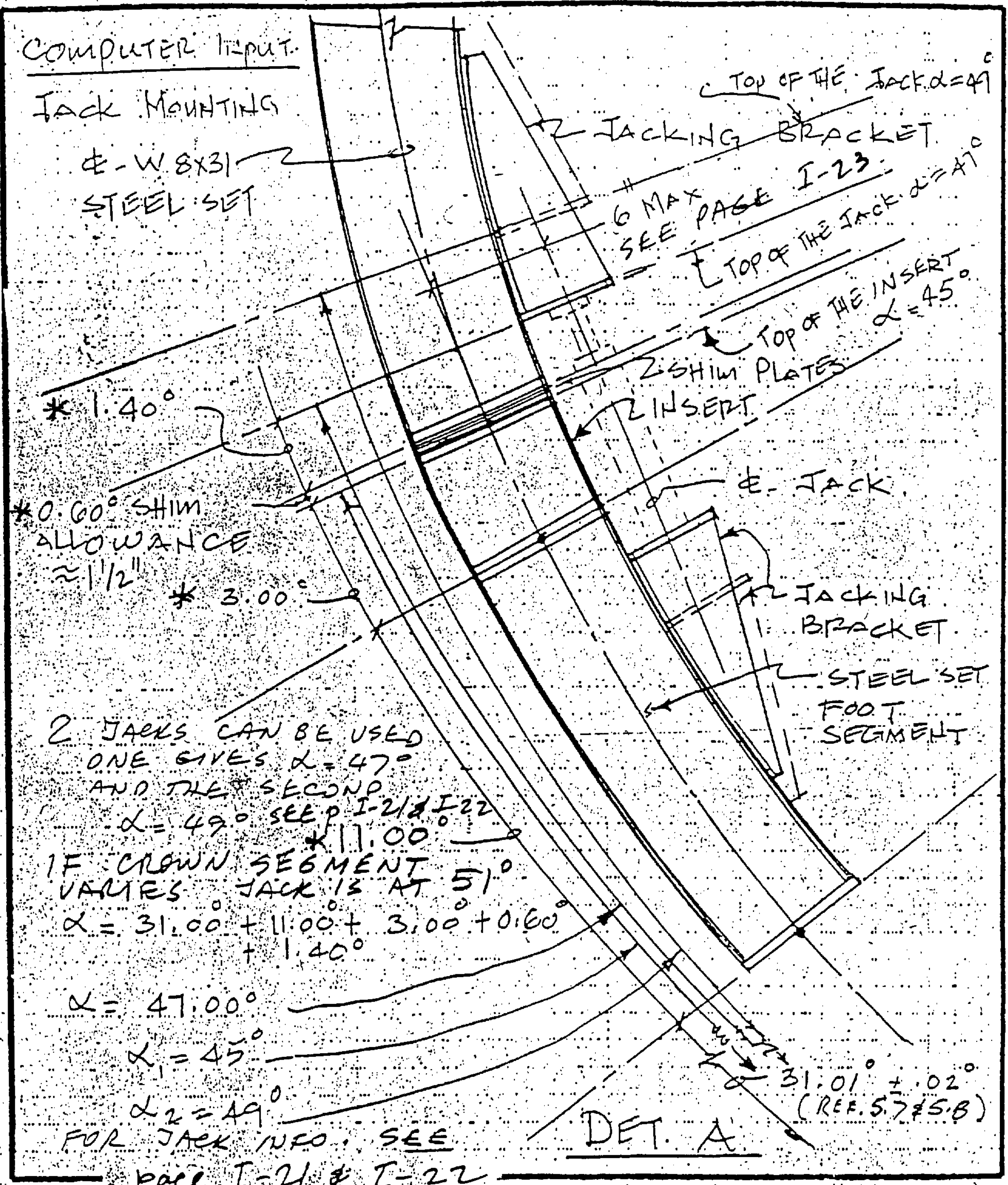
After the jacking process is completed, as described in the above paragraph, long term rock loads begin to act on the steel set . This condition is analyzed in attachment II of this analysis.

Hand calculations are performed in Attachment III based on the maximum member forces from this attachment and Attachment II.


SKETCH OF STEEL (FOR CONSTRUCTION LOADS ONLY)
SET CONFIGURATION
℄-TUNNEL
90°
3 SEGMENTS ARE SELECTED APPROX EQUAL FOR EASE OF HANDLING
+Fy (GLOBAL)
+Fx (GLOBAL)
W8 NEUTRAL AXIS
SPLICE LOCATION
R=146" STEEL SET EXPANDED RADIUS.
12'-6" NOMINAL CUTTING RADIUS OF TBM
SEE SECTION 4.1.4 AND 4.1.9
90° TYP
SPRING LINE
SEE FOLLOWING PAGE DET-A
α
Mz
PA
JACK
JACKING BRACKET (TYP.)
Fx
Fy
α
11.0°
3.00
316°
CONCRETE INVERT SEGMENT
SELECTED FOR EASE OF HANDLING OF JACKING. -
AND - INVERT CONFIGURATION
FOR JACK INFORMATION SEE p. I-21 & I-22
ELEVATION

COMPUTER INPUT

JACK MOUNTING



2 JACKS CAN BE USED
ONE GIVES α = 47°
AND THE SECOND
α = 49° SEE p I-21 & I-22

IF CROWN SEGMENT
VARIES, JACK IS AT 51°

$\alpha = 31.00^\circ + 11.00^\circ + 3.00^\circ + 0.60^\circ + 1.40^\circ$

$\alpha = 47.00^\circ$

$\alpha_1 = 45^\circ$

$\alpha_2 = 49^\circ$

FOR JACK INFO. SEE
page I-21 & I-22

DET. A

FOR PARAMETERS MARKED *
SEE SECTION 4.1.4 FOR DISCUSSION

COMPUTER INPUT

FOR THE COMPUTER MODEL OF THE STEEL SET USE 8 EQUAL LENGTH MEMBERS FROM THE CONCRETE INVERT TO THE SPRING LINE. THIS RELATES TO A MEMBER LENGTH OF 18.79 INCHES (SEE BELOW).

ARC LENGTH OF THE SEGMENT BEAM FROM THE SPRING LINE TO THE CONCRETE INVERT EQUALS:

$$\text{ARC LENGTH} = \frac{\pi r A}{180} = \frac{3.14(146)(90^\circ - 31^\circ)}{180^\circ}$$

$$= 150.34 \text{ INCHES}$$

$$\text{MEMBER LENGTH} = \frac{150.34}{8} = 18.79 \text{ INCHES}$$

FOR THE COMPUTER MODEL USE 14 MEMBERS FROM THE SPRING LINE TO THE CROWN OF THE STEEL SET. THIS RELATES TO A MEMBER LENGTH OF 16.38 INCHES (SEE BELOW)

ARC LENGTH OF THE SEGMENT FROM THE SPRING LINE TO THE CROWN EQUALS,

$$\text{ARC LENGTH} = \pi r A^\circ / 180 = 229.34 \text{ INCHES}$$

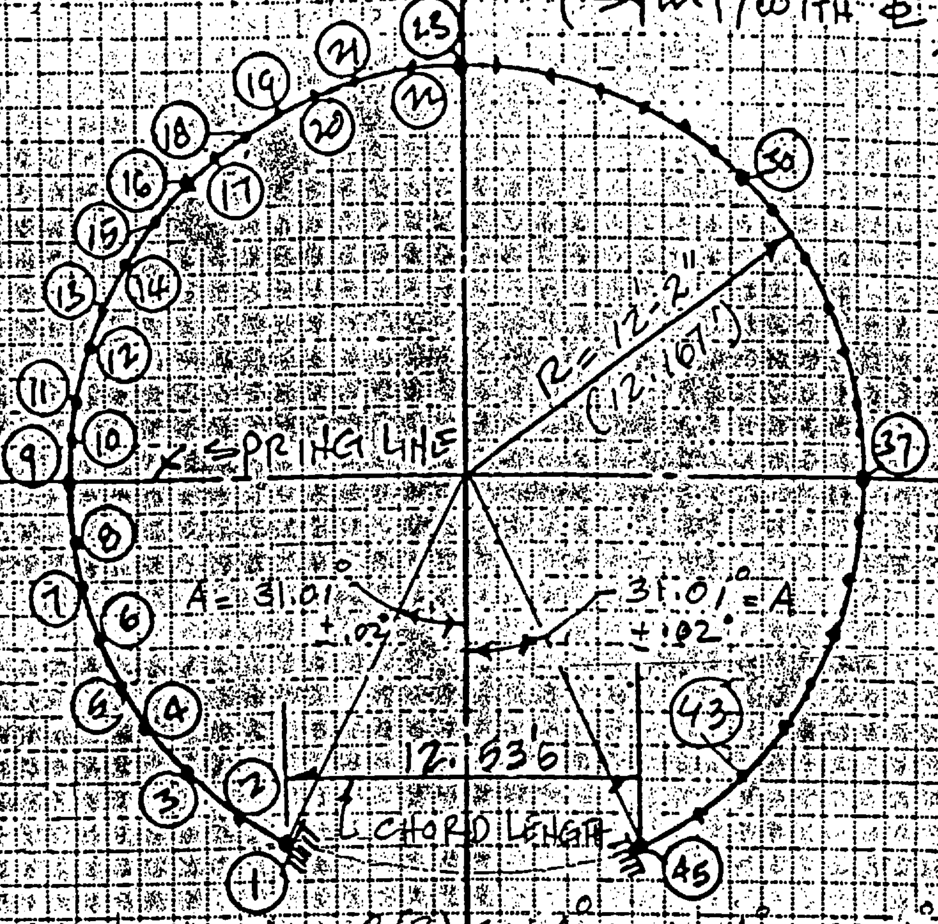
$$\text{MEMBER LENGTH} = 229.34/14 = 16.38 \text{ INCHES}$$

THIS WILL PROVIDE A REASONABLE COMPUTER MODEL MEMBER LENGTH FOR A STRUCTURAL ANALYSIS OF THE STEEL SET.

COMPUTER INPUT (FOR CONSTRUCTION AND ROCK LONG TERM LOADS)

(NO) - NODE NUMBER

℄ - TBM TUNNEL (SYMT/WITH ℄)



CHORD LENGTH = 2(R) SIN A°, A° = 31.01 ± .02°
PER REF 5.7 & 5.8

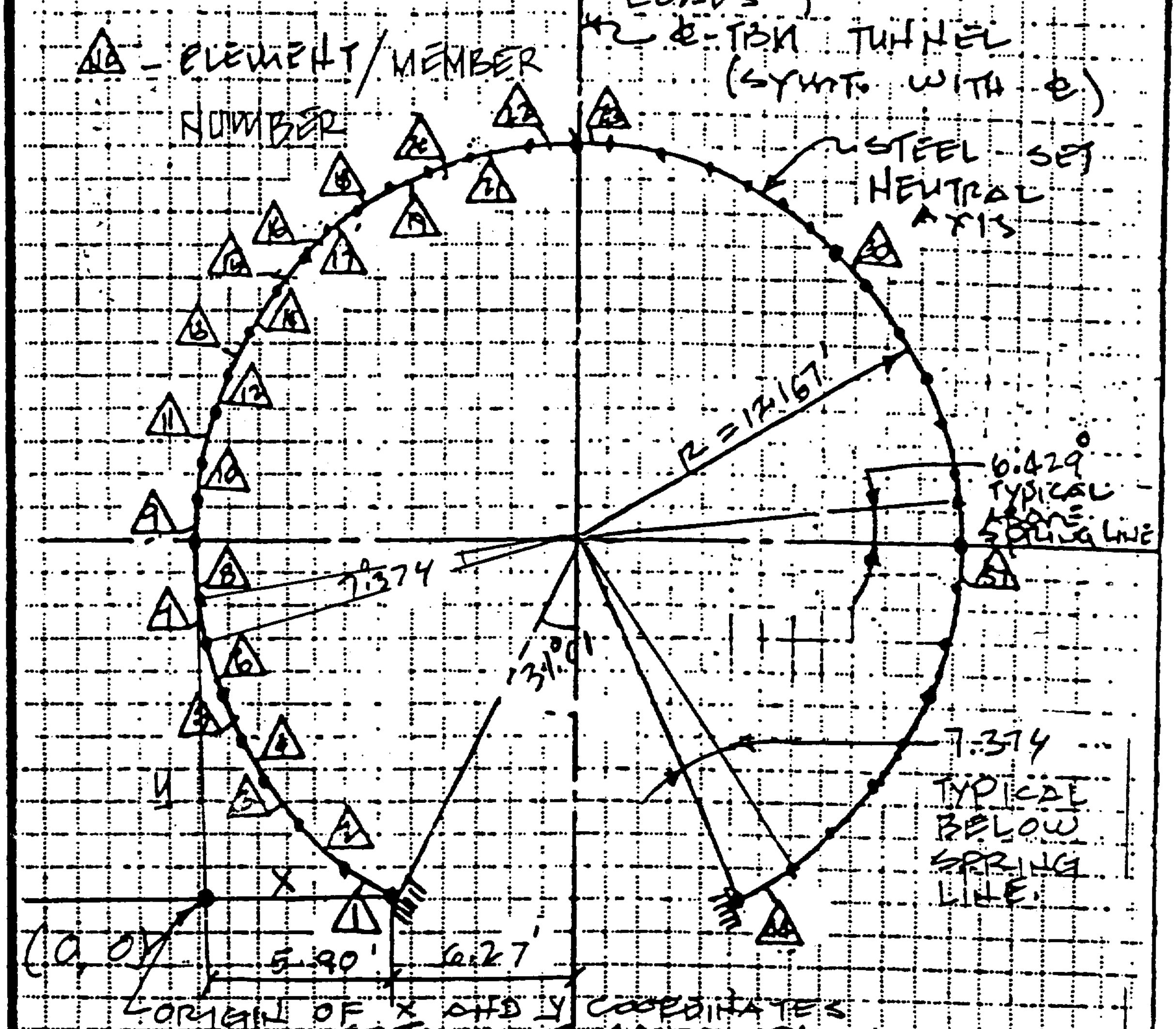
CHORD LENGTH = 2(12.167) SIN 31.0°

STEEL SET COMPUTER MODEL

CHORD LENGTH = 12.536 FT

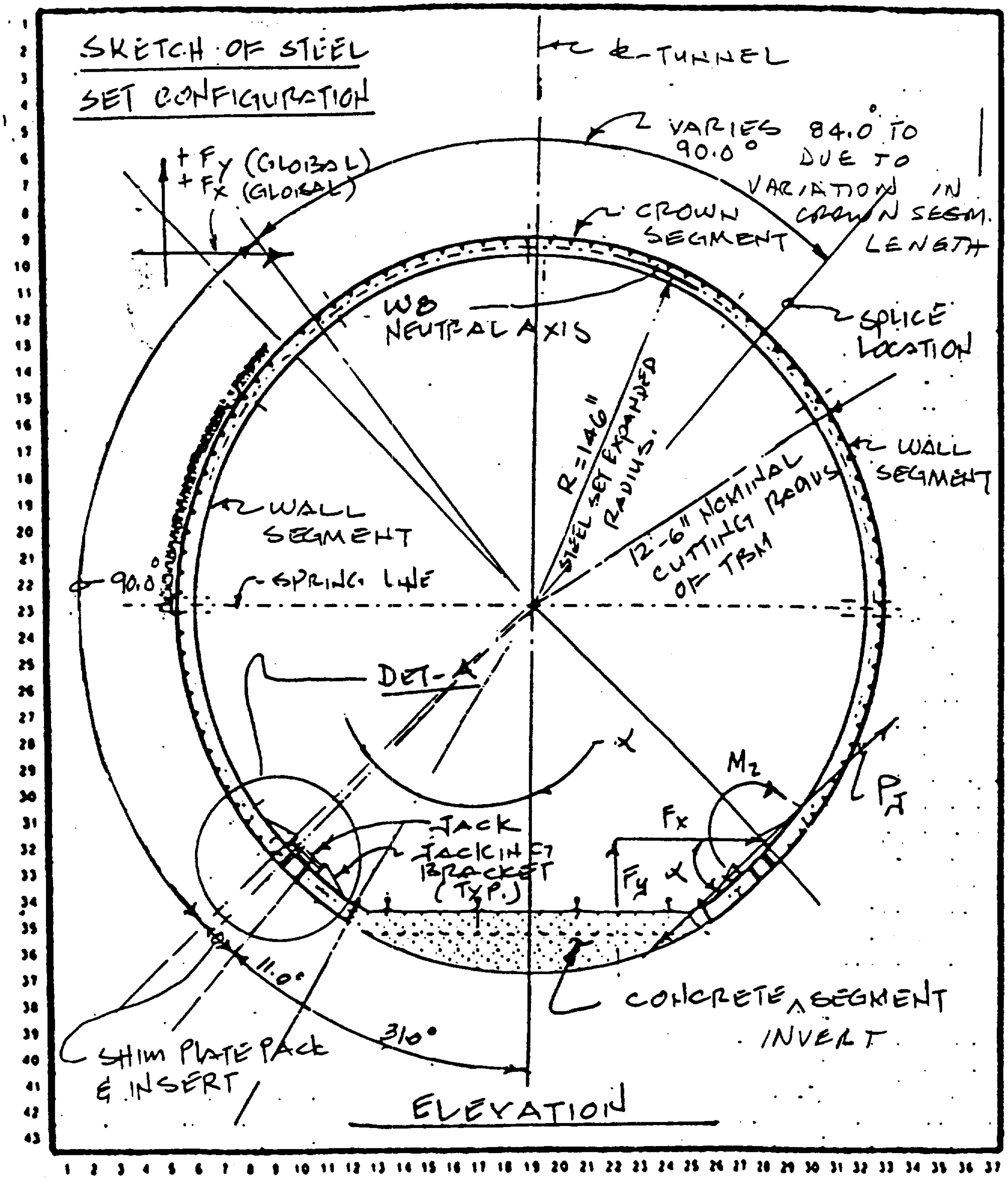
COORDINATES OF ALL NODE ARE GENERATED FROM THIS MODEL

COMPUTER INPUT (FOR CONSTRUCTION AND ROCK LONG TERM LOADS)



STEEL SET COMPUTER MODEL

COORDINATES OF ALL NODES ARE SHOWN ON INPUT PORTION OF VARIOUS ANALYSIS.


SKETCH OF STEEL SET CONFIGURATION
℄-TUNNEL
VARIES 84.0° TO 90.0° DUE TO VARIATION IN CROWN SEGM. LENGTH
+Fy (GLOBAL)
+Fx (GLOBAL)
CROWN SEGMENT
W8 NEUTRAL AXIS
SPLICE LOCATION
R=146" STEEL SET EXPANDED RADIUS.
12'-6" NOMINAL CUTTING RADIUS OF TBM
WALL SEGMENT
WALL SEGMENT
90.0°
SPRING LINE
DET-A
α
Mz
PA
Fx
Fy
α
JACK
JACKING BRACKET (TYP.)
11.0°
310°
SHIM PLATE PACK & INSERT
CONCRETE SEGMENT INVERT
ELEVATION

JACKING FORCE

LOCATION. PJ ALSO = 50±, 30#

P_J = JACKING FORCE

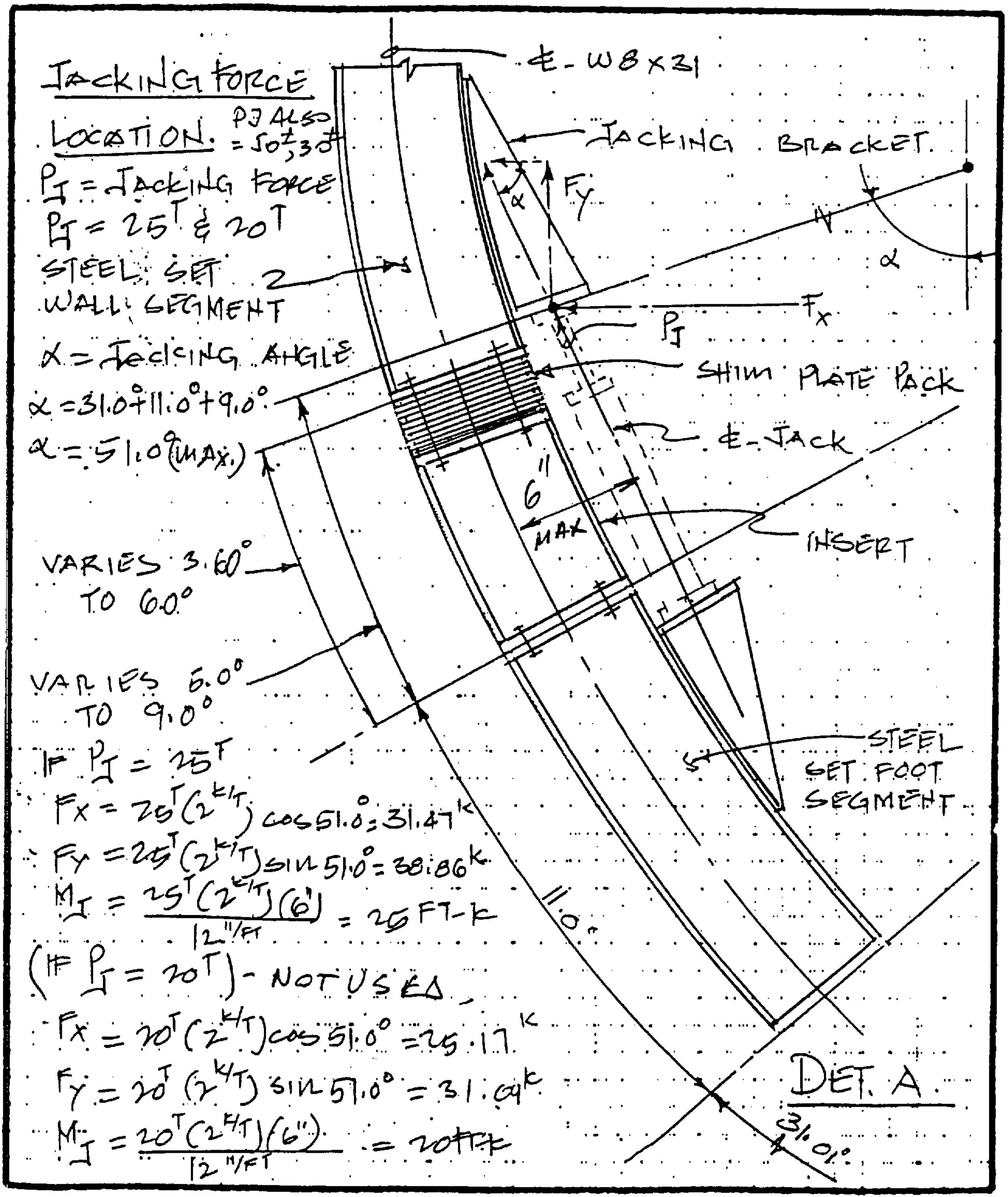
$P_J = 25^T$ & 20^T

STEEL SET WALL SEGMENT

α = JACKING ANGLE

$\alpha = 31.0° + 11.0° + 9.0°$

$\alpha = 51.0°$ (MAX.)



IF $P_J = 25^T$

$F_X = 25^T(2^{K/T})\cos 51.0° = 31.47^K$

$F_Y = 25^T(2^{K/T})\sin 51.0° = 38.86^K$

$$M_J = \frac{25^T(2^{K/T})(6')}{12''/FT} = 25\ FT\text{-}K$$

(IF $P_J = 20^T$) - NOT USED

$F_X = 20^T(2^{K/T})\cos 51.0° = 25.17^K$

$F_Y = 20^T(2^{K/T})\sin 51.0° = 31.09^K$

$$M_J = \frac{20^T(2^{K/T})(6'')}{12''/FT} = 20\ FT\text{-}K$$

COMPUTER INPUT } THE X AND Y COORDINATES ARE GENERATED FROM THE INFORMATION PRESENTED ON THE MODELS

UNIT FT

JOINT COORDINATES

	X	Y		X	Y
1	5.90	0.00	16	3.56	19.03
2	4.61	0.89	17	4.58	19.94
3	3.45	1.94	18	5.69	20.73
4	2.43	3.13	19	6.89	21.39
5	1.58	4.44	20	8.15	21.91
6	0.90	5.85	21	9.46	22.29
7	0.40	7.33	22	10.80	22.52
8	0.10	8.87	23	12.17	22.60
9	0.00	10.43	24	13.53	22.52
10	0.08	11.79	25	14.87	22.29
11	0.31	13.14	26	16.18	21.91
12	0.68	14.45	27	17.45	21.39
13	1.21	15.71	28	18.64	20.73
14	1.86	16.90	29	19.75	19.94
15	2.65	18.02	30	20.77	19.03

COMPUTER INPUT

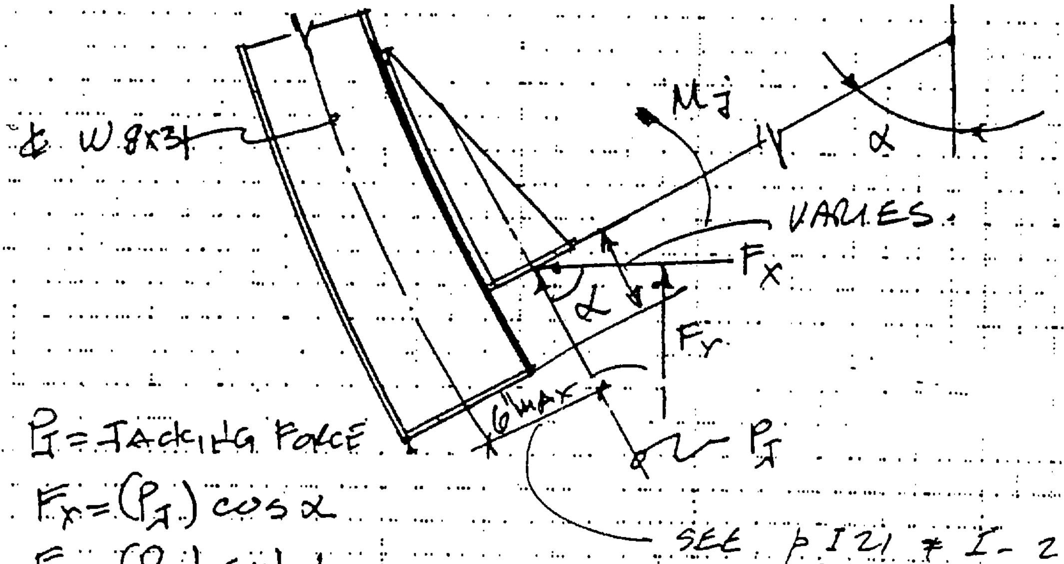
JOINT COORDINATES

	X	Y
31	21.68	18.02
32	22.47	16.90
33	23.13	15.71
34	23.65	14.45
35	24.03	13.14
36	24.26	11.79
37	24.33	10.43
38	24.23	8.87
39	23.93	7.33
40	23.44	5.85
41	22.76	4.44
42	21.90	3.13
43	20.88	1.94
44	19.72	0.89
45	18.43	0.00

COMPUTER INPUT

CONSTRUCTION LOAD - JACKING PROCESS WITH VARIOUS JACKING CAPACITY

ANALYSE W8x31 FOR JACKING.



SEE p I 21 & I-22 FOR JACK INFO

P_J = JACKING FORCE

$F_X = (P_J) \cos \alpha$

$F_Y = (P_J) \sin \alpha$

M_J = JACKING MOMENT = P_J (6")

COMPUTER INPUT (FOR JACKING LOADS ONLY)
50 TONS, 30 TONS AND 25 TONS SIMULTANEOUS JACKING

FOR: $\alpha = 47.00°$

$F_y = P_J \sin\alpha$, M_J = MOMENT FROM JACKING FORCE.

$F_x = P_J \cos\alpha$

CONVERT TON TO KIP. 1 TON = 2 KIP

FOR 50 TONS JACK $M_J = \dfrac{50^{T}(2)^{K/T}(6)}{12''/1'} = 50.0^{FT-K}$

FOR 30 TONS JACK $M_J = \dfrac{30^{T}(2)^{K/T}(6)}{12''/1'} = 30.0^{FT-K}$

FOR 25 TONS JACK $M_J = \dfrac{25^{T}(2)^{K/T}(6)}{12''/1'} = 25.0^{FT-K}$

50 TONS JACK

$F_y = 50(2)\sin 47.00° = 73.14^{K}$

$F_x = 50(2)\cos 47.00° = 68.20^{K}$

30 TONS JACK

$F_y = 30(2)\sin 47.00° = 43.88^{K}$

$F_x = 30(2)\cos 47.00° = 40.92^{K}$

25 TONS JACK

$F_y = 25(2)\sin 47.00° = 36.57^{K}$

$F_x = 25(2)\cos 47.00° = 34.10^{K}$

1.

COMPUTER INPUT FOR $\alpha = 49^\circ$

$\alpha = 49.00^\circ$

$F_Y = P_I \sin \alpha$

$P_X = P_I \cos \alpha$

50 TONS JACK

$F_Y = 50 (2) \sin 49.00^\circ = 75.47^k$

$F_X = 50 (2) \cos 49.00^\circ = 65.61^k$

30 TONS JACK

$F_Y = 30 (2) \sin 49.00^\circ = 45.28^k$

$F_X = 30 (2) \cos 49.00^\circ = 39.36^k$

25 TONS JACK

$F_Y = 25 (2) \sin 49.00^\circ = 37.74^k$

$F_X = 25 (2) \cos 49.00^\circ = 32.80$

20 TONS JACK - NOT USED -

$M_I = \frac{20^T (2)^{k/T} (6)}{12 "/'} = 20$ FT-k

$F_Y = 20 (2) \sin 49.00^\circ = 30.19^k$

$F_X = 20 (2) \cos 49.00 = 26.24^k$

FOR COMPUTER INPUT MEMBER SELFWEIGHT WILL BE INCREASED BY 2.5, TO ACCOUNT FOR LAGGING - SEE NEXT PAGE

CALCULATE LAGGING WEIGHT TRIBUTARY TO STEEL SET ~

STEEL SET SPACING = 4'-0" ±

SPACING

$C8 \times 11.5 = 11.5^{PLF} \times 4 = 46^{lb} \times 12''/8' = 69.0$

$1\frac{1}{2}''\Phi$ PIPE SPACER $= 2.7^{PLF} \times 4 = 10.8^{lb} \times 1/7.43' = 1.45$

TIE ROD ($\frac{3}{4}''\Phi$) $= 1.5^{PLF} \times 4 = \underline{6.0^{lb}} \times 1/7.43 = \underline{0.81}$

71.3

TOTAL WT $= 71.3^{lb}$

$$\frac{\text{TOTAL WT.}}{\text{STEEL SET DEAD LOAD}} = \frac{71.3}{31} = 2.3$$

(USE OF FACTOR 2.5 IN COMPUTER INPUT FOR SELFWEIGHT)

- FOR LAGGING THERE IS NO SPACING

- FOR TIE ROD SPACING SEE PAGE IX - 6

COMPUTER INPUT FOR $\alpha = 51°$.

$F_y = 25\ (2)\ \sin 51° = 38.86^{k}$.

$F_x = 25\ (2)\ \cos 51° = 31.47^{k}$.

DETERMINE POINT OF APPLICATION OF JACKING LOAD FOR ANGLES OF APPLICATION AT 47°, 49° AND 51°

THE POINT OF APPLICATION WILL ALWAYS BE AT POINTS: 3 OR 43 as applicable SO: WE WILL VARY THE COORDINATES OF JTS. 3 & 43 FOR DIFFERENT ANGLES OF APPLICATION -

47°. $X = -\sin 47° * 146'' + 146'' = 39.2236''$

$= -106.77764 + 146 = \underline{3.27'}$. SEE P I-20

$Y = -\cos 47° * 146'' + 146'' - 20.8667'' =$

$= -99.57176'' + 146'' - 20.8667'' = \underline{2.13'}$.

POINT 3 < $X = 3.27'$, $Y = 2.13'$

POINT 43 < $X = \sin 47° * 146'' + 146'' = \underline{21.06'}$, $Y = 2.13'$

$\underline{49^\circ}$ $X = -\sin 49^\circ * 146'' + 146'' = 35.8126''$

$= \underline{2.98'}$

$Y = -\underbrace{\cos 49^\circ}_{.656} * 146'' * 146'' - 20.8667''$

$= 29.3487'' = \underline{2.45'}$

Jt $\underline{3}$ $\begin{cases} X = \underline{2.98'} \\ Y = \underline{2.45'} \end{cases}$

Jt $\underline{43}$ $\begin{cases} X = \sin 49^\circ * 146'' + 146'' = \underline{21.35} \\ Y = \underline{2.45'} \end{cases}$

$\underline{51^\circ}$ - $\underline{JT\ 3}$: $X = -\sin 51^\circ * 146'' + 146'' = \underline{2.71'}$

$Y = -\cos 51' * 146 + 146 - 20.8667 = 2.77$ — SEE NEXT PAGE

$\underline{JT\ 43}$: $X = \sin 51^\circ * 146 + 146 = 113.46 + 146$

$= 259.46'' = \underline{21.62'}$

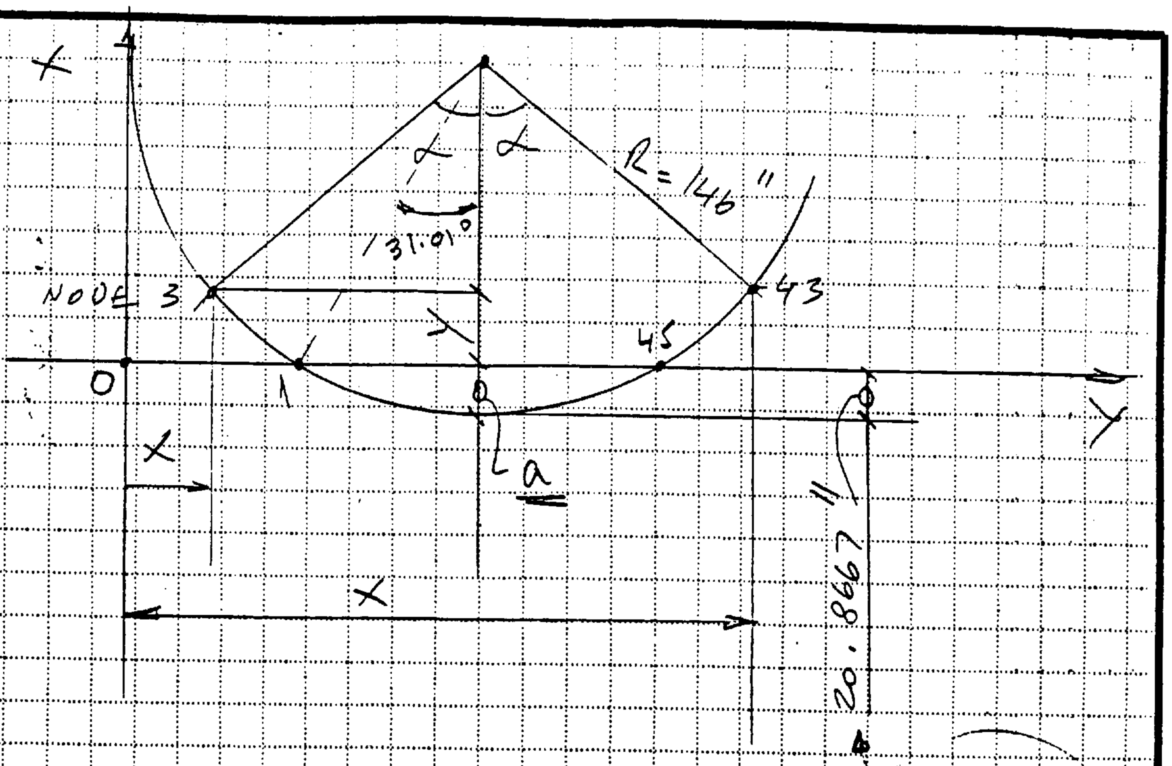
$\underline{Y = 2.77}$

$\begin{cases} X = 21.62 \\ Y = 2.77 \end{cases}$ "FOR JACKS APPLIED ON BOTH SIDES)

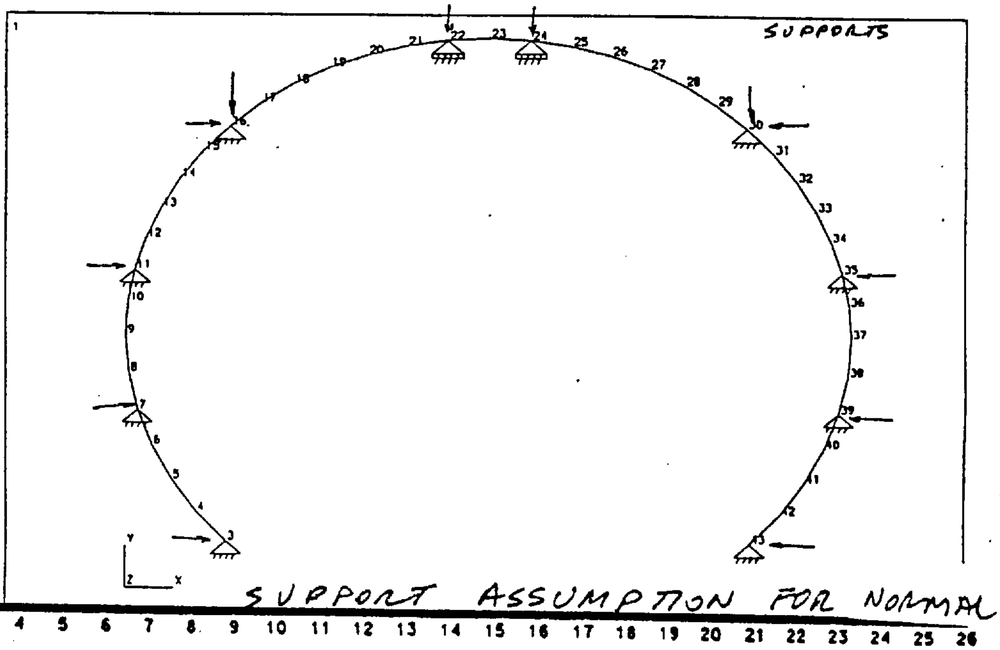
FOR JACK APPLIED ON ONE SIDE - AT JT 3 COORDINATES FOR JT.S 43, 44, 45 NEED NOT CHANGE

ALL ANGLES ARE MEASURED FROM THE VERTICAL AXIS TOWARDS THE NODE

SEE NEXT PAGE



$$\underline{\underline{a}} = 146'' - \cos 31.01 * 146'' = 20.8667''$$



SUPPORT ASSUMPTION FOR NORMAL JACKING -

DETERMINE JACK CHARACTERISTICS FOR COMPUTER INPUT - ATTACHMENT VI pg VI-3

FROM DISCUTIONS WITH CONTRACTOR, JACKS HSR 258T and HSR 2510T ARE CHOSEN AS A CLOSE REPRESENTATION OF THE JACKS THAT WOULD ACTUALLY BE PROCURED AND USED. APPROXIMATE DIMENSIONS:

JACK.	CLOSED HEIGHT	+	STROKE	=	TOTAL
HSR-258T	12''	+	8''	=	20''
HSR-2510T	14''	+	10''	=	24''

FOR BOTH JACKS THE BODY DIAMETER IS 3''

ESTABLISH JACK POSITION

FIRST POSITION IS AT 47° WITH VERTICAL AXIS IF HSR-258T IS USED - SEE Pg I-7. - FOR CALCULATION.

IF HSR-2510T IS USED.
THERE IS A MAXIMUM DIFFERENCE OF

$$24'' - 20'' = \underline{\underline{4''}}$$

FOR 1° THE ARC LENGTH $= \dfrac{2\pi \times 146''}{360^\circ} = \underline{2.55''}$

AT ℄ OF STEEL SET

$$4'' \div 2.55''/\text{DEGREE} = 1.57^\circ = 2^\circ$$

HENCE CONSIDER THE SECOND POSITION AT 49°

IN CASE THE CROWN SEGMENTation IS VARRIED FROM 90° TO 84°

$90^\circ - 84^\circ = 6^\circ$ - variation

$6^\circ \div 2 = 3^\circ$ on each side

$47^\circ + 3^\circ = 50^\circ$

$49^\circ + 3^\circ = 52^\circ$

CHECK ADEQUACY OF STEEL SET FOR 51° - WHICH WILL GIVE CLOSE RESULTS FOR BOTH CASES.

DISTANCE BETWEEN ℄ STEEL SET AND ℄ JACK.

JACK BODY = $\underline{\underline{3''}}$ - SEE ATTACHMENT VI - page VI-3 -

$3'' \div 2 = 1\frac{1}{2}''$

ADD: $4''$ ($\frac{1}{2}$ W8×31) $+ 1\frac{1}{2}'' = 5\frac{1}{2}''$

SEE ATTACHMENT IX page IX-8.

HENCE KEEP JACK AT MAX $6''$ ℄ STEEL SET TO ℄ JACK - ($\frac{1}{2}''$ TOLERANCE)

```
     **************************************************
     *                                                *
     *            S T A A D - III                     *
     *            Revision 16.0b                      *
     *            Proprietary Program of              *
     *            RESEARCH ENGINEERS, Inc.            *
     *            Date=    JUL 17, 1995               *
     *            Time=    16:12:22                   *
     *                                                *
     **************************************************

  2. STAAD PLANE BABEE0000-01717-0200-00003  ATTACHMENT  I
  3. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  4. * 50 T, 30 T AND 25 T JACKING LOADS APPLIED TO BOTH SIDES OF STEEL SET
  5. * AT 47 DEGREES.       FILE STLRV2
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 3.27 2.13 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.06 2.13
 19. MEMBER INCIDENCE
 20. 3 3 4 42
 21. UNIT KIP INCH
 22. MEMBER PROPERTIES
 23. 3 TO 42 TA STA W8X31
 24. CONSTANTS
 25. E 29000.0 ALL
 26. DENSITY 0.00028 ALL
 27. BETA 0 ALL
 28. UNIT FT
 29. SUPPORT
 30. 3 7 11 35 39 43 FIXED BUT FY MZ
 31. 22 24 FIXED BUT FX MZ
 32. 16 30 PINNED
 33. UNIT KIP
 34. LOAD 1
 35. SELF WEIGHT Y -1.0
 36. LOADING 2
 37. * 50 TON JACKS AT EACH SIDE
 38. JOINT LOADING
 39. 3 FY 73.14
 40. 43 FY 73.14
 41. 3 FX -68.20
 42. 43 FX 68.20
 43. 43 MZ -50.00              45. * 30 TON JACKS AT EACH SIDE
 44. 3 MZ 50.00                46. JOINT LOADING
 45. LOADING 3                 47. 3 FY 43.88
```

```
48. 43 FY 43.88
49. 3 FX -40.92
50. 43 FX 40.92
51. 43 MZ -30.00
52. 3 MZ 30.00
53. LOADING 4
54. * 25 TON JACKS AT EACH SIDE
55. JOINT LOADING
56. 3 FX -34.10
57. 43 FX 34.10
58. 3 FY 36.57
59. 43 FY 36.57
60. 43 MZ -25.00
61. 3 MZ 25.00
62. LOADING COMBINATION 5
63. 1 2.5 2 1.0
64. LOADING COMBINATION 6
65. 1 2.5 3 1.0
66. LOADING COMBINATION 7
67. 1 2.5 4 1.0
68. PERFORM ANALYSIS


          P R O B L E M   S T A T I S T I C S
          -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/   40/   10
  ORIGINAL/FINAL BAND-WIDTH =     1/    1
  TOTAL PRIMARY LOAD CASES  =     4, TOTAL DEGREES OF FREEDOM =    111
  SIZE OF STIFFNESS MATRIX =      666 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =     0.08 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                  15:55:54
++ PROCESSING GLOBAL STIFFNESS MATRIX.                   15:55:55
++ PROCESSING TRIANGULAR FACTORIZATION.                  15:55:55
++ CALCULATING JOINT DISPLACEMENTS.                      15:55:55
++ CALCULATING MEMBER  FORCES.                           15:55:56

  69. LOAD LIST 5 6 7
  70. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

   3     5    0.00000   0.13013   0.00000   0.00000   0.00000   0.00680
         6    0.00000   0.07763   0.00000   0.00000   0.00000   0.00409
         7    0.00000   0.06451   0.00000   0.00000   0.00000   0.00341
   4     5   -0.06137   0.07148   0.00000   0.00000   0.00000   0.00369
         6   -0.03686   0.04241   0.00000   0.00000   0.00000   0.00222
         7   -0.03074   0.03515   0.00000   0.00000   0.00000   0.00185
   5     5   -0.08369   0.04927   0.00000   0.00000   0.00000   0.00015
         6   -0.05027   0.02908   0.00000   0.00000   0.00000   0.00009
         7   -0.04192   0.02404   0.00000   0.00000   0.00000   0.00008
   6     5   -0.05310   0.05695   0.00000   0.00000   0.00000  -0.00198
         6   -0.03189   0.03371   0.00000   0.00000   0.00000  -0.00119
         7   -0.02660   0.02790   0.00000   0.00000   0.00000  -0.00099
   7     5    0.00000   0.06840   0.00000   0.00000   0.00000  -0.00145
         6    0.00000   0.04060   0.00000   0.00000   0.00000  -0.00087
         7    0.00000   0.03366   0.00000   0.00000   0.00000  -0.00073
   8     5    0.00462   0.06415   0.00000   0.00000   0.00000  -0.00012
         6    0.00281   0.03808   0.00000   0.00000   0.00000  -0.00007
         7    0.00235   0.03156   0.00000   0.00000   0.00000  -0.00006
   9     5    0.00113   0.05880   0.00000   0.00000   0.00000   0.00008
         6    0.00071   0.03488   0.00000   0.00000   0.00000   0.00005
         7    0.00060   0.02891   0.00000   0.00000   0.00000   0.00004
  10     5    0.00120   0.05432   0.00000   0.00000   0.00000   0.00012
         6    0.00072   0.03221   0.00000   0.00000   0.00000   0.00007
         7    0.00060   0.02669   0.00000   0.00000   0.00000   0.00006
  11     5    0.00000   0.05003   0.00000   0.00000   0.00000   0.00077
         6    0.00000   0.02966   0.00000   0.00000   0.00000   0.00046
         7    0.00000   0.02457   0.00000   0.00000   0.00000   0.00038
  12     5   -0.02698   0.05250   0.00000   0.00000   0.00000   0.00111
         6   -0.01598   0.03112   0.00000   0.00000   0.00000   0.00065
         7   -0.01323   0.02577   0.00000   0.00000   0.00000   0.00054
  13     5   -0.04444   0.05435   0.00000   0.00000   0.00000   0.00030
         6   -0.02631   0.03220   0.00000   0.00000   0.00000   0.00018
         7   -0.02178   0.02666   0.00000   0.00000   0.00000   0.00015
  14     5   -0.04286   0.04773   0.00000   0.00000   0.00000  -0.00088
         6   -0.02538   0.02827   0.00000   0.00000   0.00000  -0.00052
         7   -0.02101   0.02341   0.00000   0.00000   0.00000  -0.00043
  15     5   -0.02384   0.02810   0.00000   0.00000   0.00000  -0.00171
         6   -0.01412   0.01665   0.00000   0.00000   0.00000  -0.00101
         7   -0.01169   0.01378   0.00000   0.00000   0.00000  -0.00084
  16     5    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00139
         6    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00082
         7    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00068
  17     5    0.00772  -0.00961   0.00000   0.00000   0.00000  -0.00050
         6    0.00461  -0.00576   0.00000   0.00000   0.00000  -0.00030
         7    0.00383  -0.00480   0.00000   0.00000   0.00000  -0.00025
  18     5    0.00809  -0.01129   0.00000   0.00000   0.00000   0.00000
         6    0.00486  -0.00682   0.00000   0.00000   0.00000   0.00000
         7    0.00406  -0.00571   0.00000   0.00000   0.00000   0.00000
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

  19     5    0.00578  -0.00852   0.00000   0.00000   0.00000   0.00021
         6    0.00351  -0.00522   0.00000   0.00000   0.00000   0.00013
         7    0.00294  -0.00440   0.00000   0.00000   0.00000   0.00010
  20     5    0.00335  -0.00447   0.00000   0.00000   0.00000   0.00023
         6    0.00205  -0.00281   0.00000   0.00000   0.00000   0.00014
         7    0.00172  -0.00240   0.00000   0.00000   0.00000   0.00012
  21     5    0.00170  -0.00134   0.00000   0.00000   0.00000   0.00015
         6    0.00104  -0.00088   0.00000   0.00000   0.00000   0.00009
         7    0.00088  -0.00077   0.00000   0.00000   0.00000   0.00008
  22     5    0.00076   0.00000   0.00000   0.00000   0.00000   0.00008
         6    0.00046   0.00000   0.00000   0.00000   0.00000   0.00005
         7    0.00039   0.00000   0.00000   0.00000   0.00000   0.00004
  23     5    0.00001   0.00094   0.00000   0.00000   0.00000   0.00000
         6    0.00001   0.00058   0.00000   0.00000   0.00000   0.00000
         7    0.00000   0.00048   0.00000   0.00000   0.00000   0.00000
  24     5   -0.00074   0.00000   0.00000   0.00000   0.00000  -0.00008
         6   -0.00045   0.00000   0.00000   0.00000   0.00000  -0.00005
         7   -0.00037   0.00000   0.00000   0.00000   0.00000  -0.00004
  25     5   -0.00168  -0.00132   0.00000   0.00000   0.00000  -0.00015
         6   -0.00103  -0.00088   0.00000   0.00000   0.00000  -0.00009
         7   -0.00087  -0.00076   0.00000   0.00000   0.00000  -0.00008
  26     5   -0.00332  -0.00444   0.00000   0.00000   0.00000  -0.00023
         6   -0.00203  -0.00279   0.00000   0.00000   0.00000  -0.00014
         7   -0.00171  -0.00238   0.00000   0.00000   0.00000  -0.00012
  27     5   -0.00574  -0.00848   0.00000   0.00000   0.00000  -0.00021
         6   -0.00348  -0.00520   0.00000   0.00000   0.00000  -0.00013
         7   -0.00292  -0.00438   0.00000   0.00000   0.00000  -0.00010
  28     5   -0.00805  -0.01124   0.00000   0.00000   0.00000   0.00000
         6   -0.00484  -0.00680   0.00000   0.00000   0.00000   0.00000
         7   -0.00404  -0.00568   0.00000   0.00000   0.00000   0.00000
  29     5   -0.00770  -0.00959   0.00000   0.00000   0.00000   0.00050
         6   -0.00460  -0.00575   0.00000   0.00000   0.00000   0.00030
         7   -0.00382  -0.00479   0.00000   0.00000   0.00000   0.00025
  30     5    0.00000   0.00000   0.00000   0.00000   0.00000   0.00138
         6    0.00000   0.00000   0.00000   0.00000   0.00000   0.00082
         7    0.00000   0.00000   0.00000   0.00000   0.00000   0.00068
  31     5    0.02379   0.02807   0.00000   0.00000   0.00000   0.00171
         6    0.01409   0.01662   0.00000   0.00000   0.00000   0.00101
         7    0.01167   0.01377   0.00000   0.00000   0.00000   0.00084
  32     5    0.04283   0.04770   0.00000   0.00000   0.00000   0.00089
         6    0.02536   0.02825   0.00000   0.00000   0.00000   0.00053
         7    0.02099   0.02339   0.00000   0.00000   0.00000   0.00044
  33     5    0.04463   0.05450   0.00000   0.00000   0.00000  -0.00030
         6    0.02642   0.03229   0.00000   0.00000   0.00000  -0.00018
         7    0.02188   0.02674   0.00000   0.00000   0.00000  -0.00015
  34     5    0.02678   0.05260   0.00000   0.00000   0.00000  -0.00111
         6    0.01586   0.03117   0.00000   0.00000   0.00000  -0.00066
         7    0.01313   0.02582   0.00000   0.00000   0.00000  -0.00054
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

  35     5    0.00000    0.05001    0.00000    0.00000    0.00000   -0.00077
         6    0.00000    0.02965    0.00000    0.00000    0.00000   -0.00046
         7    0.00000    0.02456    0.00000    0.00000    0.00000   -0.00038
  36     5   -0.00130    0.05429    0.00000    0.00000    0.00000   -0.00014
         6   -0.00078    0.03219    0.00000    0.00000    0.00000   -0.00008
         7   -0.00065    0.02668    0.00000    0.00000    0.00000   -0.00007
  37     5   -0.00170    0.05874    0.00000    0.00000    0.00000   -0.00009
         6   -0.00105    0.03484    0.00000    0.00000    0.00000   -0.00006
         7   -0.00089    0.02888    0.00000    0.00000    0.00000   -0.00005
  38     5   -0.00513    0.06409    0.00000    0.00000    0.00000    0.00013
         6   -0.00311    0.03804    0.00000    0.00000    0.00000    0.00008
         7   -0.00261    0.03153    0.00000    0.00000    0.00000    0.00007
  39     5    0.00000    0.06824    0.00000    0.00000    0.00000    0.00149
         6    0.00000    0.04051    0.00000    0.00000    0.00000    0.00090
         7    0.00000    0.03358    0.00000    0.00000    0.00000    0.00075
  40     5    0.05403    0.05680    0.00000    0.00000    0.00000    0.00201
         6    0.03245    0.03362    0.00000    0.00000    0.00000    0.00121
         7    0.02706    0.02783    0.00000    0.00000    0.00000    0.00101
  41     5    0.08481    0.04903    0.00000    0.00000    0.00000   -0.00016
         6    0.05094    0.02894    0.00000    0.00000    0.00000   -0.00010
         7    0.04247    0.02392    0.00000    0.00000    0.00000   -0.00008
  42     5    0.06185    0.07189    0.00000    0.00000    0.00000   -0.00373
         6    0.03715    0.04265    0.00000    0.00000    0.00000   -0.00224
         7    0.03097    0.03535    0.00000    0.00000    0.00000   -0.00187
  43     5    0.00000    0.13094    0.00000    0.00000    0.00000   -0.00685
         6    0.00000    0.07812    0.00000    0.00000    0.00000   -0.00411
         7    0.00000    0.06492    0.00000    0.00000    0.00000   -0.00343
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X    FORCE-Y    FORCE-Z      MOM-X      MOM-Y      MOM Z

   3     5      12.46       0.00       0.00       0.00       0.00       0.00
         6       7.52       0.00       0.00       0.00       0.00       0.00
         7       6.28       0.00       0.00       0.00       0.00       0.00
   7     5      56.73       0.00       0.00       0.00       0.00       0.00
         6      34.02       0.00       0.00       0.00       0.00       0.00
         7      28.34       0.00       0.00       0.00       0.00       0.00
  11     5      38.74       0.00       0.00       0.00       0.00       0.00
         6      22.96       0.00       0.00       0.00       0.00       0.00
         7      19.01       0.00       0.00       0.00       0.00       0.00
  35     5     -38.86       0.00       0.00       0.00       0.00       0.00
         6     -23.03       0.00       0.00       0.00       0.00       0.00
         7     -19.07       0.00       0.00       0.00       0.00       0.00
  39     5     -56.75       0.00       0.00       0.00       0.00       0.00
         6     -34.03       0.00       0.00       0.00       0.00       0.00
         7     -28.35       0.00       0.00       0.00       0.00       0.00
  43     5     -12.40       0.00       0.00       0.00       0.00       0.00
         6      -7.49       0.00       0.00       0.00       0.00       0.00
         7      -6.25       0.00       0.00       0.00       0.00       0.00
  22     5       0.00      -2.38       0.00       0.00       0.00       0.00
         6       0.00      -1.32       0.00       0.00       0.00       0.00
         7       0.00      -1.05       0.00       0.00       0.00       0.00
  24     5       0.00      -2.39       0.00       0.00       0.00       0.00
         6       0.00      -1.33       0.00       0.00       0.00       0.00
         7       0.00      -1.06       0.00       0.00       0.00       0.00
  16     5     -28.58     -68.59       0.00       0.00       0.00       0.00
         6     -16.82     -40.39       0.00       0.00       0.00       0.00
         7     -13.88     -33.35       0.00       0.00       0.00       0.00
  30     5      28.66     -68.59       0.00       0.00       0.00       0.00
         6      16.87     -40.39       0.00       0.00       0.00       0.00
         7      13.92     -33.35       0.00       0.00       0.00       0.00
```

```
  MEMBER END FORCES    STRUCTURE TYPE = PLANE
  -----------------
  ALL UNITS ARE -- KIP  FEET

 MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y       MOM-Z


    3    5    3     91.86      4.36     0.00      0.00      0.00      -50.00
              4    -91.78     -4.30     0.00      0.00      0.00       55.65
         6    3     55.08      2.65     0.00      0.00      0.00      -30.00
              4    -55.00     -2.58     0.00      0.00      0.00       33.42
         7    3     45.89      2.22     0.00      0.00      0.00      -25.00
              4    -45.82     -2.16     0.00      0.00      0.00       27.86

    4    5    4     91.61     -7.00     0.00      0.00      0.00      -55.65
              5    -91.51      7.07     0.00      0.00      0.00       44.67
         6    4     54.91     -4.19     0.00      0.00      0.00      -33.42
              5    -54.81      4.25     0.00      0.00      0.00       26.83
         7    4     45.74     -3.48     0.00      0.00      0.00      -27.86
              5    -45.63      3.55     0.00      0.00      0.00       22.37

    5    5    5     89.89    -18.53     0.00      0.00      0.00      -44.67
              6    -89.79     18.58     0.00      0.00      0.00       15.61
         6    5     53.83    -11.12     0.00      0.00      0.00      -26.83
              6    -53.73     11.17     0.00      0.00      0.00        9.38
         7    5     44.83     -9.27     0.00      0.00      0.00      -22.37
              6    -44.72      9.32     0.00      0.00      0.00        7.82

    6    5    6     86.81    -29.51     0.00      0.00      0.00      -15.61
              7    -86.70     29.55     0.00      0.00      0.00      -30.51
         6    6     51.94    -17.71     0.00      0.00      0.00       -9.38
              7    -51.83     17.75     0.00      0.00      0.00      -18.31
         7    6     43.23    -14.76     0.00      0.00      0.00       -7.82
              7    -43.11     14.80     0.00      0.00      0.00      -15.26

    7    5    7     71.15     14.87     0.00      0.00      0.00       30.51
              8    -71.03    -14.85     0.00      0.00      0.00       -7.20
         6    7     42.50      8.91     0.00      0.00      0.00       18.31
              8    -42.38     -8.89     0.00      0.00      0.00       -4.35
         7    7     35.34      7.42     0.00      0.00      0.00       15.26
              8    -35.23     -7.40     0.00      0.00      0.00       -3.64

    8    5    8     72.35      5.63     0.00      0.00      0.00        7.20
              9    -72.23     -5.62     0.00      0.00      0.00        1.59
         6    8     43.17      3.39     0.00      0.00      0.00        4.35
              9    -43.05     -3.38     0.00      0.00      0.00        0.94
         7    8     35.88      2.83     0.00      0.00      0.00        3.64
              9    -35.76     -2.82     0.00      0.00      0.00        0.77

    9    5    9     72.37      3.27     0.00      0.00      0.00        1.59
             10    -72.27     -3.26     0.00      0.00      0.00        2.86
         6    9     43.14      1.92     0.00      0.00      0.00        0.94
             10    -43.04     -1.91     0.00      0.00      0.00        1.67
         7    9     35.84      1.58     0.00      0.00      0.00        0.77
             10    -35.73     -1.58     0.00      0.00      0.00        1.38
```

```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  10     5  10     71.47     11.17     0.00      0.00      0.00      -2.86
            11    -71.37    -11.16     0.00      0.00      0.00      18.15
         6  10     42.57      6.63     0.00      0.00      0.00      -1.67
            11    -42.46     -6.61     0.00      0.00      0.00      10.74
         7  10     35.35      5.49     0.00      0.00      0.00      -1.38
            11    -35.24     -5.47     0.00      0.00      0.00       8.88

  11     5  11     80.31    -18.60     0.00      0.00      0.00     -18.15
            12    -80.21     18.63     0.00      0.00      0.00      -7.19
         6  11     47.76    -11.01     0.00      0.00      0.00     -10.74
            12    -47.66     11.04     0.00      0.00      0.00      -4.27
         7  11     39.63     -9.11     0.00      0.00      0.00      -8.88
            12    -39.53      9.14     0.00      0.00      0.00      -3.54

  12     5  12     81.89     -8.65     0.00      0.00      0.00       7.19
            13    -81.79      8.70     0.00      0.00      0.00     -19.05
         6  12     48.65     -5.11     0.00      0.00      0.00       4.27
            13    -48.56      5.15     0.00      0.00      0.00     -11.28
         7  12     40.35     -4.22     0.00      0.00      0.00       3.54
            13    -40.25      4.26     0.00      0.00      0.00      -9.34

  13     5  13     82.25     -0.34     0.00      0.00      0.00      19.05
            14    -82.16      0.39     0.00      0.00      0.00     -19.55
         6  13     48.83     -0.19     0.00      0.00      0.00      11.28
            14    -48.74      0.24     0.00      0.00      0.00     -11.57
         7  13     40.48     -0.15     0.00      0.00      0.00       9.34
            14    -40.39      0.20     0.00      0.00      0.00      -9.58

  14     5  14     81.67      8.99     0.00      0.00      0.00      19.55
            15    -81.58     -8.93     0.00      0.00      0.00      -7.27
         6  14     48.45      5.32     0.00      0.00      0.00      11.57
            15    -48.36     -5.26     0.00      0.00      0.00      -4.32
         7  14     40.15      4.41     0.00      0.00      0.00       9.58
            15    -40.06     -4.35     0.00      0.00      0.00      -3.58

  15     5  15     79.94     18.55     0.00      0.00      0.00       7.27
            16    -79.87    -18.48     0.00      0.00      0.00      17.91
         6  15     47.39     10.97     0.00      0.00      0.00       4.32
            16    -47.32    -10.90     0.00      0.00      0.00      10.55
         7  15     39.26      9.07     0.00      0.00      0.00       3.58
            16    -39.18     -9.00     0.00      0.00      0.00       8.71

  16     5  16     10.40     -5.10     0.00      0.00      0.00     -17.91
            17    -10.33      5.18     0.00      0.00      0.00      10.89
         6  16      6.41     -2.97     0.00      0.00      0.00     -10.55
            17     -6.34      3.04     0.00      0.00      0.00       6.44
         7  16      5.41     -2.43     0.00      0.00      0.00      -8.71
            17     -5.35      2.51     0.00      0.00      0.00       5.33

  17     5  17     10.83     -4.01     0.00      0.00      0.00     -10.89
            18    -10.77      4.10     0.00      0.00      0.00       5.36
```

```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

         6  17      6.64     -2.33     0.00      0.00      0.00      -6.44
            18     -6.58      2.42     0.00      0.00      0.00       3.21
         7  17      5.59     -1.91     0.00      0.00      0.00      -5.33
            18     -5.53      1.99     0.00      0.00      0.00       2.67

  18     5  18     11.17     -2.83     0.00      0.00      0.00      -5.36
            19    -11.12      2.92     0.00      0.00      0.00       1.43
         6  18      6.81     -1.64     0.00      0.00      0.00      -3.21
            19     -6.76      1.73     0.00      0.00      0.00       0.90
         7  18      5.72     -1.34     0.00      0.00      0.00      -2.67
            19     -5.67      1.44     0.00      0.00      0.00       0.76

  19     5  19     11.38     -1.66     0.00      0.00      0.00      -1.43
            20    -11.34      1.76     0.00      0.00      0.00      -0.90
         6  19      6.91     -0.97     0.00      0.00      0.00      -0.90
            20     -6.87      1.07     0.00      0.00      0.00      -0.49
         7  19      5.79     -0.80     0.00      0.00      0.00      -0.76
            20     -5.75      0.89     0.00      0.00      0.00      -0.39

  20     5  20     11.46     -0.51     0.00      0.00      0.00       0.90
            21    -11.43      0.61     0.00      0.00      0.00      -1.67
         6  20      6.95     -0.31     0.00      0.00      0.00       0.49
            21     -6.92      0.41     0.00      0.00      0.00      -0.98
         7  20      5.82     -0.26     0.00      0.00      0.00       0.39
            21     -5.79      0.36     0.00      0.00      0.00      -0.81

  21     5  21     11.43      0.67     0.00      0.00      0.00       1.67
            22    -11.41     -0.57     0.00      0.00      0.00      -0.83
         6  21      6.92      0.37     0.00      0.00      0.00       0.98
            22     -6.90     -0.26     0.00      0.00      0.00      -0.56
         7  21      5.79      0.29     0.00      0.00      0.00       0.81
            22     -5.78     -0.19     0.00      0.00      0.00      -0.49

  22     5  22     11.14     -0.54     0.00      0.00      0.00       0.83
            23    -11.13      0.65     0.00      0.00      0.00      -1.64
         6  22      6.75     -0.29     0.00      0.00      0.00       0.56
            23     -6.75      0.39     0.00      0.00      0.00      -1.02
         7  22      5.66     -0.22     0.00      0.00      0.00       0.49
            23     -5.65      0.33     0.00      0.00      0.00      -0.86

  23     5  23     11.13      0.66     0.00      0.00      0.00       1.64
            24    -11.14     -0.55     0.00      0.00      0.00      -0.82
         6  23      6.75      0.40     0.00      0.00      0.00       1.02
            24     -6.75     -0.29     0.00      0.00      0.00      -0.55
         7  23      5.65      0.33     0.00      0.00      0.00       0.86
            24     -5.66     -0.23     0.00      0.00      0.00      -0.48

  24     5  24     11.41     -0.57     0.00      0.00      0.00       0.82
            25    -11.43      0.67     0.00      0.00      0.00      -1.66
         6  24      6.90     -0.27     0.00      0.00      0.00       0.55
            25     -6.92      0.37     0.00      0.00      0.00      -0.98
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

         7  24      5.78     -0.19     0.00      0.00      0.00       0.48
            25     -5.79      0.29     0.00      0.00      0.00      -0.81

  25     5  25     11.43      0.61     0.00      0.00      0.00       1.66
            26    -11.46     -0.51     0.00      0.00      0.00      -0.90
         6  25      6.92      0.41     0.00      0.00      0.00       0.98
            26     -6.95     -0.31     0.00      0.00      0.00      -0.49
         7  25      5.79      0.36     0.00      0.00      0.00       0.81
            26     -5.82     -0.26     0.00      0.00      0.00      -0.38

  26     5  26     11.34      1.72     0.00      0.00      0.00       0.90
            27    -11.38     -1.63     0.00      0.00      0.00       1.40
         6  26      6.87      1.05     0.00      0.00      0.00       0.49
            27     -6.91     -0.95     0.00      0.00      0.00       0.88
         7  26      5.76      0.88     0.00      0.00      0.00       0.38
            27     -5.80     -0.78     0.00      0.00      0.00       0.75

  27     5  27     11.11      2.95     0.00      0.00      0.00      -1.40
            28    -11.16     -2.86     0.00      0.00      0.00       5.36
         6  27      6.76      1.75     0.00      0.00      0.00      -0.88
            28     -6.81     -1.66     0.00      0.00      0.00       3.20
         7  27      5.67      1.45     0.00      0.00      0.00      -0.75
            28     -5.72     -1.36     0.00      0.00      0.00       2.67

  28     5  28     10.77      4.09     0.00      0.00      0.00      -5.36
            29    -10.83     -4.01     0.00      0.00      0.00      10.88
         6  28      6.58      2.41     0.00      0.00      0.00      -3.20
            29     -6.64     -2.33     0.00      0.00      0.00       6.43
         7  28      5.53      1.99     0.00      0.00      0.00      -2.67
            29     -5.59     -1.91     0.00      0.00      0.00       5.32

  29     5  29     10.33      5.17     0.00      0.00      0.00     -10.88
            30    -10.40     -5.09     0.00      0.00      0.00      17.90
         6  29      6.34      3.04     0.00      0.00      0.00      -6.43
            30     -6.41     -2.96     0.00      0.00      0.00      10.54
         7  29      5.35      2.51     0.00      0.00      0.00      -5.32
            30     -5.42     -2.43     0.00      0.00      0.00       8.70

  30     5  30     79.92    -18.42     0.00      0.00      0.00     -17.90
            31    -80.00     18.49     0.00      0.00      0.00      -7.19
         6  30     47.35    -10.86     0.00      0.00      0.00     -10.54
            31    -47.43     10.93     0.00      0.00      0.00      -4.27
         7  30     39.21     -8.97     0.00      0.00      0.00      -8.70
            31    -39.29      9.04     0.00      0.00      0.00      -3.54

  31     5  31     81.63     -8.86     0.00      0.00      0.00       7.19
            32    -81.72      8.92     0.00      0.00      0.00     -19.37
         6  31     48.39     -5.22     0.00      0.00      0.00       4.27
            32    -48.48      5.28     0.00      0.00      0.00     -11.47
         7  31     40.08     -4.31     0.00      0.00      0.00       3.54
            32    -40.17      4.37     0.00      0.00      0.00      -9.50
```

```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y     MOM-Z


 32     5   32     82.20     -0.06     0.00      0.00      0.00     19.37
            33    -82.29      0.11     0.00      0.00      0.00    -19.50
        6   32     48.76     -0.03     0.00      0.00      0.00     11.47
            33    -48.85      0.08     0.00      0.00      0.00    -11.55
        7   32     40.41     -0.02     0.00      0.00      0.00      9.50
            33    -40.50      0.07     0.00      0.00      0.00     -9.56

 33     5   33     81.76      9.33     0.00      0.00      0.00     19.50
            34    -81.86     -9.29     0.00      0.00      0.00     -6.81
        6   33     48.54      5.53     0.00      0.00      0.00     11.55
            34    -48.64     -5.49     0.00      0.00      0.00     -4.04
        7   33     40.24      4.58     0.00      0.00      0.00      9.56
            34    -40.34     -4.54     0.00      0.00      0.00     -3.35

 34     5   34     80.36     18.14     0.00      0.00      0.00      6.81
            35    -80.46    -18.11     0.00      0.00      0.00     17.92
        6   34     47.75     10.75     0.00      0.00      0.00      4.04
            35    -47.85    -10.72     0.00      0.00      0.00     10.60
        7   34     39.60      8.90     0.00      0.00      0.00      3.35
            35    -39.70     -8.87     0.00      0.00      0.00      8.77

 35     5   35     71.36    -11.19     0.00      0.00      0.00    -17.92
            36    -71.47     11.21     0.00      0.00      0.00      2.58
        6   35     42.46     -6.63     0.00      0.00      0.00    -10.60
            36    -42.56      6.65     0.00      0.00      0.00      1.51
        7   35     35.24     -5.49     0.00      0.00      0.00     -8.77
            36    -35.34      5.51     0.00      0.00      0.00      1.24

 36     5   36     72.29     -2.77     0.00      0.00      0.00     -2.58
            37    -72.39      2.77     0.00      0.00      0.00     -1.19
        6   36     43.05     -1.62     0.00      0.00      0.00     -1.51
            37    -43.15      1.62     0.00      0.00      0.00     -0.70
        7   36     35.74     -1.33     0.00      0.00      0.00     -1.24
            37    -35.85      1.34     0.00      0.00      0.00     -0.57

 37     5   37     72.23     -5.59     0.00      0.00      0.00     -1.19
            38    -72.35      5.59     0.00      0.00      0.00     -7.55
        6   37     43.05     -3.36     0.00      0.00      0.00     -0.70
            38    -43.17      3.37     0.00      0.00      0.00     -4.56
        7   37     35.76     -2.80     0.00      0.00      0.00     -0.57
            38    -35.88      2.81     0.00      0.00      0.00     -3.81

 38     5   38     71.04    -14.81     0.00      0.00      0.00      7.55
            39    -71.16     14.83     0.00      0.00      0.00    -30.80
        6   38     42.39     -8.87     0.00      0.00      0.00      4.56
            39    -42.50      8.89     0.00      0.00      0.00    -18.49
        7   38     35.23     -7.38     0.00      0.00      0.00      3.81
            39    -35.35      7.40     0.00      0.00      0.00    -15.41
 39     5   39     86.53     30.13     0.00      0.00      0.00     30.80
            40    -86.65    -30.09     0.00      0.00      0.00     16.13
```

```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

         6  39     51.73     18.09     0.00      0.00      0.00      18.49
            40    -51.84    -18.05     0.00      0.00      0.00       9.69
         7  39     43.03     15.09     0.00      0.00      0.00      15.41
            40    -43.15    -15.05     0.00      0.00      0.00       8.08

  40     5  40     89.81     18.64     0.00      0.00      0.00     -16.13
            41    -89.92    -18.58     0.00      0.00      0.00      45.26
         6  40     53.74     11.20     0.00      0.00      0.00      -9.69
            41    -53.85    -11.15     0.00      0.00      0.00      27.18
         7  40     44.73      9.34     0.00      0.00      0.00      -8.08
            41    -44.84     -9.29     0.00      0.00      0.00      22.67

  41     5  41     91.58      6.63     0.00      0.00      0.00     -45.26
            42    -91.68     -6.56     0.00      0.00      0.00      55.60
         6  41     54.85      3.99     0.00      0.00      0.00     -27.18
            42    -54.95     -3.92     0.00      0.00      0.00      33.38
         7  41     45.67      3.33     0.00      0.00      0.00     -22.67
            42    -45.77     -3.26     0.00      0.00      0.00      27.83

  42     5  42     91.82     -4.25     0.00      0.00      0.00     -55.60
            43    -91.89      4.32     0.00      0.00      0.00      50.00
         6  42     55.03     -2.56     0.00      0.00      0.00     -33.38
            43    -55.10      2.62     0.00      0.00      0.00      30.00
         7  42     45.84     -2.14     0.00      0.00      0.00     -27.83
            43    -45.91      2.20     0.00      0.00      0.00      25.00

  ************** END OF LATEST ANALYSIS RESULT **************

   71. LOAD LIST 5
   72. CHECK CODE ALL
```

```
                    STAAD-III CODE CHECKING - (AISC)
                    ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE       RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY            MZ       LOCATION
=======================================================================

*    3 ST   W8X 31         FAIL      AISC- H1-2        1.488        5
                   91.78 C              0.00         55.65       1.31
*    4 ST   W8X 31         FAIL      AISC- H1-2        1.487        5
                   91.61 C              0.00        -55.65       0.00
*    5 ST   W8X 31         FAIL      AISC- H1-2        1.276        5
                   89.89 C              0.00        -44.67       0.00
*    6 ST   W8X 31         FAIL      AISC- H1-2        1.000        5
                   86.70 C              0.00        -30.51       1.56
     7 ST   W8X 31         PASS      AISC- H1-2        0.921        5
                   71.15 C              0.00         30.51       0.00
     8 ST   W8X 31         PASS      AISC- H1-2        0.499        5
                   72.35 C              0.00          7.20       0.00
     9 ST   W8X 31         PASS      AISC- H1-2        0.419        5
                   72.27 C              0.00          2.86       1.36
    10 ST   W8X 31         PASS      AISC- H1-2        0.695        5
                   71.37 C              0.00         18.15       1.37
    11 ST   W8X 31         PASS      AISC- H1-2        0.740        5
                   80.31 C              0.00        -18.15       0.00
    12 ST   W8X 31         PASS      AISC- H1-2        0.765        5
                   81.79 C              0.00        -19.05       1.37
    13 ST   W8X 31         PASS      AISC- H1-2        0.776        5
                   82.16 C              0.00        -19.55       1.36
    14 ST   W8X 31         PASS      AISC- H1-2        0.773        5
                   81.67 C              0.00         19.55       0.00
    15 ST   W8X 31         PASS      AISC- H1-2        0.734        5
                   79.87 C              0.00         17.91       1.36
    16 ST   W8X 31         PASS      AISC- H1-3        0.382        5
                   10.40 C              0.00        -17.91       0.00
    17 ST   W8X 31         PASS      AISC- H1-3        0.256        5
                   10.83 C              0.00        -10.89       0.00
    18 ST   W8X 31         PASS      AISC- H1-3        0.156        5
                   11.17 C              0.00         -5.36       0.00
    19 ST   W8X 31         PASS      AISC- H1-3        0.085        5
                   11.38 C              0.00         -1.43       0.00
    20 ST   W8X 31         PASS      AISC- H1-3        0.090        5
                   11.43 C              0.00         -1.67       1.36
    21 ST   W8X 31         PASS      AISC- H1-3        0.090        5
                   11.43 C              0.00          1.67       0.00
    22 ST   W8X 31         PASS      AISC- H1-3        0.088        5
                   11.13 C              0.00         -1.64       1.37
    23 ST   W8X 31         PASS      AISC- H1-3        0.088        5
                   11.13 C              0.00          1.64       0.00
    24 ST   W8X 31         PASS      AISC- H1-3        0.089        5
                   11.43 C              0.00         -1.66       1.36
    25 ST   W8X 31         PASS      AISC- H1-3        0.090        5
                   11.43 C              0.00          1.66       0.00
    26 ST   W8X 31         PASS      AISC- H1-3        0.084        5
                   11.38 C              0.00          1.40       1.37
```

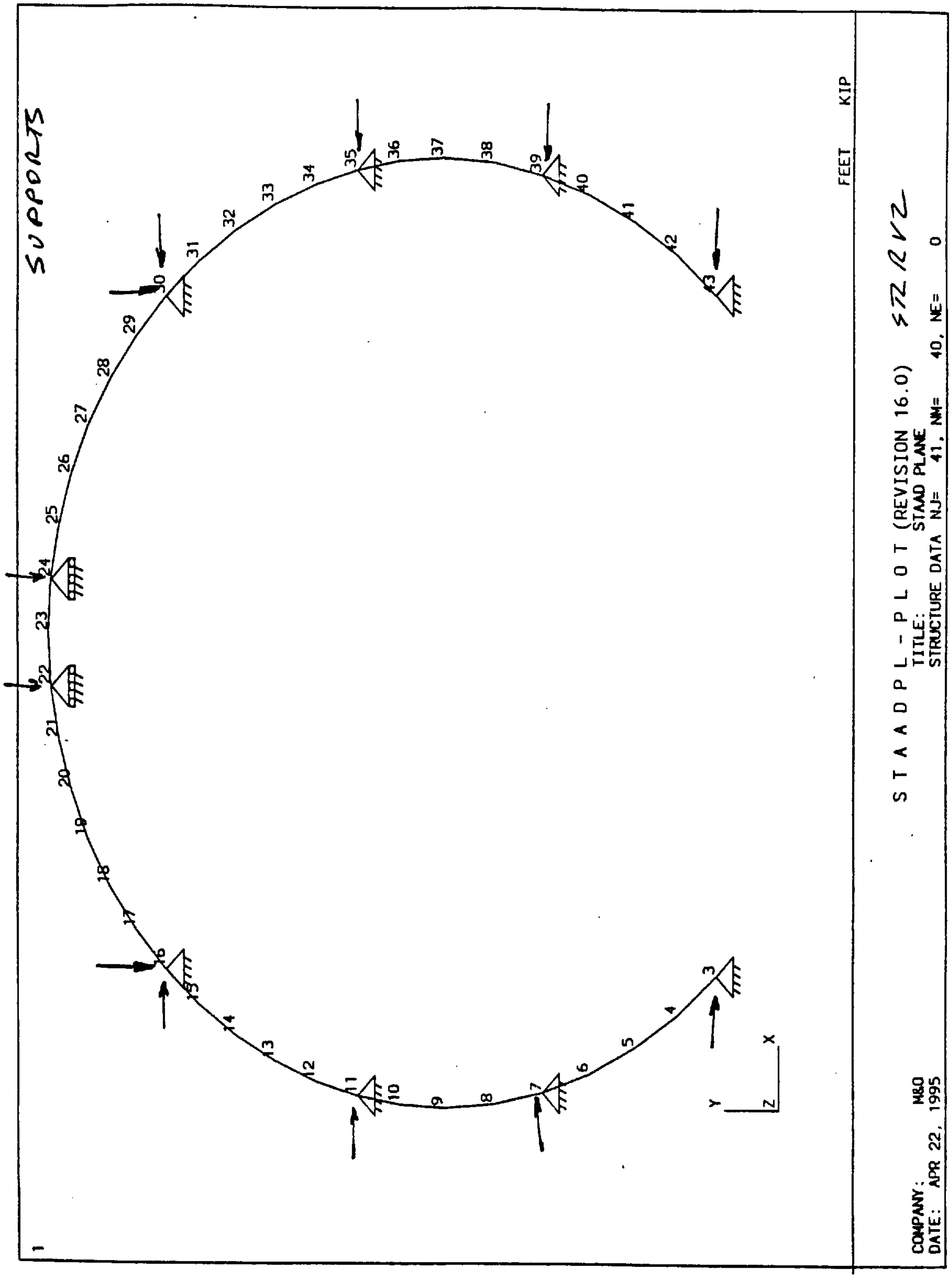
```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE         RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX          MY              MZ       LOCATION
=======================================================================

    27  ST   W8X 31          PASS     AISC- H1-3       0.156         5
                         11.16 C         0.00           5.36         1.36
    28  ST   W8X 31          PASS     AISC- H1-3       0.256         5
                         10.83 C         0.00          10.88         1.36
    29  ST   W8X 31          PASS     AISC- H1-3       0.382         5
                         10.40 C         0.00          17.90         1.37
    30  ST   W8X 31          PASS     AISC- H1-2       0.734         5
                         79.92 C         0.00         -17.90         0.00
    31  ST   W8X 31          PASS     AISC- H1-2       0.770         5
                         81.72 C         0.00         -19.37         1.37
    32  ST   W8X 31          PASS     AISC- H1-2       0.775         5
                         82.29 C         0.00         -19.50         1.36
    33  ST   W8X 31          PASS     AISC- H1-2       0.773         5
                         81.76 C         0.00          19.50         0.00
    34  ST   W8X 31          PASS     AISC- H1-2       0.737         5
                         80.46 C         0.00          17.92         1.36
    35  ST   W8X 31          PASS     AISC- H1-2       0.691         5
                         71.36 C         0.00         -17.92         0.00
    36  ST   W8X 31          PASS     AISC- H1-2       0.414         5
                         72.29 C         0.00          -2.58         0.00
    37  ST   W8X 31          PASS     AISC- H1-2       0.506         5
                         72.35 C         0.00          -7.55         1.56
    38  ST   W8X 31          PASS     AISC- H1-2       0.927         5
                         71.16 C         0.00         -30.80         1.57
*   39  ST   W8X 31          FAIL     AISC- H1-2       1.005         5
                         86.53 C         0.00          30.80         0.00
*   40  ST   W8X 31          FAIL     AISC- H1-2       1.287         5
                         89.92 C         0.00          45.26         1.57
*   41  ST   W8X 31          FAIL     AISC- H1-2       1.486         5
                         91.68 C         0.00          55.60         1.57
*   42  ST   W8X 31          FAIL     AISC- H1-2       1.487         5
                         91.82 C         0.00         -55.60         0.00

  ************** END OF TABULATED RESULT OF DESIGN **************

    73. LOAD LIST 6
    74. CHECK CODE ALL
```

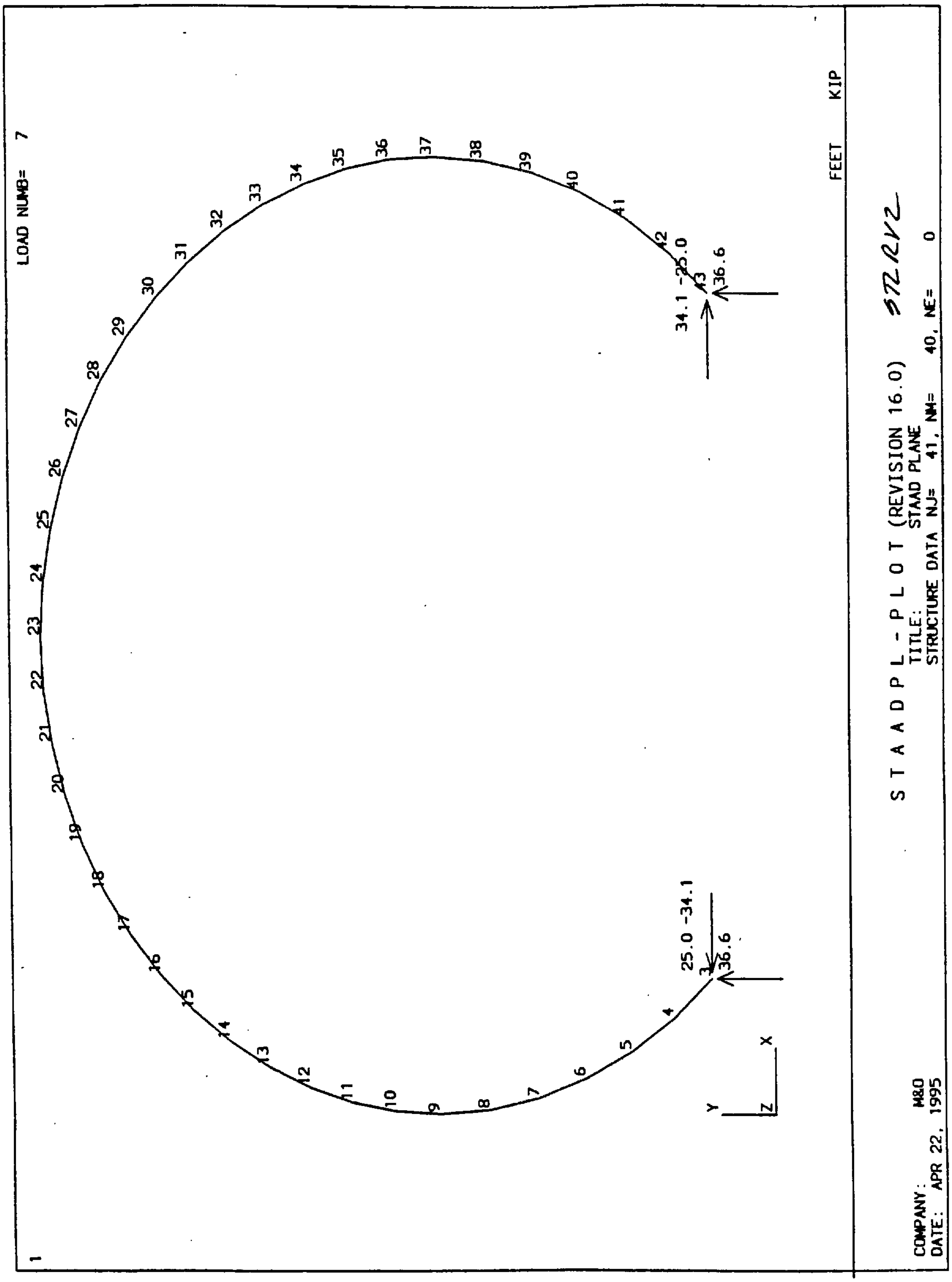
```
                         STAAD-III CODE CHECKING - (AISC)
                         ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY             MZ       LOCATION
=======================================================================

     3 ST   W8X 31          PASS     AISC- H1-2         0.893          6
                        55.00 C        0.00            33.42          1.31
     4 ST   W8X 31          PASS     AISC- H1-2         0.892          6
                        54.91 C        0.00           -33.42          0.00
     5 ST   W8X 31          PASS     AISC- H1-2         0.766          6
                        53.83 C        0.00           -26.83          0.00
     6 ST   W8X 31          PASS     AISC- H1-2         0.599          6
                        51.83 C        0.00           -18.31          1.56
     7 ST   W8X 31          PASS     AISC- H1-2         0.552          6
                        42.50 C        0.00            18.31          0.00
     8 ST   W8X 31          PASS     AISC- H1-2         0.299          6
                        43.17 C        0.00             4.35          0.00
     9 ST   W8X 31          PASS     AISC- H1-2         0.249          6
                        43.04 C        0.00             1.67          1.36
    10 ST   W8X 31          PASS     AISC- H1-2         0.412          6
                        42.46 C        0.00            10.74          1.37
    11 ST   W8X 31          PASS     AISC- H1-2         0.439          6
                        47.76 C        0.00           -10.74          0.00
    12 ST   W8X 31          PASS     AISC- H1-2         0.453          6
                        48.56 C        0.00           -11.28          1.37
    13 ST   W8X 31          PASS     AISC- H1-2         0.460          6
                        48.74 C        0.00           -11.57          1.36
    14 ST   W8X 31          PASS     AISC- H1-2         0.458          6
                        48.45 C        0.00            11.57          0.00
    15 ST   W8X 31          PASS     AISC- H1-2         0.434          6
                        47.32 C        0.00            10.55          1.36
    16 ST   W8X 31          PASS     AISC- H1-3         0.227          6
                         6.41 C        0.00           -10.55          0.00
    17 ST   W8X 31          PASS     AISC- H1-3         0.152          6
                         6.64 C        0.00            -6.44          0.00
    18 ST   W8X 31          PASS     AISC- H1-3         0.094          6
                         6.81 C        0.00            -3.21          0.00
    19 ST   W8X 31          PASS     AISC- H1-3         0.052          6
                         6.91 C        0.00            -0.90          0.00
    20 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.92 C        0.00            -0.98          1.36
    21 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.92 C        0.00             0.98          0.00
    22 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.75 C        0.00            -1.02          1.37
    23 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.75 C        0.00             1.02          0.00
    24 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.92 C        0.00            -0.98          1.36
    25 ST   W8X 31          PASS     AISC- H1-3         0.054          6
                         6.92 C        0.00             0.98          0.00
    26 ST   W8X 31          PASS     AISC- H1-3         0.052          6
                         6.91 C        0.00             0.88          1.37
```

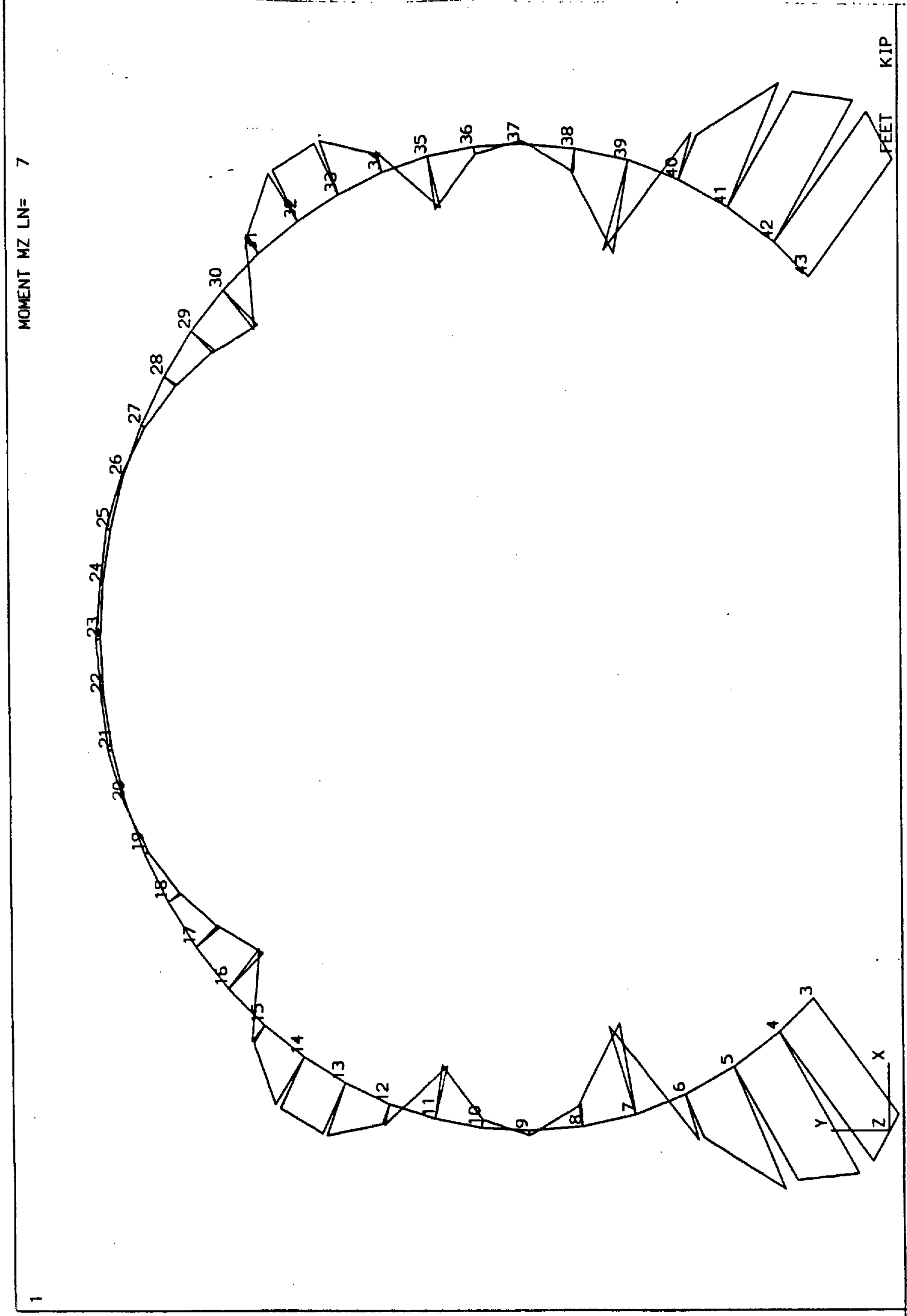
```
 L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE       RESULT/   CRITICAL COND/     RATIO/     LOADING/
                         FX            MY             MZ       LOCATION
=======================================================================

    27  ST  W8X 31         PASS      AISC- H1-3         0.094        6
                       6.81 C          0.00           3.20        1.36
    28  ST  W8X 31         PASS      AISC- H1-3         0.152        6
                       6.64 C          0.00           6.43        1.36
    29  ST  W8X 31         PASS      AISC- H1-3         0.227        6
                       6.41 C          0.00          10.54        1.37
    30  ST  W8X 31         PASS      AISC- H1-2         0.434        6
                      47.35 C          0.00         -10.54        0.00
    31  ST  W8X 31         PASS      AISC- H1-2         0.456        6
                      48.48 C          0.00         -11.47        1.37
    32  ST  W8X 31         PASS      AISC- H1-2         0.460        6
                      48.85 C          0.00         -11.55        1.36
    33  ST  W8X 31         PASS      AISC- H1-2         0.458        6
                      48.54 C          0.00          11.55        0.00
    34  ST  W8X 31         PASS      AISC- H1-2         0.437        6
                      47.85 C          0.00          10.60        1.36
    35  ST  W8X 31         PASS      AISC- H1-2         0.410        6
                      42.46 C          0.00         -10.60        0.00
    36  ST  W8X 31         PASS      AISC- H1-2         0.246        6
                      43.05 C          0.00          -1.51        0.00
    37  ST  W8X 31         PASS      AISC- H1-2         0.303        6
                      43.17 C          0.00          -4.56        1.56
    38  ST  W8X 31         PASS      AISC- H1-2         0.555        6
                      42.50 C          0.00         -18.49        1.57
    39  ST  W8X 31         PASS      AISC- H1-2         0.602        6
                      51.73 C          0.00          18.49        0.00
    40  ST  W8X 31         PASS      AISC- H1-2         0.772        6
                      53.85 C          0.00          27.18        1.57
    41  ST  W8X 31         PASS      AISC- H1-2         0.892        6
                      54.95 C          0.00          33.38        1.57
    42  ST  W8X 31         PASS      AISC- H1-2         0.892        6
                      55.03 C          0.00         -33.38        0.00

  ************** END OF TABULATED RESULT OF DESIGN **************

   75. LOAD LIST 7
   76. CHECK CODE ALL
```

```
                        STAAD-III CODE CHECKING - (AISC)
                        ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE          RESULT/   CRITICAL COND/       RATIO/     LOADING/
                             FX          MY                MZ       LOCATION
=======================================================================

      3  ST   W8X 31         PASS     AISC- H1-2          0.744         7
                          45.82 C        0.00             27.86       1.31
      4  ST   W8X 31         PASS     AISC- H1-2          0.744         7
                          45.74 C        0.00            -27.86       0.00
      5  ST   W8X 31         PASS     AISC- H1-2          0.638         7
                          44.83 C        0.00            -22.37       0.00
      6  ST   W8X 31         PASS     AISC- H1-2          0.499         7
                          43.11 C        0.00            -15.26       1.56
      7  ST   W8X 31         PASS     AISC- H1-2          0.460         7
                          35.34 C        0.00             15.26       0.00
      8  ST   W8X 31         PASS     AISC- H1-2          0.249         7
                          35.88 C        0.00              3.64       0.00
      9  ST   W8X 31         PASS     AISC- H1-2          0.207         7
                          35.73 C        0.00              1.38       1.36
     10  ST   W8X 31         PASS     AISC- H1-2          0.342         7
                          35.24 C        0.00              8.88       1.37
     11  ST   W8X 31         PASS     AISC- H1-2          0.364         7
                          39.63 C        0.00             -8.88       0.00
     12  ST   W8X 31         PASS     AISC- H1-2          0.376         7
                          40.25 C        0.00             -9.34       1.37
     13  ST   W8X 31         PASS     AISC- H1-2          0.381         7
                          40.39 C        0.00             -9.58       1.36
     14  ST   W8X 31         PASS     AISC- H1-2          0.380         7
                          40.15 C        0.00              9.58       0.00
     15  ST   W8X 31         PASS     AISC- H1-2          0.359         7
                          39.18 C        0.00              8.71       1.36
     16  ST   W8X 31         PASS     AISC- H1-3          0.188         7
                           5.41 C        0.00             -8.71       0.00
     17  ST   W8X 31         PASS     AISC- H1-3          0.127         7
                           5.59 C        0.00             -5.33       0.00
     18  ST   W8X 31         PASS     AISC- H1-3          0.078         7
                           5.72 C        0.00             -2.67       0.00
     19  ST   W8X 31         PASS     AISC- H1-3          0.044         7
                           5.79 C        0.00             -0.76       0.00
     20  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.79 C        0.00             -0.81       1.36
     21  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.79 C        0.00              0.81       0.00
     22  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.65 C        0.00             -0.86       1.37
     23  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.65 C        0.00              0.86       0.00
     24  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.79 C        0.00             -0.81       1.36
     25  ST   W8X 31         PASS     AISC- H1-3          0.045         7
                           5.79 C        0.00              0.81       0.00
     26  ST   W8X 31         PASS     AISC- H1-3          0.044         7
                           5.80 C        0.00              0.75       1.37
```

```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY            MZ        LOCATION
=======================================================================

    27  ST  W8X 31          PASS     AISC- H1-3        0.078          7
                         5.72 C          0.00          2.67        1.36
    28  ST  W8X 31          PASS     AISC- H1-3        0.127          7
                         5.59 C          0.00          5.32        1.36
    29  ST  W8X 31          PASS     AISC- H1-3        0.188          7
                         5.42 C          0.00          8.70        1.37
    30  ST  W8X 31          PASS     AISC- H1-2        0.359          7
                        39.21 C          0.00         -8.70        0.00
    31  ST  W8X 31          PASS     AISC- H1-2        0.378          7
                        40.17 C          0.00         -9.50        1.37
    32  ST  W8X 31          PASS     AISC- H1-2        0.381          7
                        40.50 C          0.00         -9.56        1.36
    33  ST  W8X 31          PASS     AISC- H1-2        0.380          7
                        40.24 C          0.00          9.56        0.00
    34  ST  W8X 31          PASS     AISC- H1-2        0.362          7
                        39.70 C          0.00          8.77        1.36
    35  ST  W8X 31          PASS     AISC- H1-2        0.340          7
                        35.24 C          0.00         -8.77        0.00
    36  ST  W8X 31          PASS     AISC- H1-2        0.204          7
                        35.74 C          0.00         -1.24        0.00
    37  ST  W8X 31          PASS     AISC- H1-2        0.252          7
                        35.88 C          0.00         -3.81        1.56
    38  ST  W8X 31          PASS     AISC- H1-2        0.462          7
                        35.35 C          0.00        -15.41        1.57
    39  ST  W8X 31          PASS     AISC- H1-2        0.501          7
                        43.03 C          0.00         15.41        0.00
    40  ST  W8X 31          PASS     AISC- H1-2        0.644          7
                        44.84 C          0.00         22.67        1.57
    41  ST  W8X 31          PASS     AISC- H1-2        0.743          7
                        45.77 C          0.00         27.83        1.57
    42  ST  W8X 31          PASS     AISC- H1-2        0.744          7
                        45.84 C          0.00        -27.83        0.00


  ************** END OF TABULATED RESULT OF DESIGN **************


    77. PLOT DISPLACEMENT FILE
    78. PLOT STRESS FILE
    79. PLOT BENDING FILE
    80. FINISH


      *************** END OF STAAD-III ***************

 DATE= JUL 17,1995   TIME= 15:56: 2 ******

      *********************************************************
      *        For questions on STAAD-III/ISDS, contact:       *
```

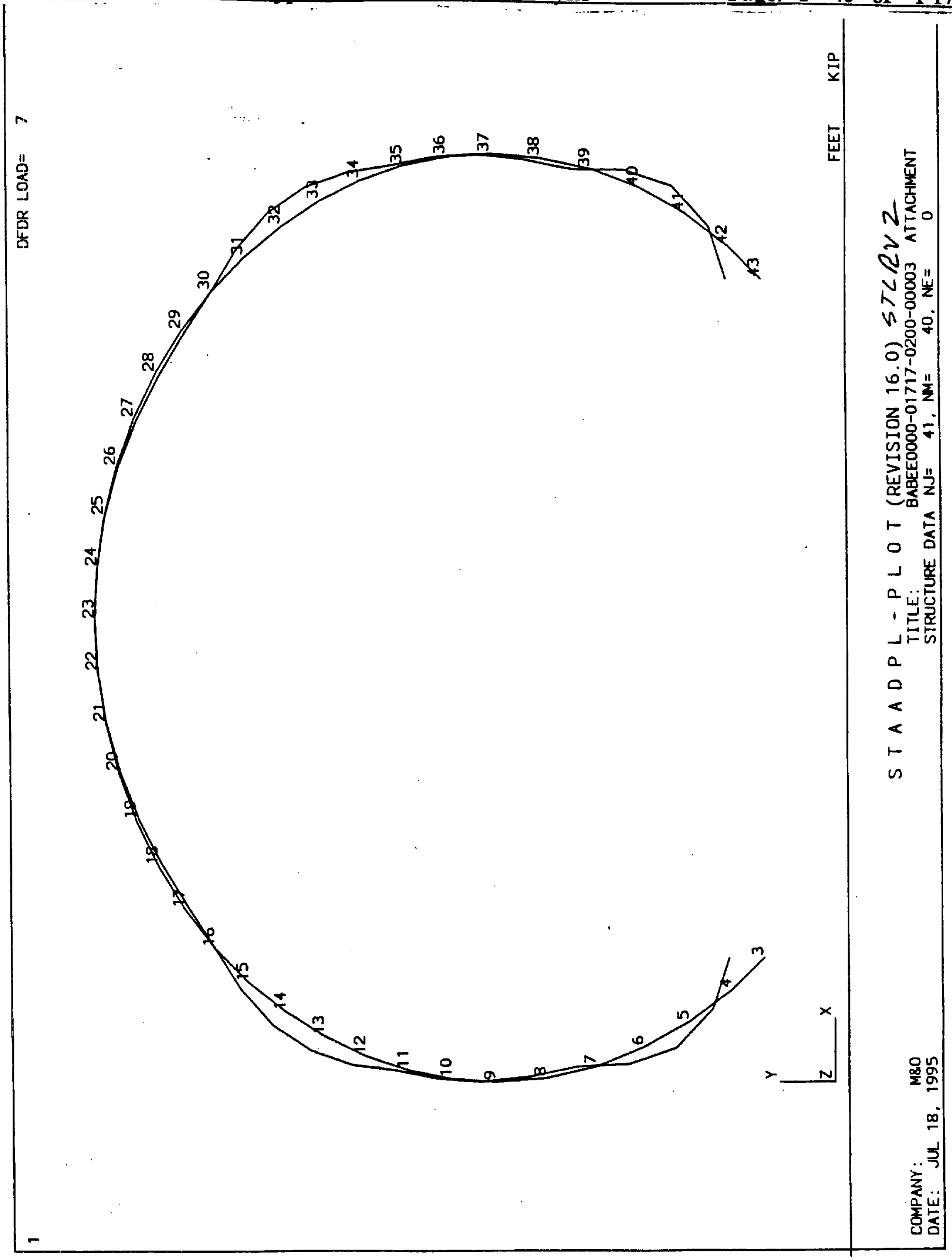

SUPPORTS
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
X
Y
Z
1
FEET KIP
S T A A D P L - P L O T (REVISION 16.0) STZ RV2
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: APR 22, 1995


LOAD NUMB= 7
FEET KIP
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
34.1 -25.0
36.6
25.0 -34.1
36.6
Y
X
Z
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
STRV2
COMPANY: M&O
DATE: APR 22, 1995



S T A A D P L - P L O T (REVISION 16.0) STRUZ
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995



S T A A D P L - P L O T (REVISION 16.0) STLRV2
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995

```
**************************************************
*                                                *
*          S T A A D - III                       *
*          Revision 16.0b                        *
*          Proprietary Program of                *
*          RESEARCH ENGINEERS, Inc.              *
*          Date=    JUL 18, 1995                 *
*          Time=     8:41:10                     *
*                                                *
**************************************************

  1. STAAD PLANE BABEE0000-01717-0200-00003  ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. * FILE STLRV3A
  4. * 25 TON JACKS APPLIED BOTH SIDES @ 49 DEGREES
  5. UNIT FT KIP
  6. JOINT COORDINATES
  7. 3 2.98 2.45 ; 4 2.43 3.13
  8. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
  9. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 10. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 11. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 12. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 13. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 14. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 15. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 16. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 17. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.35 2.45
 18. MEMBER INCIDENCE
 19. 3 3 4 42
 20. UNIT KIP INCH
 21. MEMBER PROPERTIES
 22. 3 TO 42 TA STA W8X31
 23. CONSTANTS
 24. E 29000.0 ALL
 25. DENSITY 0.00028 ALL
 26. BETA 0 ALL
 27. UNIT FT
 28. SUPPORT
 29. 3 7 11 35 39 43 FIXED BUT FY MZ
 30. 22 24 FIXED BUT FX MZ
 31. 16 30 PINNED
 32. UNIT KIP
 33. LOAD 1
 34. SELF WEIGHT Y -1.0
 35. LOADING 2
 36. * 25 TON JACKS & SIMULTANEOUS JACKING
 37. JOINT LOADING
 38. 3 FX -32.80
 39. 43 FX 32.80
 40. 3 FY 37.74
 41. 43 FY 37.74
 42. 43 MZ -25.00
 43. 3 MZ 25.00
 44. LOADING COMBINATION 3
 45. 1 2.5 2 1.0
 46. PERFORM ANALYSIS
```

```
        P R O B L E M   S T A T I S T I C S
        -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/   40/   10
  ORIGINAL/FINAL BAND-WIDTH =    1/    1
  TOTAL PRIMARY LOAD CASES  =    2, TOTAL DEGREES OF FREEDOM =    111
  SIZE OF STIFFNESS MATRIX =     666 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =    0.07 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                    8:41:13
++ PROCESSING GLOBAL STIFFNESS MATRIX.                     8:41:14
++ PROCESSING TRIANGULAR FACTORIZATION.                    8:41:14
++ CALCULATING JOINT DISPLACEMENTS.                        8:41:14
++ CALCULATING MEMBER  FORCES.                             8:41:15

 47. LOAD LIST 3
 48. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

   3     3    0.00000   0.06081   0.00000   0.00000   0.00000   0.00305
   4     3   -0.02014   0.04214   0.00000   0.00000   0.00000   0.00203
   5     3   -0.03488   0.02863   0.00000   0.00000   0.00000   0.00030
   6     3   -0.02344   0.03053   0.00000   0.00000   0.00000  -0.00079
   7     3    0.00000   0.03514   0.00000   0.00000   0.00000  -0.00060
   8     3    0.00086   0.03266   0.00000   0.00000   0.00000  -0.00001
   9     3   -0.00094   0.02992   0.00000   0.00000   0.00000   0.00002
  10     3   -0.00022   0.02759   0.00000   0.00000   0.00000   0.00002
  11     3    0.00000   0.02526   0.00000   0.00000   0.00000   0.00036
  12     3   -0.01335   0.02641   0.00000   0.00000   0.00000   0.00055
  13     3   -0.02214   0.02730   0.00000   0.00000   0.00000   0.00015
  14     3   -0.02144   0.02398   0.00000   0.00000   0.00000  -0.00044
  15     3   -0.01195   0.01414   0.00000   0.00000   0.00000  -0.00086
  16     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00070
  17     3    0.00392  -0.00491   0.00000   0.00000   0.00000  -0.00025
  18     3    0.00415  -0.00583   0.00000   0.00000   0.00000   0.00000
  19     3    0.00300  -0.00450   0.00000   0.00000   0.00000   0.00011
  20     3    0.00176  -0.00244   0.00000   0.00000   0.00000   0.00012
  21     3    0.00090  -0.00078   0.00000   0.00000   0.00000   0.00008
  22     3    0.00039   0.00000   0.00000   0.00000   0.00000   0.00004
  23     3    0.00000   0.00050   0.00000   0.00000   0.00000   0.00000
  24     3   -0.00038   0.00000   0.00000   0.00000   0.00000  -0.00004
  25     3   -0.00088  -0.00078   0.00000   0.00000   0.00000  -0.00008
  26     3   -0.00174  -0.00242   0.00000   0.00000   0.00000  -0.00012
  27     3   -0.00298  -0.00447   0.00000   0.00000   0.00000  -0.00011
  28     3   -0.00413  -0.00581   0.00000   0.00000   0.00000   0.00000
  29     3   -0.00391  -0.00490   0.00000   0.00000   0.00000   0.00025
  30     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00070
  31     3    0.01193   0.01412   0.00000   0.00000   0.00000   0.00086
  32     3    0.02142   0.02397   0.00000   0.00000   0.00000   0.00044
  33     3    0.02223   0.02738   0.00000   0.00000   0.00000  -0.00015
  34     3    0.01325   0.02645   0.00000   0.00000   0.00000  -0.00055
  35     3    0.00000   0.02525   0.00000   0.00000   0.00000  -0.00036
  36     3    0.00017   0.02757   0.00000   0.00000   0.00000  -0.00003
  37     3    0.00065   0.02988   0.00000   0.00000   0.00000  -0.00003
  38     3   -0.00111   0.03263   0.00000   0.00000   0.00000   0.00002
  39     3    0.00000   0.03506   0.00000   0.00000   0.00000   0.00062
  40     3    0.02391   0.03043   0.00000   0.00000   0.00000   0.00080
  41     3    0.03542   0.02849   0.00000   0.00000   0.00000  -0.00031
  42     3    0.02033   0.04237   0.00000   0.00000   0.00000  -0.00206
  43     3    0.00000   0.06120   0.00000   0.00000   0.00000  -0.00308
```

```
 SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
 -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

    3    3      4.96      0.00      0.00      0.00      0.00      0.00
    7    3     28.01      0.00      0.00      0.00      0.00      0.00
   11    3     20.12      0.00      0.00      0.00      0.00      0.00
   35    3    -20.18      0.00      0.00      0.00      0.00      0.00
   39    3    -28.02      0.00      0.00      0.00      0.00      0.00
   43    3     -4.93      0.00      0.00      0.00      0.00      0.00
   22    3      0.00     -1.08      0.00      0.00      0.00      0.00
   24    3      0.00     -1.09      0.00      0.00      0.00      0.00
   16    3    -14.50    -34.52      0.00      0.00      0.00      0.00
   30    3     14.54    -34.52      0.00      0.00      0.00      0.00
```

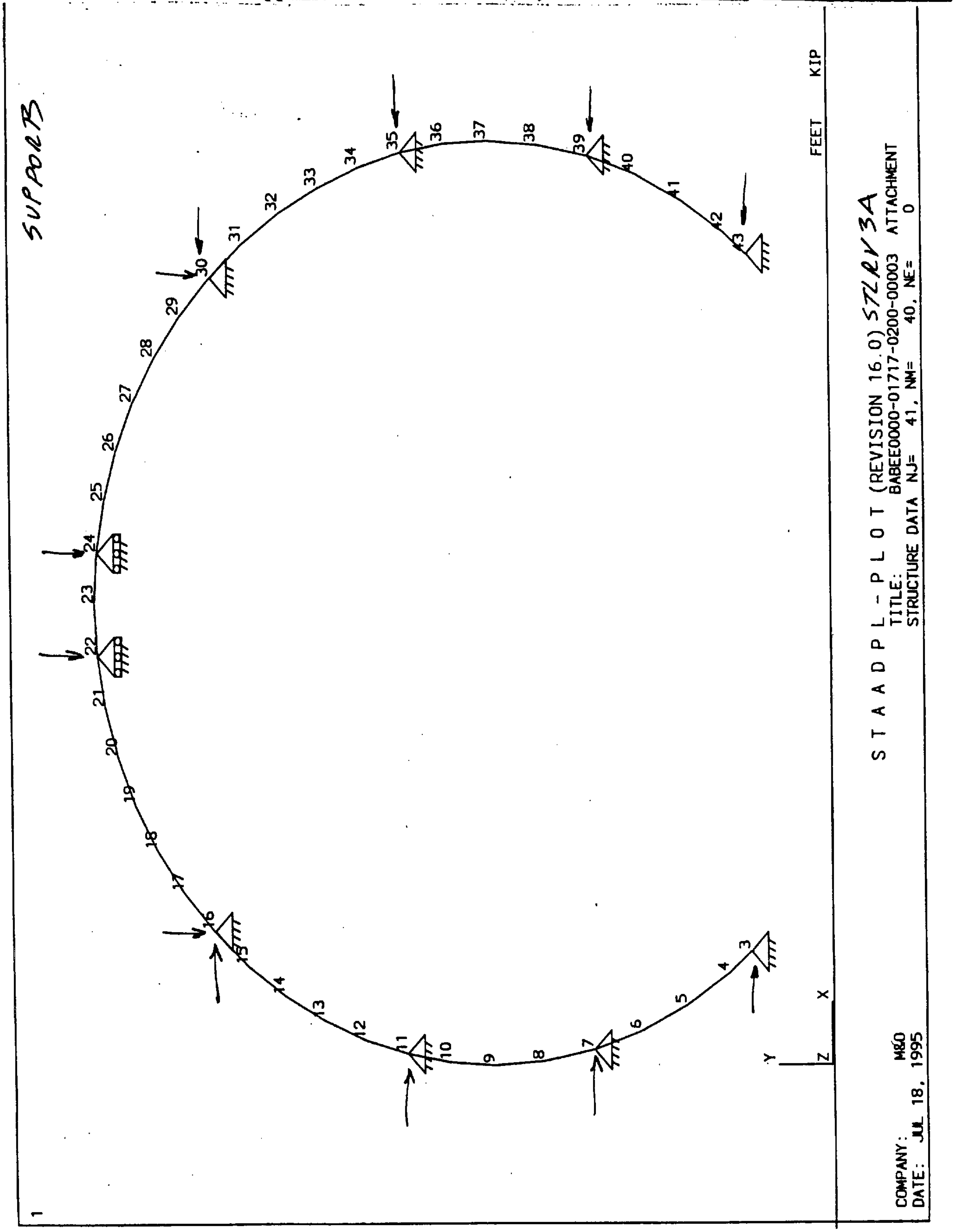
```
MEMBER END FORCES     STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL    SHEAR-Y   SHEAR-Z   TORSION     MOM-Y      MOM-Z

  3     3    3     46.85      2.09      0.00      0.00      0.00     -25.00
             4    -46.80     -2.04      0.00      0.00      0.00      26.81

  4     3    4     46.76     -2.85      0.00      0.00      0.00     -26.81
             5    -46.66      2.91      0.00      0.00      0.00      22.31

  5     3    5     45.92     -8.76      0.00      0.00      0.00     -22.31
             6    -45.81      8.82      0.00      0.00      0.00       8.54

  6     3    6     44.37    -14.40      0.00      0.00      0.00      -8.54
             7    -44.26     14.43      0.00      0.00      0.00     -13.97

  7     3    7     36.59      7.30      0.00      0.00      0.00      13.97
             8    -36.47     -7.27      0.00      0.00      0.00      -2.54

  8     3    8     37.11      2.55      0.00      0.00      0.00       2.54
             9    -36.99     -2.54      0.00      0.00      0.00       1.43

  9     3    9     37.02      2.01      0.00      0.00      0.00       1.43
            10    -36.91     -2.00      0.00      0.00      0.00       1.30

 10     3   10     36.47      6.04      0.00      0.00      0.00      -1.30
            11    -36.37     -6.03      0.00      0.00      0.00       9.57

 11     3   11     40.99     -9.50      0.00      0.00      0.00      -9.57
            12    -40.89      9.53      0.00      0.00      0.00      -3.38

 12     3   12     41.75     -4.44      0.00      0.00      0.00       3.38
            13    -41.65      4.48      0.00      0.00      0.00      -9.48

 13     3   13     41.89     -0.23      0.00      0.00      0.00       9.48
            14    -41.80      0.28      0.00      0.00      0.00      -9.83

 14     3   14     41.56      4.49      0.00      0.00      0.00       9.83
            15    -41.47     -4.43      0.00      0.00      0.00      -3.71

 15     3   15     40.65      9.33      0.00      0.00      0.00       3.71
            16    -40.58     -9.26      0.00      0.00      0.00       8.92

 16     3   16      5.53     -2.49      0.00      0.00      0.00      -8.92
            17     -5.46      2.57      0.00      0.00      0.00       5.45

 17     3   17      5.71     -1.96      0.00      0.00      0.00      -5.45
            18     -5.65      2.04      0.00      0.00      0.00       2.73

 18     3   18      5.85     -1.38      0.00      0.00      0.00      -2.73
            19     -5.80      1.47      0.00      0.00      0.00       0.78
```

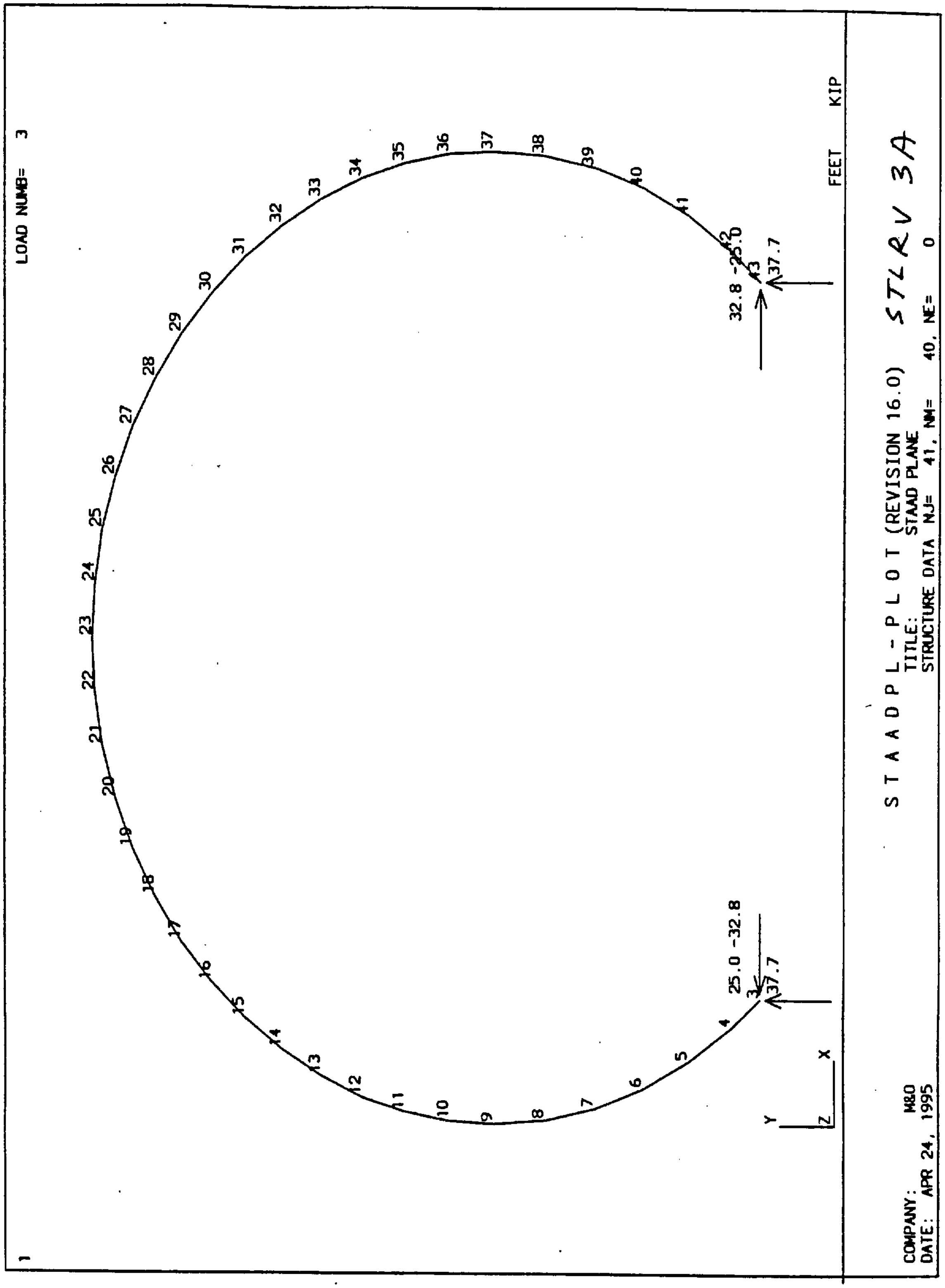
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19      5.92    -0.82     0.00      0.00       0.00      -0.78
            20     -5.88     0.91     0.00      0.00       0.00      -0.40

  20    3   20      5.95    -0.27     0.00      0.00       0.00       0.40
            21     -5.92     0.37     0.00      0.00       0.00      -0.83

  21    3   21      5.92     0.30     0.00      0.00       0.00       0.83
            22     -5.90    -0.20     0.00      0.00       0.00      -0.49

  22    3   22      5.78    -0.23     0.00      0.00       0.00       0.49
            23     -5.78     0.34     0.00      0.00       0.00      -0.88

  23    3   23      5.78     0.34     0.00      0.00       0.00       0.88
            24     -5.78    -0.24     0.00      0.00       0.00      -0.49

  24    3   24      5.90    -0.20     0.00      0.00       0.00       0.49
            25     -5.92     0.30     0.00      0.00       0.00      -0.83

  25    3   25      5.92     0.37     0.00      0.00       0.00       0.83
            26     -5.95    -0.27     0.00      0.00       0.00      -0.40

  26    3   26      5.89     0.89     0.00      0.00       0.00       0.40
            27     -5.93    -0.80     0.00      0.00       0.00       0.76

  27    3   27      5.79     1.49     0.00      0.00       0.00      -0.76
            28     -5.84    -1.40     0.00      0.00       0.00       2.73

  28    3   28      5.65     2.04     0.00      0.00       0.00      -2.73
            29     -5.71    -1.96     0.00      0.00       0.00       5.45

  29    3   29      5.46     2.57     0.00      0.00       0.00      -5.45
            30     -5.53    -2.49     0.00      0.00       0.00       8.91

  30    3   30     40.60    -9.22     0.00      0.00       0.00      -8.91
            31    -40.68     9.29     0.00      0.00       0.00      -3.68

  31    3   31     41.50    -4.40     0.00      0.00       0.00       3.68
            32    -41.58     4.46     0.00      0.00       0.00      -9.74

  32    3   32     41.82     0.05     0.00      0.00       0.00       9.74
            33    -41.91     0.00     0.00      0.00       0.00      -9.71

  33    3   33     41.64     4.81     0.00      0.00       0.00       9.71
            34    -41.73    -4.77     0.00      0.00       0.00      -3.19

  34    3   34     40.97     9.28     0.00      0.00       0.00       3.19
            35    -41.07    -9.25     0.00      0.00       0.00       9.45

  35    3   35     36.36    -6.05     0.00      0.00       0.00      -9.45
            36    -36.47     6.06     0.00      0.00       0.00       1.16
```

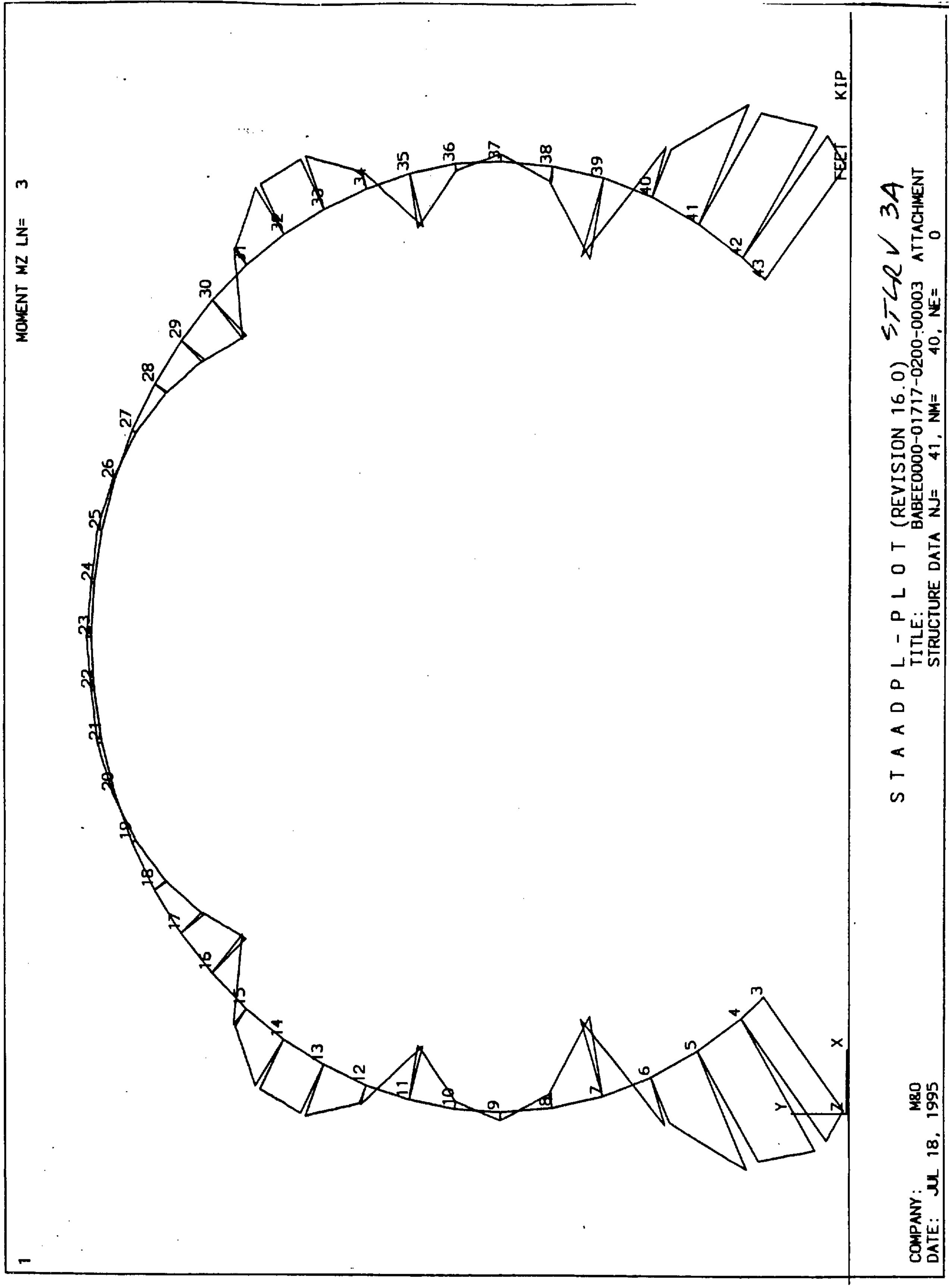
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36    3   36     36.93    -1.75     0.00      0.00      0.00      -1.16
            37    -37.03     1.76     0.00      0.00      0.00      -1.23

  37    3   37     36.99    -2.52     0.00      0.00      0.00      -1.23
            38    -37.11     2.53     0.00      0.00      0.00      -2.71

  38    3   38     36.48    -7.26     0.00      0.00      0.00       2.71
            39    -36.60     7.28     0.00      0.00      0.00     -14.12

  39    3   39     44.18    14.73     0.00      0.00      0.00      14.12
            40    -44.30   -14.69     0.00      0.00      0.00       8.82

  40    3   40     45.82     8.84     0.00      0.00      0.00      -8.82
            41    -45.93    -8.79     0.00      0.00      0.00      22.62

  41    3   41     46.69     2.69     0.00      0.00      0.00     -22.62
            42    -46.79    -2.62     0.00      0.00      0.00      26.79

  42    3   42     46.82    -2.02     0.00      0.00      0.00     -26.79
            43    -46.87     2.06     0.00      0.00      0.00      25.00

************** END OF LATEST ANALYSIS RESULT **************

 49. CHECK CODE ALL
```

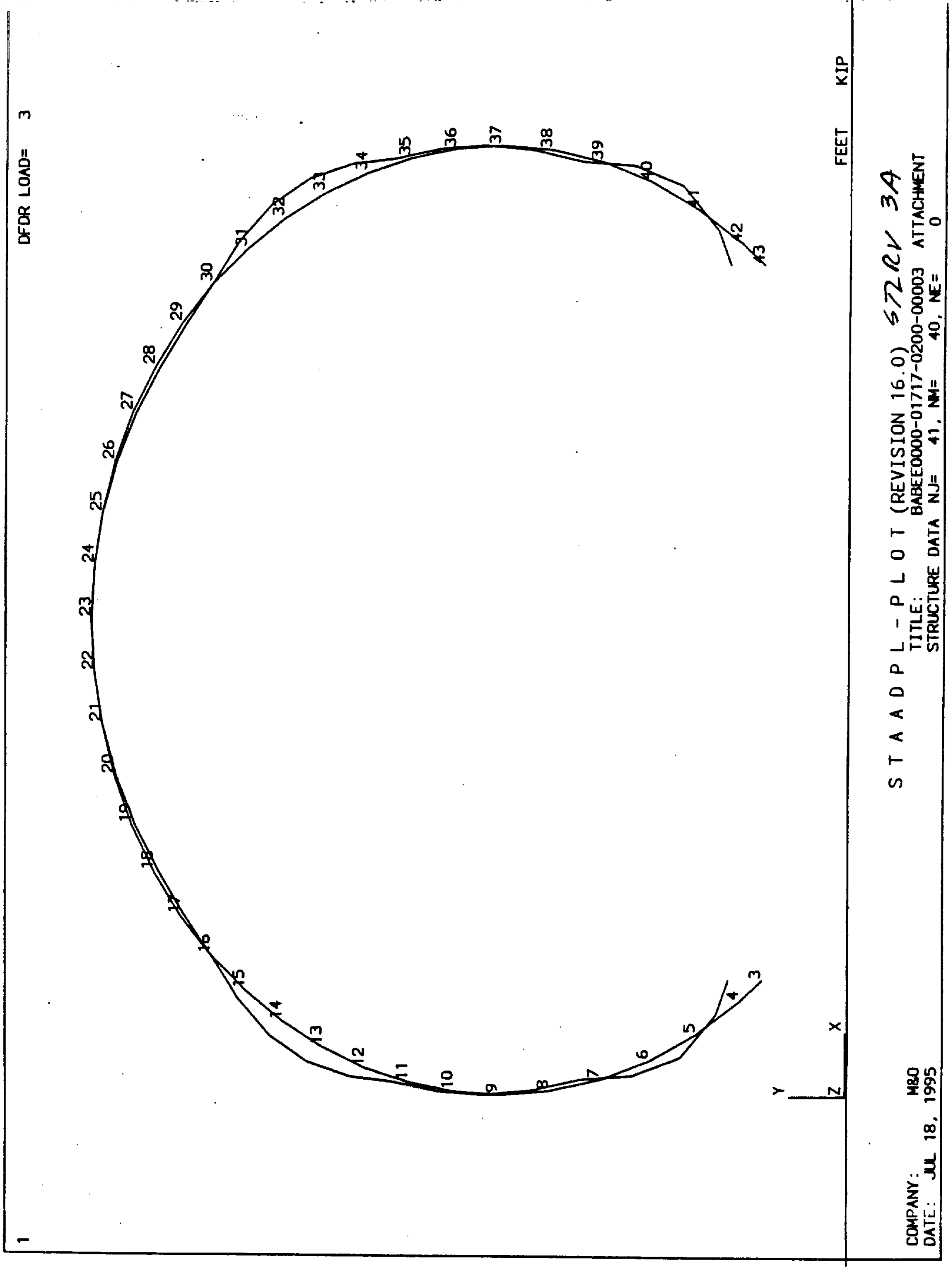
```
                          STAAD-III CODE CHECKING - (AISC)
                          ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX            MY             MZ       LOCATION
=======================================================================

     3  ST   W8X 31           PASS     AISC- H1-2       0.730          3
                         46.80 C           0.00        26.81         0.87
     4  ST   W8X 31           PASS     AISC- H1-2       0.729          3
                         46.76 C           0.00       -26.81         0.00
     5  ST   W8X 31           PASS     AISC- H1-2       0.642          3
                         45.92 C           0.00       -22.31         0.00
     6  ST   W8X 31           PASS     AISC- H1-2       0.481          3
                         44.26 C           0.00       -13.97         1.56
     7  ST   W8X 31           PASS     AISC- H1-2       0.442          3
                         36.59 C           0.00        13.97         0.00
     8  ST   W8X 31           PASS     AISC- H1-2       0.235          3
                         37.11 C           0.00         2.54         0.00
     9  ST   W8X 31           PASS     AISC- H1-2       0.214          3
                         37.02 C           0.00         1.43         0.00
    10  ST   W8X 31           PASS     AISC- H1-2       0.360          3
                         36.37 C           0.00         9.57         1.37
    11  ST   W8X 31           PASS     AISC- H1-2       0.384          3
                         40.99 C           0.00        -9.57         0.00
    12  ST   W8X 31           PASS     AISC- H1-2       0.385          3
                         41.65 C           0.00        -9.48         1.37
    13  ST   W8X 31           PASS     AISC- H1-2       0.392          3
                         41.80 C           0.00        -9.83         1.36
    14  ST   W8X 31           PASS     AISC- H1-2       0.391          3
                         41.56 C           0.00         9.83         0.00
    15  ST   W8X 31           PASS     AISC- H1-2       0.370          3
                         40.58 C           0.00         8.92         1.36
    16  ST   W8X 31           PASS     AISC- H1-3       0.192          3
                          5.53 C           0.00        -8.92         0.00
    17  ST   W8X 31           PASS     AISC- H1-3       0.130          3
                          5.71 C           0.00        -5.45         0.00
    18  ST   W8X 31           PASS     AISC- H1-3       0.080          3
                          5.85 C           0.00        -2.73         0.00
    19  ST   W8X 31           PASS     AISC- H1-3       0.045          3
                          5.92 C           0.00        -0.78         0.00
    20  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.92 C           0.00        -0.83         1.36
    21  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.92 C           0.00         0.83         0.00
    22  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.78 C           0.00        -0.88         1.37
    23  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.78 C           0.00         0.88         0.00
    24  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.92 C           0.00        -0.83         1.36
    25  ST   W8X 31           PASS     AISC- H1-3       0.046          3
                          5.92 C           0.00         0.83         0.00
    26  ST   W8X 31           PASS     AISC- H1-3       0.045          3
                          5.93 C           0.00         0.76         1.37
```

```
 L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY             MZ       LOCATION
=======================================================================

   27  ST  W8X 31          PASS      AISC- H1-3       0.080         3
                          5.84 C        0.00           2.73       1.36
   28  ST  W8X 31          PASS      AISC- H1-3       0.130         3
                          5.71 C        0.00           5.45       1.36
   29  ST  W8X 31          PASS      AISC- H1-3       0.192         3
                          5.53 C        0.00           8.91       1.37
   30  ST  W8X 31          PASS      AISC- H1-2       0.370         3
                         40.60 C        0.00          -8.91       0.00
   31  ST  W8X 31          PASS      AISC- H1-2       0.390         3
                         41.58 C        0.00          -9.74       1.37
   32  ST  W8X 31          PASS      AISC- H1-2       0.391         3
                         41.82 C       0.00           9.74       0.00
   33  ST  W8X 31          PASS      AISC- H1-2       0.389         3
                         41.64 C        0.00           9.71       0.00
   34  ST  W8X 31          PASS      AISC- H1-2       0.382         3
                         41.07 C        0.00           9.45       1.36
   35  ST  W8X 31          PASS      AISC- H1-2       0.358         3
                         36.36 C        0.00          -9.45       0.00
   36  ST  W8X 31          PASS      AISC- H1-2       0.210         3
                         37.03 C        0.00          -1.23       1.36
   37  ST  W8X 31          PASS      AISC- H1-2       0.238         3
                         37.11 C        0.00          -2.71       1.56
   38  ST  W8X 31          PASS      AISC- H1-2       0.445         3
                         36.60 C        0.00         -14.12       1.57
   39  ST  W8X 31          PASS      AISC- H1-2       0.483         3
                         44.18 C        0.00          14.12       0.00
   40  ST  W8X 31          PASS      AISC- H1-2       0.648         3
                         45.93 C        0.00          22.62       1.57
   41  ST  W8X 31          PASS      AISC- H1-2       0.729         3
                         46.79 C        0.00          26.79       1.57
   42  ST  W8X 31          PASS      AISC- H1-2       0.729         3
                         46.82 C        0.00         -26.79       0.00

 ************** END OF TABULATED RESULT OF DESIGN **************


   50. PLOT DISPLACEMENT FILE
   51. PLOT BENDING FILE
   52. FINISH


     *************** END OF STAAD-III ***************

 DATE= JUL 18,1995   TIME=  8:41:18 ******

     ************************************************************
     *      For questions on STAAD-III/ISDS, contact:           *
     *      RESEARCH ENGINEERS, Inc at (714) 974-2500           *
```


SUPPORTS
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
FEET KIP
X
Y
Z
1
S T A A D P L - P L O T (REVISION 16.0) STLRV3A
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995


LOAD NUMB= 3
1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
32.8 -25.0
37.7
25.0 -32.8
37.7
FEET KIP
Y
X
Z
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: APR 24, 1995
STLRV 3A


MOMENT MZ LN= 3
KIP
FEET
S T A A D P L - P L O T (REVISION 16.0)
STGRV 3A
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
X
Y
Z
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43


DFDR LOAD= 3
1
FEET KIP
STAADPL-PLOT (REVISION 16.0) STRV 3A
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
X
Y
Z
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43

```
 **************************************************
 *                                                *
 *             S T A A D - III                    *
 *             Revision 16.0b                     *
 *             Proprietary Program of             *
 *             RESEARCH ENGINEERS, Inc.           *
 *             Date=    JUL 18, 1995              *
 *             Time=      9: 1:57                 *
 *                                                *
 **************************************************


  1. STAAD PLANE BABEE0000-01717-0200-00003  ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. * FILE STLRV3D
  4. * 25 TON JACKS APPLIED BOTH SIDES @ 51 DEGREES
  5. UNIT FT KIP
  6. JOINT COORDINATES
  7. 3 2.71 2.77 ; 4 2.43 3.13
  8. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
  9. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 10. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 11. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 12. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 13. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 14. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 15. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 16. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 17. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.62 2.77
 18. MEMBER INCIDENCE
 19. 3 3 4 42
 20. UNIT KIP INCH
 21. MEMBER PROPERTIES
 22. 3 TO 42 TA STA W8X31
 23. CONSTANTS
 24. E 29000.0 ALL
 25. DENSITY 0.00028 ALL
 26. BETA 0 ALL
 27. UNIT FT
 28. SUPPORT
 29. 3 7 11 35 39 43 FIXED BUT FY MZ
 30. 22 24 FIXED BUT FX MZ
 31. 16 30 PINNED
 32. UNIT KIP
 33. LOAD 1
 34. SELF WEIGHT Y -1.0
 35. LOADING 2
 36. * 25 TON JACKS & SIMULTANEOUS JACKING
 37. JOINT LOADING
 38. 3 FX -31.47
 39. 43 FX 31.47
 40. 3 43 FY 38.86
 41. 43 MZ -25.00
 42. 3 MZ 25.00
 43. LOADING COMBINATION 3
 44. 1 2.5 2 1.0
```

```
        P R O B L E M    S T A T I S T I C S
        -----------------------------------

     NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/    40/    10
     ORIGINAL/FINAL BAND-WIDTH =      1/     1
     TOTAL PRIMARY LOAD CASES  =      2, TOTAL DEGREES OF FREEDOM =     111
     SIZE OF STIFFNESS MATRIX =       666 DOUBLE PREC. WORDS
     TOTAL REQUIRED DISK SPACE =      0.07 MEGA-BYTES


  ++ PROCESSING ELEMENT STIFFNESS MATRIX.                  9: 2: 0
  ++ PROCESSING GLOBAL STIFFNESS MATRIX.                   9: 2: 1
  ++ PROCESSING TRIANGULAR FACTORIZATION.                  9: 2: 1
  ++ CALCULATING JOINT DISPLACEMENTS.                      9: 2: 1
  ++ CALCULATING MEMBER  FORCES.                           9: 2: 2

    46. LOAD LIST 3
    47. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

   3     3    0.00000   0.05793   0.00000   0.00000   0.00000   0.00273
   4     3   -0.01029   0.04868   0.00000   0.00000   0.00000   0.00220
   5     3   -0.02835   0.03294   0.00000   0.00000   0.00000   0.00051
   6     3   -0.02052   0.03302   0.00000   0.00000   0.00000  -0.00060
   7     3    0.00000   0.03655   0.00000   0.00000   0.00000  -0.00048
   8     3   -0.00054   0.03372   0.00000   0.00000   0.00000   0.00003
   9     3   -0.00238   0.03088   0.00000   0.00000   0.00000   0.00001
  10     3   -0.00098   0.02845   0.00000   0.00000   0.00000  -0.00002
  11     3    0.00000   0.02592   0.00000   0.00000   0.00000   0.00034
  12     3   -0.01348   0.02702   0.00000   0.00000   0.00000   0.00055
  13     3   -0.02249   0.02792   0.00000   0.00000   0.00000   0.00016
  14     3   -0.02186   0.02454   0.00000   0.00000   0.00000  -0.00045
  15     3   -0.01221   0.01448   0.00000   0.00000   0.00000  -0.00088
  16     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00071
  17     3    0.00401  -0.00501   0.00000   0.00000   0.00000  -0.00026
  18     3    0.00424  -0.00596   0.00000   0.00000   0.00000   0.00000
  19     3    0.00307  -0.00459   0.00000   0.00000   0.00000   0.00011
  20     3    0.00180  -0.00249   0.00000   0.00000   0.00000   0.00012
  21     3    0.00092  -0.00080   0.00000   0.00000   0.00000   0.00008
  22     3    0.00040   0.00000   0.00000   0.00000   0.00000   0.00004
  23     3    0.00001   0.00051   0.00000   0.00000   0.00000   0.00000
  24     3   -0.00039   0.00000   0.00000   0.00000   0.00000  -0.00004
  25     3   -0.00090  -0.00079   0.00000   0.00000   0.00000  -0.00008
  26     3   -0.00178  -0.00247   0.00000   0.00000   0.00000  -0.00012
  27     3   -0.00304  -0.00457   0.00000   0.00000   0.00000  -0.00011
  28     3   -0.00422  -0.00593   0.00000   0.00000   0.00000   0.00000
  29     3   -0.00400  -0.00500   0.00000   0.00000   0.00000   0.00026
  30     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00071
  31     3    0.01219   0.01446   0.00000   0.00000   0.00000   0.00088
  32     3    0.02184   0.02453   0.00000   0.00000   0.00000   0.00045
  33     3    0.02259   0.02799   0.00000   0.00000   0.00000  -0.00016
  34     3    0.01337   0.02706   0.00000   0.00000   0.00000  -0.00055
  35     3    0.00000   0.02591   0.00000   0.00000   0.00000  -0.00034
  36     3    0.00094   0.02843   0.00000   0.00000   0.00000   0.00001
  37     3    0.00209   0.03085   0.00000   0.00000   0.00000  -0.00001
  38     3    0.00028   0.03367   0.00000   0.00000   0.00000  -0.00002
  39     3    0.00000   0.03646   0.00000   0.00000   0.00000   0.00050
  40     3    0.02099   0.03289   0.00000   0.00000   0.00000   0.00062
  41     3    0.02886   0.03279   0.00000   0.00000   0.00000  -0.00052
  42     3    0.01040   0.04896   0.00000   0.00000   0.00000  -0.00223
  43     3    0.00000   0.05830   0.00000   0.00000   0.00000  -0.00275
```

```
SUPPORT REACTIONS -UNIT KIP  FEET     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD    FORCE-X    FORCE-Y    FORCE-Z     MOM-X      MOM-Y      MOM Z

   3     3       3.59       0.00       0.00       0.00       0.00       0.00
   7     3      27.72       0.00       0.00       0.00       0.00       0.00
  11     3      21.16       0.00       0.00       0.00       0.00       0.00
  35     3     -21.23       0.00       0.00       0.00       0.00       0.00
  39     3     -27.72       0.00       0.00       0.00       0.00       0.00
  43     3      -3.56       0.00       0.00       0.00       0.00       0.00
  22     3       0.00      -1.11       0.00       0.00       0.00       0.00
  24     3       0.00      -1.12       0.00       0.00       0.00       0.00
  16     3     -15.09     -35.64       0.00       0.00       0.00       0.00
  30     3      15.13     -35.64       0.00       0.00       0.00       0.00
```

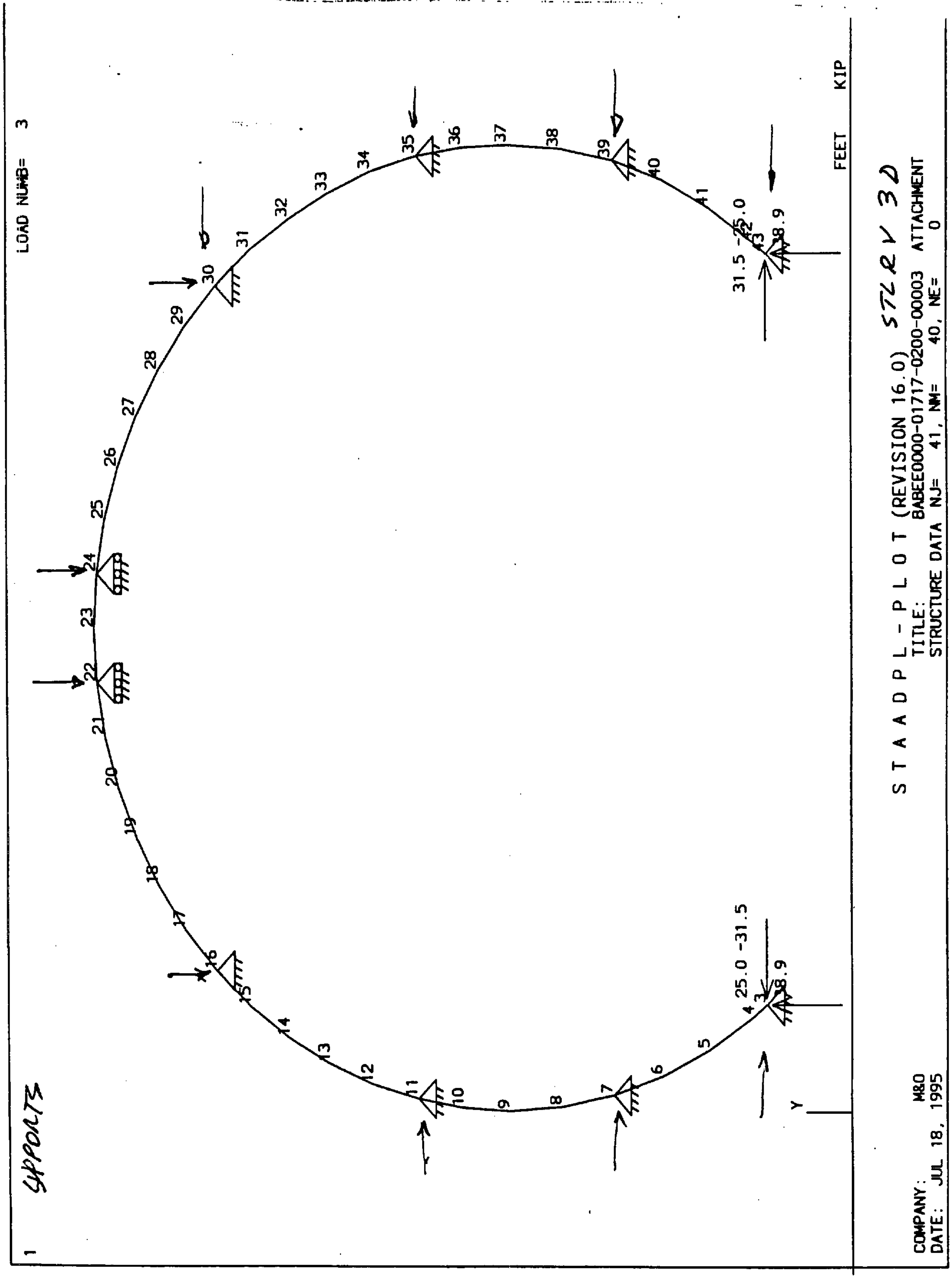
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

   3    3    3     47.79      1.85     0.00      0.00      0.00     -25.00
             4    -47.77     -1.83     0.00      0.00      0.00      25.84

   4    3    4     47.75     -2.26     0.00      0.00      0.00     -25.84
             5    -47.65      2.32     0.00      0.00      0.00      22.26

   5    3    5     46.98     -8.30     0.00      0.00      0.00     -22.26
             6    -46.87      8.35     0.00      0.00      0.00       9.22

   6    3    6     45.48    -14.07     0.00      0.00      0.00      -9.22
             7    -45.37     14.11     0.00      0.00      0.00     -12.78

   7    3    7     37.79      7.19     0.00      0.00      0.00      12.78
             8    -37.67     -7.17     0.00      0.00      0.00      -1.52

   8    3    8     38.28      2.29     0.00      0.00      0.00       1.52
             9    -38.16     -2.28     0.00      0.00      0.00       2.05

   9    3    9     38.15      2.41     0.00      0.00      0.00       2.05
            10    -38.05     -2.41     0.00      0.00      0.00       1.24

  10    3   10     37.55      6.57     0.00      0.00      0.00      -1.24
            11    -37.45     -6.55     0.00      0.00      0.00      10.22

  11    3   11     42.29     -9.87     0.00      0.00      0.00     -10.22
            12    -42.19      9.90     0.00      0.00      0.00      -3.24

  12    3   12     43.09     -4.65     0.00      0.00      0.00       3.24
            13    -42.99      4.69     0.00      0.00      0.00      -9.63

  13    3   13     43.24     -0.30     0.00      0.00      0.00       9.63
            14    -43.15      0.35     0.00      0.00      0.00     -10.07

  14    3   14     42.91      4.58     0.00      0.00      0.00      10.07
            15    -42.82     -4.51     0.00      0.00      0.00      -3.84

  15    3   15     41.99      9.57     0.00      0.00      0.00       3.84
            16    -41.91     -9.50     0.00      0.00      0.00       9.12

  16    3   16      5.64     -2.55     0.00      0.00      0.00      -9.12
            17     -5.57      2.63     0.00      0.00      0.00       5.58

  17    3   17      5.82     -2.00     0.00      0.00      0.00      -5.58
            18     -5.76      2.09     0.00      0.00      0.00       2.79

  18    3   18      5.97     -1.41     0.00      0.00      0.00      -2.79
            19     -5.92      1.50     0.00      0.00      0.00       0.79
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT      AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19       6.05     -0.84     0.00      0.00      0.00      -0.79
            20      -6.01      0.93     0.00      0.00      0.00      -0.41

  20    3   20       6.07     -0.27     0.00      0.00      0.00       0.41
            21      -6.04      0.37     0.00      0.00      0.00      -0.85

  21    3   21       6.05      0.31     0.00      0.00      0.00       0.85
            22      -6.03     -0.20     0.00      0.00      0.00      -0.50

  22    3   22       5.90     -0.24     0.00      0.00      0.00       0.50
            23      -5.90      0.34     0.00      0.00      0.00      -0.90

  23    3   23       5.90      0.35     0.00      0.00      0.00       0.90
            24      -5.90     -0.24     0.00      0.00      0.00      -0.50

  24    3   24       6.03     -0.21     0.00      0.00      0.00       0.50
            25      -6.05      0.31     0.00      0.00      0.00      -0.85

  25    3   25       6.04      0.37     0.00      0.00      0.00       0.85
            26      -6.07     -0.27     0.00      0.00      0.00      -0.41

  26    3   26       6.01      0.91     0.00      0.00      0.00       0.41
            27      -6.05     -0.82     0.00      0.00      0.00       0.78

  27    3   27       5.91      1.52     0.00      0.00      0.00      -0.78
            28      -5.96     -1.43     0.00      0.00      0.00       2.79

  28    3   28       5.77      2.09     0.00      0.00      0.00      -2.79
            29      -5.83     -2.00     0.00      0.00      0.00       5.57

  29    3   29       5.57      2.63     0.00      0.00      0.00      -5.57
            30      -5.64     -2.55     0.00      0.00      0.00       9.12

  30    3   30      41.94     -9.47     0.00      0.00      0.00      -9.12
            31     -42.02      9.54     0.00      0.00      0.00      -3.80

  31    3   31      42.85     -4.48     0.00      0.00      0.00       3.80
            32     -42.94      4.54     0.00      0.00      0.00      -9.98

  32    3   32      43.18      0.11     0.00      0.00      0.00       9.98
            33     -43.27     -0.06     0.00      0.00      0.00      -9.86

  33    3   33      42.97      5.03     0.00      0.00      0.00       9.86
            34     -43.07     -4.99     0.00      0.00      0.00      -3.04

  34    3   34      42.27      9.65     0.00      0.00      0.00       3.04
            35     -42.37     -9.62     0.00      0.00      0.00      10.10

  35    3   35      37.44     -6.57     0.00      0.00      0.00     -10.10
            36     -37.55      6.59     0.00      0.00      0.00       1.09
```

```
 MEMBER END FORCES     STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3  36     38.06     -2.15     0.00      0.00      0.00      -1.09
            37    -38.16      2.15     0.00      0.00      0.00      -1.84

  37     3  37     38.16     -2.26     0.00      0.00      0.00      -1.84
            38    -38.28      2.26     0.00      0.00      0.00      -1.69

  38     3  38     37.67     -7.15     0.00      0.00      0.00       1.69
            39    -37.79      7.17     0.00      0.00      0.00     -12.92

  39     3  39     45.29     14.41     0.00      0.00      0.00      12.92
            40    -45.40    -14.37     0.00      0.00      0.00       9.52

  40     3  40     46.88      8.38     0.00      0.00      0.00      -9.52
            41    -46.99     -8.33     0.00      0.00      0.00      22.60

  41     3  41     47.67      2.09     0.00      0.00      0.00     -22.60
            42    -47.78     -2.03     0.00      0.00      0.00      25.83

  42     3  42     47.78     -1.80     0.00      0.00      0.00     -25.83
            43    -47.81      1.82     0.00      0.00      0.00      25.00

 ************** END OF LATEST ANALYSIS RESULT **************

  48. CHECK CODE ALL
```

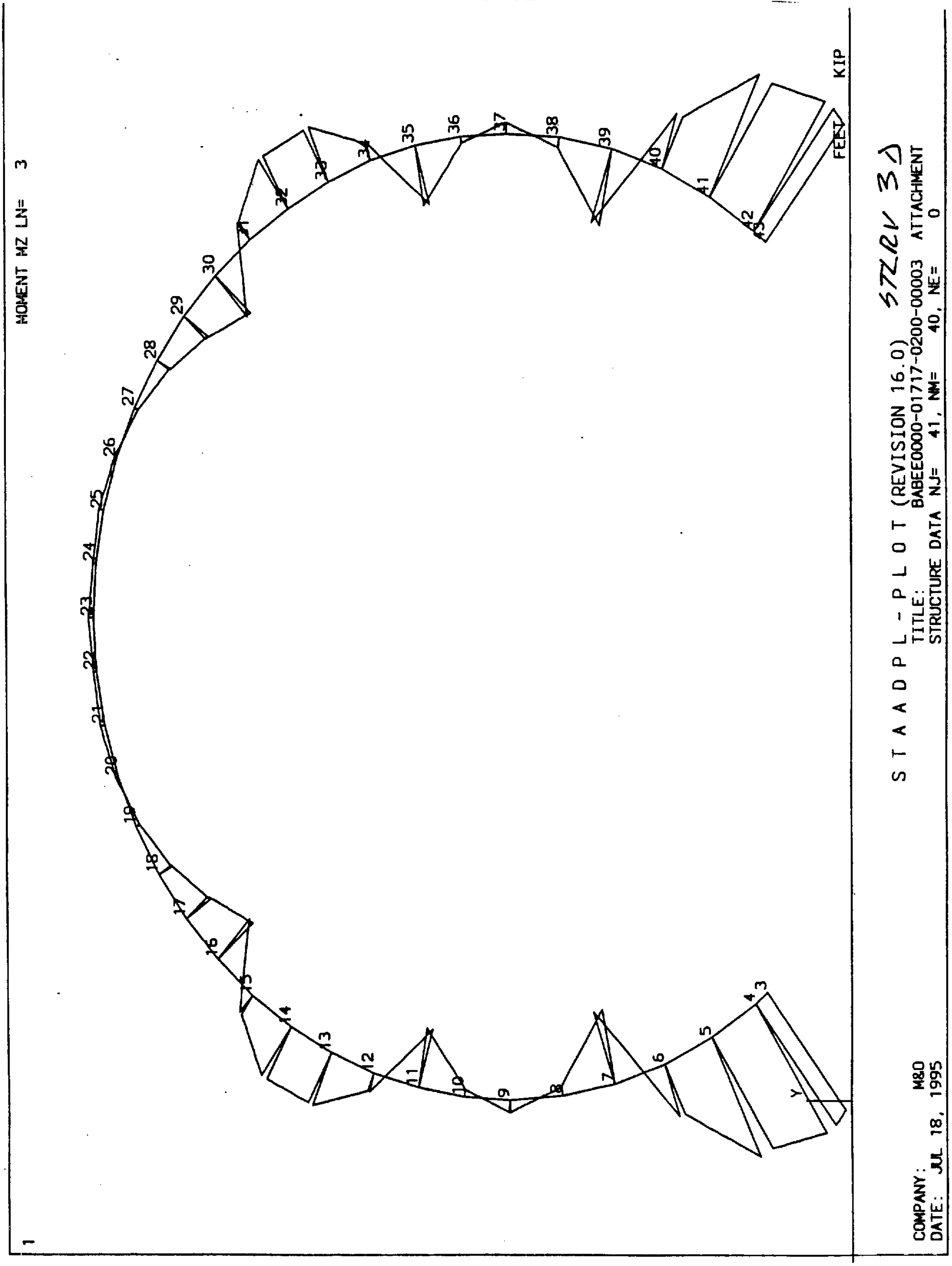
```
                          STAAD-III CODE CHECKING - (AISC)
                          ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE         RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX           MY             MZ        LOCATION
=======================================================================

    3  ST  W8X 31           PASS     AISC- H1-2        0.717         3
                         47.77 C        0.00          25.84        0.46
    4  ST  W8X 31           PASS     AISC- H1-2        0.717         3
                         47.75 C        0.00         -25.84        0.00
    5  ST  W8X 31           PASS     AISC- H1-2        0.647         3
                         46.98 C        0.00         -22.26        0.00
    6  ST  W8X 31           PASS     AISC- H1-2        0.465         3
                         45.37 C        0.00         -12.78        1.56
    7  ST  W8X 31           PASS     AISC- H1-2        0.426         3
                         37.79 C        0.00          12.78        0.00
    8  ST  W8X 31           PASS     AISC- H1-2        0.231         3
                         38.16 C        0.00           2.05        1.56
    9  ST  W8X 31           PASS     AISC- H1-2        0.231         3
                         38.15 C        0.00           2.05        0.00
   10  ST  W8X 31           PASS     AISC- H1-2        0.378         3
                         37.45 C        0.00          10.22        1.37
   11  ST  W8X 31           PASS     AISC- H1-2        0.402         3
                         42.29 C        0.00         -10.22        0.00
   12  ST  W8X 31           PASS     AISC- H1-2        0.395         3
                         42.99 C        0.00          -9.63        1.37
   13  ST  W8X 31           PASS     AISC- H1-2        0.404         3
                         43.15 C        0.00         -10.07        1.36
   14  ST  W8X 31           PASS     AISC- H1-2        0.403         3
                         42.91 C        0.00          10.07        0.00
   15  ST  W8X 31           PASS     AISC- H1-2        0.380         3
                         41.91 C        0.00           9.12        1.36
   16  ST  W8X 31           PASS     AISC- H1-3        0.197         3
                          5.64 C        0.00          -9.12        0.00
   17  ST  W8X 31           PASS     AISC- H1-3        0.132         3
                          5.82 C        0.00          -5.58        0.00
   18  ST  W8X 31           PASS     AISC- H1-3        0.082         3
                          5.97 C        0.00          -2.79        0.00
   19  ST  W8X 31           PASS     AISC- H1-3        0.046         3
                          6.05 C        0.00          -0.79        0.00
   20  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          6.04 C        0.00          -0.85        1.36
   21  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          6.05 C        0.00           0.85        0.00
   22  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          5.90 C        0.00          -0.90        1.37
   23  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          5.90 C        0.00           0.90        0.00
   24  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          6.05 C        0.00          -0.85        1.36
   25  ST  W8X 31           PASS     AISC- H1-3        0.047         3
                          6.04 C        0.00           0.85        0.00
   26  ST  W8X 31           PASS     AISC- H1-3        0.046         3
                          6.05 C        0.00           0.78        1.37
```

```
 L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/      RATIO/     LOADING/
                          FX            MY              MZ       LOCATION
=======================================================================

    27  ST   W8X 31         PASS     AISC- H1-3        0.082         3
                         5.96 C         0.00           2.79        1.36
    28  ST   W8X 31         PASS     AISC- H1-3        0.132         3
                         5.83 C         0.00           5.57        1.36
    29  ST   W8X 31         PASS     AISC- H1-3        0.196         3
                         5.64 C         0.00           9.12        1.37
    30  ST   W8X 31         PASS     AISC- H1-2        0.380         3
                        41.94 C         0.00          -9.12        0.00
    31  ST   W8X 31         PASS     AISC- H1-2        0.401         3
                        42.94 C         0.00          -9.98        1.37
    32  ST   W8X 31         PASS     AISC- H1-2        0.402         3
                        43.18 C         0.00           9.98        0.00
    33  ST   W8X 31         PASS     AISC- H1-2        0.399         3
                        42.97 C         0.00           9.86        0.00
    34  ST   W8X 31         PASS     AISC- H1-2        0.400         3
                        42.37 C         0.00          10.10        1.36
    35  ST   W8X 31         PASS     AISC- H1-2        0.375         3
                        37.44 C         0.00         -10.10        0.00
    36  ST   W8X 31         PASS     AISC- H1-2        0.227         3
                        38.16 C         0.00          -1.84        1.36
    37  ST   W8X 31         PASS     AISC- H1-2        0.227         3
                        38.16 C         0.00          -1.84        0.00
    38  ST   W8X 31         PASS     AISC- H1-2        0.429         3
                        37.79 C         0.00         -12.92        1.57
    39  ST   W8X 31         PASS     AISC- H1-2        0.467         3
                        45.29 C         0.00          12.92        0.00
    40  ST   W8X 31         PASS     AISC- H1-2        0.653         3
                        46.99 C         0.00          22.60        1.57
    41  ST   W8X 31         PASS     AISC- H1-2        0.717         3
                        47.78 C         0.00          25.83        1.57
    42  ST   W8X 31         PASS     AISC- H1-2        0.717         3
                        47.78 C         0.00         -25.83        0.00

  ************** END OF TABULATED RESULT OF DESIGN **************


   49. PLOT DISPLACEMENT FILE
   50. PLOT BENDING FILE
   51. FINISH


     *************** END OF STAAD-III ***************

  DATE= JUL 18,1995   TIME=  9: 2: 5 ******

     ************************************************************
     *       For questions on STAAD-III/ISDS, contact:          *
     *       RESEARCH ENGINEERS, Inc at (714) 974-2500          *
```



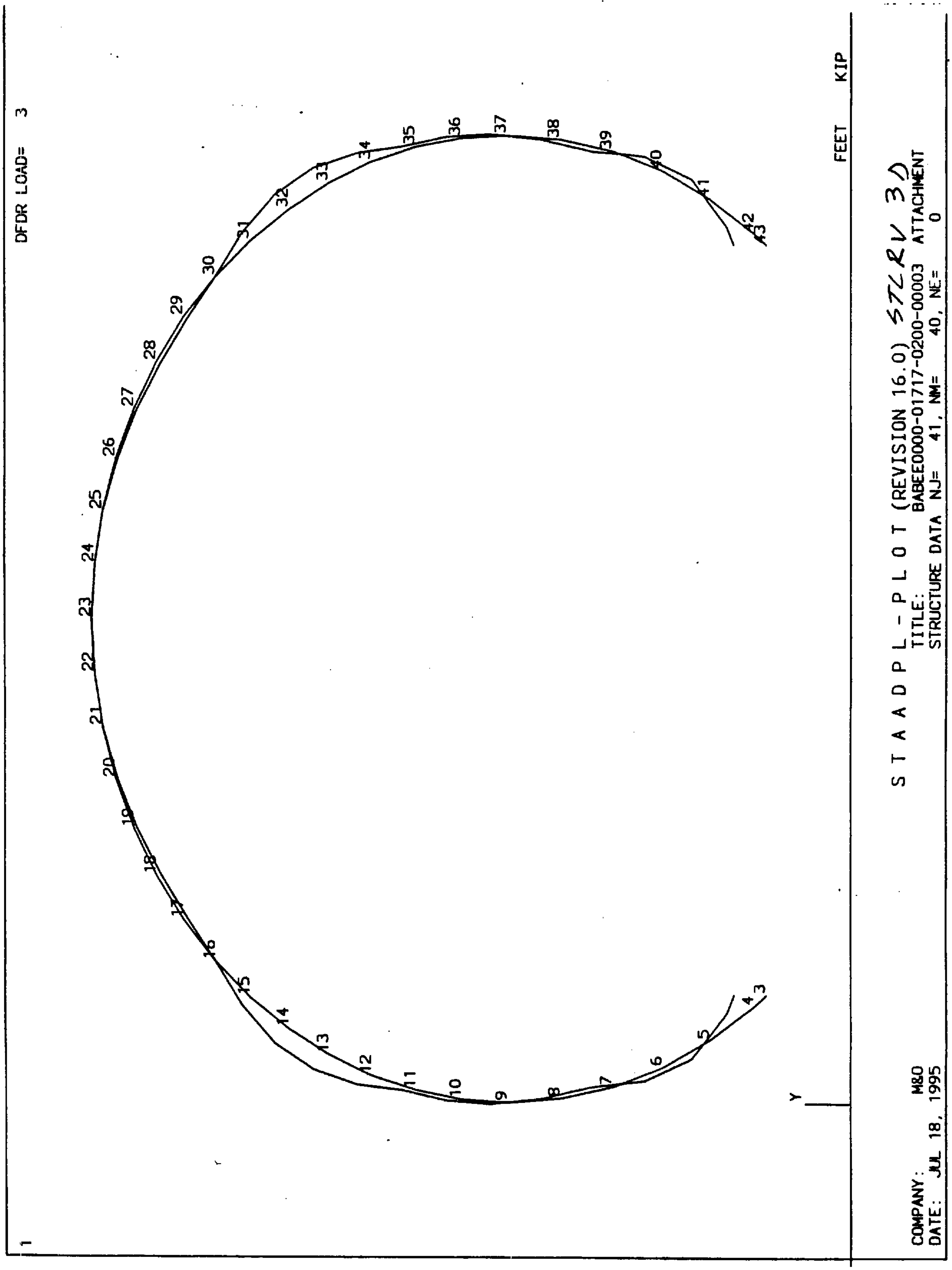
STAADPL-PLOT (REVISION 16.0) STLRV 3D
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995



S T A A D P L - P L O T (REVISION 16.0) STZRV 3A
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995


DFDR LOAD= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
Y
1
S T A A D P L - P L O T (REVISION 16.0) STLRV 3D
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995

```
 ****************************************************
 *                                                  *
 *            S T A A D - III                       *
 *            Revision 16.0b                        *
 *            Proprietary Program of                *
 *            RESEARCH ENGINEERS, Inc.              *
 *            Date=    JUL 18, 1995                 *
 *            Time=    10:10:59                     *
 *                                                  *
 ****************************************************


  1. STAAD PLANE  BABEE0000-01717-0200-00003 ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. * FILE STLRV3B
  4. * 25 TON JACKS APPLIED BOTH SIDES @ 47 DEGREES
  5. * MOMENT MZ RELEASED AT THE ENDS OF MEMBERS 15 AND 29
  6. * MOMENT MZ RELEASED AT THE START OF MEMBERS 16 AND 30
  7. UNIT FT KIP
  8. JOINT COORDINATES
  9. 3 3.27 2.13 ; 4 2.43 3.13
 10. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 11. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 12. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 13. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39; 20 8.15 21.91
 14. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 15. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 16. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 17. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 18. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 19. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.06 2.13
 20. MEMBER INCIDENCE
 21. 3 3 4 42
 22. UNIT KIP INCH
 23. MEMBER RELEASE
 24. 15 29 END MZ
 25. 16 30 START MZ
 26. MEMBER PROPERTIES
 27. 3 TO 42 TA STA W8X31
 28. CONSTANTS
 29. E 29000.0 ALL
 30. DENSITY 0.00028 ALL
 31. BETA 0 ALL
 32. UNIT FT
 33. SUPPORT
 34. 3 7 11 35 39 43 FIXED BUT FY MZ
 35. 22 24 FIXED BUT FX MZ
 36. 16 30 PINNED
 37. UNIT KIP
 38. LOAD 1
 39. SELF WEIGHT Y -1.0
 40. LOADING 2
 41. * 25 TON JACKS & SIMULTANEOUS JACKING
 42. JOINT LOADING                      45. 3 FY 36.57
 43. 3 FX -34.10                        46. 43 FY 36.57
 44. 43 FX 34.10                        47. 43 MZ -25.00
```

```
    48. 3 MZ 25.00
    49. LOADING COMBINATION 3
    50. 1 2.5 2 1.0
    51. PERFORM ANALYSIS


           P R O B L E M   S T A T I S T I C S
           -----------------------------------

     NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     41/    40/    10
     ORIGINAL/FINAL BAND-WIDTH =     1/     1
     TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =    111
     SIZE OF STIFFNESS MATRIX =      666 DOUBLE PREC. WORDS
     TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES


  ++ PROCESSING ELEMENT STIFFNESS MATRIX.                  10:11: 2
  ++ PROCESSING GLOBAL STIFFNESS MATRIX.                   10:11: 3
  ++ PROCESSING TRIANGULAR FACTORIZATION.                  10:11: 3
  ++ CALCULATING JOINT DISPLACEMENTS.                      10:11: 3
  ++ CALCULATING MEMBER  FORCES.                           10:11: 4

    52. LOAD LIST 3
    53. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

    3    3    0.00000   0.06910   0.00000   0.00000   0.00000   0.00342
    4    3   -0.03097   0.03955   0.00000   0.00000   0.00000   0.00186
    5    3   -0.04236   0.02831   0.00000   0.00000   0.00000   0.00008
    6    3   -0.02702   0.03218   0.00000   0.00000   0.00000  -0.00100
    7    3    0.00000   0.03808   0.00000   0.00000   0.00000  -0.00077
    8    3    0.00352   0.03621   0.00000   0.00000   0.00000  -0.00011
    9    3    0.00263   0.03360   0.00000   0.00000   0.00000   0.00003
   10    3    0.00239   0.03141   0.00000   0.00000   0.00000   0.00013
   11    3    0.00000   0.02960   0.00000   0.00000   0.00000   0.00056
   12    3   -0.01765   0.03201   0.00000   0.00000   0.00000   0.00079
   13    3   -0.03021   0.03454   0.00000   0.00000   0.00000   0.00030
   14    3   -0.03095   0.03205   0.00000   0.00000   0.00000  -0.00050
   15    3   -0.01909   0.02056   0.00000   0.00000   0.00000  -0.00127
   16    3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   17    3    0.00016  -0.00024   0.00000   0.00000   0.00000  -0.00001
   18    3    0.00024  -0.00042   0.00000   0.00000   0.00000  -0.00001
   19    3    0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
   20    3    0.00019  -0.00043   0.00000   0.00000   0.00000   0.00001
   21    3    0.00010  -0.00023   0.00000   0.00000   0.00000   0.00001
   22    3    0.00003   0.00000   0.00000   0.00000   0.00000   0.00001
   23    3    0.00000   0.00005   0.00000   0.00000   0.00000   0.00000
   24    3   -0.00003   0.00000   0.00000   0.00000   0.00000  -0.00001
   25    3   -0.00010  -0.00023   0.00000   0.00000   0.00000  -0.00001
   26    3   -0.00019  -0.00043   0.00000   0.00000   0.00000  -0.00001
   27    3   -0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
   28    3   -0.00024  -0.00042   0.00000   0.00000   0.00000   0.00001
   29    3   -0.00016  -0.00024   0.00000   0.00000   0.00000   0.00001
   30    3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   31    3    0.01907   0.02054   0.00000   0.00000   0.00000   0.00127
   32    3    0.03093   0.03204   0.00000   0.00000   0.00000   0.00051
   33    3    0.03030   0.03460   0.00000   0.00000   0.00000  -0.00030
   34    3    0.01755   0.03208   0.00000   0.00000   0.00000  -0.00079
   35    3    0.00000   0.02957   0.00000   0.00000   0.00000  -0.00056
   36    3   -0.00244   0.03138   0.00000   0.00000   0.00000  -0.00014
   37    3   -0.00291   0.03356   0.00000   0.00000   0.00000  -0.00004
   38    3   -0.00377   0.03616   0.00000   0.00000   0.00000   0.00012
   39    3    0.00000   0.03799   0.00000   0.00000   0.00000   0.00079
   40    3    0.02749   0.03210   0.00000   0.00000   0.00000   0.00102
   41    3    0.04292   0.02818   0.00000   0.00000   0.00000  -0.00009
   42    3    0.03121   0.03975   0.00000   0.00000   0.00000  -0.00188
   43    3    0.00000   0.06950   0.00000   0.00000   0.00000  -0.00344
```

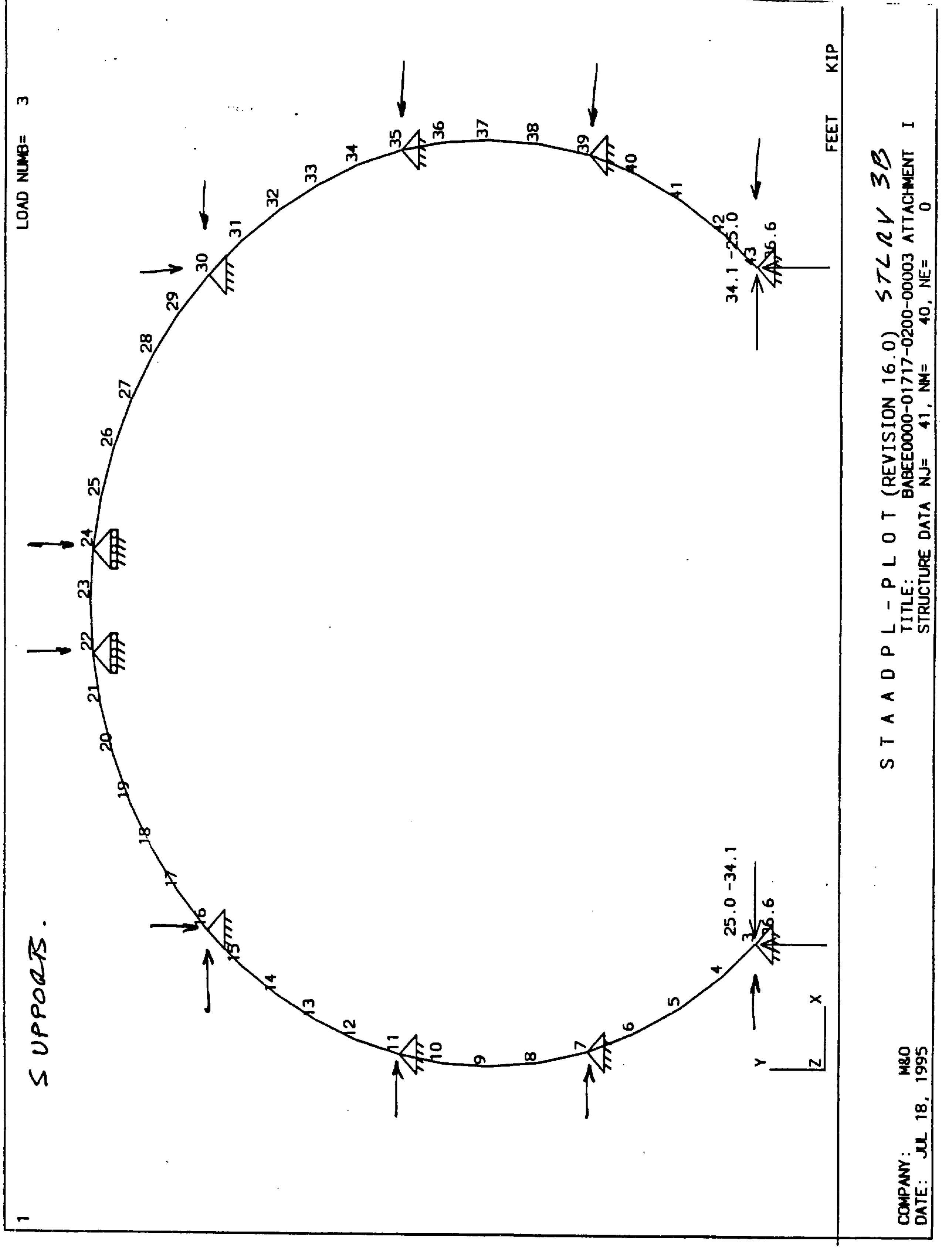
```
SUPPORT REACTIONS -UNIT KIP  FEET     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

   3     3      6.37      0.00      0.00      0.00      0.00      0.00
   7     3     27.80      0.00      0.00      0.00      0.00      0.00
  11     3     21.31      0.00      0.00      0.00      0.00      0.00
  35     3    -21.37      0.00      0.00      0.00      0.00      0.00
  39     3    -27.81      0.00      0.00      0.00      0.00      0.00
  43     3     -6.34      0.00      0.00      0.00      0.00      0.00
  22     3      0.00      0.20      0.00      0.00      0.00      0.00
  24     3      0.00      0.20      0.00      0.00      0.00      0.00
  16     3    -20.92    -34.61      0.00      0.00      0.00      0.00
  30     3     20.96    -34.61      0.00      0.00      0.00      0.00
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


   3    3    3     45.84      2.29     0.00      0.00      0.00     -25.00
             4    -45.76     -2.22     0.00      0.00      0.00      27.95

   4    3    4     45.69     -3.41     0.00      0.00      0.00     -27.95
             5    -45.59      3.48     0.00      0.00      0.00      22.57

   5    3    5     44.79     -9.19     0.00      0.00      0.00     -22.57
             6    -44.68      9.24     0.00      0.00      0.00       8.15

   6    3    6     43.20    -14.67     0.00      0.00      0.00      -8.15
             7    -43.09     14.71     0.00      0.00      0.00     -14.80

   7    3    7     35.43      6.98     0.00      0.00      0.00      14.80
             8    -35.31     -6.95     0.00      0.00      0.00      -3.88

   8    3    8     35.91      2.37     0.00      0.00      0.00       3.88
             9    -35.79     -2.37     0.00      0.00      0.00      -0.17

   9    3    9     35.81      2.03     0.00      0.00      0.00      -0.17
            10    -35.71     -2.03     0.00      0.00      0.00       2.94

  10    3   10     35.27      5.94     0.00      0.00      0.00      -2.94
            11    -35.17     -5.92     0.00      0.00      0.00      11.05

  11    3   11     40.13    -10.89     0.00      0.00      0.00     -11.05
            12    -40.03     10.92     0.00      0.00      0.00      -3.79

  12    3   12     41.07     -5.93     0.00      0.00      0.00       3.79
            13    -40.97      5.97     0.00      0.00      0.00     -11.92

  13    3   13     41.36     -1.77     0.00      0.00      0.00      11.92
            14    -41.27      1.82     0.00      0.00      0.00     -14.35

  14    3   14     41.21      2.90     0.00      0.00      0.00      14.35
            15    -41.13     -2.84     0.00      0.00      0.00     -10.42

  15    3   15     40.50      7.70     0.00      0.00      0.00      10.42
            16    -40.42     -7.63     0.00      0.00      0.00       0.00

  16    3   16      0.70      0.09     0.00      0.00      0.00       0.00
            17     -0.63     -0.01     0.00      0.00      0.00       0.07

  17    3   17      0.62      0.08     0.00      0.00      0.00      -0.07
            18     -0.56      0.01     0.00      0.00      0.00       0.12

  18    3   18      0.56      0.06     0.00      0.00      0.00      -0.12
            19     -0.51      0.03     0.00      0.00      0.00       0.13
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

  36     3  36     35.72     -1.78     0.00      0.00      0.00      -2.80
            37    -35.83      1.79     0.00      0.00      0.00       0.37

  37     3  37     35.79     -2.35     0.00      0.00      0.00       0.37
            38    -35.91      2.36     0.00      0.00      0.00      -4.05

  38     3  38     35.32     -6.94     0.00      0.00      0.00       4.05
            39    -35.43      6.96     0.00      0.00      0.00     -14.95

  39     3  39     43.00     15.00     0.00      0.00      0.00      14.95
            40    -43.12    -14.96     0.00      0.00      0.00       8.41

  40     3  40     44.69      9.26     0.00      0.00      0.00      -8.41
            41    -44.80     -9.21     0.00      0.00      0.00      22.87

  41     3  41     45.62      3.26     0.00      0.00      0.00     -22.87
            42    -45.72     -3.19     0.00      0.00      0.00      27.92

  42     3  42     45.78     -2.20     0.00      0.00      0.00     -27.92
            43    -45.86      2.27     0.00      0.00      0.00      25.00

************** END OF LATEST ANALYSIS RESULT **************

 54. CHECK CODE ALL
```

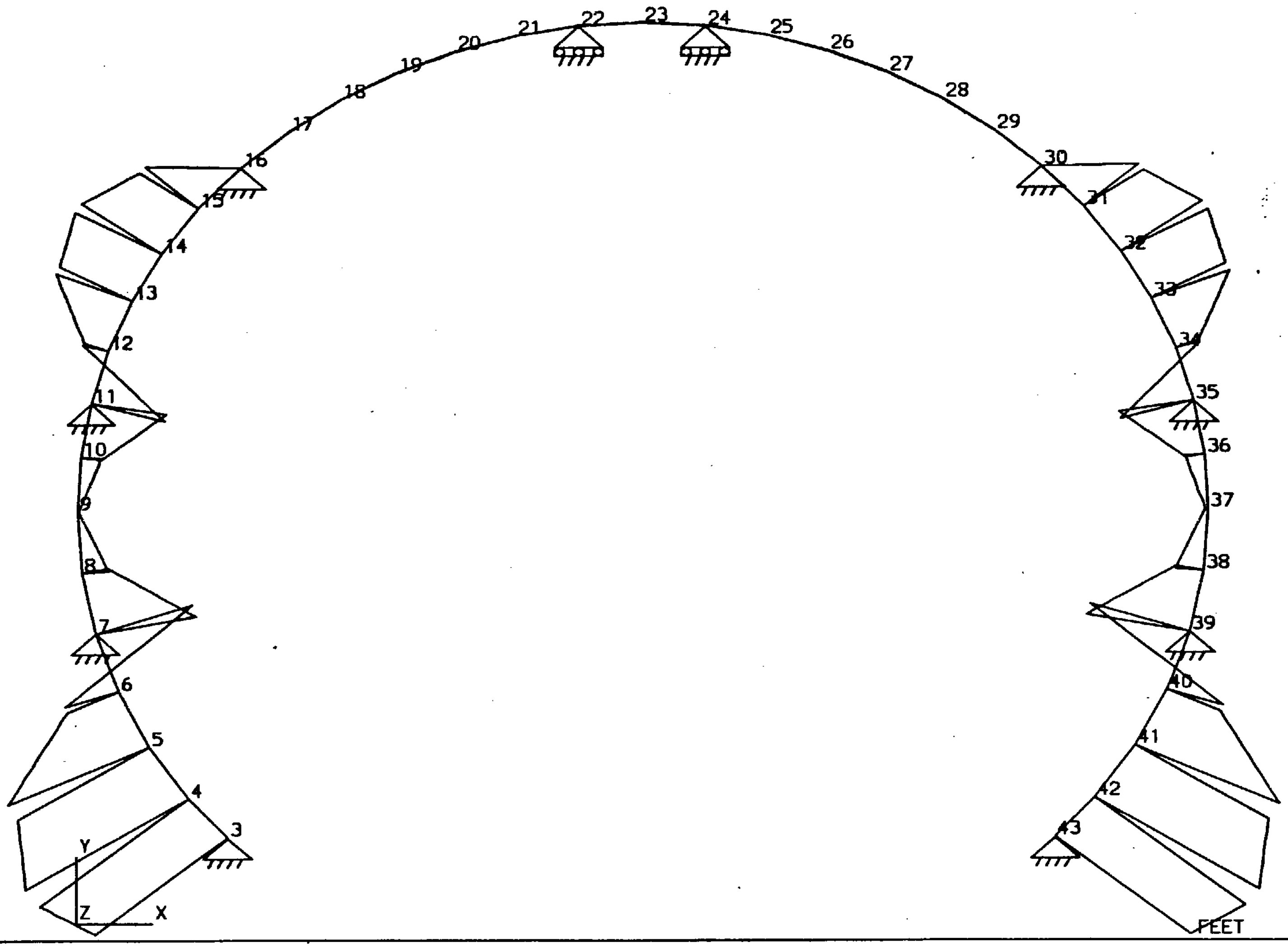
```
                    STAAD-III CODE CHECKING - (AISC)
                    ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                            FX           MY              MZ       LOCATION
=======================================================================

    3  ST   W8X 31           PASS     AISC- H1-2        0.745        3
                        45.76 C          0.00          27.95       1.31
    4  ST   W8X 31           PASS     AISC- H1-2        0.745        3
                        45.69 C          0.00         -27.95       0.00
    5  ST   W8X 31           PASS     AISC- H1-2        0.642        3
                        44.79 C          0.00         -22.57       0.00
    6  ST   W8X 31           PASS     AISC- H1-2        0.490        3
                        43.09 C          0.00         -14.80       1.56
    7  ST   W8X 31           PASS     AISC- H1-2        0.452        3
                        35.43 C          0.00          14.80       0.00
    8  ST   W8X 31           PASS     AISC- H1-2        0.253        3
                        35.91 C          0.00           3.88       0.00
    9  ST   W8X 31           PASS     AISC- H1-2        0.235        3
                        35.71 C          0.00           2.94       1.36
   10  ST   W8X 31           PASS     AISC- H1-2        0.381        3
                        35.17 C          0.00          11.05       1.37
   11  ST   W8X 31           PASS     AISC- H1-2        0.407        3
                        40.13 C          0.00         -11.05       0.00
   12  ST   W8X 31           PASS     AISC- H1-2        0.427        3
                        40.97 C          0.00         -11.92       1.37
   13  ST   W8X 31           PASS     AISC- H1-2        0.473        3
                        41.27 C          0.00         -14.35       1.36
   14  ST   W8X 31           PASS     AISC- H1-2        0.473        3
                        41.21 C          0.00          14.35       0.00
   15  ST   W8X 31           PASS     AISC- H1-2        0.397        3
                        40.50 C          0.00          10.42       0.00
   16  ST   W8X 31           PASS     AISC- H1-3        0.004        3
                         0.63 C          0.00           0.07       1.37
   17  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.56 C          0.00           0.12       1.36
   18  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.56 C          0.00          -0.12       0.00
   19  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.51 C          0.00          -0.13       0.00
   20  ST   W8X 31           PASS     AISC- H1-3        0.004        3
                         0.48 C          0.00          -0.10       0.00
   21  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.44 C          0.00          -0.16       1.36
   22  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.47 C          0.00           0.16       0.00
   23  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.47 C          0.00          -0.16       1.36
   24  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.44 C          0.00           0.16       0.00
   25  ST   W8X 31           PASS     AISC- H1-3        0.004        3
                         0.48 C          0.00           0.10       1.36
   26  ST   W8X 31           PASS     AISC- H1-3        0.005        3
                         0.51 C          0.00           0.13       1.37
```

```
 L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)
MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY             MZ       LOCATION
=======================================================================

    27  ST   W8X 31        PASS     AISC- H1-3      0.005         3
                      0.51 C           0.00        -0.13         0.00
    28  ST   W8X 31        PASS     AISC- H1-3      0.005         3
                      0.56 C           0.00        -0.12         0.00
    29  ST   W8X 31        PASS     AISC- H1-3      0.004         3
                      0.63 C           0.00        -0.07         0.00
    30  ST   W8X 31        PASS     AISC- H1-2      0.396         3
                     40.52 C           0.00       -10.38         1.36
    31  ST   W8X 31        PASS     AISC- H1-2      0.471         3
                     41.23 C           0.00       -14.27         1.37
    32  ST   W8X 31        PASS     AISC- H1-2      0.471         3
                     41.30 C           0.00        14.27         0.00
    33  ST   W8X 31        PASS     AISC- H1-2      0.430         3
                     40.94 C           0.00        12.13         0.00
    34  ST   W8X 31        PASS     AISC- H1-2      0.405         3
                     40.22 C           0.00        10.94         1.36
    35  ST   W8X 31        PASS     AISC- H1-2      0.379         3
                     35.16 C           0.00       -10.94         0.00
    36  ST   W8X 31        PASS     AISC- H1-2      0.233         3
                     35.72 C           0.00        -2.80         0.00
    37  ST   W8X 31        PASS     AISC- H1-2      0.256         3
                     35.91 C           0.00        -4.05         1.56
    38  ST   W8X 31        PASS     AISC- H1-2      0.454         3
                     35.43 C           0.00       -14.95         1.57
    39  ST   W8X 31        PASS     AISC- H1-2      0.493         3
                     43.00 C           0.00        14.95         0.00
    40  ST   W8X 31        PASS     AISC- H1-2      0.647         3
                     44.80 C           0.00        22.87         1.57
    41  ST   W8X 31        PASS     AISC- H1-2      0.745         3
                     45.72 C           0.00        27.92         1.57
    42  ST   W8X 31        PASS     AISC- H1-2      0.745         3
                     45.78 C           0.00       -27.92         0.00

  ************** END OF TABULATED RESULT OF DESIGN **************

   55. PLOT DISPLACEMENT FILE
   56. PLOT BENDING FILE
   57. FINISH

      *************** END OF STAAD-III ***************

  DATE= JUL 18,1995   TIME= 10:11: 7 ******

      ****************************************************
      *       For questions on STAAD-III/ISDS, contact:   *
      *       RESEARCH ENGINEERS, Inc at (714) 974-2500   *
```


LOAD NUMB= 3
FEET KIP
S T A A D P L - P L O T (REVISION 16.0) STLRV 3B
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
SUPPORTS.
34.1 -25.0
36.6
25.0 -34.1
36.6
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
X
Y
Z
1

1

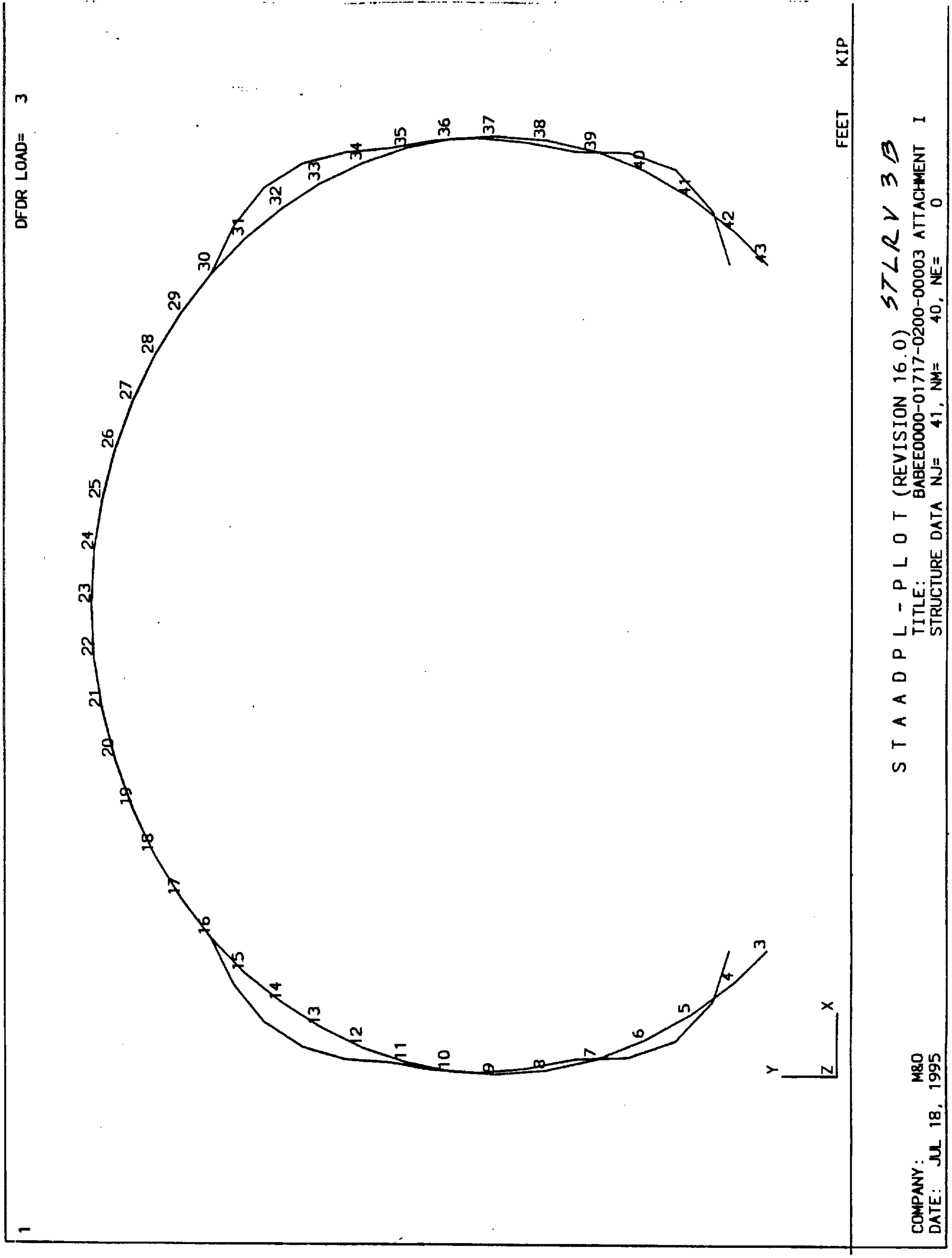
MOMENT MZ LN= 3



S T A A D P L - P L O T (REVISION 16.0) STLRV 3B

COMPANY: M&O
DATE: JUL 18, 1995

TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0


DFDR LOAD= 3
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
1
Y
Z
X
FEET KIP
S T A A D P L - P L O T (REVISION 16.0) STLRV 3B
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995

```
***************************************************
*                                                 *
*             S T A A D - III                     *
*             Revision 16.0b                      *
*             Proprietary Program of              *
*             RESEARCH ENGINEERS, Inc.            *
*             Date=    JUL 18, 1995               *
*             Time=    10:20:35                   *
*                                                 *
***************************************************

  1. STAAD PLANE  BABEE0000-01717-0200-00003  ATTACHMENT I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS  REV 00
  3. * FILE STLRV3C
  4. * 25 TON JACKS APPLIED BOTH SIDES @ 49 DEGREES
  5. * MOMENT MZ RELEASED AT THE END OF MEMBERS 15 & 29
  6. * MOMENT MZ RELEASED AT THE START OF MEMBERS 16 & 30
  7. UNIT FT KIP
  8. JOINT COORDINATES
  9. 3 2.98 2.45 ; 4 2.43 3.13
 10. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 11. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 12. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 13. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 14. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 15. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 16. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 17. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 18. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 19. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.35 2.45
 20. MEMBER INCIDENCE
 21. 3 3 4 42
 22. UNIT KIP INCH
 23. MEMBER RELEASE
 24. 15 29 END MZ
 25. 16 30 START MZ
 26. MEMBER PROPERTIES
 27. 3 TO 42 TA STA W8X31
 28. CONSTANTS
 29. E 29000.0 ALL
 30. DENSITY 0.00028 ALL
 31. BETA 0 ALL
 32. UNIT FT
 33. SUPPORT
 34. 3 7 11 35 39 43 FIXED BUT FY MZ
 35. 22 24 FIXED BUT FX MZ
 36. 16 30 PINNED
 37. UNIT KIP
 38. LOAD 1
 39. SELF WEIGHT Y -1.0
 40. LOADING 2
 41. * 25 TON JACKS & SIMULTANEOUS JACKING
 42. JOINT LOADING
 43. 3 FX -32.8            45. 3 FY 37.74
 44. 43 FX 32.8            46. 43 FY 37.74
                           47. 43 MZ -25.00
```

```
 48. 3 MZ 25.00
 49. LOADING COMBINATION 3
 50. 1 2.5 2 1.0
 51. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/   40/   10
  ORIGINAL/FINAL BAND-WIDTH =     1/    1
  TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =    111
  SIZE OF STIFFNESS MATRIX =      666 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES

++ PROCESSING ELEMENT STIFFNESS MATRIX.              10:20:38
++ PROCESSING GLOBAL STIFFNESS MATRIX.               10:20:39
++ PROCESSING TRIANGULAR FACTORIZATION.              10:20:39
++ CALCULATING JOINT DISPLACEMENTS.                  10:20:39
++ CALCULATING MEMBER  FORCES.                       10:20:40

  52. LOAD LIST 3
  53. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

   3     3    0.00000   0.06548   0.00000   0.00000   0.00000   0.00307
   4     3   -0.02030   0.04668   0.00000   0.00000   0.00000   0.00205
   5     3   -0.03527   0.03303   0.00000   0.00000   0.00000   0.00031
   6     3   -0.02385   0.03493   0.00000   0.00000   0.00000  -0.00080
   7     3    0.00000   0.03968   0.00000   0.00000   0.00000  -0.00064
   8     3    0.00203   0.03742   0.00000   0.00000   0.00000  -0.00006
   9     3    0.00112   0.03473   0.00000   0.00000   0.00000   0.00002
  10     3    0.00161   0.03242   0.00000   0.00000   0.00000   0.00009
  11     3    0.00000   0.03040   0.00000   0.00000   0.00000   0.00055
  12     3   -0.01788   0.03279   0.00000   0.00000   0.00000   0.00080
  13     3   -0.03076   0.03536   0.00000   0.00000   0.00000   0.00031
  14     3   -0.03162   0.03283   0.00000   0.00000   0.00000  -0.00051
  15     3   -0.01954   0.02107   0.00000   0.00000   0.00000  -0.00130
  16     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  17     3    0.00016  -0.00024   0.00000   0.00000   0.00000  -0.00001
  18     3    0.00024  -0.00042   0.00000   0.00000   0.00000  -0.00001
  19     3    0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
  20     3    0.00019  -0.00043   0.00000   0.00000   0.00000   0.00001
  21     3    0.00010  -0.00023   0.00000   0.00000   0.00000   0.00001
  22     3    0.00003   0.00000   0.00000   0.00000   0.00000   0.00001
  23     3    0.00000   0.00005   0.00000   0.00000   0.00000   0.00000
  24     3   -0.00003   0.00000   0.00000   0.00000   0.00000  -0.00001
  25     3   -0.00010  -0.00023   0.00000   0.00000   0.00000  -0.00001
  26     3   -0.00019  -0.00043   0.00000   0.00000   0.00000  -0.00001
  27     3   -0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
  28     3   -0.00024  -0.00042   0.00000   0.00000   0.00000   0.00001
  29     3   -0.00016  -0.00024   0.00000   0.00000   0.00000   0.00001
  30     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  31     3    0.01951   0.02105   0.00000   0.00000   0.00000   0.00130
  32     3    0.03160   0.03282   0.00000   0.00000   0.00000   0.00051
  33     3    0.03086   0.03543   0.00000   0.00000   0.00000  -0.00031
  34     3    0.01777   0.03286   0.00000   0.00000   0.00000  -0.00080
  35     3    0.00000   0.03038   0.00000   0.00000   0.00000  -0.00055
  36     3   -0.00166   0.03239   0.00000   0.00000   0.00000  -0.00010
  37     3   -0.00141   0.03468   0.00000   0.00000   0.00000  -0.00002
  38     3   -0.00229   0.03737   0.00000   0.00000   0.00000   0.00007
  39     3    0.00000   0.03958   0.00000   0.00000   0.00000   0.00066
  40     3    0.02432   0.03482   0.00000   0.00000   0.00000   0.00082
  41     3    0.03581   0.03288   0.00000   0.00000   0.00000  -0.00031
  42     3    0.02048   0.04691   0.00000   0.00000   0.00000  -0.00207
  43     3    0.00000   0.06587   0.00000   0.00000   0.00000  -0.00309
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z    MOM-X     MOM-Y     MOM Z

   3     3      5.06      0.00      0.00      0.00      0.00      0.00
   7     3     27.44      0.00      0.00      0.00      0.00      0.00
  11     3     22.48      0.00      0.00      0.00      0.00      0.00
  35     3    -22.54      0.00      0.00      0.00      0.00      0.00
  39     3    -27.45      0.00      0.00      0.00      0.00      0.00
  43     3     -5.03      0.00      0.00      0.00      0.00      0.00
  22     3      0.00      0.20      0.00      0.00      0.00      0.00
  24     3      0.00      0.20      0.00      0.00      0.00      0.00
  16     3    -21.71    -35.81      0.00      0.00      0.00      0.00
  30     3     21.75    -35.81      0.00      0.00      0.00      0.00
```

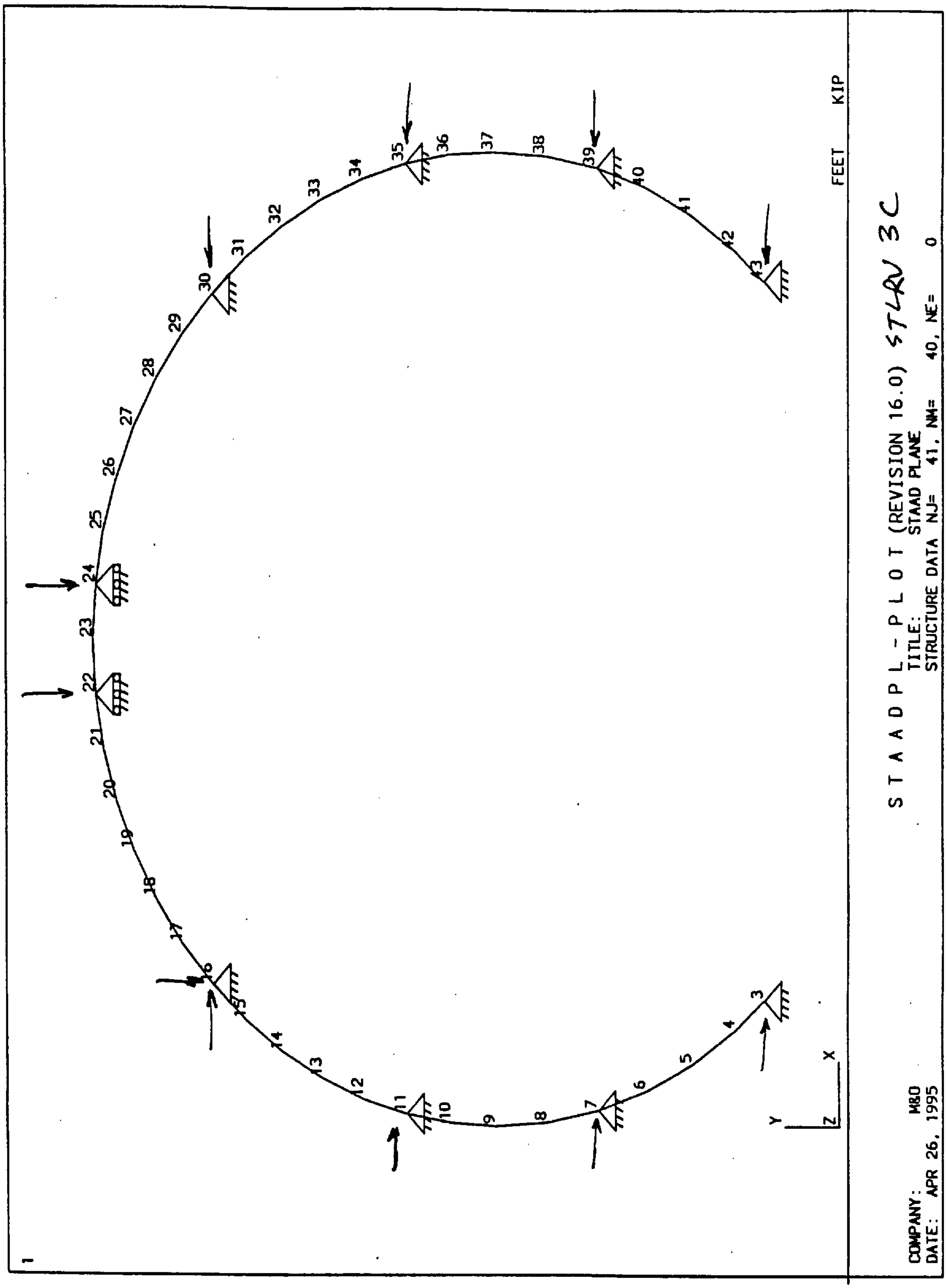
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


   3     3   3     46.79      2.16     0.00      0.00      0.00     -25.00
             4    -46.74     -2.12     0.00      0.00      0.00      26.87

   4     3   4     46.70     -2.77     0.00      0.00      0.00     -26.87
             5    -46.60      2.83     0.00      0.00      0.00      22.50

   5     3   5     45.88     -8.68     0.00      0.00      0.00     -22.50
             6    -45.77      8.73     0.00      0.00      0.00       8.88

   6     3   6     44.34    -14.30     0.00      0.00      0.00      -8.88
             7    -44.23     14.34     0.00      0.00      0.00     -13.49

   7     3   7     36.68      6.84     0.00      0.00      0.00      13.49
             8    -36.56     -6.82     0.00      0.00      0.00      -2.78

   8     3   8     37.14      2.08     0.00      0.00      0.00       2.78
             9    -37.02     -2.07     0.00      0.00      0.00       0.47

   9     3   9     36.99      2.48     0.00      0.00      0.00       0.47
            10    -36.89     -2.47     0.00      0.00      0.00       2.90

  10     3  10     36.39      6.50     0.00      0.00      0.00      -2.90
            11    -36.29     -6.49     0.00      0.00      0.00      11.80

  11     3  11     41.50    -11.32     0.00      0.00      0.00     -11.80
            12    -41.40     11.35     0.00      0.00      0.00      -3.63

  12     3  12     42.48     -6.19     0.00      0.00      0.00       3.63
            13    -42.39      6.23     0.00      0.00      0.00     -12.12

  13     3  13     42.80     -1.89     0.00      0.00      0.00      12.12
            14    -42.71      1.94     0.00      0.00      0.00     -14.72

  14     3  14     42.65      2.95     0.00      0.00      0.00      14.72
            15    -42.56     -2.89     0.00      0.00      0.00     -10.72

  15     3  15     41.92      7.92     0.00      0.00      0.00      10.72
            16    -41.84     -7.85     0.00      0.00      0.00       0.00

  16     3  16      0.70      0.09     0.00      0.00      0.00       0.00
            17     -0.63     -0.01     0.00      0.00      0.00       0.07

  17     3  17      0.62      0.08     0.00      0.00      0.00      -0.07
            18     -0.56      0.01     0.00      0.00      0.00       0.12

  18     3  18      0.56      0.06     0.00      0.00      0.00      -0.12
            19     -0.51      0.03     0.00      0.00      0.00       0.13
```

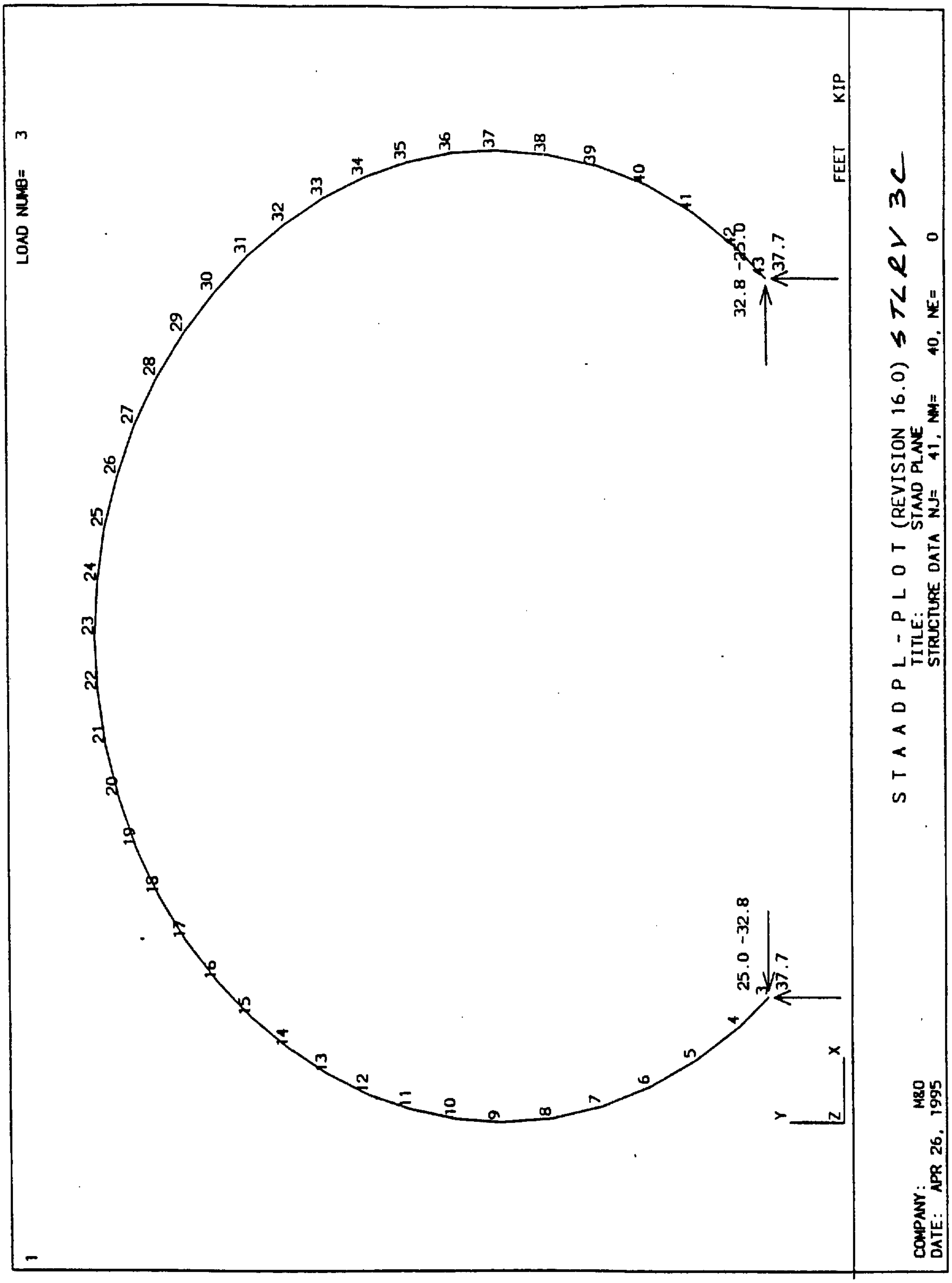
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19      0.51      0.02     0.00      0.00      0.00      -0.13
            20     -0.47      0.07     0.00      0.00      0.00       0.10

  20    3   20      0.48     -0.02     0.00      0.00      0.00      -0.10
            21     -0.45      0.12     0.00      0.00      0.00       0.00

  21    3   21      0.46     -0.07     0.00      0.00      0.00       0.00
            22     -0.44      0.17     0.00      0.00      0.00      -0.16

  22    3   22      0.47      0.08     0.00      0.00      0.00       0.16
            23     -0.46      0.03     0.00      0.00      0.00      -0.13

  23    3   23      0.46      0.03     0.00      0.00      0.00       0.13
            24     -0.47      0.08     0.00      0.00      0.00      -0.16

  24    3   24      0.44      0.17     0.00      0.00      0.00       0.16
            25     -0.46     -0.07     0.00      0.00      0.00       0.00

  25    3   25      0.45      0.12     0.00      0.00      0.00       0.00
            26     -0.48     -0.02     0.00      0.00      0.00       0.10

  26    3   26      0.47      0.07     0.00      0.00      0.00      -0.10
            27     -0.51      0.03     0.00      0.00      0.00       0.13

  27    3   27      0.51      0.03     0.00      0.00      0.00      -0.13
            28     -0.56      0.06     0.00      0.00      0.00       0.12

  28    3   28      0.56      0.01     0.00      0.00      0.00      -0.12
            29     -0.62      0.08     0.00      0.00      0.00       0.07

  29    3   29      0.63     -0.01     0.00      0.00      0.00      -0.07
            30     -0.70      0.09     0.00      0.00      0.00       0.00

  30    3   30     41.87     -7.82     0.00      0.00      0.00       0.00
            31    -41.95      7.89     0.00      0.00      0.00     -10.68

  31    3   31     42.59     -2.85     0.00      0.00      0.00      10.68
            32    -42.67      2.91     0.00      0.00      0.00     -14.63

  32    3   32     42.74      1.70     0.00      0.00      0.00      14.63
            33    -42.83     -1.65     0.00      0.00      0.00     -12.34

  33    3   33     42.36      6.55     0.00      0.00      0.00      12.34
            34    -42.45     -6.51     0.00      0.00      0.00      -3.44

  34    3   34     41.49     11.10     0.00      0.00      0.00       3.44
            35    -41.59    -11.07     0.00      0.00      0.00      11.68

  35    3   35     36.29     -6.51     0.00      0.00      0.00     -11.68
            36    -36.39      6.52     0.00      0.00      0.00       2.76
```

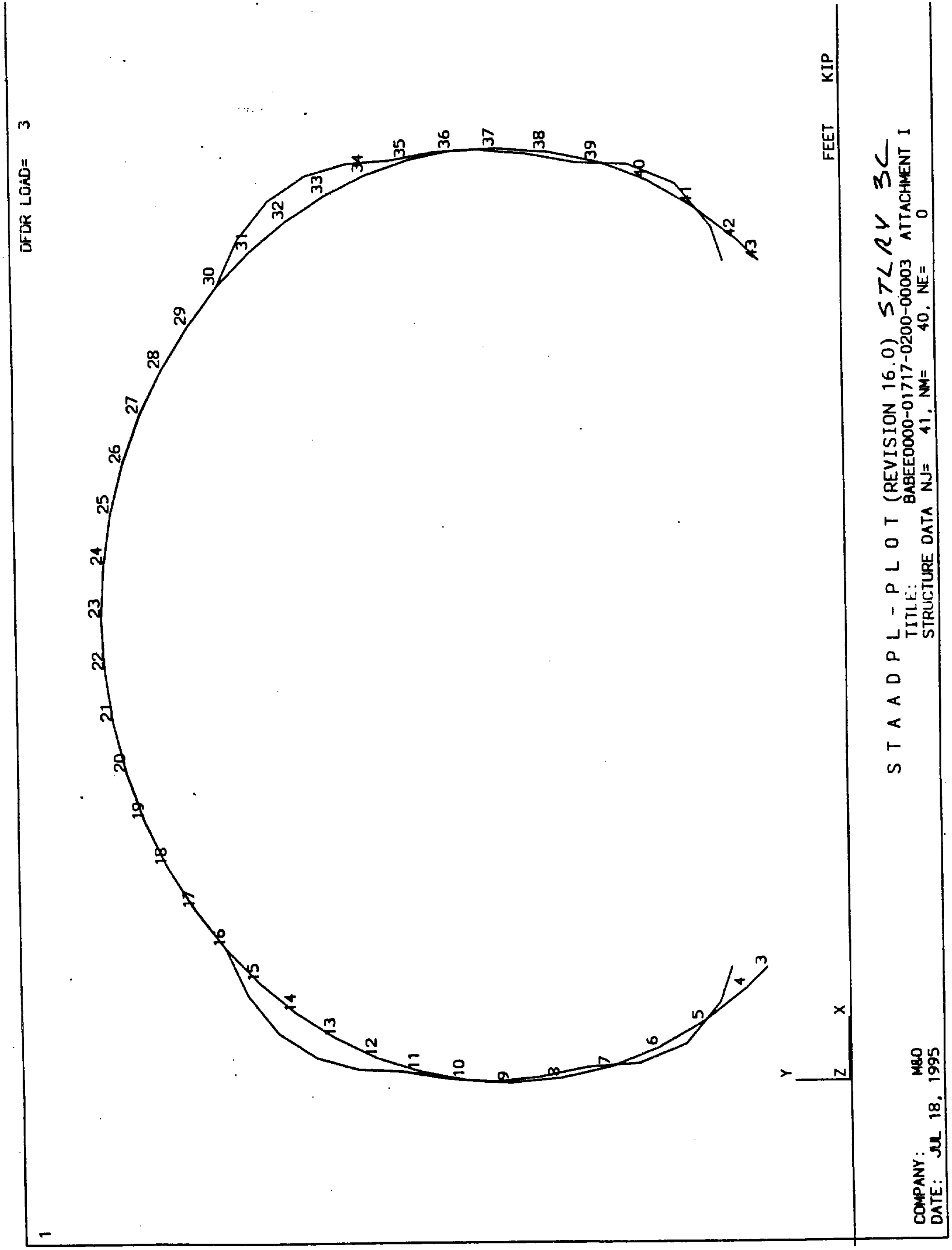
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y       MOM-Z


  36     3  36     36.90     -2.22     0.00      0.00      0.00       -2.76
            37    -37.01      2.22     0.00      0.00      0.00       -0.27

  37     3  37     37.02     -2.05     0.00      0.00      0.00       -0.27
            38    -37.14      2.06     0.00      0.00      0.00       -2.95

  38     3  38     36.57     -6.80     0.00      0.00      0.00        2.95
            39    -36.69      6.82     0.00      0.00      0.00      -13.63

  39     3  39     44.15     14.64     0.00      0.00      0.00       13.63
            40    -44.26    -14.60     0.00      0.00      0.00        9.16

  40     3  40     45.78      8.75     0.00      0.00      0.00       -9.16
            41    -45.89     -8.70     0.00      0.00      0.00       22.82

  41     3  41     46.63      2.61     0.00      0.00      0.00      -22.82
            42    -46.73     -2.54     0.00      0.00      0.00       26.85

  42     3  42     46.76     -2.10     0.00      0.00      0.00      -26.85
            43    -46.81      2.14     0.00      0.00      0.00       25.00

 ************** END OF LATEST ANALYSIS RESULT **************

  54. CHECK CODE ALL
```

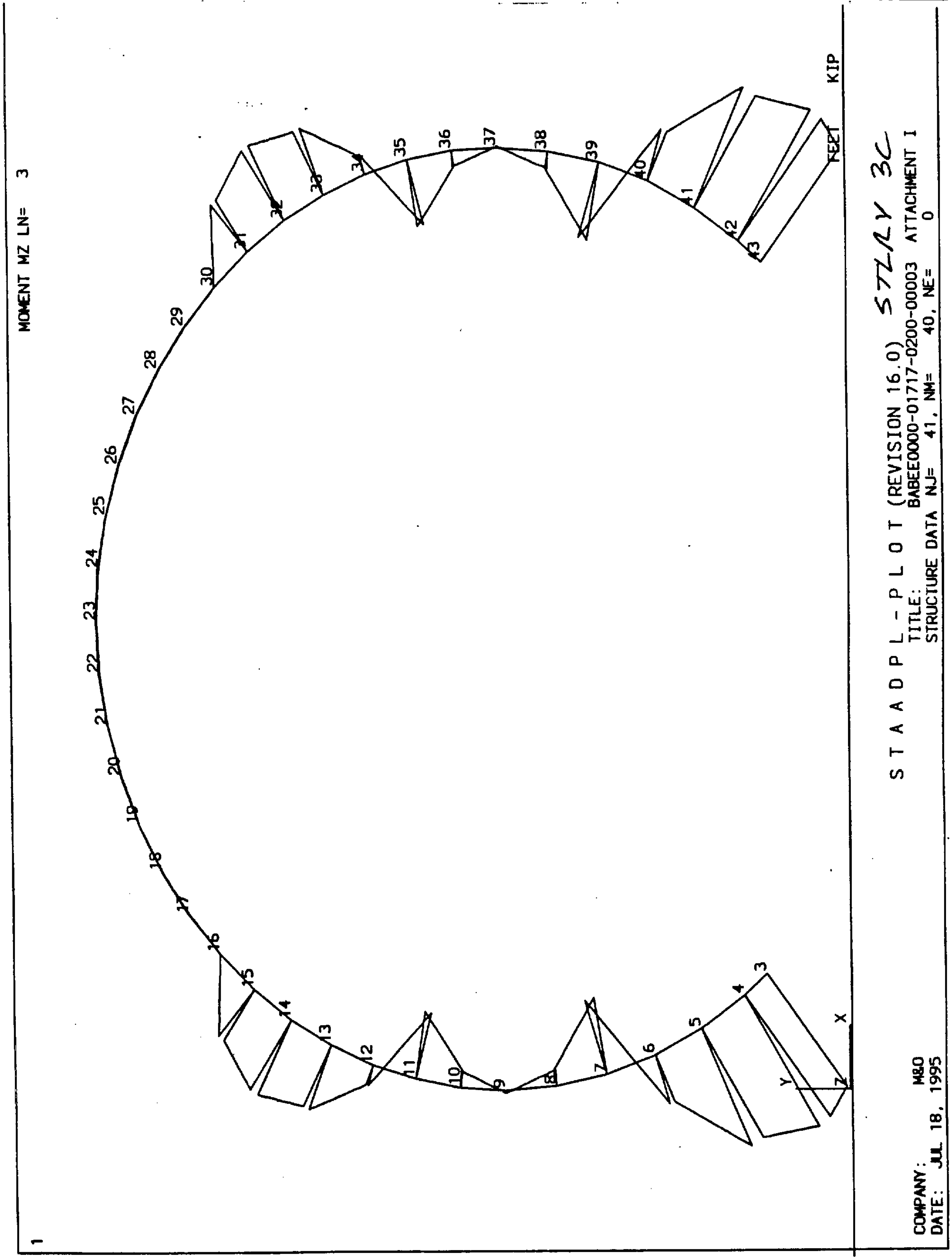
```
                         STAAD-III CODE CHECKING - (AISC)
                         ************************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE         RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX           MY             MZ       LOCATION
=======================================================================

     3 ST   W8X 31          PASS     AISC- H1-2        0.731         3
                        46.74 C         0.00          26.87        0.87
     4 ST   W8X 31          PASS     AISC- H1-2        0.730         3
                        46.70 C         0.00         -26.87        0.00
     5 ST   W8X 31          PASS     AISC- H1-2        0.646         3
                        45.88 C         0.00         -22.50        0.00
     6 ST   W8X 31          PASS     AISC- H1-2        0.472         3
                        44.23 C         0.00         -13.49        1.56
     7 ST   W8X 31          PASS     AISC- H1-2        0.434         3
                        36.68 C         0.00          13.49        0.00
     8 ST   W8X 31          PASS     AISC- H1-2        0.239         3
                        37.14 C         0.00           2.78        0.00
     9 ST   W8X 31          PASS     AISC- H1-2        0.240         3
                        36.89 C         0.00           2.90        1.36
    10 ST   W8X 31          PASS     AISC- H1-2        0.401         3
                        36.29 C         0.00          11.80        1.37
    11 ST   W8X 31          PASS     AISC- H1-2        0.427         3
                        41.50 C         0.00         -11.80        0.00
    12 ST   W8X 31          PASS     AISC- H1-2        0.438         3
                        42.39 C         0.00         -12.12        1.37
    13 ST   W8X 31          PASS     AISC- H1-2        0.487         3
                        42.71 C         0.00         -14.72        1.36
    14 ST   W8X 31          PASS     AISC- H1-2        0.487         3
                        42.65 C         0.00          14.72        0.00
    15 ST   W8X 31          PASS     AISC- H1-2        0.409         3
                        41.92 C         0.00          10.72        0.00
    16 ST   W8X 31          PASS     AISC- H1-3        0.004         3
                         0.63 C         0.00           0.07        1.37
    17 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.56 C         0.00           0.12        1.36
    18 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.56 C         0.00          -0.12        0.00
    19 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.51 C         0.00          -0.13        0.00
    20 ST   W8X 31          PASS     AISC- H1-3        0.004         3
                         0.48 C         0.00          -0.10        0.00
    21 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.44 C         0.00          -0.16        1.36
    22 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.47 C         0.00           0.16        0.00
    23 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.47 C         0.00          -0.16        1.36
    24 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.44 C         0.00           0.16        0.00
    25 ST   W8X 31          PASS     AISC- H1-3        0.004         3
                         0.48 C         0.00           0.10        1.36
    26 ST   W8X 31          PASS     AISC- H1-3        0.005         3
                         0.51 C         0.00           0.13        1.37

          ********************************************
```

```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                            FX           MY             MZ       LOCATION
=======================================================================

    27  ST  W8X 31          PASS     AISC- H1-3        0.005          3
                         0.51 C          0.00         -0.13         0.00
    28  ST  W8X 31          PASS     AISC- H1-3        0.005          3
                         0.56 C          0.00         -0.12         0.00
    29  ST  W8X 31          PASS     AISC- H1-3        0.004          3
                         0.63 C          0.00         -0.07         0.00
    30  ST  W8X 31          PASS     AISC- H1-2        0.409          3
                        41.95 C          0.00        -10.68         1.36
    31  ST  W8X 31          PASS     AISC- H1-2        0485           3
                        42.67 C          0.00        -14.63         1.37
    32  ST  W8X 31          PASS     AISC- H1-2        0.485          3
                        42.74 C          0.00         14.63         0.00
    33  ST  W8X 31          PASS     AISC- H1-2        0.442          3
                        42.36 C          0.00         12.34         0.00
    34  ST  W8X 31          PASS     AISC- H1-2        0.425          3
                        41.59 C          0.00         11.68         1.36
    35  ST  W8X 31          PASS     AISC- H1-2        0.398          3
                        36.29 C          0.00        -11.68         0.00
    36  ST  W8X 31          PASS     AISC- H1-2        0.238          3
                        36.90 C          0.00         -2.76         0.00
    37  ST  W8X 31          PASS     AISC- H1-2        0.242          3
                        37.14 C          0.00         -2.95         1.56
    38  ST  W8X 31          PASS     AISC- H1-2        0.436          3
                        36.69 C          0.00        -13.63         1.57
    39  ST  W8X 31          PASS     AISC- H1-2        0.474          3
                        44.15 C          0.00         13.63         0.00
    40  ST  W8X 31          PASS     AISC- H1-2        0.652          3
                        45.89 C          0.00         22.82         1.57
    41  ST  W8X 31          PASS     AISC- H1-2        0.730          3
                        46.73 C          0.00         26.85         1.57
    42  ST  W8X 31          PASS     AISC- H1-2        0.730          3
                        46.76 C          0.00        -26.85         0.00

   *************** END OF TABULATED RESULT OF DESIGN **************


   55. PLOT DISPLACEMENT FILE
   56. PLOT BENDING FILE
   57. FINISH


      *************** END OF STAAD-III ***************

  DATE= JUL 18,1995   TIME= 10:20:43 ******

      ************************************************************
      *       For questions on STAAD-III/ISDS, contact:          *
      *       RESEARCH ENGINEERS, Inc at (714) 974-2500          *
```


S T A A D P L - P L O T (REVISION 16.0) STLRV 3C
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
FEET KIP
COMPANY: M&O
DATE: APR 26, 1995
Y
X
Z
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43


LOAD NUMB= 3
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
32.8 -25.0
37.7
25.0 -32.8
37.7
FEET KIP
Y
X
Z
S T A A D P L - P L O T (REVISION 16.0) STLRV 3C
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: APR 26, 1995
1


DFDR LOAD= 3
FEET KIP
S T A A D P L - P L O T (REVISION 16.0) STLRV 3C
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
X
Y
Z
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43


MOMENT MZ LN= 3
KIP
FEET
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
X
Y
Z
1
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995

STLAY 3C

```
*****************************************************
*                                                   *
*            S T A A D - III                        *
*            Revision 16.0b                         *
*            Proprietary Program of                 *
*            RESEARCH ENGINEERS, Inc.               *
*            Date=    JUL 18, 1995                  *
*            Time=    10:36:37                      *
*                                                   *
*****************************************************

 1. STAAD PLANE BABEE0000-01717-0200-00003  ATTACHMENT I
 2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
 3. * FILE STLRV3A1
 4. * 25 TON JACKS APPLIED BOTH SIDES @ 47 DEGREES
 5. * WITH ROCK ENGAGEMENT AT MOST JOINTS
 6. UNIT FT KIP
 7. JOINT COORDINATES
 8. 3 3.27 2.13 ; 4 2.43 3.13
 9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.06 2.13
19. MEMBER INCIDENCE
20. 3 3 4 42
21. UNIT KIP INCH
22. MEMBER PROPERTIES
23. 3 TO 42 TA STA W8X31
24. CONSTANTS
25. E 29000.0 ALL
26. DENSITY 0.00028 ALL
27. BETA 0 ALL
28. UNIT FT
29. SUPPORT
30. 3 5 7 9 11 35 37 39 41 43 FIXED BUT FY MZ
31. 20 21 22 23 24 25 26 FIXED BUT FX MZ
32. 14 16 18 28 30 32 PINNED
33. UNIT KIP
34. LOAD 1
35. SELF WEIGHT Y -1.0
36. LOADING 2
37. * 25 TON JACKS & SIMULTANEOUS JACKING
38. JOINT LOADING
39. 3 FX -34.1
40. 43 FX 34.1
41. 3 FY 36.57
42. 43 FY 36.57          45. LOADING COMBINATION 3
43. 43 MZ -25.00         46. 1 2.5 2 1.0
44. 3 MZ 25.00           47. PERFORM ANALYSIS
```

```
        P R O B L E M   S T A T I S T I C S
        -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/   40/   23
   ORIGINAL/FINAL BAND-WIDTH =     1/    1
   TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =     94
   SIZE OF STIFFNESS MATRIX =      564 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                    10:36:40
++ PROCESSING GLOBAL STIFFNESS MATRIX.                     10:36:41
++ PROCESSING TRIANGULAR FACTORIZATION.                    10:36:41
++ CALCULATING JOINT DISPLACEMENTS.                        10:36:41
++ CALCULATING MEMBER  FORCES.                             10:36:42

  48. LOAD LIST 3
  49. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD    X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

    3     3    0.00000   0.03461   0.00000   0.00000   0.00000   0.00163
    4     3   -0.00727   0.02439   0.00000   0.00000   0.00000   0.00040
    5     3    0.00000   0.02473   0.00000   0.00000   0.00000  -0.00004
    6     3   -0.00104   0.02118   0.00000   0.00000   0.00000   0.00005
    7     3    0.00000   0.01864   0.00000   0.00000   0.00000   0.00006
    8     3   -0.00191   0.01564   0.00000   0.00000   0.00000   0.00002
    9     3    0.00000   0.01319   0.00000   0.00000   0.00000  -0.00002
   10     3   -0.00079   0.01102   0.00000   0.00000   0.00000  -0.00001
   11     3    0.00000   0.00863   0.00000   0.00000   0.00000   0.00005
   12     3   -0.00371   0.00722   0.00000   0.00000   0.00000   0.00002
   13     3   -0.00337   0.00451   0.00000   0.00000   0.00000  -0.00016
   14     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00015
   15     3    0.00053  -0.00042   0.00000   0.00000   0.00000  -0.00002
   16     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00001
   17     3   -0.00002   0.00002   0.00000   0.00000   0.00000   0.00000
   18     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   19     3    0.00002  -0.00003   0.00000   0.00000   0.00000   0.00000
   20     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   21     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   22     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   23     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   24     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   25     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   26     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   27     3   -0.00002  -0.00003   0.00000   0.00000   0.00000   0.00000
   28     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   29     3    0.00002   0.00003   0.00000   0.00000   0.00000   0.00000
   30     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00001
   31     3   -0.00054  -0.00043   0.00000   0.00000   0.00000   0.00002
   32     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00016
   33     3    0.00345   0.00460   0.00000   0.00000   0.00000   0.00016
   34     3    0.00358   0.00722   0.00000   0.00000   0.00000  -0.00003
   35     3    0.00000   0.00864   0.00000   0.00000   0.00000  -0.00004
   36     3    0.00090   0.01105   0.00000   0.00000   0.00000   0.00001
   37     3    0.00000   0.01322   0.00000   0.00000   0.00000   0.00002
   38     3    0.00188   0.01567   0.00000   0.00000   0.00000  -0.00002
   39     3    0.00000   0.01866   0.00000   0.00000   0.00000  -0.00005
   40     3    0.00115   0.02116   0.00000   0.00000   0.00000  -0.00005
   41     3    0.00000   0.02476   0.00000   0.00000   0.00000   0.00004
   42     3    0.00719   0.02446   0.00000   0.00000   0.00000  -0.00040
   43     3    0.00000   0.03462   0.00000   0.00000   0.00000  -0.00162
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

    3    3      -5.08      0.00      0.00      0.00      0.00      0.00
    5    3      25.28      0.00      0.00      0.00      0.00      0.00
    7    3       9.28      0.00      0.00      0.00      0.00      0.00
    9    3       8.23      0.00      0.00      0.00      0.00      0.00
   11    3      10.91      0.00      0.00      0.00      0.00      0.00
   35    3     -11.09      0.00      0.00      0.00      0.00      0.00
   37    3      -8.12      0.00      0.00      0.00      0.00      0.00
   39    3      -9.17      0.00      0.00      0.00      0.00      0.00
   41    3     -25.55      0.00      0.00      0.00      0.00      0.00
   43    3       5.24      0.00      0.00      0.00      0.00      0.00
   20    3       0.00      0.17      0.00      0.00      0.00      0.00
   21    3       0.00      0.09      0.00      0.00      0.00      0.00
   22    3       0.00      0.10      0.00      0.00      0.00      0.00
   23    3       0.00      0.10      0.00      0.00      0.00      0.00
   24    3       0.00      0.10      0.00      0.00      0.00      0.00
   25    3       0.00      0.09      0.00      0.00      0.00      0.00
   26    3       0.00      0.17      0.00      0.00      0.00      0.00
   14    3     -13.16    -35.48      0.00      0.00      0.00      0.00
   16    3      -1.44      0.51      0.00      0.00      0.00      0.00
   18    3       0.10      0.15      0.00      0.00      0.00      0.00
   28    3      -0.10      0.15      0.00      0.00      0.00      0.00
   30    3       1.46      0.52      0.00      0.00      0.00      0.00
   32    3      13.22    -35.49      0.00      0.00      0.00      0.00
```

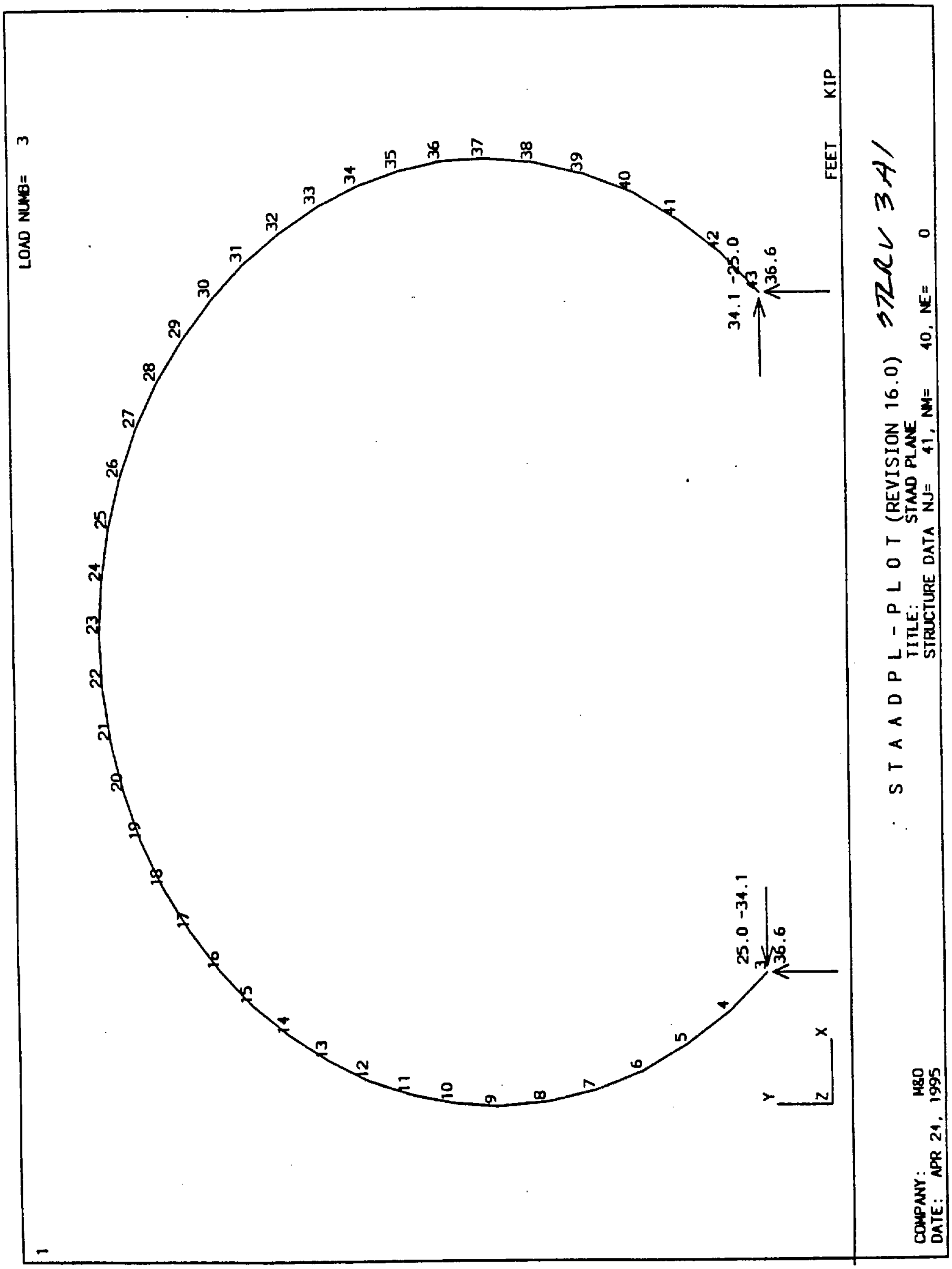
```
 MEMBER END FORCES     STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL    SHEAR-Y   SHEAR-Z   TORSION     MOM-Y      MOM-Z


   3     3   3     53.20     -6.48      0.00      0.00      0.00     -25.00
             4    -53.13      6.55      0.00      0.00      0.00      16.49

   4     3   4     51.92    -13.02      0.00      0.00      0.00     -16.49
             5    -51.82     13.08      0.00      0.00      0.00      -3.89

   5     3   5     38.78      3.26      0.00      0.00      0.00       3.89
             6    -38.67     -3.21      0.00      0.00      0.00       1.18

   6     3   6     38.78     -1.58      0.00      0.00      0.00      -1.18
             7    -38.66      1.62      0.00      0.00      0.00      -1.31

   7     3   7     36.33      2.37      0.00      0.00      0.00       1.31
             8    -36.21     -2.34      0.00      0.00      0.00       2.38

   8     3   8     36.21     -2.31      0.00      0.00      0.00      -2.38
             9    -36.09      2.32      0.00      0.00      0.00      -1.24

   9     3   9     36.02     -1.49      0.00      0.00      0.00      -1.24
            10    -35.92      1.50      0.00      0.00      0.00      -0.79

  10     3  10     35.86      2.45      0.00      0.00      0.00       0.79
            11    -35.76     -2.44      0.00      0.00      0.00       2.56

  11     3  11     38.26     -4.27      0.00      0.00      0.00      -2.56
            12    -38.16      4.30      0.00      0.00      0.00      -3.28

  12     3  12     38.40      0.41      0.00      0.00      0.00       3.28
            13    -38.30     -0.37      0.00      0.00      0.00      -2.75

  13     3  13     38.07      4.26      0.00      0.00      0.00       2.75
            14    -37.98     -4.21      0.00      0.00      0.00       2.99

  14     3  14      0.66     -1.18      0.00      0.00      0.00      -2.99
            15     -0.58      1.24      0.00      0.00      0.00       1.33

  15     3  15      0.72     -1.16      0.00      0.00      0.00      -1.33
            16     -0.64      1.23      0.00      0.00      0.00      -0.29

  16     3  16      0.04      0.18      0.00      0.00      0.00       0.29
            17      0.03     -0.10      0.00      0.00      0.00      -0.10

  17     3  17     -0.04      0.10      0.00      0.00      0.00       0.10
            18      0.10     -0.02      0.00      0.00      0.00      -0.02

  18     3  18      0.06      0.09      0.00      0.00      0.00       0.02
            19     -0.01      0.00      0.00      0.00      0.00       0.04
```

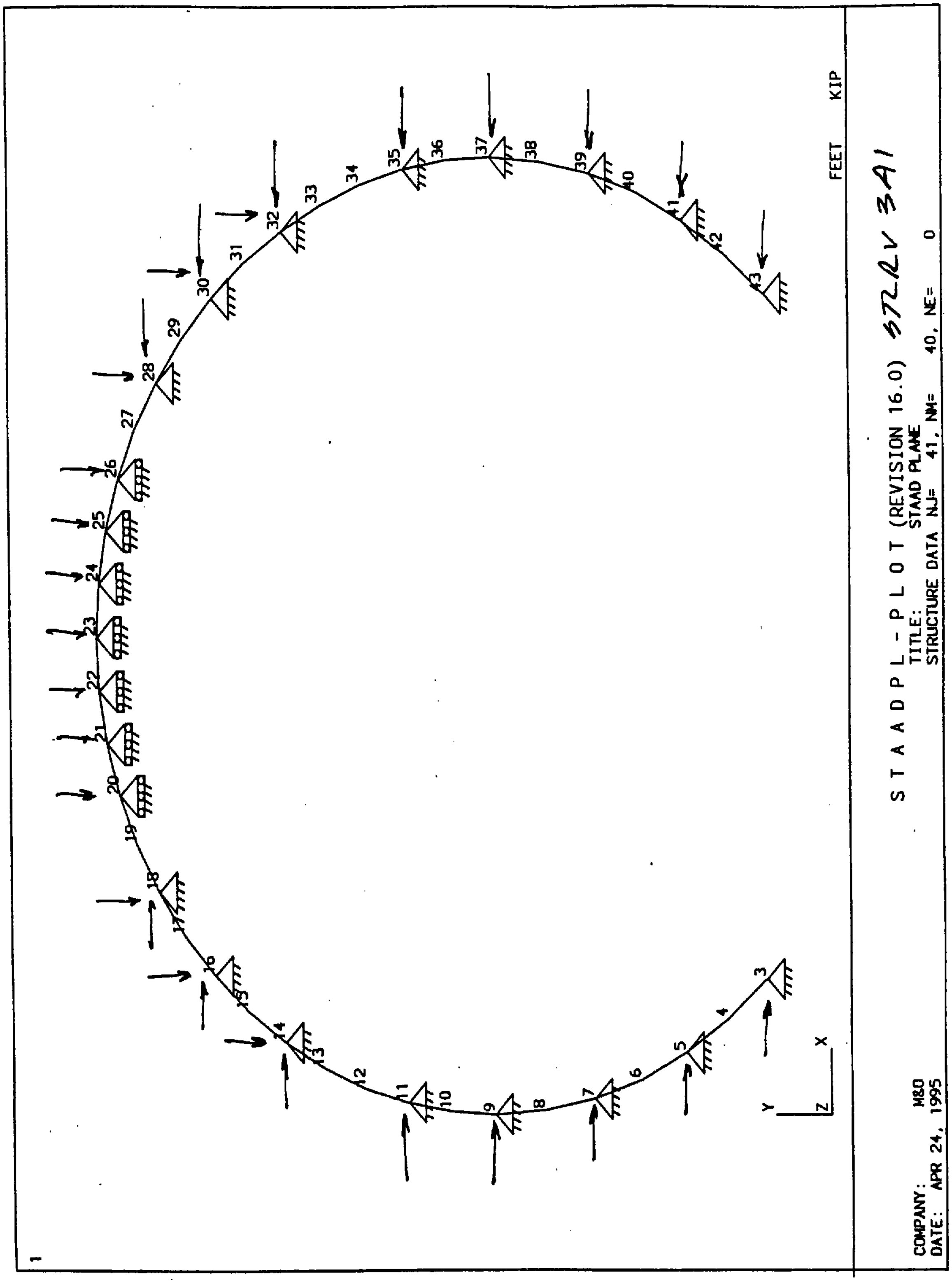
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL    SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19      0.01      0.00     0.00      0.00      0.00      -0.04
            20      0.03      0.10     0.00      0.00      0.00      -0.03

  20    3   20      0.03      0.06     0.00      0.00      0.00       0.03
            21      0.00      0.04     0.00      0.00      0.00      -0.01

  21    3   21      0.02      0.05     0.00      0.00      0.00       0.01
            22      0.00      0.05     0.00      0.00      0.00      -0.01

  22    3   22      0.02      0.05     0.00      0.00      0.00       0.01
            23     -0.01      0.05     0.00      0.00      0.00      -0.01

  23    3   23      0.01      0.05     0.00      0.00      0.00       0.01
            24     -0.02      0.05     0.00      0.00      0.00      -0.01

  24    3   24      0.00      0.05     0.00      0.00      0.00       0.01
            25     -0.02      0.05     0.00      0.00      0.00      -0.01

  25    3   25      0.00      0.04     0.00      0.00      0.00       0.01
            26     -0.03      0.06     0.00      0.00      0.00      -0.03

  26    3   26     -0.03      0.10     0.00      0.00      0.00       0.03
            27     -0.01      0.00     0.00      0.00      0.00       0.04

  27    3   27      0.01      0.00     0.00      0.00      0.00      -0.04
            28     -0.06      0.09     0.00      0.00      0.00      -0.02

  28    3   28     -0.10     -0.02     0.00      0.00      0.00       0.02
            29      0.04      0.10     0.00      0.00      0.00      -0.10

  29    3   29     -0.03     -0.11     0.00      0.00      0.00       0.10
            30     -0.04      0.18     0.00      0.00      0.00      -0.30

  30    3   30      0.66      1.25     0.00      0.00      0.00       0.30
            31     -0.73     -1.18     0.00      0.00      0.00       1.35

  31    3   31      0.59      1.26     0.00      0.00      0.00      -1.35
            32     -0.67     -1.20     0.00      0.00      0.00       3.04

  32    3   32     37.99     -4.39     0.00      0.00      0.00      -3.04
            33    -38.08      4.44     0.00      0.00      0.00      -2.96

  33    3   33     38.34     -0.04     0.00      0.00      0.00       2.96
            34    -38.43      0.08     0.00      0.00      0.00      -3.04

  34    3   34     38.21      4.11     0.00      0.00      0.00       3.04
            35    -38.31     -4.08     0.00      0.00      0.00       2.54

  35    3   35     35.74     -2.54     0.00      0.00      0.00      -2.54
            36    -35.84      2.56     0.00      0.00      0.00      -0.95
```

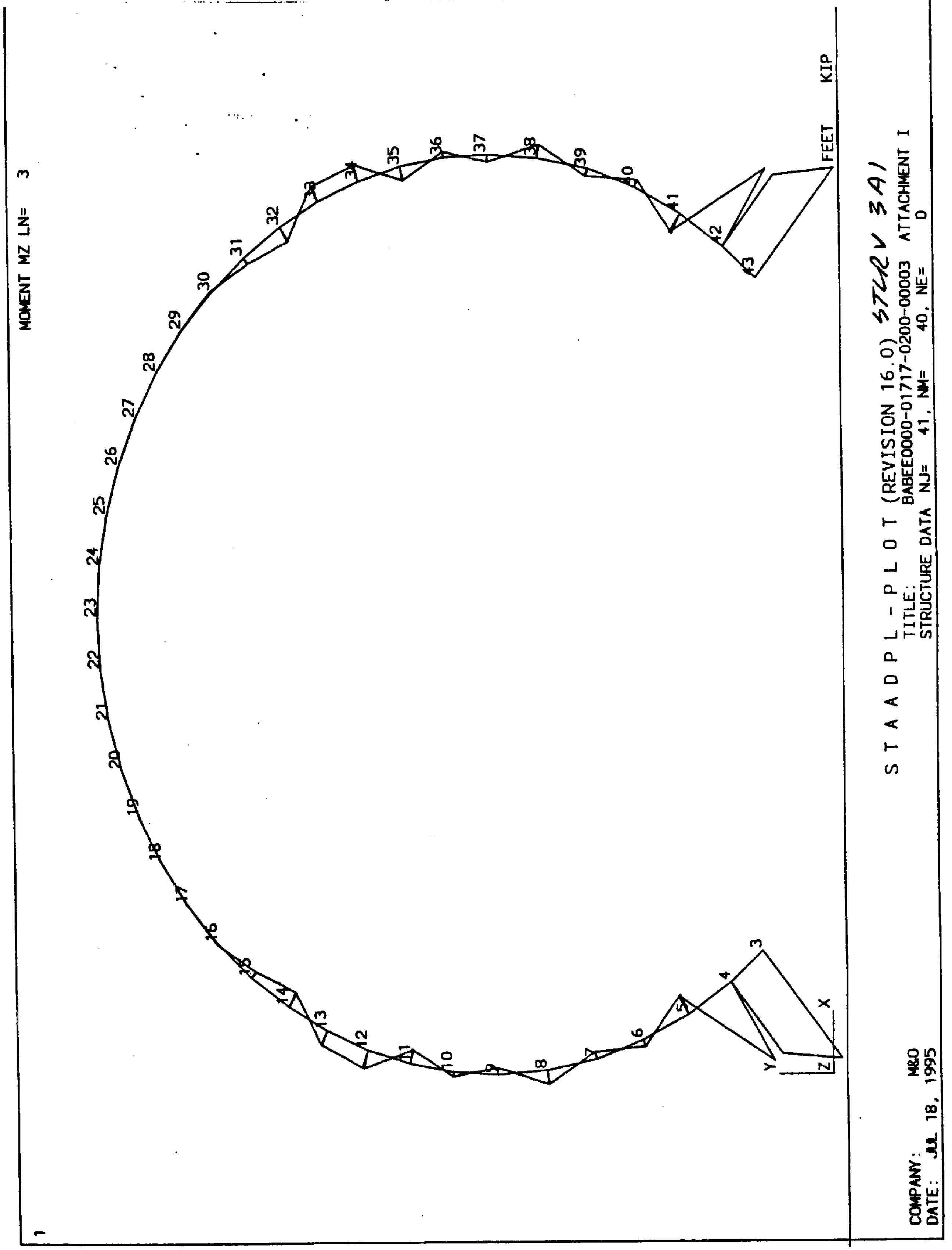
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT      AXIAL    SHEAR-Y   SHEAR-Z    TORSION      MOM-Y       MOM-Z


  36     3  36      35.90       1.65      0.00       0.00       0.00        0.95
            37     -36.00      -1.65      0.00       0.00       0.00        1.29

  37     3  37      36.09       2.32      0.00       0.00       0.00        1.29
            38     -36.21      -2.31      0.00       0.00       0.00        2.33

  38     3  38      36.21      -2.34      0.00       0.00       0.00       -2.33
            39     -36.33       2.37      0.00       0.00       0.00       -1.37

  39     3  39      38.62       1.75      0.00       0.00       0.00        1.37
            40     -38.73      -1.71      0.00       0.00       0.00        1.33

  40     3  40      38.63      -3.31      0.00       0.00       0.00       -1.33
            41     -38.73       3.36      0.00       0.00       0.00       -3.90

  41     3  41      51.98      12.94      0.00       0.00       0.00        3.90
            42     -52.08     -12.88      0.00       0.00       0.00       16.33

  42     3  42      53.23       6.67      0.00       0.00       0.00      -16.33
            43     -53.31      -6.60      0.00       0.00       0.00       25.00


 ************** END OF LATEST ANALYSIS RESULT **************

  50. CHECK CODE ALL
```

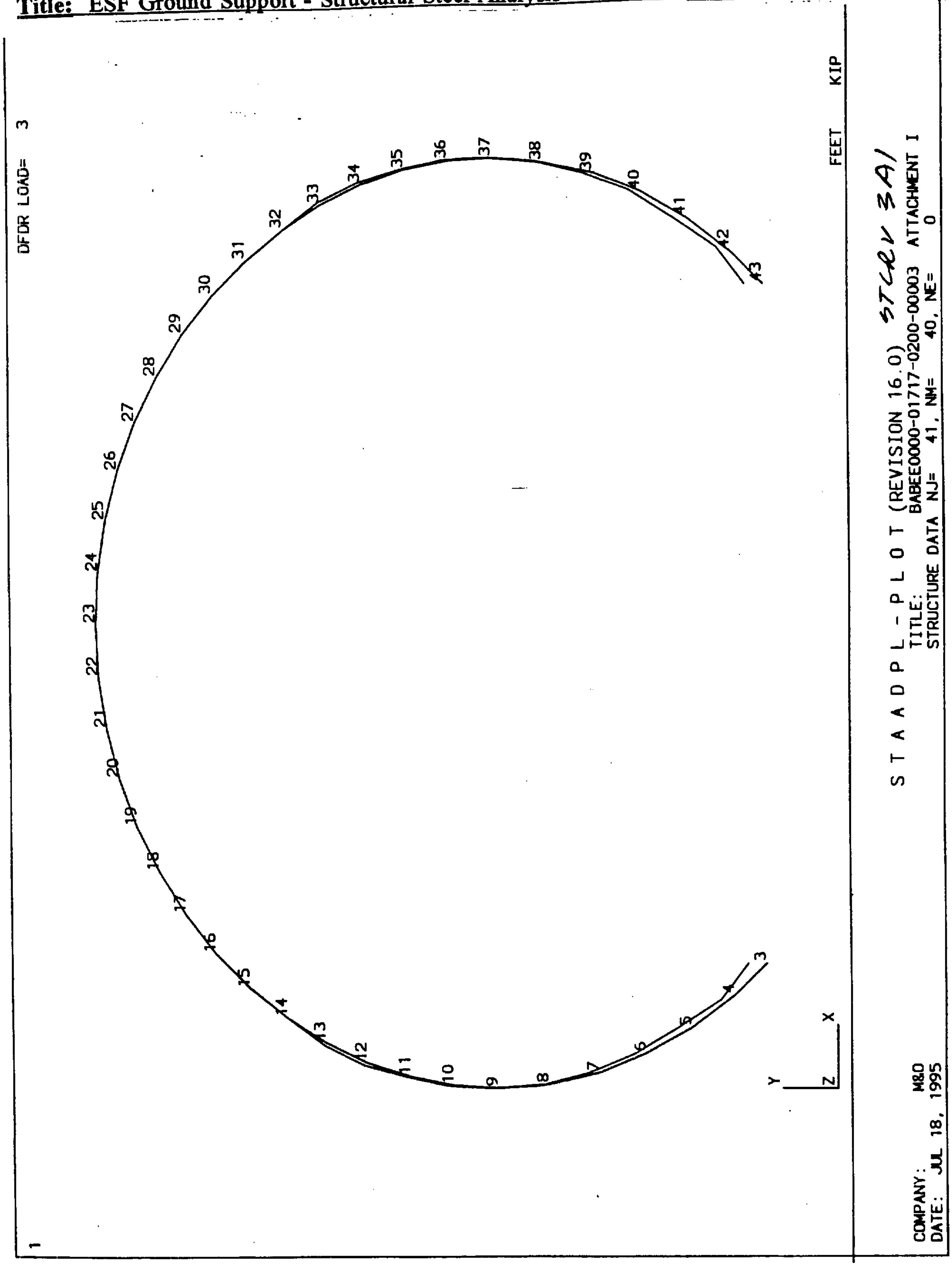
```
                         STAAD-III CODE CHECKING - (AISC)
                         ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                            FX            MY             MZ       LOCATION
=======================================================================

     3  ST   W8X 31          PASS    AISC- H1-2        0.729         3
                          53.20 C         0.00        -25.00        0.00
     4  ST   W8X 31          PASS    AISC- H1-2        0.566         3
                          51.92 C         0.00        -16.49        0.00
     5  ST   W8X 31          PASS    AISC- H1-2        0.268         3
                          38.78 C         0.00          3.89        0.00
     6  ST   W8X 31          PASS    AISC- H1-1        0.220         3
                          38.66 C         0.00         -1.31        1.56
     7  ST   W8X 31          PASS    AISC- H1-2        0.227         3
                          36.21 C         0.00          2.38        1.57
     8  ST   W8X 31          PASS    AISC- H1-2        0.227         3
                          36.21 C         0.00         -2.38        0.00
     9  ST   W8X 31          PASS    AISC- H1-2        0.205         3
                          36.02 C         0.00         -1.24        0.00
    10  ST   W8X 31          PASS    AISC- H1-2        0.228         3
                          35.76 C         0.00          2.56        1.37
    11  ST   W8X 31          PASS    AISC- H1-2        0.254         3
                          38.16 C         0.00         -3.28        1.36
    12  ST   W8X 31          PASS    AISC- H1-2        0.255         3
                          38.40 C         0.00          3.28        0.00
    13  ST   W8X 31          PASS    AISC- H1-2        0.248         3
                          37.98 C         0.00          2.99        1.36
    14  ST   W8X 31          PASS    AISC- H1-3        0.058         3
                           0.66 C         0.00         -2.99        0.00
    15  ST   W8X 31          PASS    SHEAR    -Y       0.038         3
                           0.64 C         0.00         -0.29        1.36
    16  ST   W8X 31          PASS    AISC- H1-3        0.006         3
                           0.04 C         0.00          0.29        0.00
    17  ST   W8X 31          PASS    SHEAR    -Y       0.003         3
                           0.04 T         0.00          0.10        0.00
    18  ST   W8X 31          PASS    SHEAR    -Y       0.003         3
                           0.06 C         0.00          0.02        0.00
    19  ST   W8X 31          PASS    SHEAR    -Y       0.003         3
                           0.03 T         0.00         -0.03        1.36
    20  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.03 C         0.00          0.03        0.00
    21  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.02 C         0.00          0.01        0.00
    22  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.02 C         0.00          0.01        0.00
    23  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.01 C         0.00          0.01        0.00
    24  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.00 C         0.00          0.01        0.00
    25  ST   W8X 31          PASS    SHEAR    -Y       0.002         3
                           0.03 C         0.00         -0.03        1.36
    26  ST   W8X 31          PASS    SHEAR    -Y       0.003         3
                           0.03 T         0.00          0.03        0.00
```

```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)
MEMBER      TABLE         RESULT/   CRITICAL COND/     RATIO/     LOADING/
                              FX            MY           MZ       LOCATION
=======================================================================

  27   ST   W8X 31          PASS     SHEAR    -Y       0.003         3
                   0.06 C             0.00            -0.02         1.36
  28   ST   W8X 31          PASS     SHEAR    -Y       0.003         3
                   0.04 T             0.00            -0.10         1.36
  29   ST   W8X 31          PASS     AISC- H1-3        0.006         3
                   0.04 C             0.00            -0.30         1.37
  30   ST   W8X 31          PASS     SHEAR    -Y       0.038         3
                   0.66 C             0.00             0.30         0.00
  31   ST   W8X 31          PASS     AISC- H1-3        0.059         3
                   0.67 C             0.00             3.04         1.37
  32   ST   W8X 31          PASS     AISC- H1-2        0.248         3
                  37.99 C             0.00            -3.04         0.00
  33   ST   W8X 31          PASS     AISC- H1-2        0.251         3
                  38.43 C             0.00            -3.04         1.36
  34   ST   W8X 31          PASS     AISC- H1-2        0.250         3
                  38.21 C             0.00             3.04         0.00
  35   ST   W8X 31          PASS     AISC- H1-2        0.228         3
                  35.74 C             0.00            -2.54         0.00
  36   ST   W8X 31          PASS     AISC- H1-2        0.206         3
                  36.00 C             0.00             1.29         1.36
  37   ST   W8X 31          PASS     AISC- H1-2        0.226         3
                  36.21 C             0.00             2.33         1.56
  38   ST   W8X 31          PASS     AISC- H1-2        0.226         3
                  36.21 C             0.00            -2.33         0.00
  39   ST   W8X 31          PASS     AISC- H1-1        0.221         3
                  38.62 C             0.00             1.37         0.00
  40   ST   W8X 31          PASS     AISC- H1-2        0.268         3
                  38.73 C             0.00            -3.90         1.57
  41   ST   W8X 31          PASS     AISC- H1-2        0.564         3
                  52.08 C             0.00            16.33         1.57
  42   ST   W8X 31          PASS     AISC- H1-2        0.729         3
                  53.31 C             0.00            25.00         1.31

   ************** END OF TABULATED RESULT OF DESIGN **************


    51. PLOT DISPLACEMENT FILE
    52. PLOT BENDING FILE
    53. FINISH


     *************** END OF STAAD-III ***************

   DATE= JUL 18,1995   TIME= 10:36:45 ******

     ************************************************************
     *       For questions on STAAD-III/ISDS, contact:          *
     *       RESEARCH ENGINEERS, Inc at (714) 974-2500          *
```


LOAD NUMB= 3
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
25.0 -34.1
36.6
34.1 -25.0
36.6
X
Y
Z
FEET
KIP
1
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: APR 24, 1995
STRLV 3A1


3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
FEET KIP
S T A A D P L - P L O T (REVISION 16.0)
STRV 3A1
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: APR 24, 1995
X
Y
Z


MOMENT MZ LN= 3
KIP
FEET
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
X
Y
Z
STLRV 3A)
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995


DFDR LOAD= 3
FEET KIP
S T A A D P L - P L O T (REVISION 16.0) STCRV 3A1
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&D
DATE: JUL 18, 1995
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
X
Y
Z
1

```
     **************************************************
     *                                                *
     *            S T A A D - III                     *
     *            Revision 16.0b                      *
     *            Proprietary Program of              *
     *            RESEARCH ENGINEERS, Inc.            *
     *            Date=    JUL 18, 1995               *
     *            Time=    11: 2:59                   *
     *                                                *
     **************************************************

  1. STAAD PLANE  BABEE0000-01717-0200-00003  ATTACHMENT I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS  REV 00
  3. * FILE STLRV3A2
  4. * 25 TON JACKS APPLIED BOTH SIDES @ 47 DEGREES
  5. * WITH ROCK ENGAGEMENT AT ALL JOINTS
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 3.27 2.13 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.06 2.13
 19. MEMBER INCIDENCE
 20. 3 3 4 42
 21. UNIT KIP INCH
 22. MEMBER PROPERTIES
 23. 3 TO 42 TA STA W8X31
 24. CONSTANTS
 25. E 29000.0 ALL
 26. DENSITY 0.00028 ALL
 27. BETA 0 ALL
 28. UNIT FT
 29. SUPPORT
 30. 3 4 5 6 7 8 9 10 11 12 13 FIXED BUT FY MZ
 31. 33 34 35 36 37 38 39 40 41 42 43 FIXED BUT FY MZ
 32. 19 20 21 22 23 24 25 26 27 FIXED BUT FX MZ
 33. 14 15 16 17 18 28 29 30 31 32 PINNED
 34. UNIT KIP
 35. LOAD 1
 36. SELF WEIGHT Y -1.0
 37. LOADING 2
 38. * 25 TON JACKS & SIMULTANEOUS JACKING
 39. JOINT LOADING
 40. 3 FX -34.1
 41. 43 FX 34.1
 42. 3 FY 36.57              45. 3 MZ 25.00
 43. 43 FY 36.57             46. LOADING COMBINATION 3
 44. 43 MZ -25.00            47. 1 2.5 2 1.0
```

```
  48. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     41/    40/    41
   ORIGINAL/FINAL BAND-WIDTH =     1/     1
   TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =     72
   SIZE OF STIFFNESS MATRIX =      288 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                   11: 3: 1
++ PROCESSING GLOBAL STIFFNESS MATRIX.                    11: 3: 2
++ PROCESSING TRIANGULAR FACTORIZATION.                   11: 3: 2
++ CALCULATING JOINT DISPLACEMENTS.                       11: 3: 3
++ CALCULATING MEMBER  FORCES.                            11: 3: 3

  49. LOAD LIST 3
  50. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

   3     3    0.00000   0.03200   0.00000   0.00000   0.00000   0.00120
   4     3    0.00000   0.02731   0.00000   0.00000   0.00000   0.00031
   5     3    0.00000   0.02351   0.00000   0.00000   0.00000   0.00011
   6     3    0.00000   0.02032   0.00000   0.00000   0.00000   0.00006
   7     3    0.00000   0.01747   0.00000   0.00000   0.00000   0.00004
   8     3    0.00000   0.01481   0.00000   0.00000   0.00000   0.00002
   9     3    0.00000   0.01225   0.00000   0.00000   0.00000   0.00000
  10     3    0.00000   0.01003   0.00000   0.00000   0.00000  -0.00002
  11     3    0.00000   0.00775   0.00000   0.00000   0.00000  -0.00003
  12     3    0.00000   0.00538   0.00000   0.00000   0.00000  -0.00005
  13     3    0.00000   0.00279   0.00000   0.00000   0.00000  -0.00006
  14     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00004
  15     3    0.00000   0.00000   0.00000   0.00000   0.00000  -0.00001
  16     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  17     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  18     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  19     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  20     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  21     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  22     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  23     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  24     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  25     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  26     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  27     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  28     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  29     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  30     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
  31     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00001
  32     3    0.00000   0.00000   0.00000   0.00000   0.00000   0.00004
  33     3    0.00000   0.00282   0.00000   0.00000   0.00000   0.00006
  34     3    0.00000   0.00539   0.00000   0.00000   0.00000   0.00005
  35     3    0.00000   0.00777   0.00000   0.00000   0.00000   0.00003
  36     3    0.00000   0.01005   0.00000   0.00000   0.00000   0.00002
  37     3    0.00000   0.01227   0.00000   0.00000   0.00000   0.00000
  38     3    0.00000   0.01483   0.00000   0.00000   0.00000  -0.00002
  39     3    0.00000   0.01749   0.00000   0.00000   0.00000  -0.00004
  40     3    0.00000   0.02033   0.00000   0.00000   0.00000  -0.00006
  41     3    0.00000   0.02351   0.00000   0.00000   0.00000  -0.00011
  42     3    0.00000   0.02735   0.00000   0.00000   0.00000  -0.00032
  43     3    0.00000   0.03204   0.00000   0.00000   0.00000  -0.00120
```

```
SUPPORT REACTIONS -UNIT KIP  FEET     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

   3     3    -16.66      0.00      0.00      0.00      0.00      0.00
   4     3     24.06      0.00      0.00      0.00      0.00      0.00
   5     3      8.84      0.00      0.00      0.00      0.00      0.00
   6     3      5.58      0.00      0.00      0.00      0.00      0.00
   7     3      5.22      0.00      0.00      0.00      0.00      0.00
   8     3      4.74      0.00      0.00      0.00      0.00      0.00
   9     3      4.42      0.00      0.00      0.00      0.00      0.00
  10     3      3.99      0.00      0.00      0.00      0.00      0.00
  11     3      4.00      0.00      0.00      0.00      0.00      0.00
  12     3      4.72      0.00      0.00      0.00      0.00      0.00
  13     3      3.59      0.00      0.00      0.00      0.00      0.00
  33     3     -4.09      0.00      0.00      0.00      0.00      0.00
  34     3     -4.23      0.00      0.00      0.00      0.00      0.00
  35     3     -4.24      0.00      0.00      0.00      0.00      0.00
  36     3     -4.24      0.00      0.00      0.00      0.00      0.00
  37     3     -4.17      0.00      0.00      0.00      0.00      0.00
  38     3     -4.73      0.00      0.00      0.00      0.00      0.00
  39     3     -5.00      0.00      0.00      0.00      0.00      0.00
  40     3     -5.81      0.00      0.00      0.00      0.00      0.00
  41     3     -9.09      0.00      0.00      0.00      0.00      0.00
  42     3    -23.83      0.00      0.00      0.00      0.00      0.00
  43     3     16.68      0.00      0.00      0.00      0.00      0.00
  19     3      0.00      0.11      0.00      0.00      0.00      0.00
  20     3      0.00      0.10      0.00      0.00      0.00      0.00
  21     3      0.00      0.10      0.00      0.00      0.00      0.00
  22     3      0.00      0.10      0.00      0.00      0.00      0.00
  23     3      0.00      0.11      0.00      0.00      0.00      0.00
  24     3      0.00      0.10      0.00      0.00      0.00      0.00
  25     3      0.00      0.10      0.00      0.00      0.00      0.00
  26     3      0.00      0.11      0.00      0.00      0.00      0.00
  27     3      0.00      0.11      0.00      0.00      0.00      0.00
  14     3    -17.91    -35.64      0.00      0.00      0.00      0.00
  15     3     -0.43      0.39      0.00      0.00      0.00      0.00
  16     3     -0.06      0.15      0.00      0.00      0.00      0.00
  17     3     -0.01      0.11      0.00      0.00      0.00      0.00
  18     3      0.00      0.11      0.00      0.00      0.00      0.00
  28     3      0.00      0.11      0.00      0.00      0.00      0.00
  29     3      0.01      0.11      0.00      0.00      0.00      0.00
  30     3      0.06      0.15      0.00      0.00      0.00      0.00
  31     3      0.44      0.40      0.00      0.00      0.00      0.00
  32     3     18.16    -35.65      0.00      0.00      0.00      0.00
```

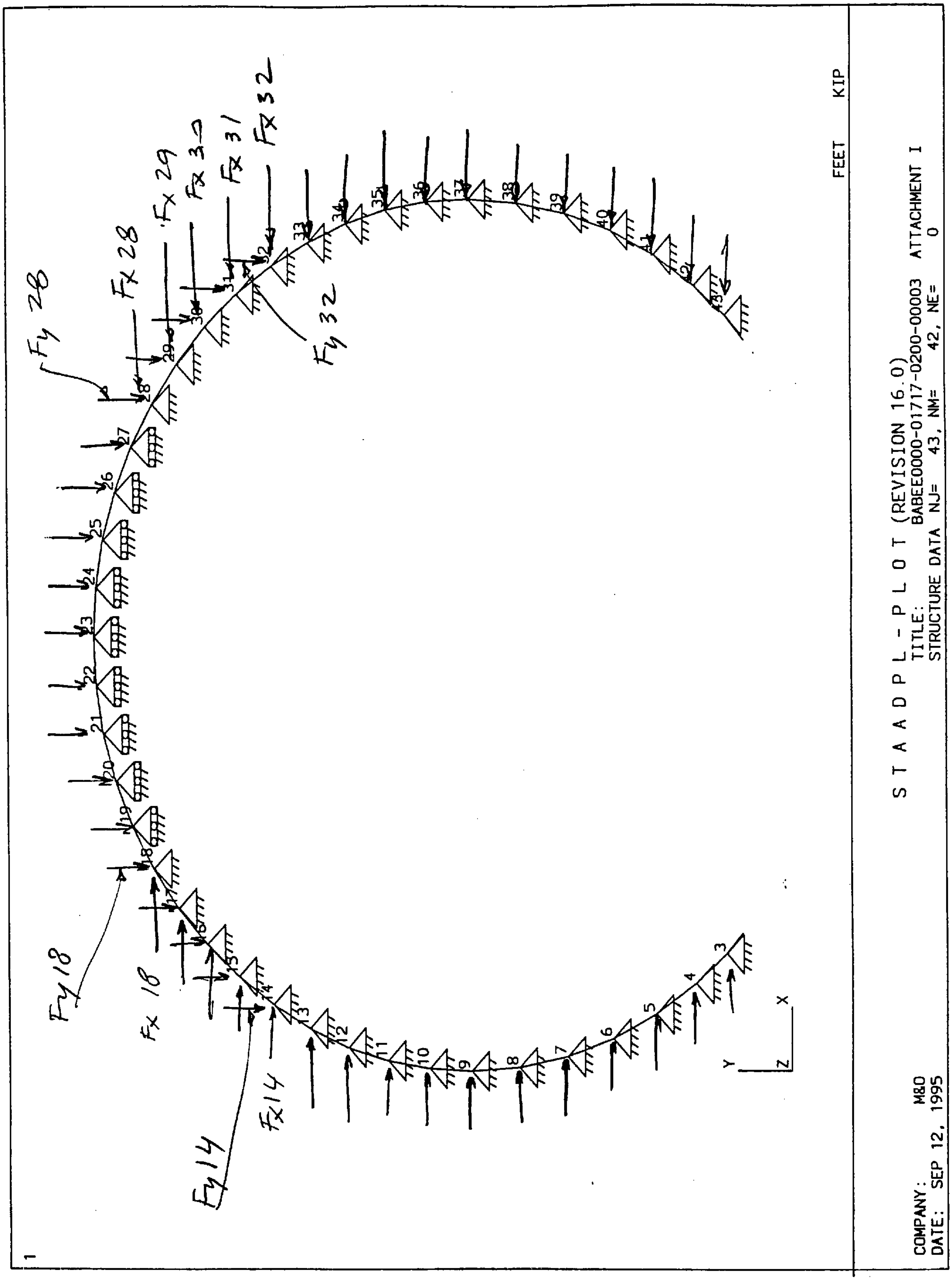
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

   3     3   3     60.65    -15.34     0.00      0.00      0.00     -25.00
             4    -60.57     15.41     0.00      0.00      0.00       4.92

   4     3   4     45.13     -2.55     0.00      0.00      0.00      -4.92
             5    -45.03      2.61     0.00      0.00      0.00       0.89

   5     3   5     40.50     -0.30     0.00      0.00      0.00      -0.89
             6    -40.39      0.35     0.00      0.00      0.00       0.39

   6     3   6     38.25     -0.03     0.00      0.00      0.00      -0.39
             7    -38.14      0.07     0.00      0.00      0.00       0.31

   7     3   7     36.79     -0.02     0.00      0.00      0.00      -0.31
             8    -36.67      0.04     0.00      0.00      0.00       0.26

   8     3   8     36.06      0.00     0.00      0.00      0.00      -0.26
             9    -35.94      0.01     0.00      0.00      0.00       0.25

   9     3   9     35.93      0.00     0.00      0.00      0.00       0.25
            10    -35.83      0.00     0.00      0.00      0.00      -0.25

  10     3  10     36.28      0.00     0.00      0.00      0.00       0.25
            11    -36.18      0.02     0.00      0.00      0.00      -0.27

  11     3  11     37.06     -0.02     0.00      0.00      0.00       0.27
            12    -36.96      0.05     0.00      0.00      0.00      -0.32

  12     3  12     38.52      0.13     0.00      0.00      0.00       0.32
            13    -38.42     -0.09     0.00      0.00      0.00      -0.16

  13     3  13     39.93      0.85     0.00      0.00      0.00       0.16
            14    -39.84     -0.80     0.00      0.00      0.00       0.95

  14     3  14      0.04     -0.57     0.00      0.00      0.00      -0.95
            15      0.04      0.63     0.00      0.00      0.00       0.13

  15     3  15      0.04     -0.05     0.00      0.00      0.00      -0.13
            16      0.04      0.12     0.00      0.00      0.00       0.01

  16     3  16      0.03      0.03     0.00      0.00      0.00      -0.01
            17      0.03      0.05     0.00      0.00      0.00      -0.01

  17     3  17      0.03      0.04     0.00      0.00      0.00       0.01
            18      0.03      0.04     0.00      0.00      0.00      -0.01

  18     3  18      0.03      0.05     0.00      0.00      0.00       0.01
            19      0.03      0.05     0.00      0.00      0.00      -0.01
```

```
MEMBER END FORCES     STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


 19     3   19      0.02      0.05     0.00      0.00      0.00       0.01
            20      0.02      0.05     0.00      0.00      0.00      -0.01

 20     3   20      0.01      0.05     0.00      0.00      0.00       0.01
            21      0.01      0.05     0.00      0.00      0.00      -0.01

 21     3   21      0.01      0.05     0.00      0.00      0.00       0.01
            22      0.01      0.05     0.00      0.00      0.00      -0.01

 22     3   22      0.00      0.05     0.00      0.00      0.00       0.01
            23      0.00      0.05     0.00      0.00      0.00      -0.01

 23     3   23      0.00      0.05     0.00      0.00      0.00       0.01
            24      0.00      0.05     0.00      0.00      0.00      -0.01

 24     3   24     -0.01      0.05     0.00      0.00      0.00       0.01
            25     -0.01      0.05     0.00      0.00      0.00      -0.01

 25     3   25     -0.01      0.05     0.00      0.00      0.00       0.01
            26     -0.01      0.05     0.00      0.00      0.00      -0.01

 26     3   26     -0.02      0.05     0.00      0.00      0.00       0.01
            27     -0.02      0.05     0.00      0.00      0.00      -0.01

 27     3   27     -0.03      0.05     0.00      0.00      0.00       0.01
            28     -0.03      0.04     0.00      0.00      0.00      -0.01

 28     3   28     -0.03      0.04     0.00      0.00      0.00       0.01
            29     -0.03      0.04     0.00      0.00      0.00      -0.01

 29     3   29     -0.03      0.05     0.00      0.00      0.00       0.01
            30     -0.03      0.03     0.00      0.00      0.00       0.01

 30     3   30     -0.04      0.12     0.00      0.00      0.00      -0.01
            31     -0.04     -0.05     0.00      0.00      0.00       0.13

 31     3   31     -0.04      0.64     0.00      0.00      0.00      -0.13
            32     -0.04     -0.58     0.00      0.00      0.00       0.97

 32     3   32     39.96     -0.83     0.00      0.00      0.00      -0.97
            33    -40.05      0.88     0.00      0.00      0.00      -0.19

 33     3   33     38.33     -0.06     0.00      0.00      0.00       0.19
            34    -38.43      0.10     0.00      0.00      0.00      -0.29

 34     3   34     37.03      0.02     0.00      0.00      0.00       0.29
            35    -37.13      0.01     0.00      0.00      0.00      -0.28

 35     3   35     36.18      0.02     0.00      0.00      0.00       0.28
            36    -36.28      0.00     0.00      0.00      0.00      -0.27
```

```
   MEMBER END FORCES    STRUCTURE TYPE = PLANE
   -----------------
   ALL UNITS ARE -- KIP  FEET

  MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y       MOM-Z


    36     3  36     35.81      0.02     0.00      0.00      0.00        0.27
              37    -35.92     -0.01     0.00      0.00      0.00       -0.24

    37     3  37     35.94      0.01     0.00      0.00      0.00       -0.24
              38    -36.06     -0.01     0.00      0.00      0.00        0.26

    38     3  38     36.67      0.04     0.00      0.00      0.00       -0.26
              39    -36.79     -0.01     0.00      0.00      0.00        0.30

    39     3  39     38.07      0.09     0.00      0.00      0.00       -0.30
              40    -38.18     -0.05     0.00      0.00      0.00        0.40

    40     3  40     40.39      0.35     0.00      0.00      0.00       -0.40
              41    -40.50     -0.29     0.00      0.00      0.00        0.91

    41     3  41     45.18      2.58     0.00      0.00      0.00       -0.91
              42    -45.28     -2.51     0.00      0.00      0.00        4.90

    42     3  42     60.58     15.42     0.00      0.00      0.00       -4.90
              43    -60.66    -15.36     0.00      0.00      0.00       25.00

   ************** END OF LATEST ANALYSIS RESULT **************

    51. CHECK CODE ALL
```

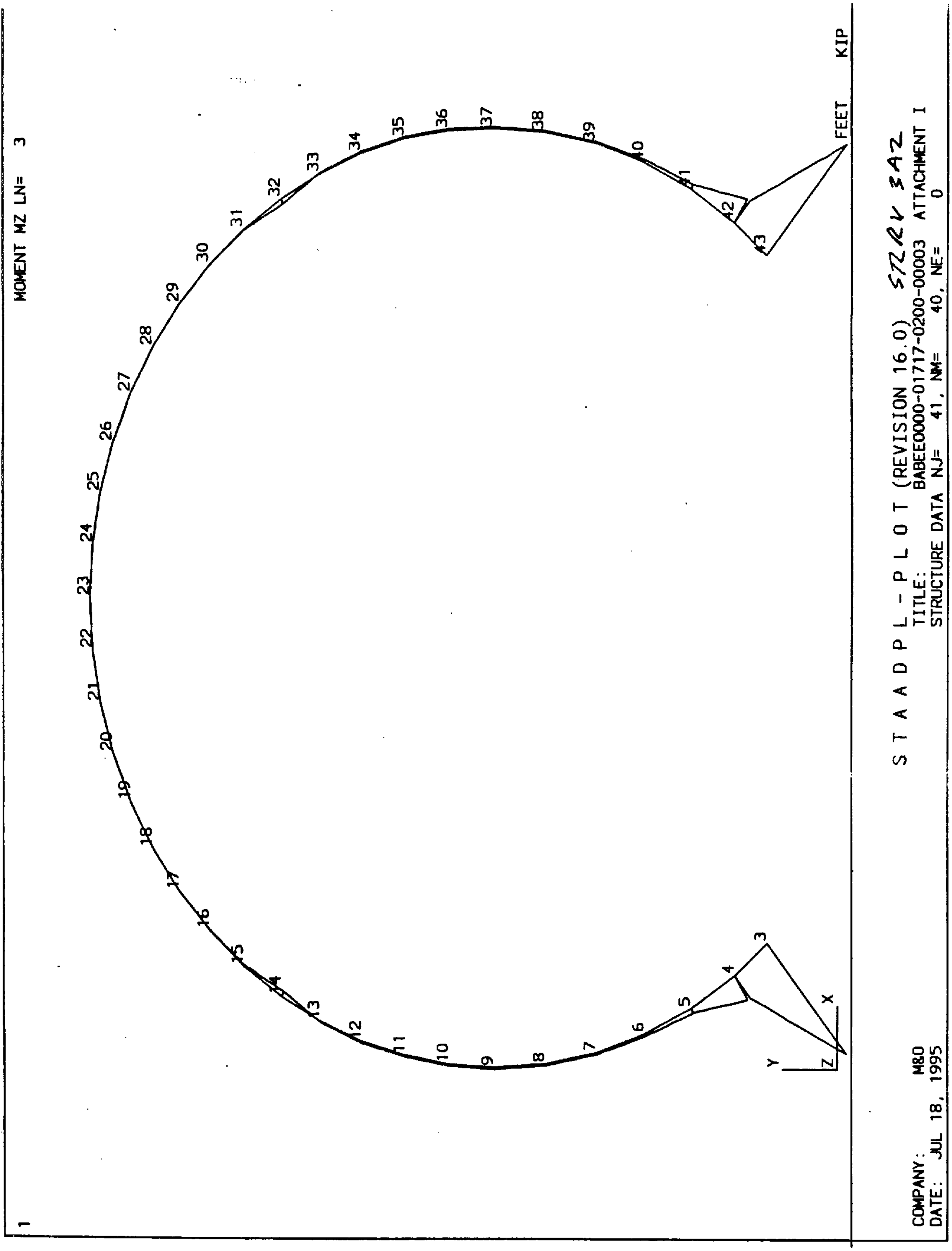
```
                    STAAD-III CODE CHECKING - (AISC)
                    ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX           MY              MZ       LOCATION
=======================================================================

     3  ST   W8X 31        PASS     AISC- H1-2        0.767         3
                        60.65 C        0.00         -25.00       0.00
     4  ST   W8X 31        PASS     AISC- H1-2        0.319         3
                        45.13 C        0.00          -4.92       0.00
     5  ST   W8X 31        PASS     AISC- H1-1        0.223         3
                        40.50 C        0.00          -0.89       0.00
     6  ST   W8X 31        PASS     AISC- H1-1        0.204         3
                        38.25 C        0.00          -0.39       0.00
     7  ST   W8X 31        PASS     AISC- H1-1        0.195         3
                        36.79 C        0.00          -0.31       0.00
     8  ST   W8X 31        PASS     AISC- H1-1        0.191         3
                        36.06 C        0.00          -0.26       0.00
     9  ST   W8X 31        PASS     AISC- H1-1        0.189         3
                        35.93 C        0.00           0.25       0.00
    10  ST   W8X 31        PASS     AISC- H1-1        0.191         3
                        36.28 C        0.00           0.25       0.00
    11  ST   W8X 31        PASS     AISC- H1-1        0.195         3
                        36.96 C        0.00          -0.32       1.36
    12  ST   W8X 31        PASS     AISC- H1-1        0.204         3
                        38.52 C        0.00           0.32       0.00
    13  ST   W8X 31        PASS     AISC- H1-1        0.220         3
                        39.84 C        0.00           0.95       1.36
    14  ST   W8X 31        PASS     SHEAR    -Y       0.019         3
                         0.04 T        0.00           0.13       1.37
    15  ST   W8X 31        PASS     SHEAR    -Y       0.004         3
                         0.04 T        0.00           0.01       1.36
    16  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.03 T        0.00          -0.01       1.37
    17  ST   W8X 31        PASS     SHEAR    -Y       0.001         3
                         0.03 T        0.00          -0.01       1.36
    18  ST   W8X 31        PASS     SHEAR    -Y       0.001         3
                         0.03 C        0.00           0.01       0.00
    19  ST   W8X 31        PASS     SHEAR    -Y       0.001         3
                         0.02 C        0.00           0.01       0.00
    20  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.01 C        0.00           0.01       0.00
    21  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.01 C        0.00           0.01       0.00
    22  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.00 C        0.00           0.01       0.00
    23  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.00 T        0.00           0.01       0.00
    24  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.01 T        0.00           0.01       0.00
    25  ST   W8X 31        PASS     SHEAR    -Y       0.002         3
                         0.01 T        0.00           0.01       0.00
    26  ST   W8X 31        PASS     SHEAR    -Y       0.001         3
                         0.02 T        0.00           0.01       0.00
```

```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/    RATIO/     LOADING/
                          FX            MY            MZ       LOCATION
=======================================================================

   27  ST  W8X 31         PASS     SHEAR     -Y      0.001         3
                      0.03 T          0.00           0.01        0.00
   28  ST  W8X 31         PASS     SHEAR     -Y      0.001         3
                      0.03 T          0.00           0.01        0.00
   29  ST  W8X 31         PASS     SHEAR     -Y      0.002         3
                      0.03          0.00           0.01        0.00
   30  ST  W8X 31         PASS     SHEAR     -Y      0.004         3
                      0.04 T          0.00          -0.01        0.00
   31  ST  W8X 31         PASS     SHEAR     -Y      0.020         3
                      0.04 T          0.00          -0.13        0.00
   32  ST  W8X 31         PASS     AISC- H1-1        0.221         3
                     39.96 C          0.00          -0.97        0.00
   33  ST  W8X 31         PASS     AISC- H1-1        0.203         3
                     38.43 C          0.00          -0.29        1.36
   34  ST  W8X 31         PASS     AISC- H1-1        0.196         3
                     37.13 C          0.00          -0.28        1.36
   35  ST  W8X 31         PASS     AISC- H1-1        0.191         3
                     36.28 C          0.00          -0.27        1.37
   36  ST  W8X 31         PASS     AISC- H1-1        0.189         3
                     35.92 C          0.00          -0.24        1.36
   37  ST  W8X 31         PASS     AISC- H1-1        0.190         3
                     36.06 C          0.00           0.26        1.56
   38  ST  W8X 31         PASS     AISC- H1-1        0.195         3
                     36.79 C          0.00           0.30        1.57
   39  ST  W8X 31         PASS     AISC- H1-1        0.204         3
                     38.18 C          0.00           0.40        1.56
   40  ST  W8X 31         PASS     AISC- H1-1        0.224         3
                     40.50 C          0.00           0.91        1.57
   41  ST  W8X 31         PASS     AISC- H1-2        0.320         3
                     45.28 C          0.00           4.90        1.57
   42  ST  W8X 31         PASS     AISC- H1-2        0.767         3
                     60.66 C          0.00          25.00        1.31

 ************** END OF TABULATED RESULT OF DESIGN **************


  52. PLOT DISPLACEMENT FILE
  53. PLOT BENDING FILE
  54. FINISH

    *************** END OF STAAD-III ***************

 DATE= JUL 18,1995   TIME= 11: 3: 7 ******

    ***********************************************************
    *      For questions on STAAD-III/ISDS, contact:          *
    *      RESEARCH ENGINEERS, Inc at (714) 974-2500          *
```



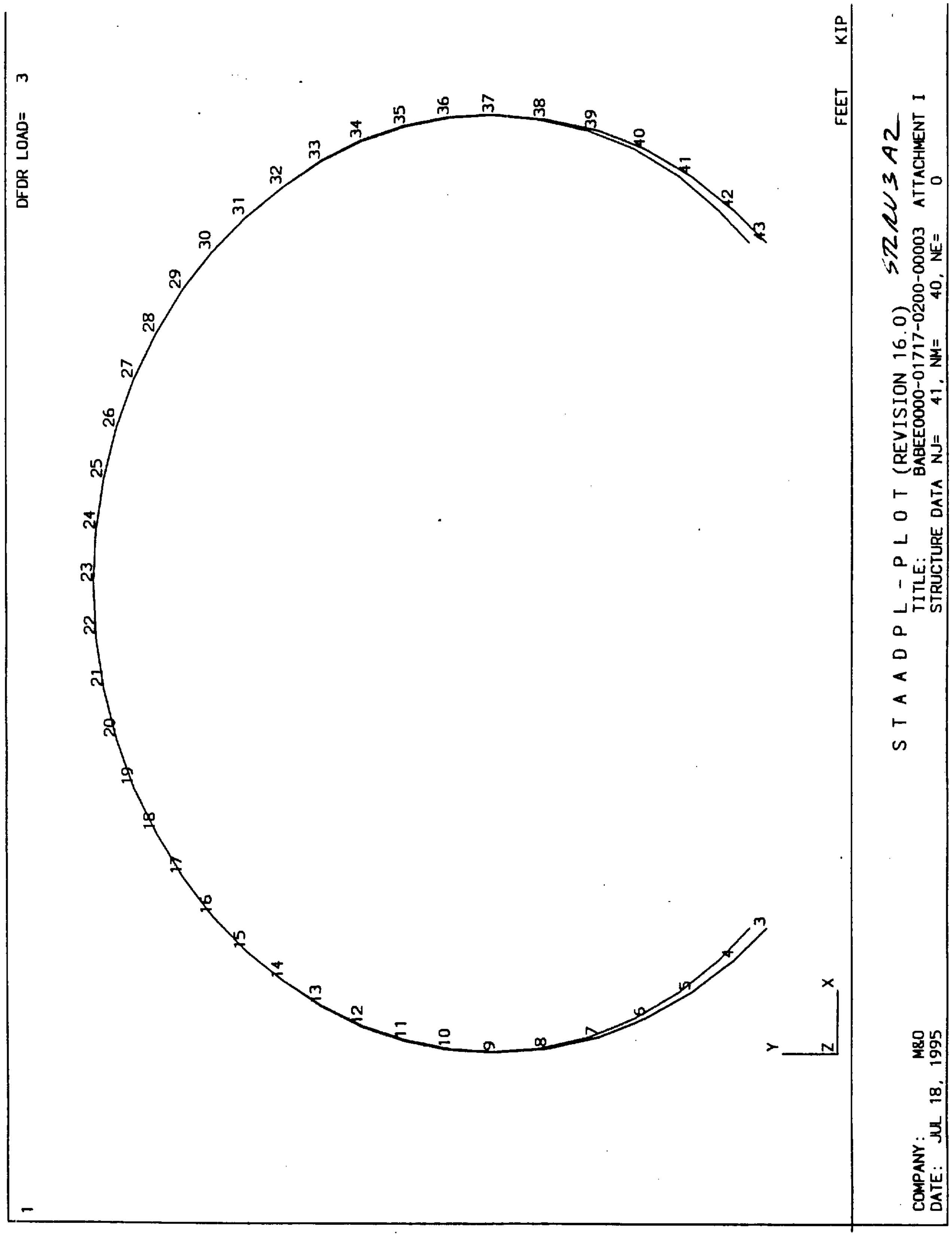
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 43, NM= 42, NE= 0

COMPANY: M&O
DATE: SEP 12, 1995



S T A A D P L - P L O T (REVISION 16.0) STRRV 3A2
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995



S T A A D P L - P L O T (REVISION 16.0) STRU3A2
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: JUL 18, 1995

```
     *                                                   *
     *            S T A A D - III                        *
     *            Revision 16.0b                         *
     *            Proprietary Program of                 *
     *            RESEARCH ENGINEERS, Inc.               *
     *            Date=    JUL 18, 1995                  *
     *            Time=     7:30: 6                      *
     *                                                   *
     *****************************************************


  1. STAAD PLANE BABEE0000-01717-0200-00003  ATTACHMENT I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. *
  4. * FILE STLRV4
  5. * 25 TON JACK APPLIED ONE SIDE @ 47 DEGREES
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 3.27 2.13 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 20.88 1.94 ; 44 19.72 0.89
 19. 45 18.43 0.00
 20. MEMBER INCIDENCE
 21. 3 3 4 44
 22. UNIT KIP INCH
 23. MEMBER PROPERTIES
 24. 3 TO 44 TA STA W8X31
 25. CONSTANTS
 26. E 29000.0 ALL
 27. DENSITY 0.00028 ALL
 28. BETA 0 ALL
 29. UNIT FT
 30. SUPPORT
 31. 3 7 11 35 39 43 FIXED BUT FY MZ
 32. 22 24 FIXED BUT FX MZ
 33. 16 30 45 PINNED
 34. UNIT KIP
 35. LOAD 1
 36. SELF WEIGHT Y -1.0
 37. LOADING 2
 38. * 25 TON JACK & ONE SIDED JACKING
 39. JOINT LOADING
 40. 3 FX -34.1
 41. 3 FY 36.57
 42. 3 MZ 25.00
 43. LOADING COMBINATION 3
 44. 1 2.5 2 1.0
 45. PERFORM ANALYSIS
```

```
        P R O B L E M   S T A T I S T I C S
        -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    43/   42/   11
   ORIGINAL/FINAL BAND-WIDTH =    1/    1
   TOTAL PRIMARY LOAD CASES  =    2, TOTAL DEGREES OF FREEDOM =    115
   SIZE OF STIFFNESS MATRIX =    690 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =    0.08 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                    7:30: 9
++ PROCESSING GLOBAL STIFFNESS MATRIX.                     7:30:10
++ PROCESSING TRIANGULAR FACTORIZATION.                    7:30:10
++ CALCULATING JOINT DISPLACEMENTS.                        7:30:10
++ CALCULATING MEMBER  FORCES.                             7:30:11

  46. LOAD LIST 3
  47. PRINT ANALYSIS RESULTS
```

```
 JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
 ------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

    3    3    0.00000    0.06495    0.00000    0.00000    0.00000    0.00341
    4    3   -0.03076    0.03557    0.00000    0.00000    0.00000    0.00185
    5    3   -0.04196    0.02445    0.00000    0.00000    0.00000    0.00008
    6    3   -0.02664    0.02831    0.00000    0.00000    0.00000   -0.00099
    7    3    0.00000    0.03408    0.00000    0.00000    0.00000   -0.00073
    8    3    0.00247    0.03201    0.00000    0.00000    0.00000   -0.00006
    9    3    0.00080    0.02935    0.00000    0.00000    0.00000    0.00004
   10    3    0.00077    0.02714    0.00000    0.00000    0.00000    0.00007
   11    3    0.00000    0.02505    0.00000    0.00000    0.00000    0.00040
   12    3   -0.01365    0.02637    0.00000    0.00000    0.00000    0.00057
   13    3   -0.02259    0.02741    0.00000    0.00000    0.00000    0.00016
   14    3   -0.02196    0.02423    0.00000    0.00000    0.00000   -0.00044
   15    3   -0.01240    0.01443    0.00000    0.00000    0.00000   -0.00088
   16    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00077
   17    3    0.00533   -0.00621    0.00000    0.00000    0.00000   -0.00035
   18    3    0.00669   -0.00840    0.00000    0.00000    0.00000   -0.00007
   19    3    0.00608   -0.00763    0.00000    0.00000    0.00000    0.00010
   20    3    0.00487   -0.00514    0.00000    0.00000    0.00000    0.00016
   21    3    0.00384   -0.00221    0.00000    0.00000    0.00000    0.00015
   22    3    0.00328    0.00000    0.00000    0.00000    0.00000    0.00008
   23    3    0.00307    0.00026    0.00000    0.00000    0.00000    0.00002
   24    3    0.00288    0.00000    0.00000    0.00000    0.00000    0.00003
   25    3    0.00289    0.00123    0.00000    0.00000    0.00000    0.00006
   26    3    0.00302    0.00239    0.00000    0.00000    0.00000    0.00004
   27    3    0.00300    0.00288    0.00000    0.00000    0.00000   -0.00001
   28    3    0.00253    0.00246    0.00000    0.00000    0.00000   -0.00006
   29    3    0.00147    0.00133    0.00000    0.00000    0.00000   -0.00010
   30    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00009
   31    3   -0.00093   -0.00089    0.00000    0.00000    0.00000   -0.00006
   32    3   -0.00136   -0.00125    0.00000    0.00000    0.00000   -0.00001
   33    3   -0.00124   -0.00122    0.00000    0.00000    0.00000    0.00002
   34    3   -0.00068   -0.00102    0.00000    0.00000    0.00000    0.00003
   35    3    0.00000   -0.00084    0.00000    0.00000    0.00000    0.00003
   36    3    0.00023   -0.00081    0.00000    0.00000    0.00000    0.00001
   37    3    0.00023   -0.00081    0.00000    0.00000    0.00000    0.00000
   38    3    0.00010   -0.00079    0.00000    0.00000    0.00000    0.00000
   39    3    0.00000   -0.00075    0.00000    0.00000    0.00000    0.00000
   40    3    0.00027   -0.00081    0.00000    0.00000    0.00000    0.00001
   41    3    0.00041   -0.00083    0.00000    0.00000    0.00000    0.00000
   42    3    0.00027   -0.00068    0.00000    0.00000    0.00000   -0.00001
   43    3    0.00000   -0.00038    0.00000    0.00000    0.00000   -0.00001
   44    3    0.00006   -0.00029    0.00000    0.00000    0.00000   -0.00001
   45    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00001
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X    FORCE-Y    FORCE-Z      MOM-X      MOM-Y      MOM Z

   3     3      6.29       0.00       0.00       0.00       0.00       0.00
   7     3     28.29       0.00       0.00       0.00       0.00       0.00
  11     3     19.23       0.00       0.00       0.00       0.00       0.00
  35     3      0.48       0.00       0.00       0.00       0.00       0.00
  39     3     -0.41       0.00       0.00       0.00       0.00       0.00
  43     3     -0.93       0.00       0.00       0.00       0.00       0.00
  22     3      0.00       1.24       0.00       0.00       0.00       0.00
  24     3      0.00      -2.05       0.00       0.00       0.00       0.00
  16     3    -16.75     -34.69       0.00       0.00       0.00       0.00
  30     3     -3.37       2.49       0.00       0.00       0.00       0.00
  45     3      1.26       1.03       0.00       0.00       0.00       0.00
```

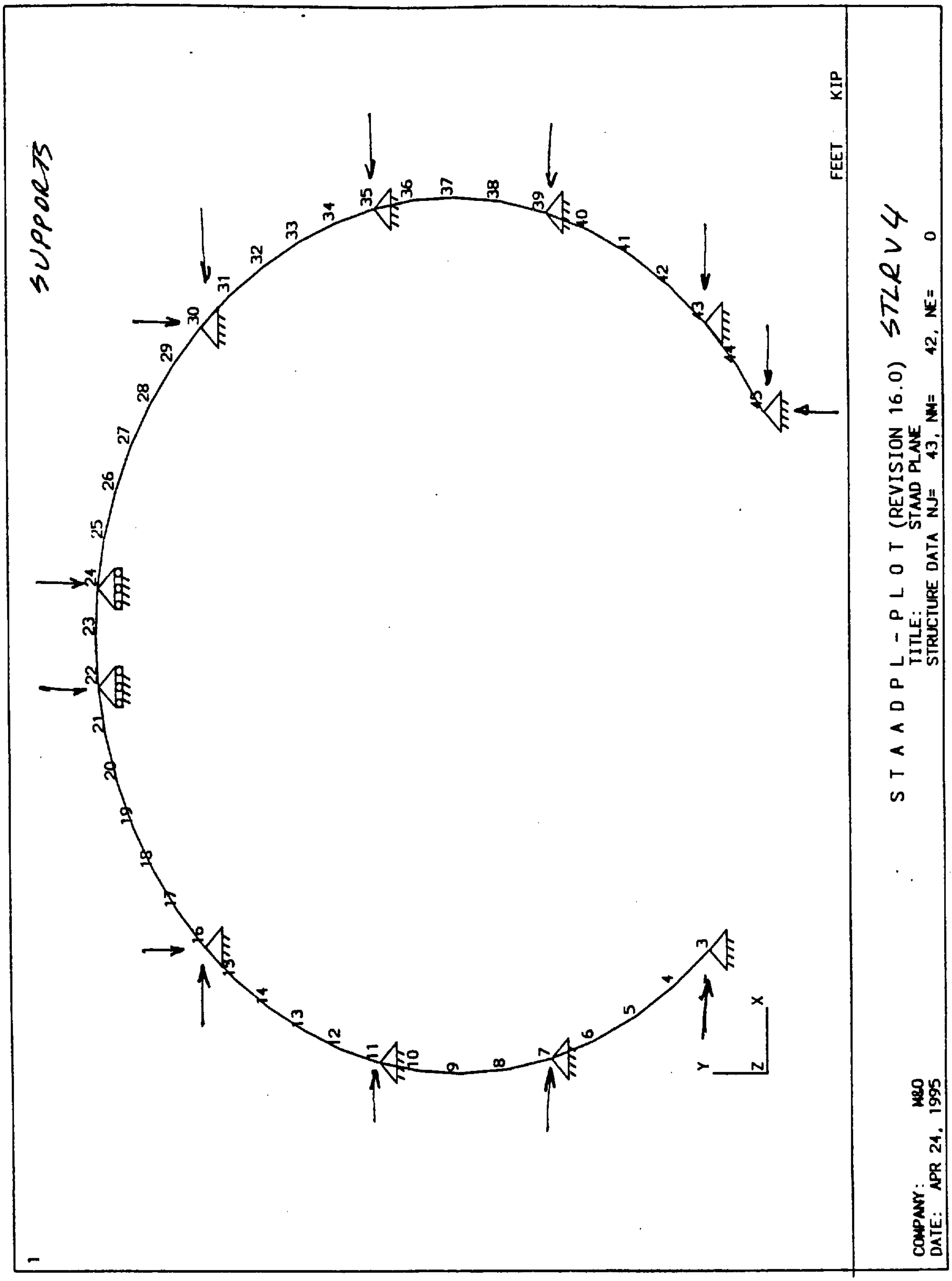
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

   3     3   3     45.89      2.23     0.00      0.00      0.00     -25.00
             4    -45.81     -2.16     0.00      0.00      0.00      27.87

   4     3   4     45.73     -3.48     0.00      0.00      0.00     -27.87
             5    -45.63      3.54     0.00      0.00      0.00      22.39

   5     3   5     44.82     -9.26     0.00      0.00      0.00     -22.39
             6    -44.71      9.31     0.00      0.00      0.00       7.85

   6     3   6     43.22    -14.75     0.00      0.00      0.00      -7.85
             7    -43.11     14.79     0.00      0.00      0.00     -15.22

   7     3   7     35.35      7.38     0.00      0.00      0.00      15.22
             8    -35.23     -7.35     0.00      0.00      0.00      -3.66

   8     3   8     35.89      2.78     0.00      0.00      0.00       3.66
             9    -35.77     -2.78     0.00      0.00      0.00       0.68

   9     3   9     35.84      1.63     0.00      0.00      0.00       0.68
            10    -35.73     -1.62     0.00      0.00      0.00       1.53

  10     3  10     35.34      5.53     0.00      0.00      0.00      -1.53
            11    -35.23     -5.51     0.00      0.00      0.00       9.09

  11     3  11     39.68     -9.28     0.00      0.00      0.00      -9.09
            12    -39.58      9.31     0.00      0.00      0.00      -3.56

  12     3  12     40.42     -4.39     0.00      0.00      0.00       3.56
            13    -40.32      4.43     0.00      0.00      0.00      -9.59

  13     3  13     40.56     -0.31     0.00      0.00      0.00       9.59
            14    -40.47      0.36     0.00      0.00      0.00     -10.04

  14     3  14     40.25      4.26     0.00      0.00      0.00      10.04
            15    -40.16     -4.20     0.00      0.00      0.00      -4.24

  15     3  15     39.38      8.94     0.00      0.00      0.00       4.24
            16    -39.30     -8.87     0.00      0.00      0.00       7.88

  16     3  16      2.51     -1.64     0.00      0.00      0.00      -7.88
            17     -2.44      1.72     0.00      0.00      0.00       5.58

  17     3  17      2.62     -1.44     0.00      0.00      0.00      -5.58
            18     -2.56      1.53     0.00      0.00      0.00       3.56

  18     3  18      2.72     -1.22     0.00      0.00      0.00      -3.56
            19     -2.67      1.31     0.00      0.00      0.00       1.82
```

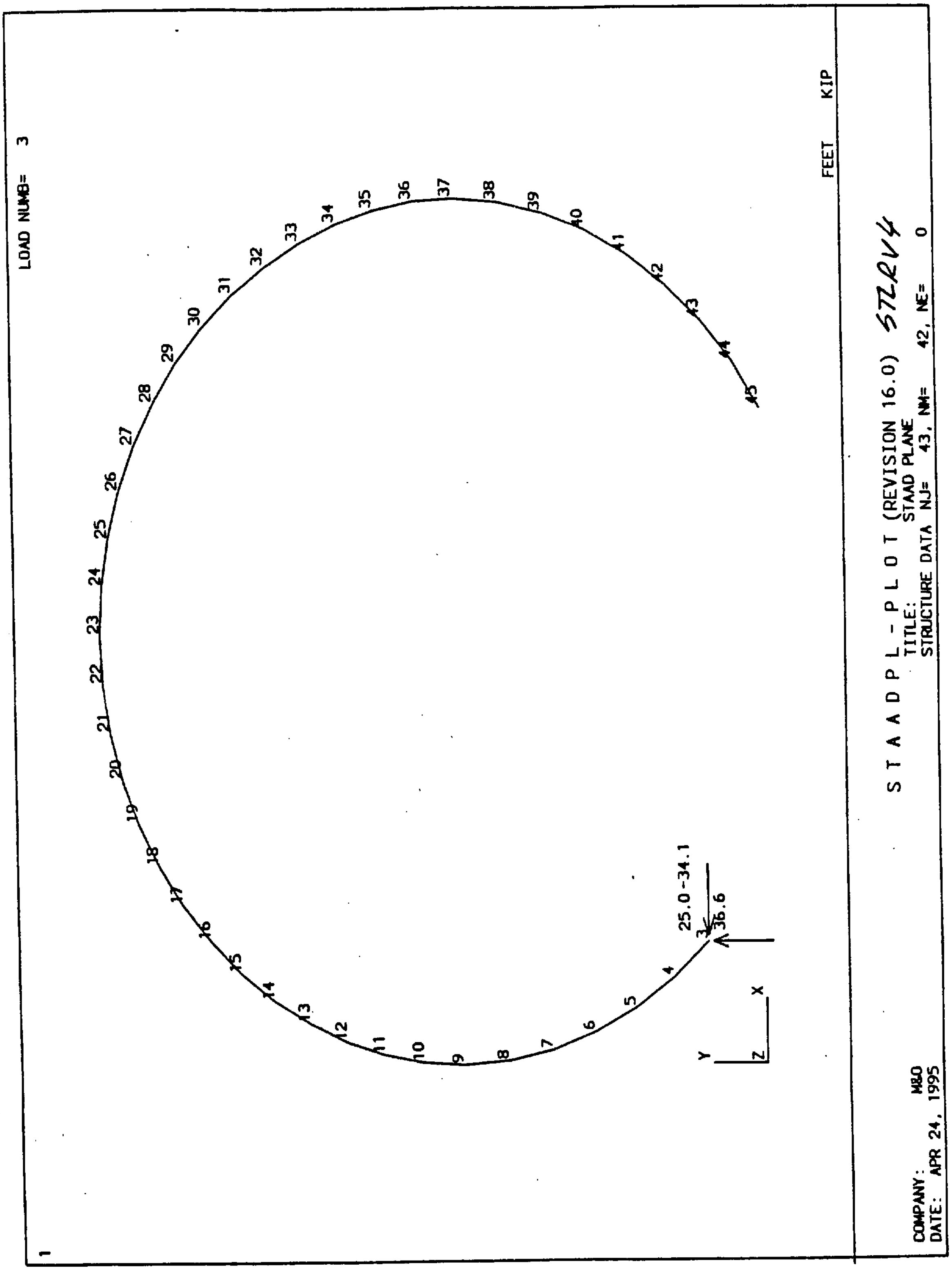
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT      AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19     3  19       2.80     -1.01     0.00      0.00      0.00      -1.82
            20      -2.76      1.10     0.00      0.00      0.00       0.38

  20     3  20       2.86     -0.80     0.00      0.00      0.00      -0.38
            21      -2.83      0.90     0.00      0.00      0.00      -0.77

  21     3  21       2.91     -0.58     0.00      0.00      0.00       0.77
            22      -2.90      0.68     0.00      0.00      0.00      -1.62

  22     3  22       3.03      0.89     0.00      0.00      0.00       1.62
            23      -3.02     -0.78     0.00      0.00      0.00      -0.48

  23     3  23       2.91      1.13     0.00      0.00      0.00       0.48
            24      -2.91     -1.02     0.00      0.00      0.00       0.99

  24     3  24       3.13     -0.68     0.00      0.00      0.00      -0.99
            25      -3.15      0.78     0.00      0.00      0.00       0.00

  25     3  25       3.21     -0.42     0.00      0.00      0.00       0.00
            26      -3.24      0.52     0.00      0.00      0.00      -0.65

  26     3  26       3.28     -0.18     0.00      0.00      0.00       0.65
            27      -3.32      0.27     0.00      0.00      0.00      -0.96

  27     3  27       3.33      0.12     0.00      0.00      0.00       0.96
            28      -3.38     -0.03     0.00      0.00      0.00      -0.86

  28     3  28       3.36      0.40     0.00      0.00      0.00       0.86
            29      -3.42     -0.32     0.00      0.00      0.00      -0.37

  29     3  29       3.36      0.69     0.00      0.00      0.00       0.37
            30      -3.43     -0.61     0.00      0.00      0.00       0.52

  30     3  30      -0.76      0.15     0.00      0.00      0.00      -0.52
            31       0.68     -0.08     0.00      0.00      0.00       0.68

  31     3  31      -0.69      0.00     0.00      0.00      0.00      -0.68
            32       0.60      0.06     0.00      0.00      0.00       0.64

  32     3  32      -0.59     -0.13     0.00      0.00      0.00      -0.64
            33       0.50      0.18     0.00      0.00      0.00       0.43

  33     3  33      -0.48     -0.23     0.00      0.00      0.00      -0.43
            34       0.38      0.27     0.00      0.00      0.00       0.09

  34     3  34      -0.35     -0.31     0.00      0.00      0.00      -0.09
            35       0.25      0.34     0.00      0.00      0.00      -0.36

  35     3  35      -0.13      0.11     0.00      0.00      0.00       0.36
            36       0.02     -0.09     0.00      0.00      0.00      -0.23
```

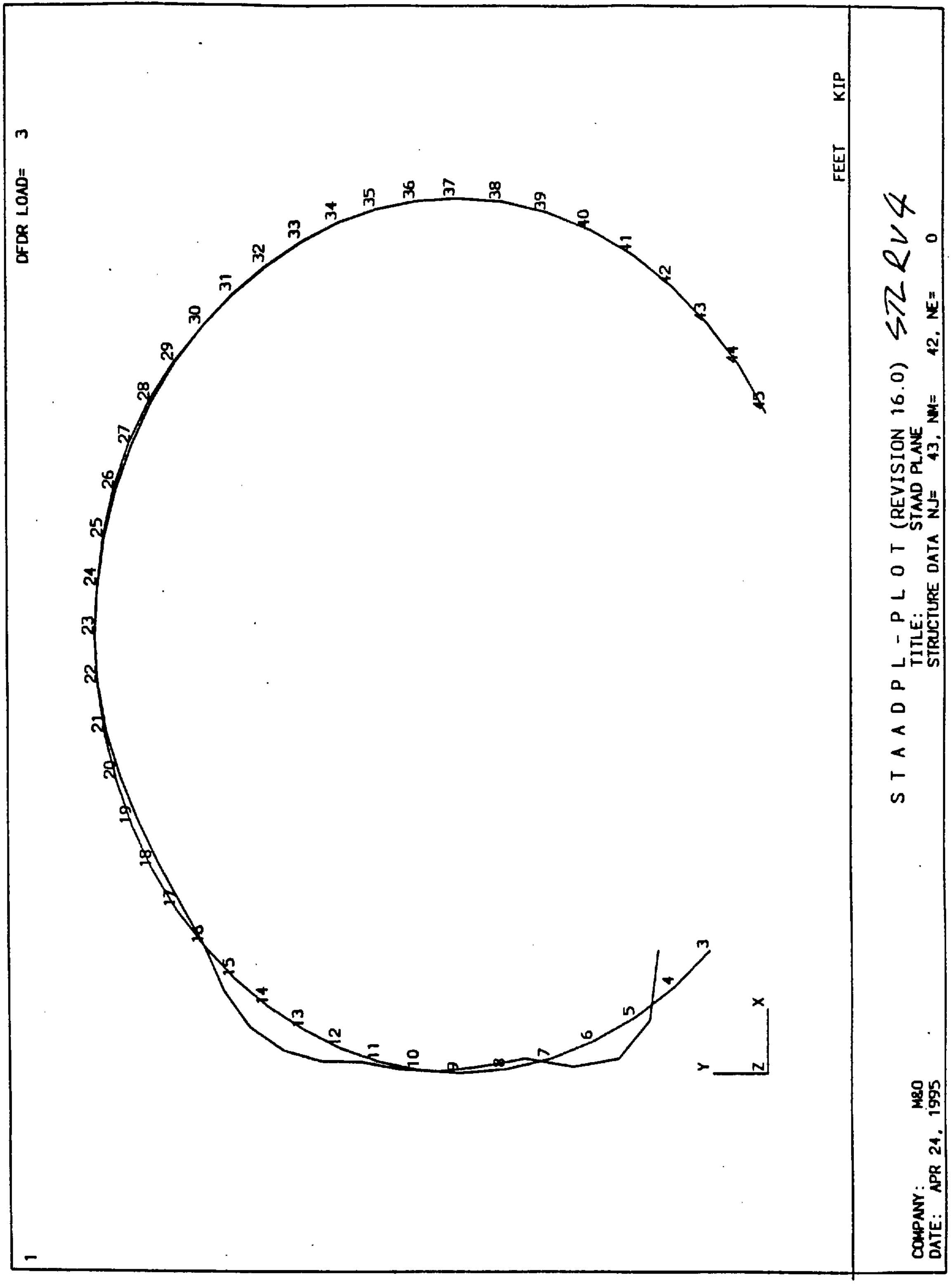
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3  36     -0.03      0.09     0.00      0.00      0.00       0.23
            37     -0.07     -0.08     0.00      0.00      0.00      -0.11

  37     3  37      0.06     -0.09     0.00      0.00      0.00      -0.11
            38     -0.18      0.10     0.00      0.00      0.00      -0.03

  38     3  38      0.17     -0.12     0.00      0.00      0.00       0.03
            39     -0.28      0.14     0.00      0.00      0.00      -0.23

  39     3  39      0.39      0.22     0.00      0.00      0.00       0.23
            40     -0.51     -0.18     0.00      0.00      0.00       0.08

  40     3  40      0.53      0.11     0.00      0.00      0.00      -0.08
            41     -0.63     -0.06     0.00      0.00      0.00       0.21

  41     3  41      0.64     -0.02     0.00      0.00      0.00      -0.21
            42     -0.74      0.09     0.00      0.00      0.00       0.12

  42     3  42      0.72     -0.18     0.00      0.00      0.00      -0.12
            43     -0.81      0.26     0.00      0.00      0.00      -0.22

  43     3  43      1.46      0.26     0.00      0.00      0.00       0.22
            44     -1.54     -0.18     0.00      0.00      0.00       0.12

  44     3  44      1.55     -0.03     0.00      0.00      0.00      -0.12
            45     -1.62      0.13     0.00      0.00      0.00       0.00

  ************** END OF LATEST ANALYSIS RESULT **************

   48. CHECK CODE ALL
```

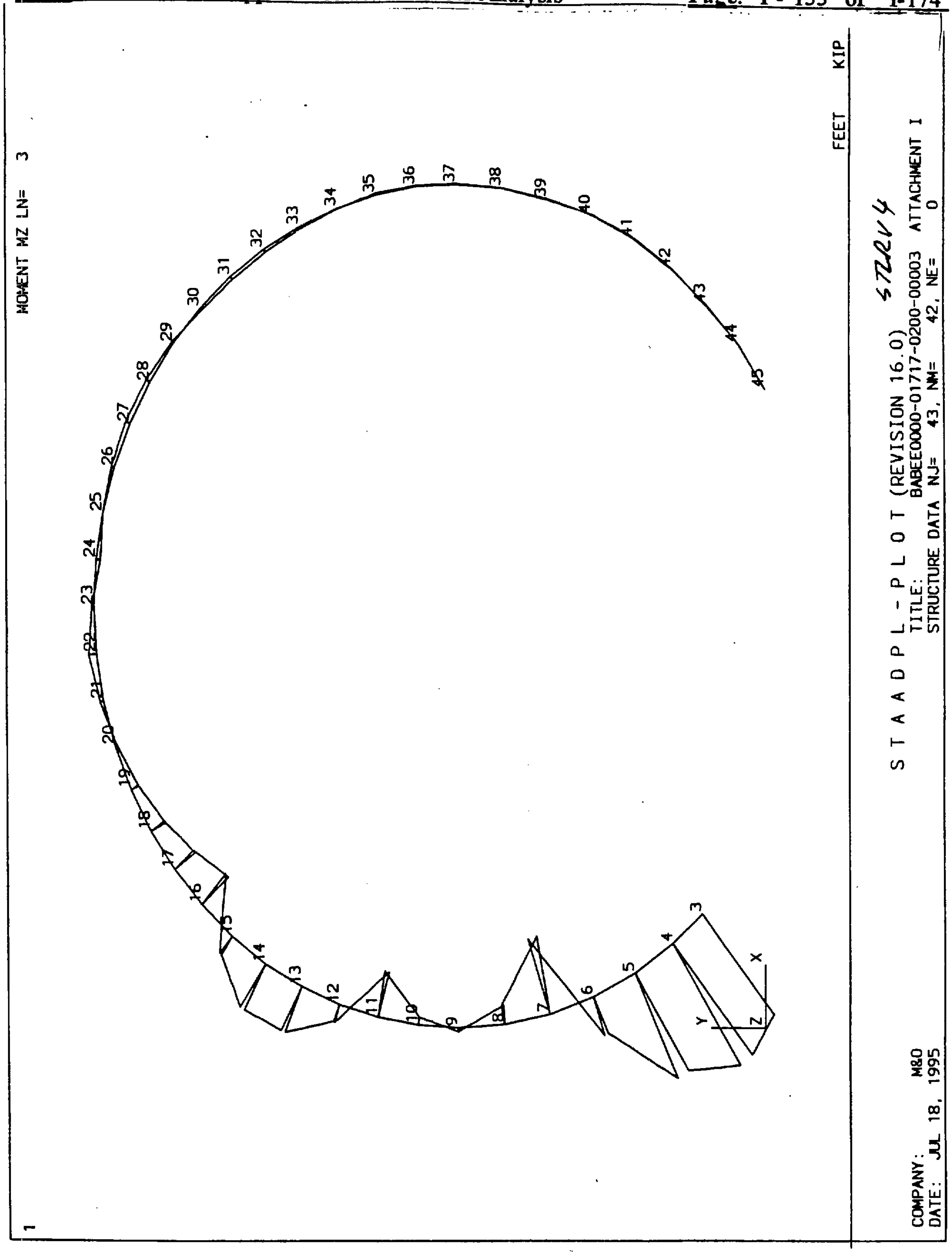
```
                         STAAD-III CODE CHECKING - (AISC)
                         ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE        RESULT/   CRITICAL COND/      RATIO/     LOADING/
                           FX            MY              MZ       LOCATION
=======================================================================

     3  ST   W8X 31         PASS     AISC- H1-2         0.744         3
                        45.81 C           0.00          27.87       1.31
     4  ST   W8X 31         PASS     AISC- H1-2         0.744         3
                        45.73 C           0.00         -27.87       0.00
     5  ST   W8X 31         PASS     AISC- H1-2         0.638         3
                        44.82 C           0.00         -22.39       0.00
     6  ST   W8X 31         PASS     AISC- H1-2         0.498         3
                        43.11 C           0.00         -15.22       1.56
     7  ST   W8X 31         PASS     AISC- H1-2         0.459         3
                        35.35 C           0.00          15.22       0.00
     8  ST   W8X 31         PASS     AISC- H1-2         0.249         3
                        35.89 C           0.00           3.66       0.00
     9  ST   W8X 31         PASS     AISC- H1-2         0.209         3
                        35.73 C           0.00           1.53       1.36
    10  ST   W8X 31         PASS     AISC- H1-2         0.346         3
                        35.23 C           0.00           9.09       1.37
    11  ST   W8X 31         PASS     AISC- H1-2         0.368         3
                        39.68 C           0.00          -9.09       0.00
    12  ST   W8X 31         PASS     AISC- H1-2         0.381         3
                        40.32 C           0.00          -9.59       1.37
    13  ST   W8X 31         PASS     AISC- H1-2         0.390         3
                        40.47 C           0.00         -10.04       1.36
    14  ST   W8X 31         PASS     AISC- H1-2         0.388         3
                        40.25 C           0.00          10.04       0.00
    15  ST   W8X 31         PASS     AISC- H1-2         0.344         3
                        39.30 C           0.00           7.88       1.36
    16  ST   W8X 31         PASS     AISC- H1-3         0.158         3
                         2.51 C           0.00          -7.88       0.00
    17  ST   W8X 31         PASS     AISC- H1-3         0.116         3
                         2.62 C           0.00          -5.58       0.00
    18  ST   W8X 31         PASS     AISC- H1-3         0.079         3
                         2.72 C           0.00          -3.56       0.00
    19  ST   W8X 31         PASS     AISC- H1-3         0.048         3
                         2.80 C           0.00          -1.82       0.00
    20  ST   W8X 31         PASS     AISC- H1-3         0.029         3
                         2.83 C           0.00          -0.77       1.36
    21  ST   W8X 31         PASS     AISC- H1-3         0.045         3
                         2.90 C           0.00          -1.62       1.36
    22  ST   W8X 31         PASS     AISC- H1-3         0.045         3
                         3.03 C           0.00           1.62       0.00
    23  ST   W8X 31         PASS     SHEAR    -Y        0.034         3
                         2.91 C           0.00           0.48       0.00
    24  ST   W8X 31         PASS     AISC- H1-3         0.034         3
                         3.13 C           0.00          -0.99       0.00
    25  ST   W8X 31         PASS     AISC- H1-3         0.029         3
                         3.24 C           0.00          -0.65       1.36
                                                        0.035         3
    26  ST   W8X 31         PASS     AISC- H1-3        -0.96        1.37
                         3.32 C           0.00
```

```
 LL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)
MEMBER      TABLE          RESULT/   CRITICAL COND/      RATIO/     LOADING/
                              FX            MY              MZ       LOCATION
=======================================================================

    27   ST   W8X 31          PASS    AISC- H1-3         0.035         3
                           3.33 C          0.00          0.96         0.00
    28   ST   W8X 31          PASS    AISC- H1-3         0.033         3
                           3.36 C          0.00          0.86         0.00
    29   ST   W8X 31          PASS    AISC- H1-3         0.027         3
                           3.43 C          0.00          0.52         1.37
    30   ST   W8X 31          PASS    AISC- H2-1         0.016         3
                           0.68 T          0.00          0.68         1.36
    31   ST   W8X 31          PASS    AISC- H2-1         0.016         3
                           0.69 T          0.00         -0.68         0.00
    32   ST   W8X 31          PASS    AISC- H2-1         0.015         3
                           0.59 T          0.00         -0.64         0.00
    33   ST   W8X 31          PASS    AISC- H2-1         0.010         3
                           0.48 T          0.00         -0.43         0.00
    34   ST   W8X 31          PASS    SHEAR    -Y        0.010         3
                           0.25 T          0.00         -0.36         1.36
    35   ST   W8X 31          PASS    AISC- H2-1         0.007         3
                           0.13 T          0.00          0.36         0.00
    36   ST   W8X 31          PASS    AISC- H2-1         0.004         3
                           0.03 T          0.00          0.23         0.00
    37   ST   W8X 31          PASS    SHEAR    -Y        0.003         3
                           0.18 C          0.00         -0.03         1.56
    38   ST   W8X 31          PASS    AISC- H1-3         0.006         3
                           0.28 C          0.00         -0.23         1.57
    39   ST   W8X 31          PASS    SHEAR    -Y        0.007         3
                           0.39 C          0.00          0.23         0.00
    40   ST   W8X 31          PASS    AISC- H1-3         0.007         3
                           0.63 C          0.00          0.21         1.57
    41   ST   W8X 31          PASS    AISC- H1-3         0.007         3
                           0.64 C          0.00         -0.21         0.00
    42   ST   W8X 31          PASS    AISC- H1-3         0.008         3
                           0.81 C          0.00         -0.22         1.57
    43   ST   W8X 31          PASS    AISC- H1-3         0.012         3
                           1.46 C          0.00          0.22         0.00
    44   ST   W8X 31          PASS    AISC- H1-3         0.010         3
                           1.55 C          0.00         -0.12         0.00


   ************** END OF TABULATED RESULT OF DESIGN **************


    49. PLOT DISPLACEMENT FILE
    50. PLOT BENDING FILE
    51. FINISH


     *************** END OF STAAD-III ***************

   DATE= JUL 18,1995   TIME=   7:30:14 ******
```


SUPPORTS
STLRV4
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
Y
X
Z
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: MBO
DATE: APR 24, 1995
1


LOAD NUMB= 3
FEET KIP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
25.0 -34.1
36.6
X
Y
Z
S T A A D P L - P L O T (REVISION 16.0) STRV4
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: APR 24, 1995


DFDR LOAD= 3
FEET KIP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
Y
X
Z
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
STR RV 4
COMPANY: M&O
DATE: APR 24, 1995


MOMENT MZ LN= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
X
Y
Z
1
S T A A D P L - P L O T (REVISION 16.0)
STZRV4
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT I
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995

```
**************************************************
*                                                *
*              S T A A D - III                   *
*              Revision 16.0b                    *
*              Proprietary Program of            *
*              RESEARCH ENGINEERS, Inc.          *
*              Date=    JUL 18, 1995             *
*              Time=      7:58:50                *
*                                                *
**************************************************


  1. STAAD PLANE  BABEE0000-01717-0200-00003  ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. *
  4. * FILE STLRV4A
  5. * 25 TON JACK APPLIED ONE SIDE @ 49 DEGREES
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 2.98 2.45 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 20.88 1.94 ; 44 19.72 0.89
 19. 45 18.43 0.00
 20. MEMBER INCIDENCE
 21. 3 3 4 44
 22. UNIT KIP INCH
 23. MEMBER PROPERTIES
 24. 3 TO 44 TA STA W8X31
 25. CONSTANTS
 26. E 29000.0 ALL
 27. DENSITY 0.00028 ALL
 28. BETA 0 ALL
 29. UNIT FT
 30. SUPPORT
 31. 3 7 11 35 39 43 FIXED BUT FY MZ
 32. 22 24 FIXED BUT FX MZ
 33. 16 30 45 PINNED
 34. UNIT KIP
 35. LOAD 1
 36. SELF WEIGHT Y -1.0
 37. LOADING 2
 38. * 25 TON JACK & ONE SIDED JACKING
 39. JOINT LOADING
 40. 3 FX -32.80
 41. 3 FY 37.74
 42. 3 MZ 25.00
 43. LOADING COMBINATION 3
 44. 1 2.5 2 1.0
```

```
        P R O B L E M   S T A T I S T I C S
        -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    43/   42/   11
   ORIGINAL/FINAL BAND-WIDTH =    1/    1
   TOTAL PRIMARY LOAD CASES  =    2, TOTAL DEGREES OF FREEDOM =   115
   SIZE OF STIFFNESS MATRIX =     690 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =    0.08 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                    7:58:52
++ PROCESSING GLOBAL STIFFNESS MATRIX.                     7:58:53
++ PROCESSING TRIANGULAR FACTORIZATION.                    7:58:53
++ CALCULATING JOINT DISPLACEMENTS.                        7:58:54
++ CALCULATING MEMBER  FORCES.                             7:58:54

  46. LOAD LIST 3
  47. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

    3    3    0.00000    0.06126    0.00000    0.00000    0.00000    0.00306
    4    3   -0.02016    0.04257    0.00000    0.00000    0.00000    0.00203
    5    3   -0.03492    0.02905    0.00000    0.00000    0.00000    0.00030
    6    3   -0.02348    0.03095    0.00000    0.00000    0.00000   -0.00079
    7    3    0.00000    0.03557    0.00000    0.00000    0.00000   -0.00060
    8    3    0.00097    0.03312    0.00000    0.00000    0.00000   -0.00002
    9    3   -0.00074    0.03038    0.00000    0.00000    0.00000    0.00002
   10    3   -0.00004    0.02805    0.00000    0.00000    0.00000    0.00003
   11    3    0.00000    0.02575    0.00000    0.00000    0.00000    0.00037
   12    3   -0.01379    0.02701    0.00000    0.00000    0.00000    0.00057
   13    3   -0.02296    0.02807    0.00000    0.00000    0.00000    0.00017
   14    3   -0.02241    0.02483    0.00000    0.00000    0.00000   -0.00045
   15    3   -0.01268    0.01480    0.00000    0.00000    0.00000   -0.00090
   16    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00079
   17    3    0.00545   -0.00635    0.00000    0.00000    0.00000   -0.00036
   18    3    0.00685   -0.00859    0.00000    0.00000    0.00000   -0.00007
   19    3    0.00622   -0.00780    0.00000    0.00000    0.00000    0.00010
   20    3    0.00498   -0.00526    0.00000    0.00000    0.00000    0.00017
   21    3    0.00392   -0.00226    0.00000    0.00000    0.00000    0.00016
   22    3    0.00335    0.00000    0.00000    0.00000    0.00000    0.00008
   23    3    0.00314    0.00026    0.00000    0.00000    0.00000    0.00002
   24    3    0.00294    0.00000    0.00000    0.00000    0.00000    0.00003
   25    3    0.00296    0.00126    0.00000    0.00000    0.00000    0.00006
   26    3    0.00309    0.00245    0.00000    0.00000    0.00000    0.00004
   27    3    0.00307    0.00295    0.00000    0.00000    0.00000   -0.00001
   28    3    0.00259    0.00252    0.00000    0.00000    0.00000   -0.00006
   29    3    0.00151    0.00137    0.00000    0.00000    0.00000   -0.00010
   30    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00010
   31    3   -0.00094   -0.00091    0.00000    0.00000    0.00000   -0.00006
   32    3   -0.00138   -0.00127    0.00000    0.00000    0.00000   -0.00001
   33    3   -0.00125   -0.00123    0.00000    0.00000    0.00000    0.00002
   34    3   -0.00069   -0.00103    0.00000    0.00000    0.00000    0.00004
   35    3    0.00000   -0.00085    0.00000    0.00000    0.00000    0.00003
   36    3    0.00023   -0.00081    0.00000    0.00000    0.00000    0.00001
   37    3    0.00024   -0.00081    0.00000    0.00000    0.00000    0.00000
   38    3    0.00010   -0.00079    0.00000    0.00000    0.00000   -0.00001
   39    3    0.00000   -0.00076    0.00000    0.00000    0.00000    0.00000
   40    3    0.00027   -0.00081    0.00000    0.00000    0.00000    0.00001
   41    3    0.00041   -0.00083    0.00000    0.00000    0.00000    0.00000
   42    3    0.00027   -0.00069    0.00000    0.00000    0.00000   -0.00001
   43    3    0.00000   -0.00038    0.00000    0.00000    0.00000   -0.00001
   44    3    0.00006   -0.00029    0.00000    0.00000    0.00000   -0.00001
   45    3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00001
```

```
SUPPORT REACTIONS -UNIT KIP  FEET     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD     FORCE-X    FORCE-Y    FORCE-Z     MOM-X      MOM-Y      MOM Z

   3     3        4.97       0.00       0.00       0.00       0.00       0.00
   7     3       27.95       0.00       0.00       0.00       0.00       0.00
  11     3       20.34       0.00       0.00       0.00       0.00       0.00
  35     3        0.48       0.00       0.00       0.00       0.00       0.00
  39     3       -0.42       0.00       0.00       0.00       0.00       0.00
  43     3       -0.94       0.00       0.00       0.00       0.00       0.00
  22     3        0.00       1.26       0.00       0.00       0.00       0.00
  24     3        0.00      -2.10       0.00       0.00       0.00       0.00
  16     3      -17.43     -35.89       0.00       0.00       0.00       0.00
  30     3       -3.43       2.52       0.00       0.00       0.00       0.00
  45     3        1.27       1.03       0.00       0.00       0.00       0.00
```

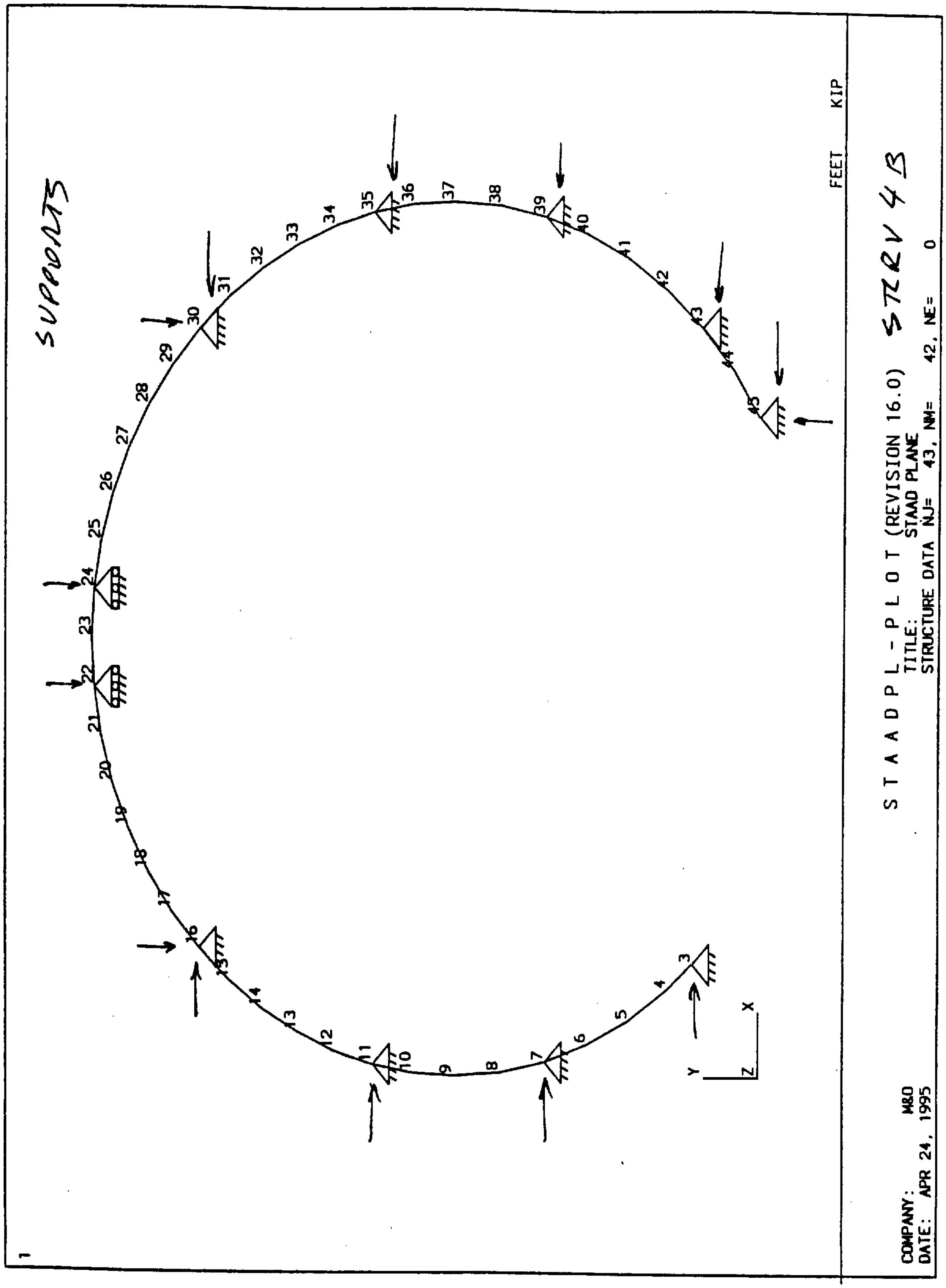
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


   3    3    3     46.85      2.09     0.00      0.00      0.00     -25.00
             4    -46.79     -2.05     0.00      0.00      0.00      26.81

   4    3    4     46.75     -2.84     0.00      0.00      0.00     -26.81
             5    -46.65      2.91     0.00      0.00      0.00      22.32

   5    3    5     45.91     -8.76     0.00      0.00      0.00     -22.32
             6    -45.81      8.81     0.00      0.00      0.00       8.58

   6    3    6     44.37    -14.39     0.00      0.00      0.00      -8.58
             7    -44.26     14.42     0.00      0.00      0.00     -13.93

   7    3    7     36.60      7.25     0.00      0.00      0.00      13.93
             8    -36.48     -7.23     0.00      0.00      0.00      -2.56

   8    3    8     37.11      2.50     0.00      0.00      0.00       2.56
             9    -36.99     -2.49     0.00      0.00      0.00       1.34

   9    3    9     37.02      2.06     0.00      0.00      0.00       1.34
            10    -36.91     -2.05     0.00      0.00      0.00       1.46

  10    3   10     36.46      6.09     0.00      0.00      0.00      -1.46
            11    -36.36     -6.07     0.00      0.00      0.00       9.78

  11    3   11     41.04     -9.67     0.00      0.00      0.00      -9.78
            12    -40.94      9.70     0.00      0.00      0.00      -3.41

  12    3   12     41.82     -4.61     0.00      0.00      0.00       3.41
            13    -41.72      4.65     0.00      0.00      0.00      -9.74

  13    3   13     41.98     -0.39     0.00      0.00      0.00       9.74
            14    -41.89      0.44     0.00      0.00      0.00     -10.30

  14    3   14     41.66      4.34     0.00      0.00      0.00      10.30
            15    -41.58     -4.28     0.00      0.00      0.00      -4.38

  15    3   15     40.77      9.19     0.00      0.00      0.00       4.38
            16    -40.70     -9.12     0.00      0.00      0.00       8.07

  16    3   16      2.56     -1.68     0.00      0.00      0.00      -8.07
            17     -2.49      1.76     0.00      0.00      0.00       5.71

  17    3   17      2.67     -1.48     0.00      0.00      0.00      -5.71
            18     -2.61      1.56     0.00      0.00      0.00       3.64

  18    3   18      2.77     -1.25     0.00      0.00      0.00      -3.64
            19     -2.72      1.34     0.00      0.00      0.00       1.86
```

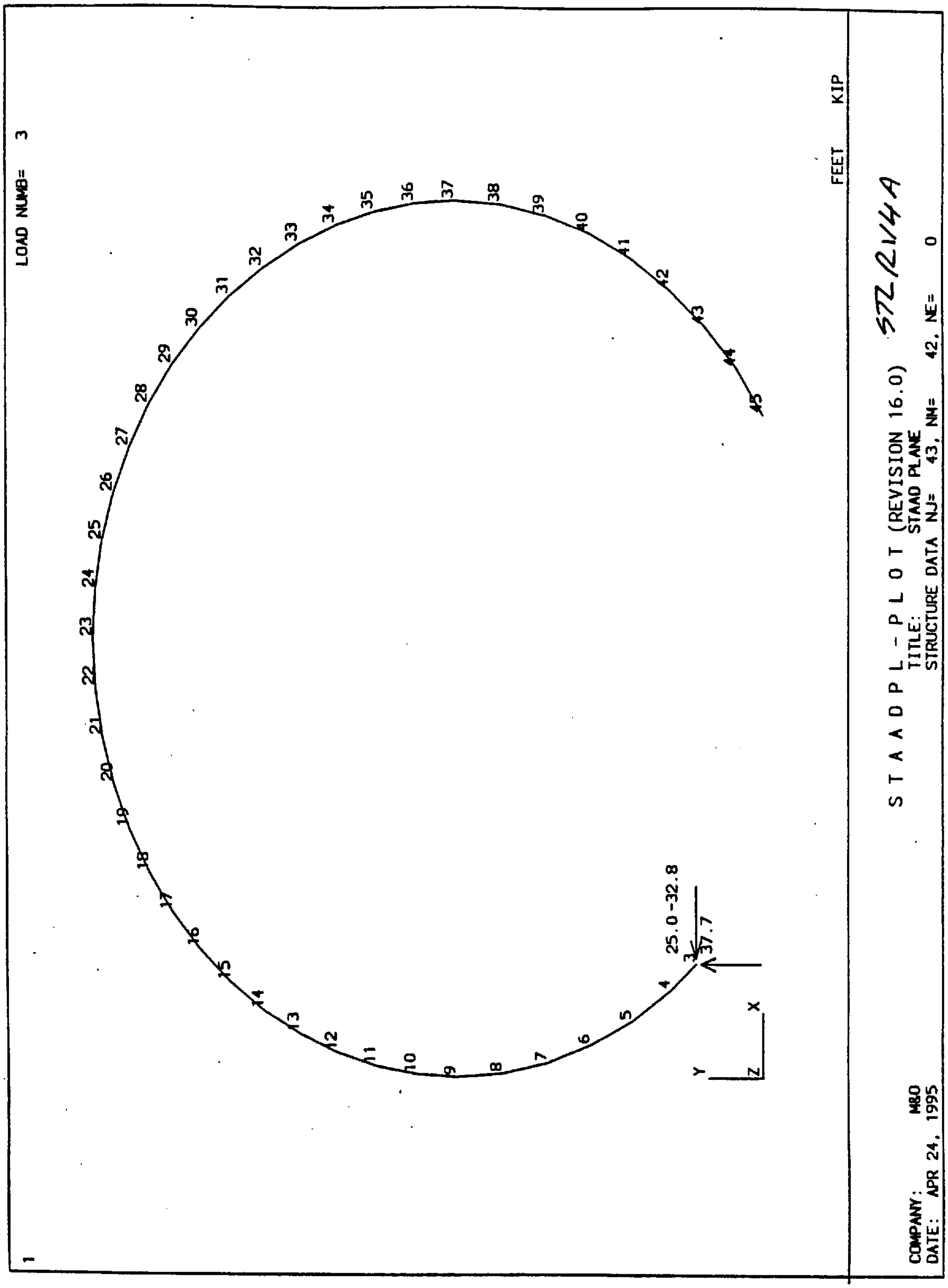
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19     3  19      2.85     -1.03     0.00      0.00      0.00      -1.86
            20     -2.81      1.13     0.00      0.00      0.00       0.39

  20     3  20      2.92     -0.82     0.00      0.00      0.00      -0.39
            21     -2.89      0.92     0.00      0.00      0.00      -0.79

  21     3  21      2.98     -0.59     0.00      0.00      0.00       0.79
            22     -2.96      0.69     0.00      0.00      0.00      -1.66

  22     3  22      3.09      0.90     0.00      0.00      0.00       1.66
            23     -3.08     -0.80     0.00      0.00      0.00      -0.49

  23     3  23      2.97      1.15     0.00      0.00      0.00       0.49
            24     -2.98     -1.05     0.00      0.00      0.00       1.01

  24     3  24      3.20     -0.70     0.00      0.00      0.00      -1.01
            25     -3.21      0.80     0.00      0.00      0.00      -0.01

  25     3  25      3.28     -0.44     0.00      0.00      0.00       0.01
            26     -3.31      0.54     0.00      0.00      0.00      -0.67

  26     3  26      3.35     -0.18     0.00      0.00      0.00       0.67
            27     -3.39      0.28     0.00      0.00      0.00      -0.99

  27     3  27      3.40      0.12     0.00      0.00      0.00       0.99
            28     -3.45     -0.03     0.00      0.00      0.00      -0.88

  28     3  28      3.43      0.42     0.00      0.00      0.00       0.88
            29     -3.49     -0.33     0.00      0.00      0.00      -0.37

  29     3  29      3.43      0.71     0.00      0.00      0.00       0.37
            30     -3.50     -0.63     0.00      0.00      0.00       0.54

  30     3  30     -0.76      0.15     0.00      0.00      0.00      -0.54
            31      0.68     -0.08     0.00      0.00      0.00       0.70

  31     3  31     -0.69     -0.01     0.00      0.00      0.00      -0.70
            32      0.60      0.07     0.00      0.00      0.00       0.65

  32     3  32     -0.59     -0.13     0.00      0.00      0.00      -0.65
            33      0.50      0.18     0.00      0.00      0.00       0.44

  33     3  33     -0.47     -0.24     0.00      0.00      0.00      -0.44
            34      0.38      0.28     0.00      0.00      0.00       0.09

  34     3  34     -0.35     -0.32     0.00      0.00      0.00      -0.09
            35      0.24      0.34     0.00      0.00      0.00      -0.36

  35     3  35     -0.12      0.11     0.00      0.00      0.00       0.36
            36      0.02     -0.09     0.00      0.00      0.00      -0.23
```

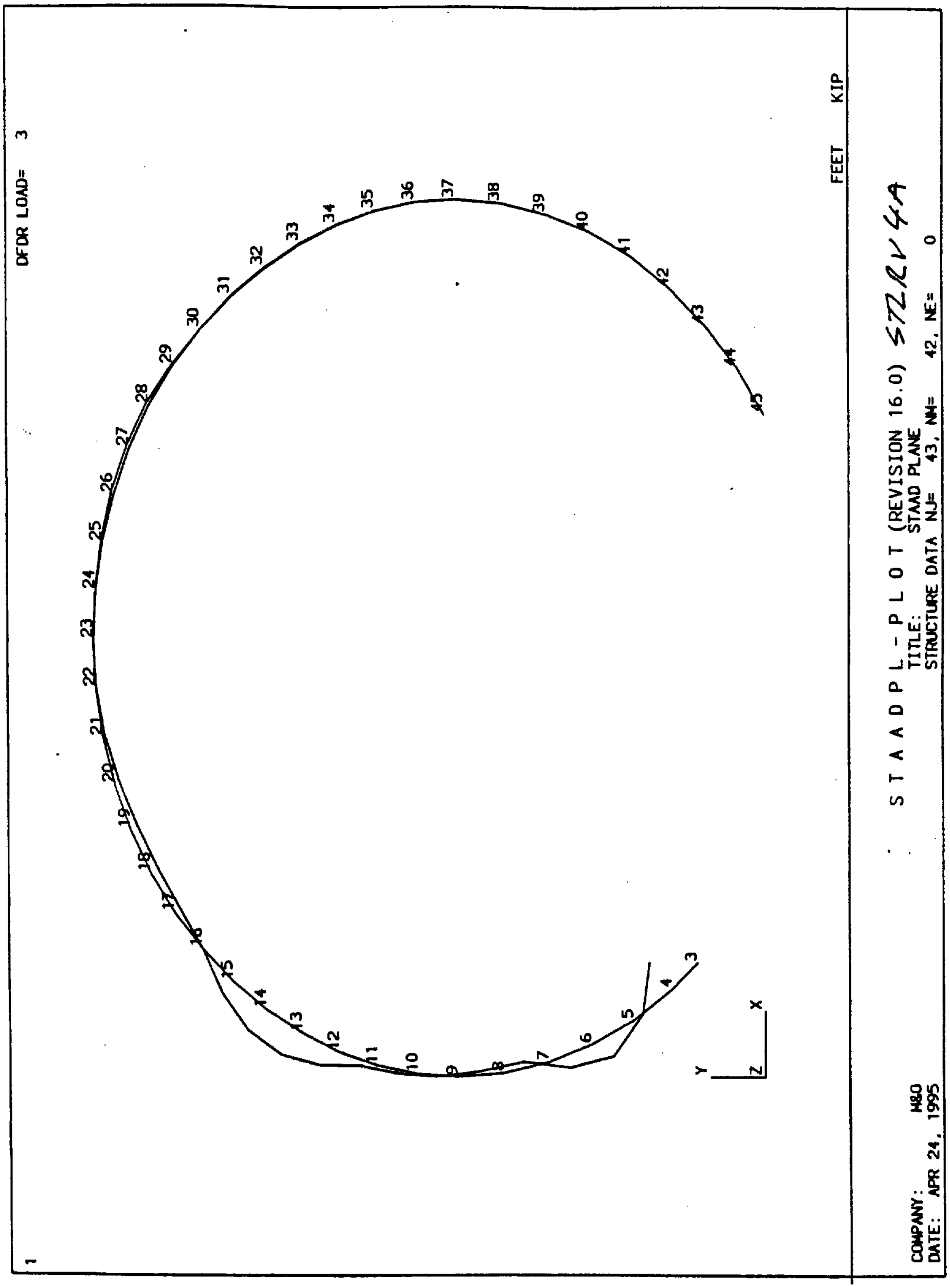
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


 36    3    36     -0.03     0.09     0.00      0.00       0.00        0.23
            37     -0.07    -0.08     0.00      0.00       0.00       -0.12

 37    3    37      0.07    -0.09     0.00      0.00       0.00       -0.12
            38     -0.18     0.10     0.00      0.00       0.00       -0.03

 38    3    38      0.17    -0.12     0.00      0.00       0.00        0.03
            39     -0.29     0.14     0.00      0.00       0.00       -0.23

 39    3    39      0.40     0.22     0.00      0.00       0.00        0.23
            40     -0.51    -0.18     0.00      0.00       0.00        0.08

 40    3    40      0.53     0.11     0.00      0.00       0.00       -0.08
            41     -0.64    -0.06     0.00      0.00       0.00        0.21

 41    3    41      0.64    -0.02     0.00      0.00       0.00       -0.21
            42     -0.74     0.09     0.00      0.00       0.00        0.13

 42    3    42      0.73    -0.18     0.00      0.00       0.00       -0.13
            43     -0.82     0.26     0.00      0.00       0.00       -0.22

 43    3    43      1.47     0.27     0.00      0.00       0.00        0.22
            44     -1.55    -0.18     0.00      0.00       0.00        0.12

 44    3    44      1.56    -0.03     0.00      0.00       0.00       -0.12
            45     -1.63     0.13     0.00      0.00       0.00        0.00

 ************** END OF LATEST ANALYSIS RESULT **************

  48. CHECK CODE ALL
```

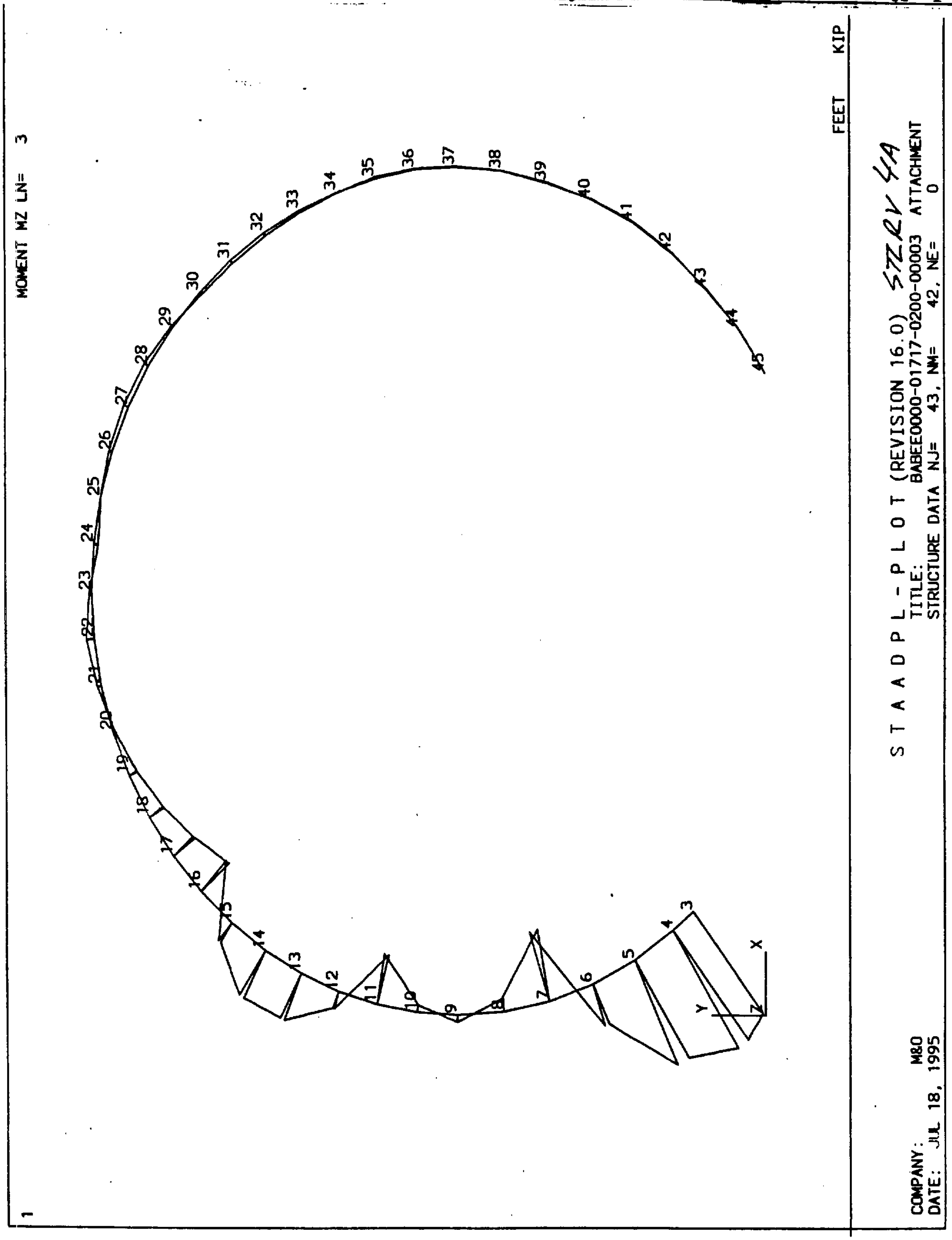
```
                         STAAD-III CODE CHECKING - (AISC)
                         ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY             MZ       LOCATION
=======================================================================

     3 ST   W8X 31          PASS     AISC- H1-2        0.730         3
                        46.79 C         0.00          26.81        0.87
     4 ST   W8X 31          PASS     AISC- H1-2        0.730         3
                        46.75 C         0.00         -26.81        0.00
     5 ST   W8X 31          PASS     AISC- H1-2        0.643         3
                        45.91 C         0.00         -22.32        0.00
     6 ST   W8X 31          PASS     AISC- H1-2        0.480         3
                        44.26 C         0.00         -13.93        1.56
     7 ST   W8X 31          PASS     AISC- H1-2        0.441         3
                        36.60 C         0.00          13.93        0.00
     8 ST   W8X 31          PASS     AISC- H1-2        0.235         3
                        37.11 C         0.00           2.56        0.00
     9 ST   W8X 31          PASS     AISC- H1-2        0.214         3
                        36.91 C         0.00           1.46        1.36
    10 ST   W8X 31          PASS     AISC- H1-2        0.364         3
                        36.36 C         0.00           9.78        1.37
    11 ST   W8X 31          PASS     AISC- H1-2        0.388         3
                        41.04 C         0.00          -9.78        0.00
    12 ST   W8X 31          PASS     AISC- H1-2        0.390         3
                        41.72 C         0.00          -9.74        1.37
    13 ST   W8X 31          PASS     AISC- H1-2        0.401         3
                        41.89 C         0.00         -10.30        1.36
    14 ST   W8X 31          PASS     AISC- H1-2        0.400         3
                        41.66 C         0.00          10.30        0.00
    15 ST   W8X 31          PASS     AISC- H1-2        0.355         3
                        40.70 C         0.00           8.07        1.36
    16 ST   W8X 31          PASS     AISC- H1-3        0.161         3
                         2.56 C         0.00          -8.07        0.00
    17 ST   W8X 31          PASS     AISC- H1-3        0.119         3
                         2.67 C         0.00          -5.71        0.00
    18 ST   W8X 31          PASS     AISC- H1-3        0.081         3
                         2.77 C         0.00          -3.64        0.00
    19 ST   W8X 31          PASS     AISC- H1-3        0.049         3
                         2.85 C         0.00          -1.86        0.00
    20 ST   W8X 31          PASS     AISC- H1-3        0.029         3
                         2.89 C         0.00          -0.79        1.36
    21 ST   W8X 31          PASS     AISC- H1-3        0.046         3
                         2.96 C         0.00          -1.66        1.36
    22 ST   W8X 31          PASS     AISC- H1-3        0.046         3
                         3.09 C         0.00           1.66        0.00
    23 ST   W8X 31          PASS     SHEAR   -Y        0.035         3
                         2.97 C         0.00           0.49        0.00
    24 ST   W8X 31          PASS     AISC- H1-3        0.035         3
                         3.20 C         0.00          -1.01        0.00
    25 ST   W8X 31          PASS     AISC- H1-3        0.029         3
                         3.31 C         0.00          -0.67        1.36
    26 ST   W8X 31          PASS     AISC- H1-3        0.036         3
                         3.39 C         0.00          -0.99        1.37
```

```
LL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)
MEMBER      TABLE          RESULT/   CRITICAL COND/      RATIO/     LOADING/
                              FX            MY             MZ       LOCATION
=======================================================================

    27  ST   W8X 31          PASS      AISC- H1-3         0.036         3
                          3.40 C           0.00           0.99         0.00
    28  ST   W8X 31          PASS      AISC- H1-3         0.034         3
                          3.43 C           0.00           0.88         0.00
    29  ST   W8X 1          PASS      AISC- H1-3         0.028         3
                          3.50 C           0.00           0.54         1.37
    30  ST   W8X 31          PASS      AISC- H2-1         0.016         3
                          0.68 T           0.00           0.70         1.36
    31  ST   W8X 31          PASS      AISC- H2-1         0.016         3
                          0.69 T           0.00          -0.70         0.00
    32  ST   W8X 31          PASS      AISC- H2-1         0.015         3
                          0.59 T           0.00          -0.65         0.00
    33  ST   W8X 31          PASS      AISC- H2-1         0.010         3
                          0.47 T           0.00          -0.44         0.00
    34  ST   W8X 31          PASS      SHEAR    -Y        0.011         3
                          0.24 T           0.00          -0.36         1.36
    35  ST   W8X 31          PASS      AISC- H2-1         0.007         3
                          0.12 T           0.00           0.36         0.00
    36  ST   W8X 31          PASS      AISC- H2-1         0.004         3
                          0.03 T           0.00           0.23         0.00
    37  ST   W8X 31          PASS      SHEAR    -Y        0.003         3
                          0.18 C           0.00          -0.03         1.56
    38  ST   W8X 31          PASS      AISC- H1-3         0.006         3
                          0.29 C           0.00          -0.23         1.57
    39  ST   W8X 31          PASS      SHEAR    -Y        0.007         3
                          0.40 C           0.00           0.23         0.00
    40  ST   W8X 31          PASS      AISC- H1-3         0.007         3
                          0.64 C           0.00           0.21         1.57
    41  ST   W8X 31          PASS      AISC- H1-3         0.007         3
                          0.64 C           0.00          -0.21         0.00
    42  ST   W8X 31          PASS      AISC- H1-3         0.008         3
                          0.82 C           0.00          -0.22         1.57
    43  ST   W8X 31          PASS      AISC- H1-3         0.012         3
                          1.47 C           0.00           0.22         0.00
    44  ST   W8X 31          PASS      AISC- H1-3         0.010         3
                          1.56 C           0.00          -0.12         0.00

  ************** END OF TABULATED RESULT OF DESIGN **************


   49. PLOT DISPLACEMENT FILE
   50. PLOT BENDING FILE
   51. FINISH


     *************** END OF STAAD-III ***************

  DATE= JUL 18,1995   TIME=  7:58:58 ******
```


SUPPORTS
STRV 4B
FEET KIP
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: APR 24, 1995
X
Y
Z
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45


LOAD NUMB= 3
FEET KIP
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
STZR1V4A
COMPANY: M&O
DATE: APR 24, 1995
25.0 -32.8
37.7
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
X
Y
Z
1


DFDR LOAD= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
Y
Z
X
1
STAADPL-PLOT (REVISION 16.0) STRV4A
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: APR 24, 1995


MOMENT MZ LN= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
X
Y
Z
1
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
STZRV 4A
COMPANY: M&O
DATE: JUL 18, 1995

```
**************************************************
*                                                *
*            S T A A D - III                     *
*            Revision 16.0b                      *
*            Proprietary Program of              *
*            RESEARCH ENGINEERS, Inc.            *
*            Date=    JUL 18, 1995               *
*            Time=     8:26:52                   *
*                                                *
**************************************************

  1. STAAD PLANE  BABEE0000-01717-0200-00003  ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. *
  4. * FILE STLRV4B
  5. * 25 TON JACK APPLIED ONE SIDE @ 51 DEGREES
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 2.71 2.77 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 20.88 1.94 ; 44 19.72 0.89
 19. 45 18.43 0.00
 20. MEMBER INCIDENCE
 21. 3 3 4 44
 22. UNIT KIP INCH
 23. MEMBER PROPERTIES
 24. 3 TO 44 TA STA W8X31
 25. CONSTANTS
 26. E 29000.0 ALL
 27. DENSITY 0.00028 ALL
 28. BETA 0 ALL
 29. UNIT FT
 30. SUPPORT
 31. 3 7 11 35 39 43 FIXED BUT FY MZ
 32. 22 24 FIXED BUT FX MZ
 33. 16 30 45 PINNED
 34. UNIT KIP
 35. LOAD 1
 36. SELF WEIGHT Y -1.0
 37. LOADING 2
 38. * 25 TON JACK & ONE SIDED JACKING
 39. JOINT LOADING
 40. 3 FX -31.47
 41. 3 FY 38.86
 42. 3 MZ 25.00
 43. LOADING COMBINATION 3
 44. 1 2.5 2 1.0
```

```
         P R O B L E M   S T A T I S T I C S
         -----------------------------------

    NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    43/   42/   11
    ORIGINAL/FINAL BAND-WIDTH =     1/    1
    TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =   115
    SIZE OF STIFFNESS MATRIX =      690 DOUBLE PREC. WORDS
    TOTAL REQUIRED DISK SPACE =     0.08 MEGA-BYTES


 ++ PROCESSING ELEMENT STIFFNESS MATRIX.                  8:26:55
 ++ PROCESSING GLOBAL STIFFNESS MATRIX.                   8:26:55
 ++ PROCESSING TRIANGULAR FACTORIZATION.                  8:26:56
 ++ CALCULATING JOINT DISPLACEMENTS.                      8:26:56
 ++ CALCULATING MEMBER  FORCES.                           8:26:56

   46. LOAD LIST 3
   47. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

    3     3   0.00000   0.05839   0.00000   0.00000   0.00000   0.00273
    4     3  -0.01030   0.04913   0.00000   0.00000   0.00000   0.00221
    5     3  -0.02838   0.03337   0.00000   0.00000   0.00000   0.00051
    6     3  -0.02056   0.03345   0.00000   0.00000   0.00000  -0.00061
    7     3   0.00000   0.03700   0.00000   0.00000   0.00000  -0.00048
    8     3  -0.00043   0.03418   0.00000   0.00000   0.00000   0.00002
    9     3  -0.00218   0.03135   0.00000   0.00000   0.00000   0.00001
   10     3  -0.00080   0.02892   0.00000   0.00000   0.00000  -0.00001
   11     3   0.00000   0.02642   0.00000   0.00000   0.00000   0.00036
   12     3  -0.01392   0.02764   0.00000   0.00000   0.00000   0.00058
   13     3  -0.02333   0.02870   0.00000   0.00000   0.00000   0.00017
   14     3  -0.02285   0.02541   0.00000   0.00000   0.00000  -0.00045
   15     3  -0.01295   0.01516   0.00000   0.00000   0.00000  -0.00092
   16     3   0.00000   0.00000   0.00000   0.00000   0.00000  -0.00080
   17     3   0.00557  -0.00649   0.00000   0.00000   0.00000  -0.00037
   18     3   0.00700  -0.00877   0.00000   0.00000   0.00000  -0.00007
   19     3   0.00635  -0.00796   0.00000   0.00000   0.00000   0.00010
   20     3   0.00509  -0.00536   0.00000   0.00000   0.00000   0.00017
   21     3   0.00401  -0.00230   0.00000   0.00000   0.00000   0.00016
   22     3   0.00342   0.00000   0.00000   0.00000   0.00000   0.00008
   23     3   0.00321   0.00027   0.00000   0.00000   0.00000   0.00002
   24     3   0.00301   0.00000   0.00000   0.00000   0.00000   0.00003
   25     3   0.00303   0.00129   0.00000   0.00000   0.00000   0.00007
   26     3   0.00316   0.00252   0.00000   0.00000   0.00000   0.00005
   27     3   0.00314   0.00303   0.00000   0.00000   0.00000  -0.00001
   28     3   0.00265   0.00258   0.00000   0.00000   0.00000  -0.00006
   29     3   0.00154   0.00140   0.00000   0.00000   0.00000  -0.00010
   30     3   0.00000   0.00000   0.00000   0.00000   0.00000  -0.00010
   31     3  -0.00096  -0.00092   0.00000   0.00000   0.00000  -0.00006
   32     3  -0.00140  -0.00128   0.00000   0.00000   0.00000  -0.00001
   33     3  -0.00127  -0.00125   0.00000   0.00000   0.00000   0.00002
   34     3  -0.00070  -0.00104   0.00000   0.00000   0.00000   0.00004
   35     3   0.00000  -0.00086   0.00000   0.00000   0.00000   0.00003
   36     3   0.00023  -0.00082   0.00000   0.00000   0.00000   0.00001
   37     3   0.00024  -0.00082   0.00000   0.00000   0.00000   0.00000
   38     3   0.00011  -0.00080   0.00000   0.00000   0.00000  -0.00001
   39     3   0.00000  -0.00076   0.00000   0.00000   0.00000   0.00000
   40     3   0.00027  -0.00082   0.00000   0.00000   0.00000   0.00001
   41     3   0.00041  -0.00084   0.00000   0.00000   0.00000   0.00000
   42     3   0.00027  -0.00069   0.00000   0.00000   0.00000  -0.00001
   43     3   0.00000  -0.00038   0.00000   0.00000   0.00000  -0.00001
   44     3   0.00006  -0.00029   0.00000   0.00000   0.00000  -0.00001
   45     3   0.00000   0.00000   0.00000   0.00000   0.00000  -0.00001
```

```
 SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
 -----------------

JOINT  LOAD    FORCE-X    FORCE-Y    FORCE-Z     MOM-X     MOM-Y     MOM Z

    3    3       3.60       0.00       0.00       0.00      0.00      0.00
    7    3      27.66       0.00       0.00       0.00      0.00      0.00
   11    3      21.39       0.00       0.00       0.00      0.00      0.00
   35    3       0.49       0.00       0.00       0.00      0.00      0.00
   39    3      -0.42       0.00       0.00       0.00      0.00      0.00
   43    3      -0.94       0.00       0.00       0.00      0.00      0.00
   22    3       0.00       1.28       0.00       0.00      0.00      0.00
   24    3       0.00      -2.15       0.00       0.00      0.00      0.00
   16    3     -18.09     -37.04       0.00       0.00      0.00      0.00
   30    3      -3.49       2.54       0.00       0.00      0.00      0.00
   45    3       1.28       1.04       0.00       0.00      0.00      0.00
```

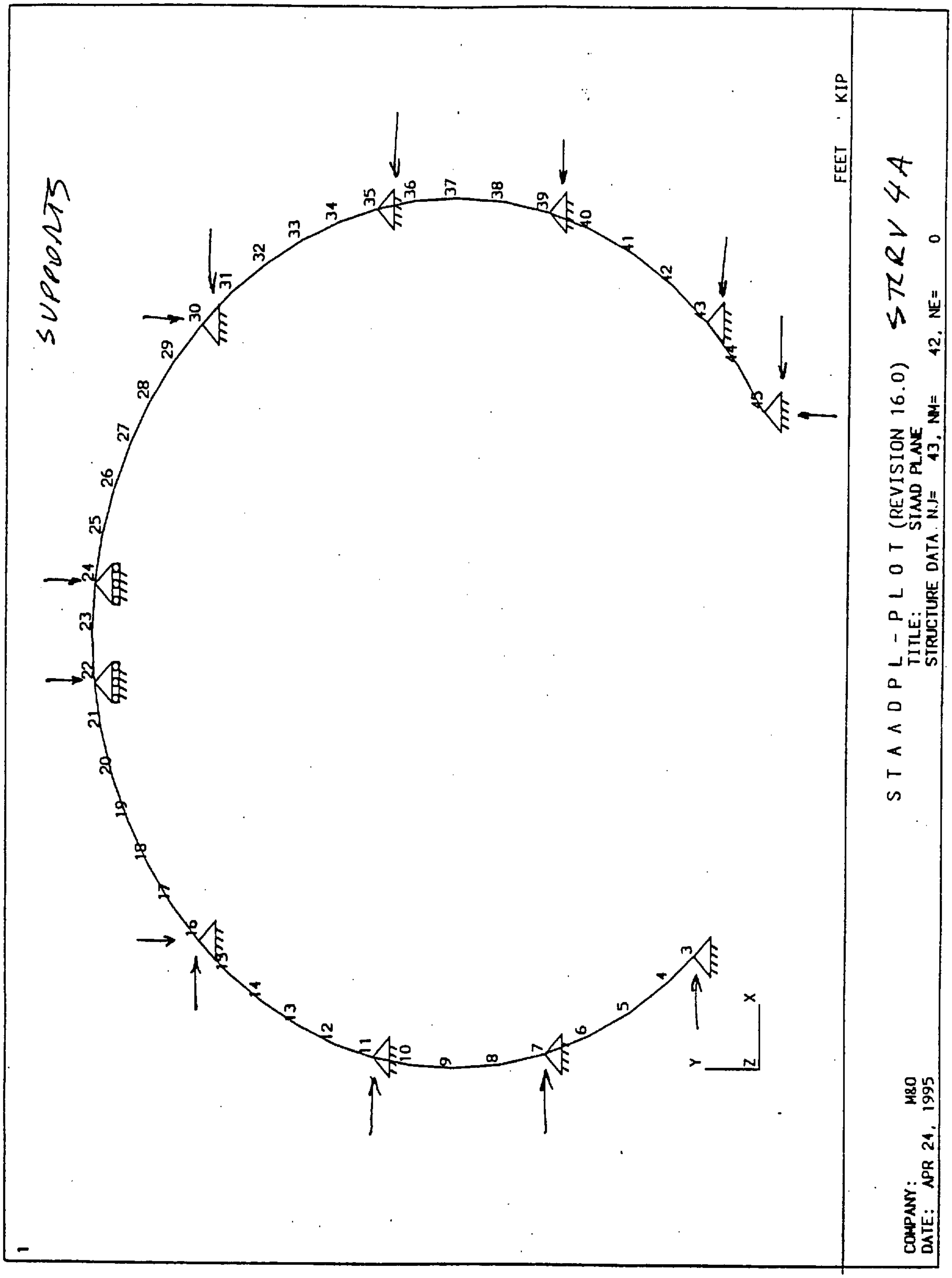
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


   3     3   3     47.79      1.86     0.00      0.00      0.00     -25.00
             4    -47.76     -1.83     0.00      0.00      0.00      25.84

   4     3   4     47.74     -2.25     0.00      0.00      0.00     -25.84
             5    -47.64      2.31     0.00      0.00      0.00      22.28

   5     3   5     46.97     -8.29     0.00      0.00      0.00     -22.28
             6    -46.86      8.34     0.00      0.00      0.00       9.26

   6     3   6     45.48    -14.06     0.00      0.00      0.00      -9.26
             7    -45.36     14.10     0.00      0.00      0.00     -12.73

   7     3   7     37.80      7.15     0.00      0.00      0.00      12.73
             8    -37.68     -7.12     0.00      0.00      0.00      -1.54

   8     3   8     38.28      2.24     0.00      0.00      0.00       1.54
             9    -38.16     -2.23     0.00      0.00      0.00       1.95

   9     3   9     38.15      2.46     0.00      0.00      0.00       1.95
            10    -38.04     -2.45     0.00      0.00      0.00       1.39

  10     3  10     37.54      6.61     0.00      0.00      0.00      -1.39
            11    -37.44     -6.60     0.00      0.00      0.00      10.44

  11     3  11     42.34    -10.05     0.00      0.00      0.00     -10.44
            12    -42.24     10.08     0.00      0.00      0.00      -3.26

  12     3  12     43.16     -4.82     0.00      0.00      0.00       3.26
            13    -43.06      4.86     0.00      0.00      0.00      -9.88

  13     3  13     43.33     -0.46     0.00      0.00      0.00       9.88
            14    -43.24      0.51     0.00      0.00      0.00     -10.55

  14     3  14     43.02      4.42     0.00      0.00      0.00      10.55
            15    -42.93     -4.36     0.00      0.00      0.00      -4.52

  15     3  15     42.11      9.43     0.00      0.00      0.00       4.52
            16    -42.03     -9.36     0.00      0.00      0.00       8.25

  16     3  16      2.61     -1.72     0.00      0.00      0.00      -8.25
            17     -2.54      1.80     0.00      0.00      0.00       5.84

  17     3  17      2.72     -1.51     0.00      0.00      0.00      -5.84
            18     -2.66      1.60     0.00      0.00      0.00       3.72

  18     3  18      2.83     -1.28     0.00      0.00      0.00      -3.72
            19     -2.77      1.37     0.00      0.00      0.00       1.90
```

```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19      2.91     -1.06     0.00      0.00      0.00      -1.90
            20     -2.87      1.15     0.00      0.00      0.00       0.40

  20    3   20      2.98     -0.83     0.00      0.00      0.00      -0.40
            21     -2.95      0.93     0.00      0.00      0.00      -0.81

  21    3   21      3.04     -0.60     0.00      0.00      0.00       0.81
            22     -3.02      0.70     0.00      0.00      0.00      -1.69

  22    3   22      3.15      0.92     0.00      0.00      0.00       1.69
            23     -3.15     -0.82     0.00      0.00      0.00      -0.50

  23    3   23      3.03      1.18     0.00      0.00      0.00       0.50
            24     -3.04     -1.08     0.00      0.00      0.00       1.04

  24    3   24      3.26     -0.72     0.00      0.00      0.00      -1.04
            25     -3.28      0.82     0.00      0.00      0.00      -0.01

  25    3   25      3.35     -0.45     0.00      0.00      0.00       0.01
            26     -3.38      0.55     0.00      0.00      0.00      -0.69

  26    3   26      3.42     -0.19     0.00      0.00      0.00       0.69
            27     -3.46      0.28     0.00      0.00      0.00      -1.01

  27    3   27      3.47      0.12     0.00      0.00      0.00       1.01
            28     -3.52     -0.03     0.00      0.00      0.00      -0.90

  28    3   28      3.49      0.43     0.00      0.00      0.00       0.90
            29     -3.55     -0.34     0.00      0.00      0.00      -0.38

  29    3   29      3.49      0.73     0.00      0.00      0.00       0.38
            30     -3.56     -0.65     0.00      0.00      0.00       0.56

  30    3   30     -0.76      0.14     0.00      0.00      0.00      -0.56
            31      0.68     -0.07     0.00      0.00      0.00       0.71

  31    3   31     -0.68     -0.01     0.00      0.00      0.00      -0.71
            32      0.60      0.07     0.00      0.00      0.00       0.66

  32    3   32     -0.59     -0.13     0.00      0.00      0.00      -0.66
            33      0.49      0.18     0.00      0.00      0.00       0.44

  33    3   33     -0.47     -0.24     0.00      0.00      0.00      -0.44
            34      0.37      0.28     0.00      0.00      0.00       0.09

  34    3   34     -0.34     -0.32     0.00      0.00      0.00      -0.09
            35      0.24      0.35     0.00      0.00      0.00      -0.37

  35    3   35     -0.12      0.11     0.00      0.00      0.00       0.37
            36      0.01     -0.09     0.00      0.00      0.00      -0.23
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT      AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3  36      -0.02      0.09     0.00      0.00      0.00       0.23
            37      -0.08     -0.08     0.00      0.00      0.00      -0.12

  37     3  37       0.07     -0.09     0.00      0.00      0.00      -0.12
            38      -0.19      0.10     0.00      0.00      0.00      -0.03

  38     3  38       0.18     -0.12     0.00      0.00      0.00       0.03
            39      -0.29      0.14     0.00      0.00      0.00      -0.24

  39     3  39       0.41      0.22     0.00      0.00      0.00       0.24
            40      -0.52     -0.18     0.00      0.00      0.00       0.08

  40     3  40       0.54      0.11     0.00      0.00      0.00      -0.08
            41      -0.65     -0.06     0.00      0.00      0.00       0.21

  41     3  41       0.65     -0.02     0.00      0.00      0.00      -0.21
            42      -0.75      0.09     0.00      0.00      0.00       0.13

  42     3  42       0.73     -0.18     0.00      0.00      0.00      -0.13
            43      -0.82      0.26     0.00      0.00      0.00      -0.22

  43     3  43       1.48      0.27     0.00      0.00      0.00       0.22
            44      -1.56     -0.18     0.00      0.00      0.00       0.12

  44     3  44       1.57     -0.03     0.00      0.00      0.00      -0.12
            45      -1.64      0.13     0.00      0.00      0.00       0.00


************** END OF LATEST ANALYSIS RESULT **************

 48. CHECK CODE ALL
```

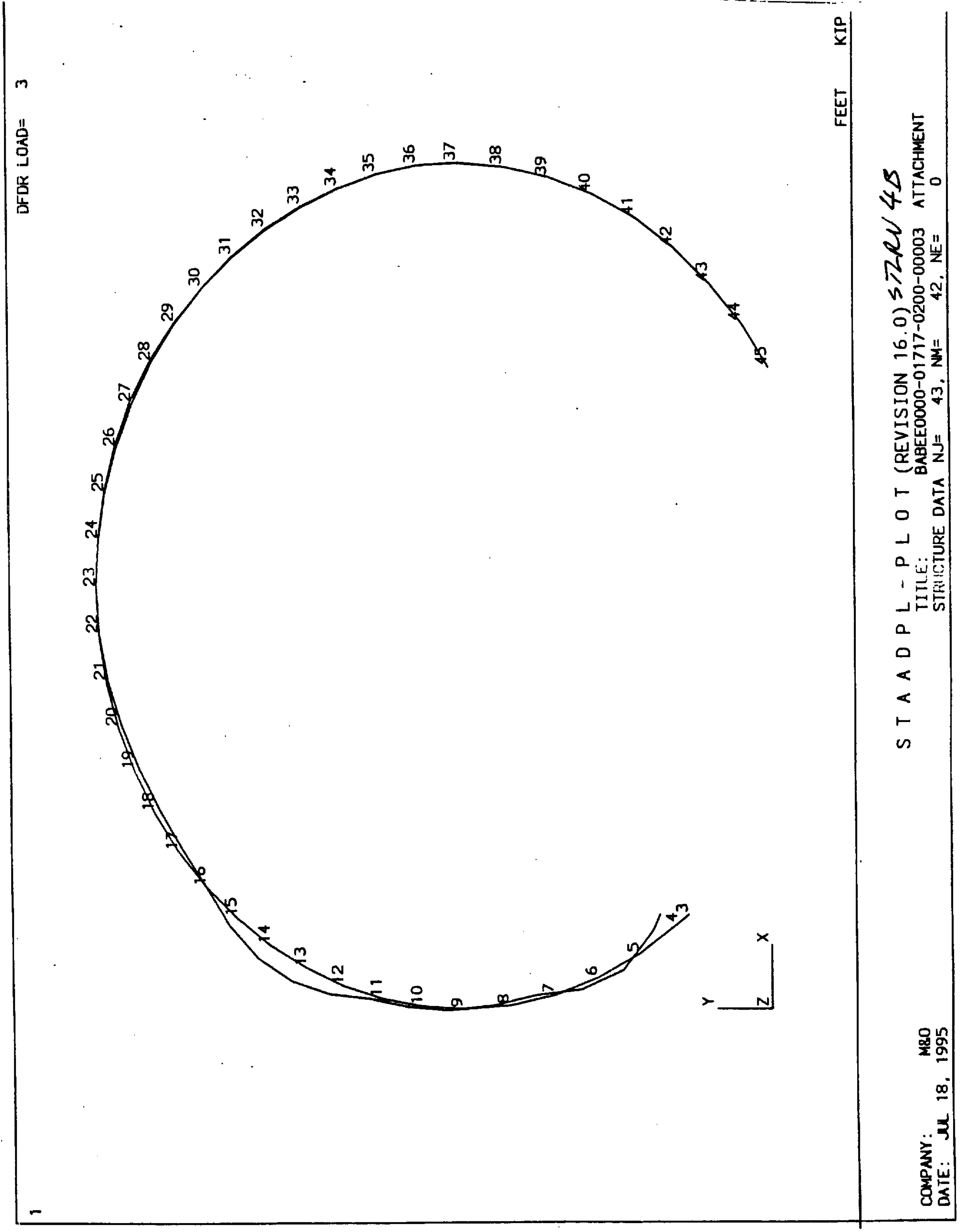
```
                         STAAD-III CODE CHECKING - (AISC)
                         ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE           RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX            MY             MZ       LOCATION
=======================================================================

     3  ST   W8X 31           PASS     AISC- H1-2        0.717         3
                          47.76 C          0.00         25.84         0.46
     4  ST   W8X 31           PASS     AISC- H1-2        0.717         3
                          47.74 C          0.00        -25.84         0.00
     5  ST   W8X 31           PASS     AISC- H1-2        0.647         3
                          46.97 C          0.00        -22.28         0.00
     6  ST   W8X 31           PASS     AISC- H1-2        0.464         3
                          45.36 C          0.00        -12.73         1.56
     7  ST   W8X 31           PASS     AISC- H1-2        0.426         3
                          37.80 C          0.00         12.73         0.00
     8  ST   W8X 31           PASS     AISC- H1-2        0.229         3
                          38.16 C          0.00          1.95         1.56
     9  ST   W8X 31           PASS     AISC- H1-2        0.229         3
                          38.15 C          0.00          1.95         0.00
    10  ST   W8X 31           PASS     AISC- H1-2        0.382         3
                          37.44 C          0.00         10.44         1.37
    11  ST   W8X 31           PASS     AISC- H1-2        0.406         3
                          42.34 C          0.00        -10.44         0.00
    12  ST   W8X 31           PASS     AISC- H1-2        0.400         3
                          43.06 C          0.00         -9.88         1.37
    13  ST   W8X 31           PASS     AISC- H1-2        0.413         3
                          43.24 C          0.00        -10.55         1.36
    14  ST   W8X 31           PASS     AISC- H1-2        0.412         3
                          43.02 C          0.00         10.55         0.00
    15  ST   W8X 31           PASS     AISC- H1-2        0.365         3
                          42.03 C          0.00          8.25         1.36
    16  ST   W8X 31           PASS     AISC- H1-3        0.165         3
                           2.61 C          0.00         -8.25         0.00
    17  ST   W8X 31           PASS     AISC- H1-3        0.121         3
                           2.72 C          0.00         -5.84         0.00
    18  ST   W8X 31           PASS     AISC- H1-3        0.083         3
                           2.83 C          0.00         -3.72         0.00
    19  ST   W8X 31           PASS     AISC- H1-3        0.050         3
                           2.91 C          0.00         -1.90         0.00
    20  ST   W8X 31           PASS     AISC- H1-3        0.030         3
                           2.95 C          0.00         -0.81         1.36
    21  ST   W8X 31           PASS     AISC- H1-3        0.047         3
                           3.02 C          0.00         -1.69         1.36
    22  ST   W8X 31           PASS     AISC- H1-3        0.047         3
                           3.15 C          0.00          1.69         0.00
    23  ST   W8X 31           PASS     SHEAR    -Y       0.036         3
                           3.03 C          0.00          0.50         0.00
    24  ST   W8X 31           PASS     AISC- H1-3        0.036         3
                           3.26 C          0.00         -1.04         0.00
    25  ST   W8X 31           PASS     AISC- H1-3        0.030         3
                           3.38 C          0.00         -0.69         1.36
    26  ST   W8X 31           PASS     AISC- H1-3        0.036         3
                           3.46 C          0.00         -1.01         1.37
```

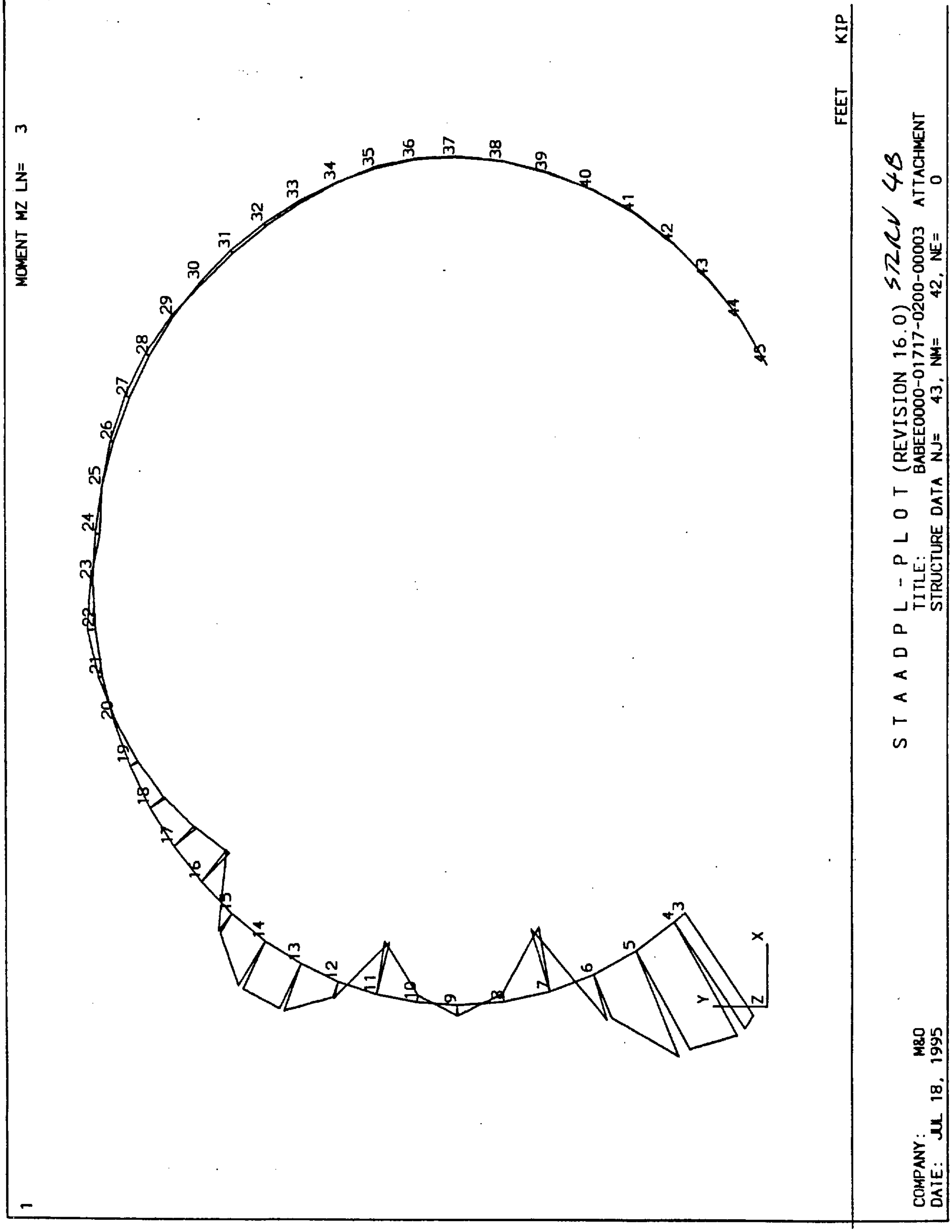
```
 L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX          MY             MZ       LOCATION
=======================================================================

    27   ST   W8X 31          PASS     AISC- H1-3         0.036          3
                        3.47 C            0.00           1.01         0.00
    28   ST   W8X 31          PASS     AISC- H1-3         0.035          3
                        3.49 C            0.00           0.90         0.00
    29   ST   W8X 1          PASS     AISC- H1-3         0.029          3
                        3.56 C            0.00           0.56         1.37
    30   ST   W8X 31          PASS     AISC- H2-1         0.016          3
                        0.68 T            0.00           0.71         1.36
    31   ST   W8X 31          PASS     AISC- H2-1         0.017          3
                        0.68 T            0.00          -0.71         0.00
    32   ST   W8X 31          PASS     AISC- H2-1         0.015          3
                        0.59 T            0.00          -0.66         0.00
    33   ST   W8X 31          PASS     AISC- H2-1         0.010          3
                        0.47 T            0.00          -0.44         0.00
    34   ST   W8X 31          PASS     SHEAR    -Y        0.011          3
                        0.24 T            0.00          -0.37         1.36
    35   ST   W8X 31          PASS     AISC- H2-1         0.007          3
                        0.12 T            0.00           0.37         0.00
    36   ST   W8X 31          PASS     AISC- H2-1         0.004          3
                        0.02 T            0.00           0.23         0.00
    37   ST   W8X 31          PASS     SHEAR    -Y        0.003          3
                        0.19 C            0.00          -0.03         1.56
    38   ST   W8X 31          PASS     AISC- H1-3         0.006          3
                        0.29 C            0.00          -0.24         1.57
    39   ST   W8X 31          PASS     SHEAR    -Y        0.007          3
                        0.41 C            0.00           0.24         0.00
    40   ST   W8X 31          PASS     AISC- H1-3         0.007          3
                        0.65 C            0.00           0.21         1.57
    41   ST   W8X 31          PASS     AISC- H1-3         0.007          3
                        0.65 C            0.00          -0.21         0.00
    42   ST   W8X 31          PASS     AISC- H1-3         0.008          3
                        0.82 C            0.00          -0.22         1.57
    43   ST   W8X 31          PASS     AISC- H1-3         0.012          3
                        1.48 C            0.00           0.22         0.00
    44   ST   W8X 31          PASS     AISC- H1-3         0.010          3
                        1.57 C            0.00          -0.12         0.00


  ************** END OF TABULATED RESULT OF DESIGN **************


   49. PLOT DISPLACEMENT FILE
   50. PLOT BENDING FILE
   51. FINISH


      *************** END OF STAAD-III ***************

 DATE= JUL 18,1995   TIME=  8:27: 0 ******
```



S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0

COMPANY: M&O
DATE: APR 24, 1995


DFDR LOAD= 3
FEET
KIP
S T A A D P L - P L O T (REVISION 16.0) STRU 4B
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
1
X
Y
Z
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45


MOMENT MZ LN= 3
FEET
KIP
S T A A D P L - P L O T (REVISION 16.0)
STRV 4B
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
1
X
Y
Z
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

```
     **************************************************
     *                                                *
     *           S T A A D - III                      *
     *           Revision 16.0b                       *
     *           Proprietary Program of               *
     *           RESEARCH ENGINEERS, Inc.             *
     *           Date=    JUL 18, 1995                *
     *           Time=    11:28:30                    *
     *                                                *
     **************************************************


  1. STAAD PLANE  BABEE0000-01717-0200-00003  ATTACHMENT  I
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. *
  4. * FILE STLRV4C
  5. * 25 TON JACK APPLIED ONE SIDE @ 47 DEGREES
  6. * MOMENT MZ RELEASED AT THE END OF MEMBERS 15 & 29
  7. * MOMENT MZ RELEASED AT THE START OF MEMBERS 16 & 30
  8. UNIT FT KIP
  9. JOINT COORDINATES
 10. 3 3.27 2.13 ; 4 2.43 3.13
 11. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 12. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 13. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 14. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 15. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 16. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 17. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 18. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 19. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 20. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 20.88 1.94 ; 44 19.72 0.89
 21. 45 18.43 0.00
 22. MEMBER INCIDENCE
 23. 3 3 4 44
 24. UNIT KIP INCH
 25. MEMBER RELEASE
 26. 15 29 END MZ
 27. 16 30 START MZ
 28. MEMBER PROPERTIES
 29. 3 TO 44 TA STA W8X31
 30. CONSTANTS
 31. E 29000.0 ALL
 32. DENSITY 0.00028 ALL
 33. BETA 0 ALL
 34. UNIT FT
 35. SUPPORT
 36. 3 7 11 35 39 43 FIXED BUT FY MZ
 37. 22 24 FIXED BUT FX MZ
 38. 16 30 45 PINNED
 39. UNIT KIP
 40. LOAD 1
 41. SELF WEIGHT Y -1.0
 42. LOADING 2                                  45. 3 FX -34.1
 43. * 25 TON JACK & ONE SIDED JACKING          46. 3 FY 36.57
 44. JOINT LOADING                              47. 3 MZ 25.00
```

```
  48. LOADING COMBINATION 3
  49. 1 2.5 2 1.0
  50. PERFORM ANALYSIS

         P R O B L E M   S T A T I S T I C S
         -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    43/   42/   11
   ORIGINAL/FINAL BAND-WIDTH =     1/     1
   TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =   115
   SIZE OF STIFFNESS MATRIX =      690 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =     0.08 MEGA-BYTES

++ PROCESSING ELEMENT STIFFNESS MATRIX.                  11:28:33
++ PROCESSING GLOBAL STIFFNESS MATRIX.                   11:28:34
++ PROCESSING TRIANGULAR FACTORIZATION.                  11:28:34
++ CALCULATING JOINT DISPLACEMENTS.                      11:28:35
++ CALCULATING MEMBER  FORCES.                           11:28:35

  51. LOAD LIST 3
  52. PRINT ANALYSIS RESULTS
```

```
 JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
 ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

    3     3   0.00000   0.06910   0.00000   0.00000   0.00000   0.00342
    4     3  -0.03097   0.03955   0.00000   0.00000   0.00000   0.00186
    5     3  -0.04236   0.02831   0.00000   0.00000   0.00000   0.00008
    6     3  -0.02702   0.03218   0.00000   0.00000   0.00000  -0.00100
    7     3   0.00000   0.03808   0.00000   0.00000   0.00000  -0.00077
    8     3   0.00352   0.03621   0.00000   0.00000   0.00000  -0.00011
    9     3   0.00263   0.03360   0.00000   0.00000   0.00000   0.00003
   10     3   0.00239   0.03141   0.00000   0.00000   0.00000   0.00013
   11     3   0.00000   0.02960   0.00000   0.00000   0.00000   0.00056
   12     3  -0.01765   0.03201   0.00000   0.00000   0.00000   0.00079
   13     3  -0.03021   0.03454   0.00000   0.00000   0.00000   0.00030
   14     3  -0.03095   0.03205   0.00000   0.00000   0.00000  -0.00050
   15     3  -0.01909   0.02056   0.00000   0.00000   0.00000  -0.00127
   16     3   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   17     3   0.00016  -0.00024   0.00000   0.00000   0.00000  -0.00001
   18     3   0.00024  -0.00042   0.00000   0.00000   0.00000  -0.00001
   19     3   0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
   20     3   0.00019  -0.00043   0.00000   0.00000   0.00000   0.00001
   21     3   0.00010  -0.00023   0.00000   0.00000   0.00000   0.00001
   22     3   0.00003   0.00000   0.00000   0.00000   0.00000   0.00001
   23     3   0.00000   0.00005   0.00000   0.00000   0.00000   0.00000
   24     3  -0.00003   0.00000   0.00000   0.00000   0.00000  -0.00001
   25     3  -0.00010  -0.00023   0.00000   0.00000   0.00000  -0.00001
   26     3  -0.00019  -0.00043   0.00000   0.00000   0.00000  -0.00001
   27     3  -0.00025  -0.00050   0.00000   0.00000   0.00000   0.00000
   28     3  -0.00024  -0.00042   0.00000   0.00000   0.00000   0.00001
   29     3  -0.00016  -0.00024   0.00000   0.00000   0.00000   0.00001
   30     3   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
   31     3  -0.00055  -0.00056   0.00000   0.00000   0.00000  -0.00003
   32     3  -0.00087  -0.00085   0.00000   0.00000   0.00000  -0.00001
   33     3  -0.00084  -0.00087   0.00000   0.00000   0.00000   0.00001
   34     3  -0.00048  -0.00076   0.00000   0.00000   0.00000   0.00002
   35     3   0.00000  -0.00065   0.00000   0.00000   0.00000   0.00002
   36     3   0.00012  -0.00064   0.00000   0.00000   0.00000   0.00000
   37     3   0.00010  -0.00065   0.00000   0.00000   0.00000   0.00000
   38     3   0.00002  -0.00065   0.00000   0.00000   0.00000   0.00000
   39     3   0.00000  -0.00063   0.00000   0.00000   0.00000   0.00001
   40     3   0.00025  -0.00069   0.00000   0.00000   0.00000   0.00001
   41     3   0.00037  -0.00072   0.00000   0.00000   0.00000   0.00000
   42     3   0.00024  -0.00059   0.00000   0.00000   0.00000  -0.00001
   43     3   0.00000  -0.00033   0.00000   0.00000   0.00000  -0.00001
   44     3   0.00006  -0.00025   0.00000   0.00000   0.00000  -0.00001
   45     3   0.00000   0.00000   0.00000   0.00000   0.00000  -0.00001
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X      MOM-Y      MOM Z

   3     3      6.37      0.00      0.00       0.00       0.00       0.00
   7     3     27.80      0.00      0.00       0.00       0.00       0.00
  11     3     21.31      0.00      0.00       0.00       0.00       0.00
  35     3      0.43      0.00      0.00       0.00       0.00       0.00
  39     3     -0.31      0.00      0.00       0.00       0.00       0.00
  43     3     -0.84      0.00      0.00       0.00       0.00       0.00
  22     3      0.00      0.20      0.00       0.00       0.00       0.00
  24     3      0.00      0.20      0.00       0.00       0.00       0.00
  16     3    -20.92    -34.61      0.00       0.00       0.00       0.00
  30     3     -0.83      1.33      0.00       0.00       0.00       0.00
  45     3      1.08      0.89      0.00       0.00       0.00       0.00
```

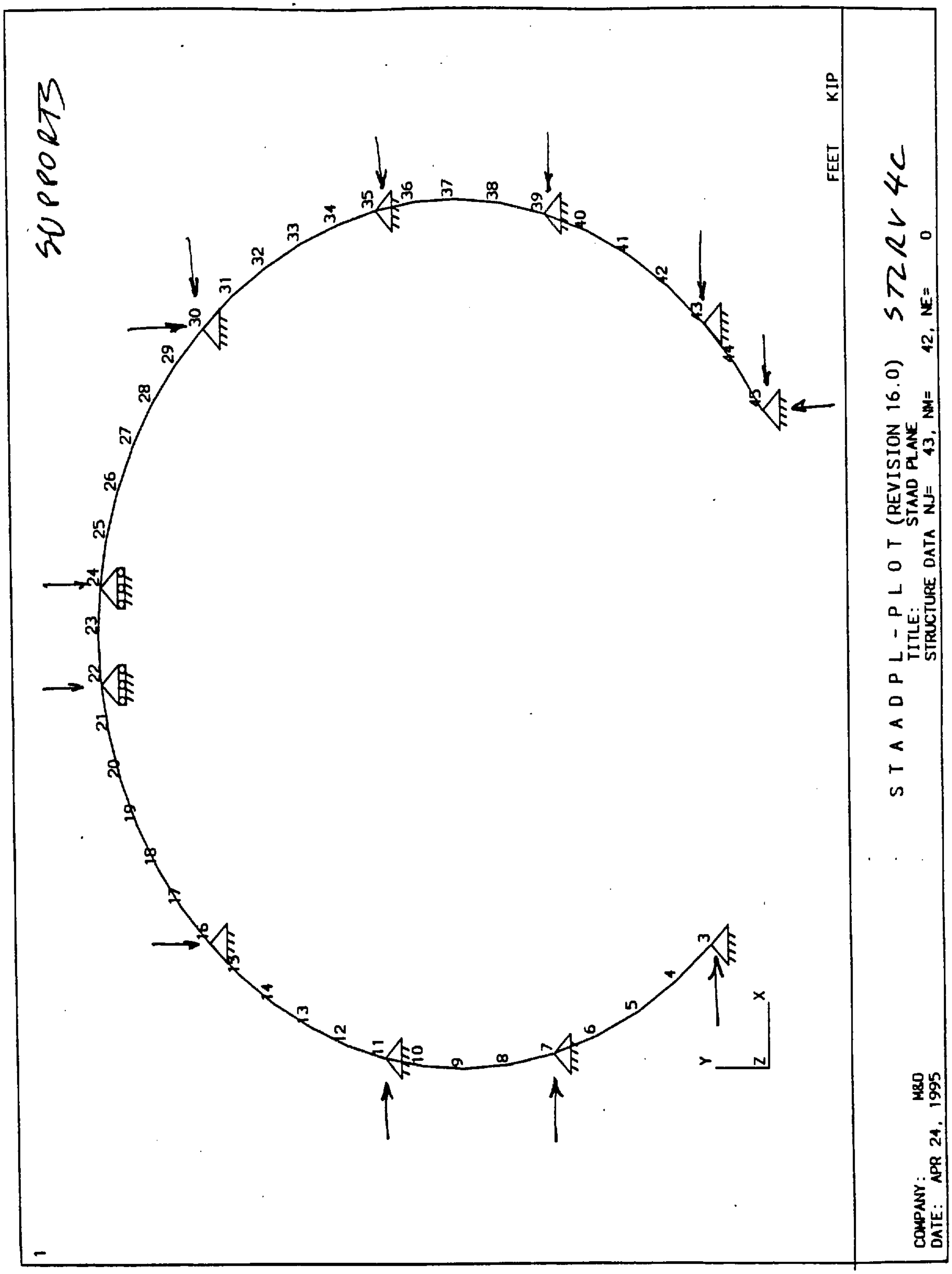
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

   3     3   3     45.84      2.29     0.00      0.00      0.00     -25.00
             4    -45.76     -2.22     0.00      0.00      0.00      27.95

   4     3   4     45.69     -3.41     0.00      0.00      0.00     -27.95
             5    -45.59      3.48     0.00      0.00      0.00      22.57

   5     3   5     44.79     -9.19     0.00      0.00      0.00     -22.57
             6    -44.68      9.24     0.00      0.00      0.00       8.15

   6     3   6     43.20    -14.67     0.00      0.00      0.00      -8.15
             7    -43.09     14.71     0.00      0.00      0.00     -14.80

   7     3   7     35.43      6.98     0.00      0.00      0.00      14.80
             8    -35.31     -6.95     0.00      0.00      0.00      -3.88

   8     3   8     35.91      2.37     0.00      0.00      0.00       3.88
             9    -35.79     -2.37     0.00      0.00      0.00      -0.17

   9     3   9     35.81      2.03     0.00      0.00      0.00      -0.17
            10    -35.71     -2.03     0.00      0.00      0.00       2.94

  10     3  10     35.27      5.94     0.00      0.00      0.00      -2.94
            11    -35.17     -5.92     0.00      0.00      0.00      11.05

  11     3  11     40.13    -10.89     0.00      0.00      0.00     -11.05
            12    -40.03     10.92     0.00      0.00      0.00      -3.79

  12     3  12     41.07     -5.93     0.00      0.00      0.00       3.79
            13    -40.97      5.97     0.00      0.00      0.00     -11.92

  13     3  13     41.36     -1.77     0.00      0.00      0.00      11.92
            14    -41.27      1.82     0.00      0.00      0.00     -14.35

  14     3  14     41.21      2.90     0.00      0.00      0.00      14.35
            15    -41.13     -2.84     0.00      0.00      0.00     -10.42

  15     3  15     40.50      7.70     0.00      0.00      0.00      10.42
            16    -40.42     -7.63     0.00      0.00      0.00       0.00

  16     3  16      0.70      0.09     0.00      0.00      0.00       0.00
            17     -0.63     -0.01     0.00      0.00      0.00       0.07

  17     3  17      0.62      0.03     0.00      0.00      0.00      -0.07
            18     -0.56      0.01     0.00      0.00      0.00       0.12

  18     3  18      0.56      0.06     0.00      0.00      0.00      -0.12
            19     -0.51      0.03     0.00      0.00      0.00       0.13
```

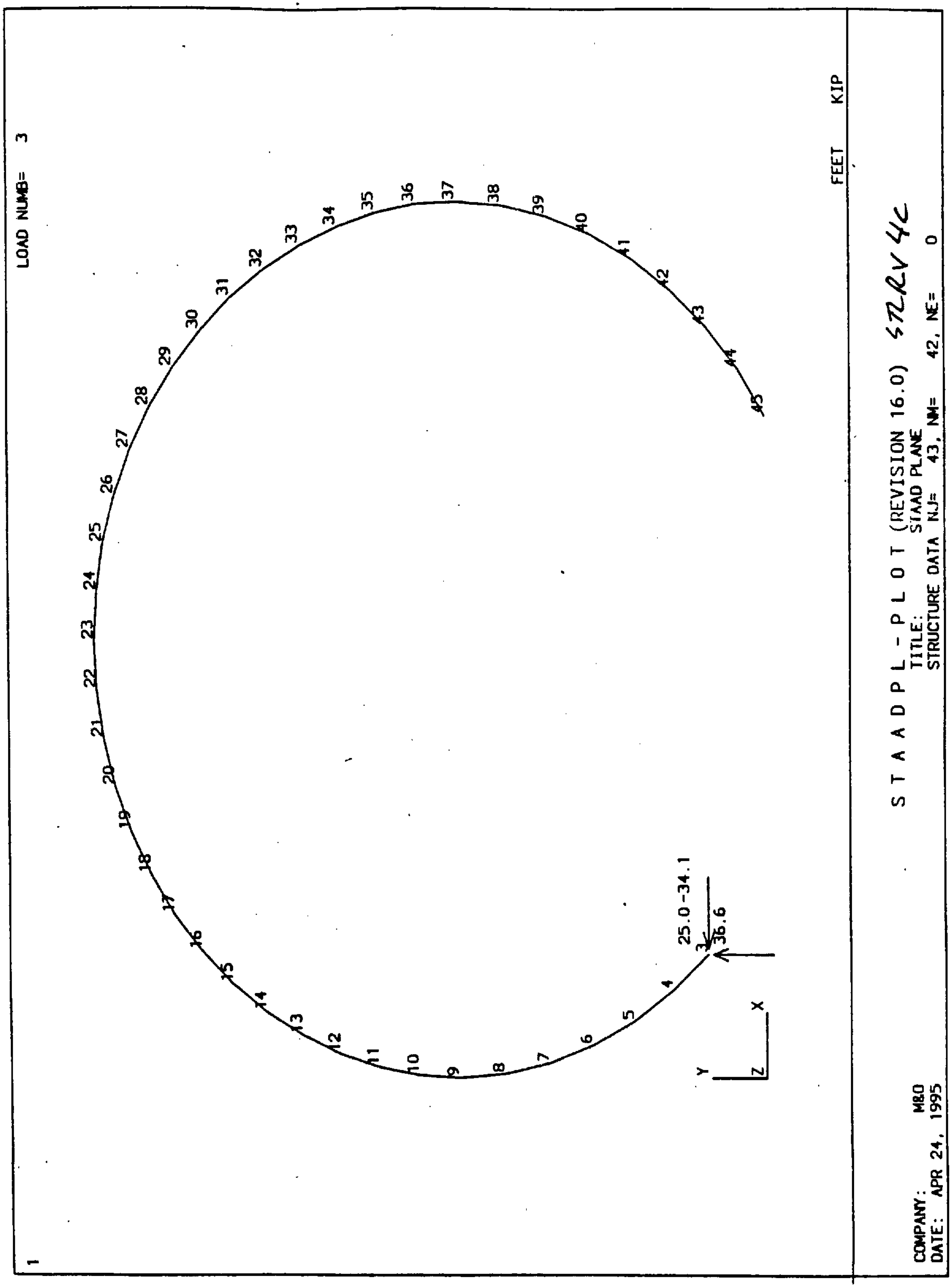
```
 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  19    3   19      0.51      0.02     0.00      0.00      0.00      -0.13
            20     -0.47      0.07     0.00      0.00      0.00       0.10

  20    3   20      0.48     -0.02     0.00      0.00      0.00      -0.10
            21     -0.45      0.12     0.00      0.00      0.00       0.00

  21    3   21      0.46     -0.07     0.00      0.00      0.00       0.00
            22     -0.44      0.17     0.00      0.00      0.00      -0.16

  22    3   22      0.47      0.08     0.00      0.00      0.00       0.16
            23     -0.46      0.03     0.00      0.00      0.00      -0.13

  23    3   23      0.46      0.03     0.00      0.00      0.00       0.13
            24     -0.47      0.08     0.00      0.00      0.00      -0.16

  24    3   24      0.44      0.17     0.00      0.00      0.00       0.16
            25     -0.46     -0.07     0.00      0.00      0.00       0.00

  25    3   25      0.45      0.12     0.00      0.00      0.00       0.00
            26     -0.48     -0.02     0.00      0.00      0.00       0.10

  26    3   26      0.47      0.07     0.00      0.00      0.00      -0.10
            27     -0.51      0.03     0.00      0.00      0.00       0.13

  27    3   27      0.51      0.03     0.00      0.00      0.00      -0.13
            28     -0.56      0.06     0.00      0.00      0.00       0.12

  28    3   28      0.56      0.01     0.00      0.00      0.00      -0.12
            29     -0.62      0.08     0.00      0.00      0.00       0.07

  29    3   29      0.63     -0.01     0.00      0.00      0.00      -0.07
            30     -0.70      0.09     0.00      0.00      0.00       0.00

  30    3   30     -0.84      0.26     0.00      0.00      0.00       0.00
            31      0.76     -0.19     0.00      0.00      0.00       0.31

  31    3   31     -0.78      0.10     0.00      0.00      0.00      -0.31
            32      0.69     -0.04     0.00      0.00      0.00       0.40

  32    3   32     -0.69     -0.04     0.00      0.00      0.00      -0.40
            33      0.60      0.09     0.00      0.00      0.00       0.32

  33    3   33     -0.59     -0.16     0.00      0.00      0.00      -0.32
            34      0.49      0.20     0.00      0.00      0.00       0.08

  34    3   34     -0.47     -0.25     0.00      0.00      0.00      -0.08
            35      0.37      0.28     0.00      0.00      0.00      -0.28

  35    3   35     -0.26      0.11     0.00      0.00      0.00       0.28
            36      0.16     -0.09     0.00      0.00      0.00      -0.14
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3   36    -0.17      0.07     0.00      0.00      0.00       0.14
             37     0.06     -0.06     0.00      0.00      0.00      -0.05

  37     3   37    -0.07     -0.06     0.00      0.00      0.00      -0.05
             38    -0.05      0.06     0.00      0.00      0.00      -0.04

  38     3   38     0.04     -0.07     0.00      0.00      0.00       0.04
             39    -0.16      0.09     0.00      0.00      0.00      -0.17

  39     3   39     0.24      0.18     0.00      0.00      0.00       0.17
             40    -0.36     -0.14     0.00      0.00      0.00       0.08

  40     3   40     0.37      0.10     0.00      0.00      0.00      -0.08
             41    -0.48     -0.04     0.00      0.00      0.00       0.19

  41     3   41     0.48     -0.02     0.00      0.00      0.00      -0.19
             42    -0.58      0.09     0.00      0.00      0.00       0.11

  42     3   42     0.57     -0.16     0.00      0.00      0.00      -0.11
             43    -0.66      0.24     0.00      0.00      0.00      -0.20

  43     3   43     1.24      0.24     0.00      0.00      0.00       0.20
             44    -1.32     -0.15     0.00      0.00      0.00       0.11

  44     3   44     1.33     -0.02     0.00      0.00      0.00      -0.11
             45    -1.40      0.12     0.00      0.00      0.00       0.00


 ************** END OF LATEST ANALYSIS RESULT **************

  53. CHECK CODE ALL
```

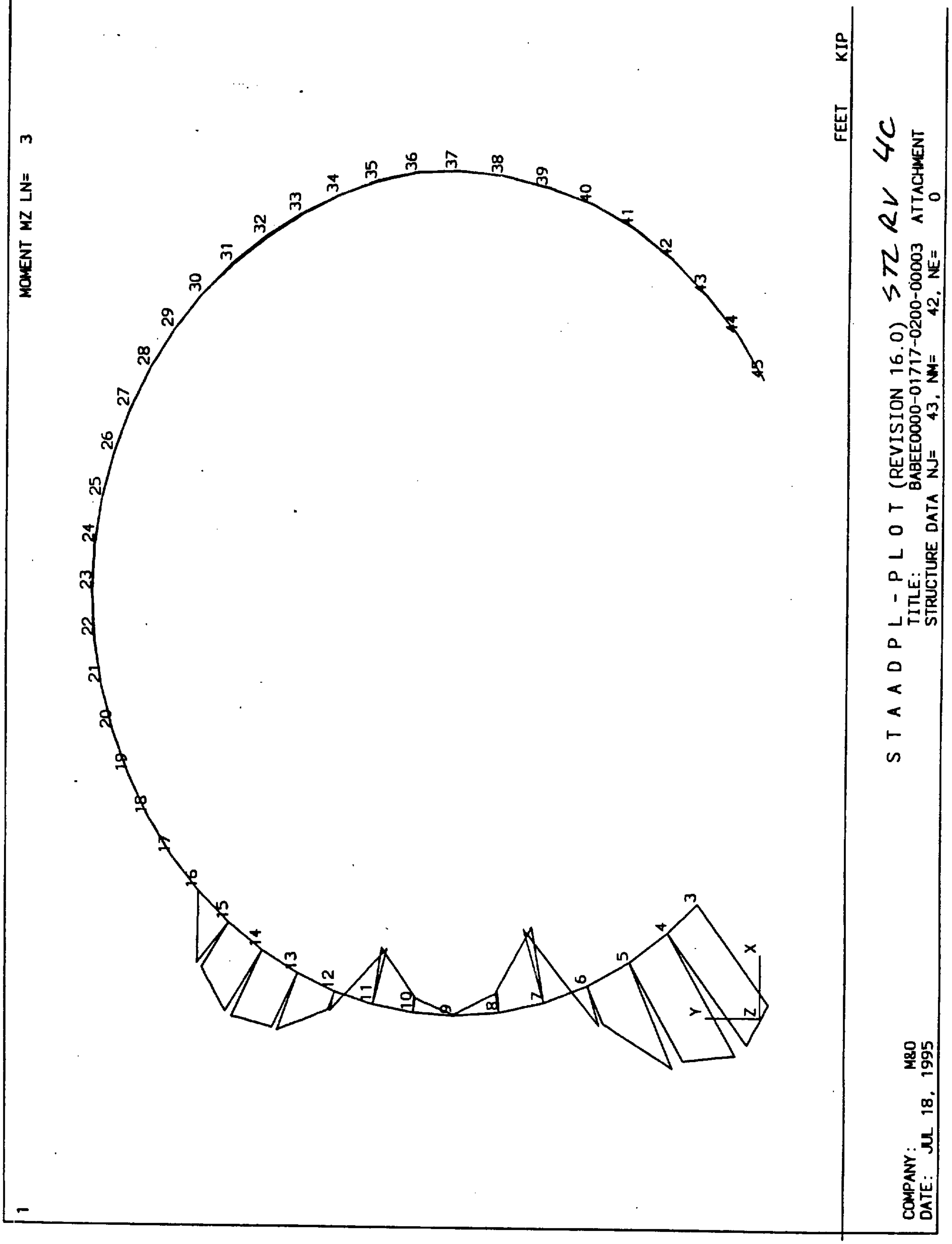
```
                    STAAD-III CODE CHECKING - (AISC)
                    ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY             MZ       LOCATION
=======================================================================

    3  ST   W8X 31          PASS     AISC- H1-2       0.745         3
                      45.76 C          0.00         27.95        1.31
    4  ST   W8X 31          PASS     AISC- H1-2       0.745         3
                      45.69 C          0.00        -27.95        0.00
    5  ST   W8X 31          PASS     AISC- H1-2       0.642         3
                      44.79 C          0.00        -22.57        0.00
    6  ST   W8X 31          PASS     AISC- H1-2       0.490         3
                      43.09 C          0.00        -14.80        1.56
    7  ST   W8X 31          PASS     AISC- H1-2       0.452         3
                      35.43 C          0.00         14.80        0.00
    8  ST   W8X 31          PASS     AISC- H1-2       0.253         3
                      35.91 C          0.00          3.88        0.00
    9  ST   W8X 31          PASS     AISC- H1-2       0.235         3
                      35.71 C          0.00          2.94        1.36
   10  ST   W8X 31          PASS     AISC- H1-2       0.381         3
                      35.17 C          0.00         11.05        1.37
   11  ST   W8X 31          PASS     AISC- H1-2       0.407         3
                      40.13 C          0.00        -11.05        0.00
   12  ST   W8X 31          PASS     AISC- H1-2       0.427         3
                      40.97 C          0.00        -11.92        1.37
   13  ST   W8X 31          PASS     AISC- H1-2       0.473         3
                      41.27 C          0.00        -14.35        1.36
   14  ST   W8X 31          PASS     AISC- H1-2       0.473         3
                      41.21 C          0.00         14.35        0.00
   15  ST   W8X 31          PASS     AISC- H1-2       0.397         3
                      40.50 C          0.00         10.42        0.00
   16  ST   W8X 31          PASS     AISC- H1-3       0.004         3
                       0.63 C          0.00          0.07        1.37
   17  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.56 C          0.00          0.12        1.36
   18  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.56 C          0.00         -0.12        0.00
   19  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.51 C          0.00         -0.13        0.00
   20  ST   W8X 31          PASS     AISC- H1-3       0.004         3
                       0.48 C          0.00         -0.10        0.00
   21  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.44 C          0.00         -0.16        1.36
   22  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.47 C          0.00          0.16        0.00
   23  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.47 C          0.00         -0.16        1.36
   24  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.44 C          0.00          0.16        0.00
   25  ST   W8X 31          PASS     AISC- H1-3       0.004         3
                       0.48 C          0.00          0.10        1.36
   26  ST   W8X 31          PASS     AISC- H1-3       0.005         3
                       0.51 C          0.00          0.13        1.37
```

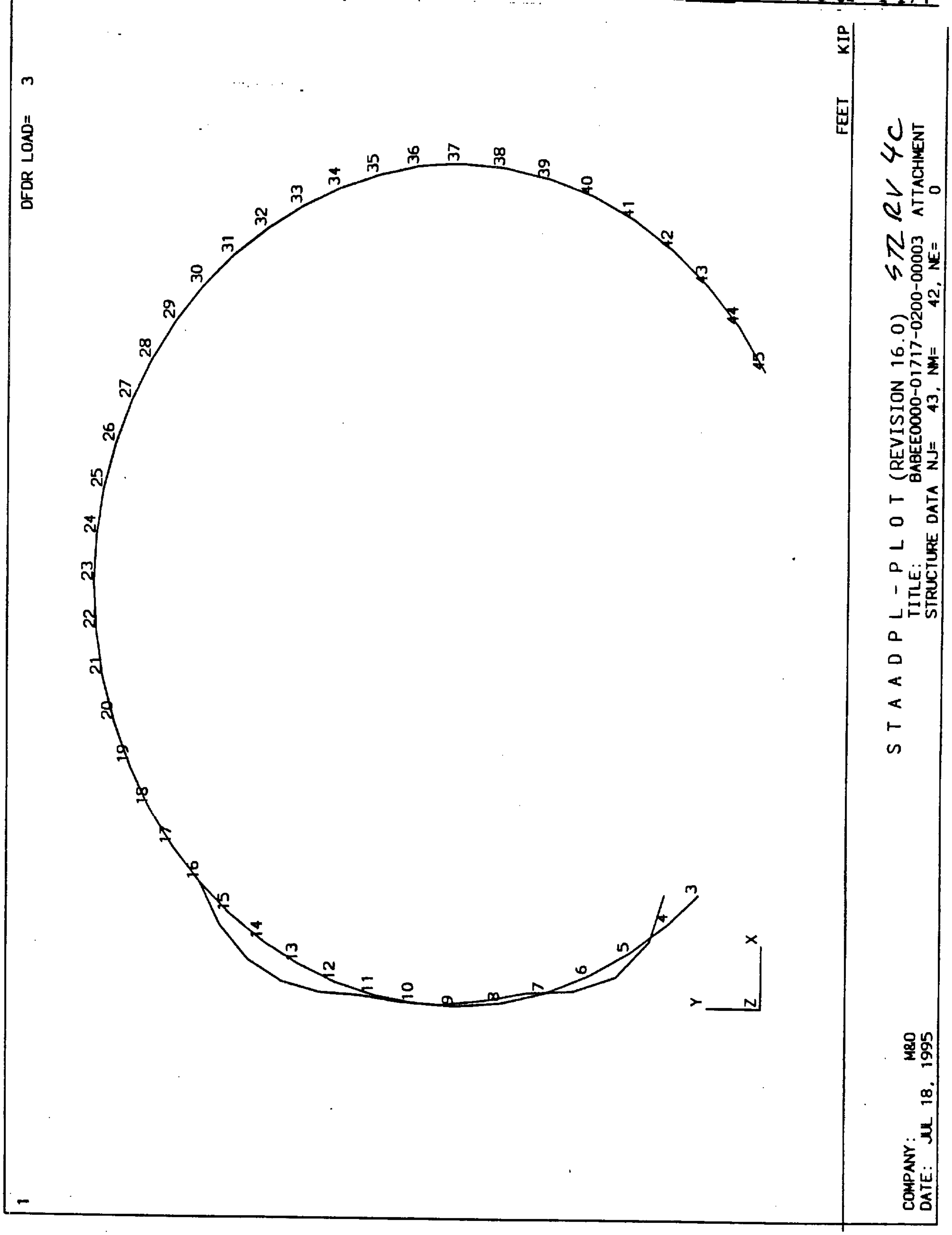
```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY             MZ       LOCATION
=======================================================================

   27  ST   W8X 31          PASS     AISC- H1-3        0.005        3
                        0.51 C           0.00         -0.13       0.00
   28  ST   W8X 31          PASS     AISC- H1-3        0.005        3
                        0.56 C           0.00         -0.12       0.00
   29  ST   W8X 31          PASS     AISC- H1-3        0.004        3
                        0.63 C           0.00         -0.07       0.00
   30  ST   W8X 31          PASS     AISC- H2-1        0.010        3
                        0.76 T           0.00          0.31       1.36
   31  ST   W8X 31          PASS     AISC- H2-1        0.011        3
                        0.69 T           0.00          0.40       1.37
   32  ST   W8X 31          PASS     AISC- H2-1        0.011        3
                        0.69 T           0.00         -0.40       0.00
   33  ST   W8X 31          PASS     AISC- H2-1        0.009        3
                        0.59 T           0.00         -0.32       0.00
   34  ST   W8X 31          PASS     SHEAR   -Y        0.008        3
                        0.37 T           0.00         -0.28       1.36
   35  ST   W8X 31          PASS     AISC- H2-1        0.006        3
                        0.26 T           0.00          0.28       0.00
   36  ST   W8X 31          PASS     AISC- H2-1        0.003        3
                        0.17 T           0.00          0.14       0.00
   37  ST   W8X 31          PASS     SHEAR   -Y        0.002        3
                        0.05 C           0.00         -0.04       1.56
   38  ST   W8X 31          PASS     AISC- H1-3        0.004        3
                        0.16 C           0.00         -0.17       1.57
   39  ST   W8X 31          PASS     SHEAR   -Y        0.006        3
                        0.24 C           0.00          0.17       0.00
   40  ST   W8X 31          PASS     AISC- H1-3        0.006        3
                        0.48 C           0.00          0.19       1.57
   41  ST   W8X 31          PASS     AISC- H1-3        0.006        3
                        0.48 C           0.00         -0.19       0.00
   42  ST   W8X 31          PASS     SHEAR   -Y        0.007        3
                        0.66 C           0.00         -0.20       1.57
   43  ST   W8X 31          PASS     AISC- H1-3        0.010        3
                        1.24 C           0.00          0.20       0.00
   44  ST   W8X 31          PASS     AISC- H1-3        0.009        3
                        1.33 C           0.00         -0.11       0.00

 ************** END OF TABULATED RESULT OF DESIGN **************


  54. PLOT DISPLACEMENT FILE
  55. PLOT BENDING FILE
  56. FINISH


     *************** END OF STAAD-III ***************

 DATE= JUL 18,1995   TIME= 11:28:39 ******
```


SUPPORTS
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
X
Y
Z
FEET KIP
STRLV 4C
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&D
DATE: APR 24, 1995
1


LOAD NUMB= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
25.0 -34.1
36.6
X
Y
Z
1
S T A A D P L - P L O T (REVISION 16.0)
TITLE: STAAD PLANE
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: APR 24, 1995

STRV 4C


MOMENT MZ LN= 3
FEET KIP
STAADPL-PLOT (REVISION 16.0)
STL RV 4C
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995
1
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
X
Y
Z


DFDR LOAD= 3
FEET KIP
1
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
X
Y
Z
S T A A D P L - P L O T (REVISION 16.0)
STL RV 4C
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT
STRUCTURE DATA NJ= 43, NM= 42, NE= 0
COMPANY: M&O
DATE: JUL 18, 1995

SUMMARY OF COMPUTER ANALYSES FOR JACKING LOADS

Analysis No.	LOAD	SCOPE	Supports	Interaction coefficient	Member	Comparison Conclusion
1. STLRV2	50T @ 47 30T @ 47 25T @ 47 Both sides	Determine jack capacity to be used	@ every 4th node	50T: 1.488 30T: 0.893 25T: 0.744	3 3 3, 4, 42	Steel set not adequate Too close Steel set adequate
2. STLRV3A	25T @ 49 Both sides	)Check W8X31 size of)steel set	@ every 4th node	0.730	3	Size of steel set W8X31 is adequate
3. STLRV3D	25T @ 51 Both sides	)Compare results of)varying the angle of)application of the jack	@ every 4th node	0.717	3,4,41,42	47 degree governs by a very small margin.
4. STLRV3B	25T @ 47 Both sides	)) Same as above)with moment released)at splice)	@ every 4th node	0.745	3,4,41,42	Moment release at splice can be accommodated by the steel set W8X31
5. STLRV3C	25T @ 49 Both sides		@ every 4th node	0.731	3	
6. STLRV3A1	25T @ 47 Both sides	)) Check stresses for) partial and full)rock engagement)	@ most nodes	0.729	3, 42	Full rock engagement governs
7. STLRV3A2	25 T @ 47 Both sides		@ all nodes	0.767	3, 42	Size of W8X31 steel set is adequate
8. STLRV4	25T @ 47 on one side	)Evaluate stresses)in the steel set due)to one side jacking)for the applicable)angles of application)of the jacking load	@ every 4th node	0.744	3, 4	Jacking from one side only, can be accommodated by the steel sets. 47 deg. governs by a small margin.
9. STLRV4A	25T @ 49 on one side		@ every 4th node	0.730	3,4	

10. STLRV4B	25T @ 51 on one side	) See above on)previous page	@ every 4th node	0.717	3, 4	
11. STLRV4C	25T @ 47 on one side	)Check stresses in the)steel set with the)moment released)at splice.	@ every 4th node	0.745	3, 4	Moment release at splice can be accommodated by the steel sets

JACKING PROCESS CONCLUSIONS

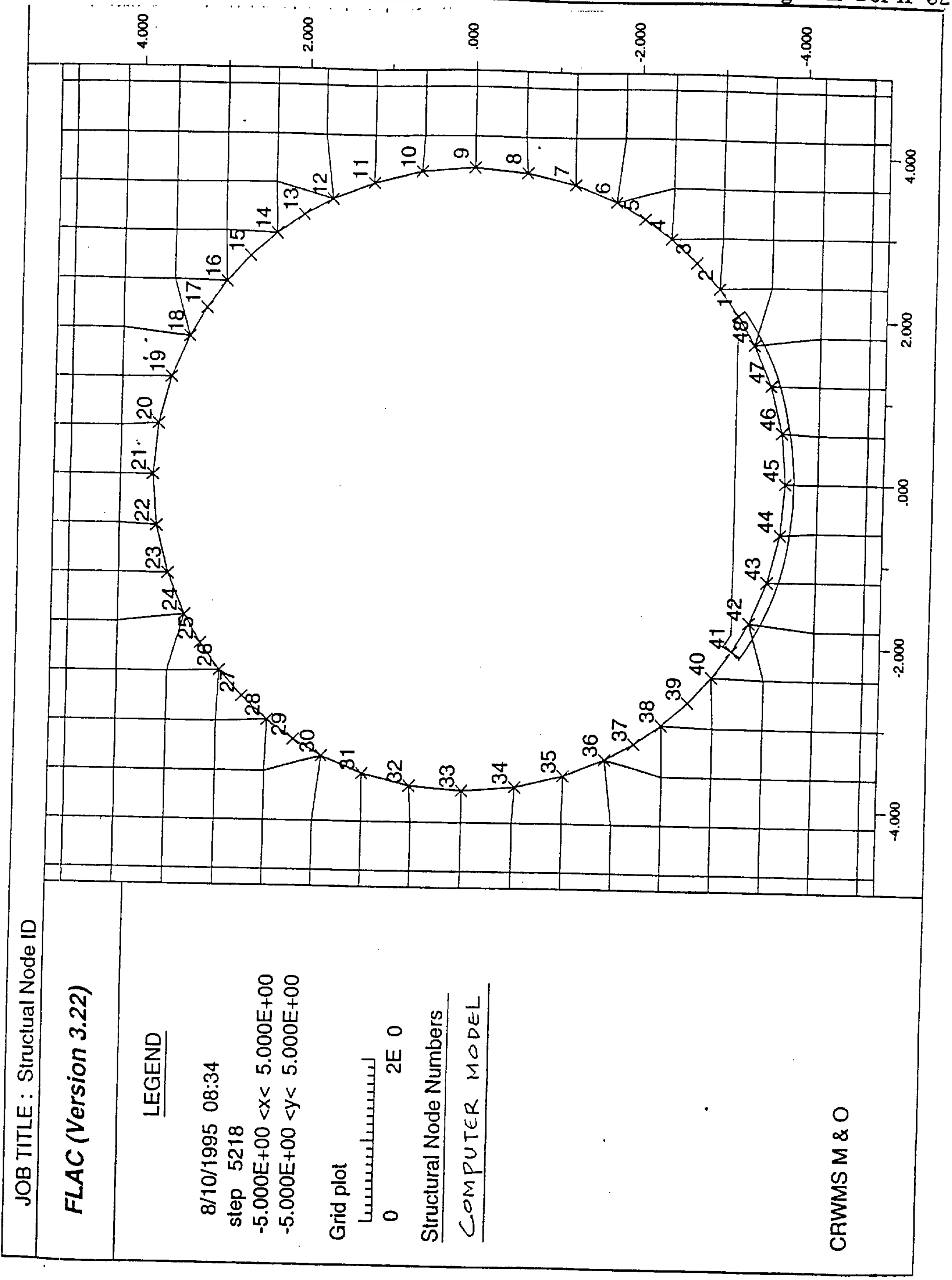
A W8X31 shape is selected as a trial member for the steel set ring member, to be verified in Attachment III, provided that the Contractor uses the following controls in the jacking procedure:

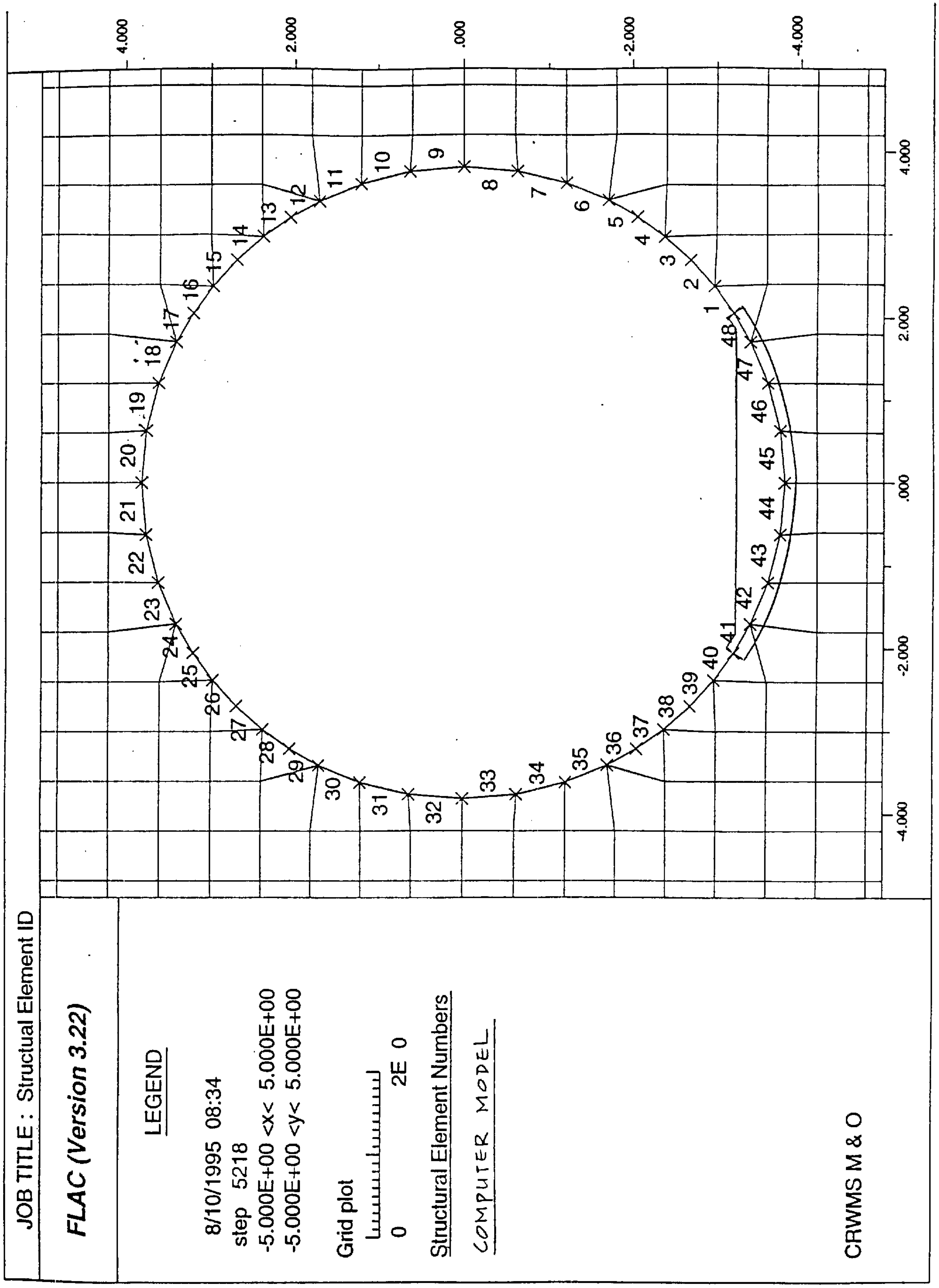
- The jacking force shall not exceed 27 tons per jack. (See File STLRV2 and Attachment III page III-27)
- The jack centerline position shall be no more than 6 inch from the X-X axis of the W8X31.
  (see pages I-7 and I - 23).
- Jacking forces may be applied on both sides or one one side only of the steel set, since stresses are the same in either condition. (See Summary of Computer Analyses for Jacking Loads).

ATTACHMENT II

ROCK LONG-TERM LOAD COMPUTER ANALYSIS RESULTS

THIS ATTACHMENT CONTAINS THE COMPUTER ANALYSIS RESULTS EXTRACTED FROM ESF GROUND SUPPORT DESIGN ANALYSIS (REFERENCE 5.20). THE RESULTS PRESENTED HERE ARE THE REPRESENTATION OF THE CATEGORY I ROCK MASS PROPERTY LOADING FOR BOTH W8X31 AND W6X20 STEEL SETS. ONLY THE FORCE RESULTS IN STEEL SET ARE INCLUDED. THE COMPUTER ANALYSIS WAS PERFORMED BY THE GEOTECHNICAL GROUP. THE ANALYSIS HAS CONSIDERED DEAD LOAD, SEISMIC LOAD AND UTILITY LOADS ON THE STEEL SET AT VARIOUS STRATA ALONG THE ESF MAIN LOOP.


JOB TITLE : Structural Node ID
FLAC (Version 3.22)
LEGEND
8/10/1995 08:34
step 5218
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00
Grid plot
0 2E 0
Structural Node Numbers
COMPUTER MODEL
CRWMS M & O
4.000
2.000
.000
-2.000
-4.000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48


JOB TITLE : Structual Element ID
FLAC (Version 3.22)
LEGEND
8/10/1995 08:34
step 5218
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00
Grid plot
0
2E 0
Structural Element Numbers
COMPUTER MODEL
CRWMS M & O
4.000
2.000
.000
-2.000
-4.000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

STATION: **PTN @ 10+00**

LOADING: **STATIC: DL+UTIL**

STEEL SET: **W8X31 @ 2'-0" O.C.**

```
* FLAC log-file opened  7-Aug-95   8:59

From File : m10k250w.sav
>or stru

 Structural node data ...
 Node          X            Y       X-disp       Y-disp     Ang-disp  Xfix  Yfix  Rfix
   48  1.704E+00 -3.408E+00  1.129E-04   2.042E-03 -4.581E-04   no    no    no
   47  1.205E+00 -3.614E+00  4.070E-05   2.265E-03 -3.911E-04   no    no    no
   46  6.264E-01 -3.758E+00  1.114E-06   2.457E-03 -2.584E-04   no    no    no
   45  0.000E+00 -3.810E+00 -5.098E-06   2.544E-03 -2.606E-05   no    no    no
   44 -6.264E-01 -3.758E+00 -9.474E-06   2.481E-03  2.330E-04   no    no    no
   43 -1.205E+00 -3.614E+00 -4.786E-05   2.287E-03  4.021E-04   no    no    no
   42 -1.704E+00 -3.408E+00 -1.223E-04   2.066E-03  4.743E-04   no    no    no
   41 -2.053E+00 -3.209E+00 -2.023E-04   1.889E-03  0.000E+00   no    no    no
   40 -2.380E+00 -2.975E+00 -2.769E-04   1.612E-03  7.118E-04   no    no    no
   39 -2.694E+00 -2.694E+00 -4.027E-04   1.293E-03  7.904E-04   no    no    no
   38 -2.975E+00 -2.380E+00 -5.480E-04   9.557E-04  7.966E-04   no    no    no
   37 -3.209E+00 -2.053E+00 -7.041E-04   6.330E-04  7.365E-04   no    no    no
   36 -3.408E+00 -1.704E+00 -8.359E-04   3.427E-04  5.202E-04   no    no    no
   35 -3.614E+00 -1.205E+00 -9.258E-04   4.610E-05  2.646E-04   no    no    no
   34 -3.758E+00 -6.264E-01 -9.793E-04  -2.593E-04  1.465E-04   no    no    no
   33 -3.810E+00  0.000E+00 -9.967E-04  -5.825E-04  3.502E-06   no    no    no
   32 -3.758E+00  6.264E-01 -9.806E-04  -9.038E-04 -1.469E-04   no    no    no
   31 -3.614E+00  1.205E+00 -9.207E-04  -1.214E-03 -2.942E-04   no    no    no
   30 -3.408E+00  1.704E+00 -8.074E-04  -1.525E-03 -5.882E-04   no    no    no
   29 -3.209E+00  2.053E+00 -6.496E-04  -1.835E-03 -8.254E-04   no    no    no
   28 -2.975E+00  2.380E+00 -4.624E-04  -2.176E-03 -9.038E-04   no    no    no
   27 -2.694E+00  2.694E+00 -2.916E-04  -2.551E-03 -8.759E-04   no    no    no
   26 -2.380E+00  2.975E+00 -1.544E-04  -2.886E-03 -7.184E-04   no    no    no
   25 -2.053E+00  3.209E+00 -8.694E-05  -3.141E-03 -5.358E-04   no    no    no
   24 -1.704E+00  3.408E+00 -4.541E-05  -3.340E-03 -4.369E-04   no    no    no
   23 -1.205E+00  3.614E+00 -1.952E-05  -3.560E-03 -3.577E-04   no    no    no
   22 -6.264E-01  3.758E+00 -1.157E-07  -3.741E-03 -2.132E-04   no    no    no
   21  0.000E+00  3.810E+00  5.438E-06  -3.795E-03  2.951E-05   no    no    no
   20  6.264E-01  3.758E+00  1.031E-05  -3.702E-03  2.658E-04   no    no    no
   19  1.205E+00  3.614E+00  3.291E-05  -3.497E-03  3.939E-04   no    no    no
   18  1.704E+00  3.408E+00  6.387E-05  -3.263E-03  4.434E-04   no    no    no
   17  2.053E+00  3.209E+00  1.053E-04  -3.071E-03  5.222E-04   no    no    no
   16  2.380E+00  2.975E+00  1.714E-04  -2.825E-03  6.812E-04   no    no    no
   15  2.694E+00  2.694E+00  2.915E-04  -2.504E-03  8.125E-04   no    no    no
   14  2.975E+00  2.380E+00  4.473E-04  -2.148E-03  8.677E-04   no    no    no
   13  3.209E+00  2.053E+00  6.333E-04  -1.802E-03  8.774E-04   no    no    no
   12  3.408E+00  1.704E+00  7.988E-04  -1.485E-03  6.260E-04   no    no    no
   11  3.614E+00  1.205E+00  9.184E-04  -1.174E-03  3.447E-04   no    no    no
   10  3.758E+00  6.264E-01  9.837E-04  -8.643E-04  1.416E-04   no    no    no
    9  3.810E+00  0.000E+00  9.995E-04  -5.484E-04 -1.104E-05   no    no    no
    8  3.758E+00 -6.264E-01  9.739E-04  -2.327E-04 -1.511E-04   no    no    no
    7  3.614E+00 -1.205E+00  9.184E-04   6.737E-05 -2.723E-04   no    no    no
    6  3.408E+00 -1.704E+00  8.188E-04   3.635E-04 -5.402E-04   no    no    no
    5  3.209E+00 -2.053E+00  6.777E-04   6.588E-04 -7.621E-04   no    no    no
    4  2.975E+00 -2.380E+00  5.134E-04   9.789E-04 -8.096E-04   no    no    no
    3  2.694E+00 -2.694E+00  3.705E-04   1.312E-03 -7.434E-04   no    no    no
    2  2.380E+00 -2.975E+00  2.604E-04   1.609E-03 -6.549E-04   no    no    no
    1  2.053E+00 -3.209E+00  1.911E-04   1.865E-03  0.000E+00   no    no    no
 Node     X-load      Y-load      Moment     i  j Pin  Sh. force   Angle    Bond
   48  0.000E+00   0.000E+00   0.000E+00   39 30  no
   47  0.000E+00   0.000E+00   0.000E+00   38 30  no
   46  0.000E+00   0.000E+00   0.000E+00   37 30  no
   45  0.000E+00   0.000E+00   0.000E+00   36 30  no
```

```
  44  0.000E+00   0.000E+00  0.000E+00  35 30  no
  43  0.000E+00   0.000E+00  0.000E+00  34 30  no
  42  0.000E+00   0.000E+00  0.000E+00  33 30  no
  41  0.000E+00  -9.099E+01  0.000E+00  33 31 yes
  40  0.000E+00  -1.381E+03  0.000E+00  32 31  no
  39  0.000E+00  -2.993E+03  0.000E+00  32 32  no
  38  0.000E+00  -2.988E+03  0.000E+00  31 32  no
  37  0.000E+00  -1.819E+02  0.000E+00  31 33  no
  36  0.000E+00  -2.131E+02  0.000E+00  30 33  no
  35  0.000E+00  -2.571E+02  0.000E+00  30 34  no
  34  0.000E+00  -2.771E+02  0.000E+00  30 35  no
  33  0.000E+00  -2.845E+02  0.000E+00  30 36  no
  32  0.000E+00  -2.771E+02  0.000E+00  30 37  no
  31  0.000E+00  -2.571E+02  0.000E+00  30 38  no
  30  0.000E+00  -2.131E+02  0.000E+00  30 39  no
  29  0.000E+00  -1.819E+02  0.000E+00  31 39  no
  28  0.000E+00  -1.863E+02  0.000E+00  31 40  no
  27  0.000E+00  -1.907E+02  0.000E+00  32 40  no
  26  0.000E+00  -1.863E+02  0.000E+00  32 41  no
  25  0.000E+00  -5.413E+03  0.000E+00  33 41  no
  24  0.000E+00  -2.131E+02  0.000E+00  33 42  no
  23  0.000E+00  -2.571E+02  0.000E+00  34 42  no
  22  0.000E+00  -2.771E+02  0.000E+00  35 42  no
  21  0.000E+00  -1.052E+04  0.000E+00  36 42  no
  20  0.000E+00  -2.771E+02  0.000E+00  37 42  no
  19  0.000E+00  -2.571E+02  0.000E+00  38 42  no
  18  0.000E+00  -2.131E+02  0.000E+00  39 42  no
  17  0.000E+00  -5.413E+03  0.000E+00  39 41  no
  16  0.000E+00  -1.863E+02  0.000E+00  40 41  no
  15  0.000E+00  -1.907E+02  0.000E+00  40 40  no
  14  0.000E+00  -1.863E+02  0.000E+00  41 40  no
  13  0.000E+00  -1.518E+04  9.085E+03  41 39  no
  12  0.000E+00  -1.521E+04  9.085E+03  42 39  no
  11  0.000E+00  -1.525E+04  9.085E+03  42 38  no
  10  0.000E+00  -2.771E+02  0.000E+00  42 37  no
   9  0.000E+00  -2.845E+02  0.000E+00  42 36  no
   8  0.000E+00  -2.771E+02  0.000E+00  42 35  no
   7  0.000E+00  -2.571E+02  0.000E+00  42 34  no
   6  0.000E+00  -2.131E+02  0.000E+00  42 33  no
   5  0.000E+00  -1.819E+02  0.000E+00  41 33  no
   4  0.000E+00  -1.863E+02  0.000E+00  41 32  no
   3  0.000E+00  -1.907E+02  0.000E+00  40 32  no
   2  0.000E+00  -1.863E+02  0.000E+00  40 31  no
   1  0.000E+00  -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop          F-shear     F-axial       Mom-1       Mom-2
   48  1   48    1     3  beam  1.805E+04  3.410E+05   7.253E+03  -7.597E-04
   47  1   47   48     3  beam  3.049E+03  2.825E+05   8.901E+03  -7.254E+03
   46  1   46   47     3  beam  1.874E+04  1.250E+05   2.007E+04  -8.902E+03
   45  1   45   46     3  beam  1.271E+04  1.413E+04   2.806E+04  -2.007E+04
   44  1   44   45     3  beam -3.905E+03  1.173E+04   2.560E+04  -2.806E+04
   43  1   43   44     3  beam -2.397E+04  1.227E+05   1.132E+04  -2.560E+04
   42  1   42   43     3  beam -9.689E+03  2.891E+05   6.082E+03  -1.132E+04
   41  1   41   42     3  beam -1.513E+04  3.543E+05  -5.462E-04  -6.083E+03
   40  2   40   41     2  beam  1.246E+04  4.875E+05   5.009E+03   1.872E-04
   39  2   39   40     2  beam -1.049E+04  5.488E+05   5.906E+02  -5.010E+03
   38  2   38   39     2  beam -1.759E+03  7.255E+05  -1.503E+02  -5.911E+02
   37  2   37   38     2  beam -1.042E+04  8.162E+05  -4.337E+03   1.477E+02
   36  2   36   37     2  beam -1.863E+04  9.068E+05  -1.182E+04   4.336E+03
```

```
 35  2   35   36    2  beam  1.747E+04  8.610E+05 -2.383E+03  1.182E+04
 34  2   34   35    2  beam -1.985E+03  9.420E+05 -3.565E+03  2.382E+03
 33  2   33   34    2  beam  4.821E+02  9.861E+05 -3.263E+03  3.566E+03
 32  2   32   33    2  beam -1.053E+03  9.899E+05 -3.924E+03  3.262E+03
 31  2   31   32    2  beam  7.175E+02  9.502E+05 -3.495E+03  3.923E+03
 30  2   30   31    2  beam -1.730E+04  8.707E+05 -1.284E+04  3.496E+03
 29  2   29   30    2  beam  1.981E+04  9.220E+05 -4.876E+03  1.284E+04
 28  2   28   29    2  beam  9.680E+03  8.187E+05 -9.844E+02  4.875E+03
 27  2   27   28    2  beam  9.388E+03  7.643E+05  2.971E+03  9.849E+02
 26  2   26   27    2  beam  1.254E+04  5.683E+05  8.253E+03 -2.969E+03
 25  2   25   26    2  beam -7.132E+03  4.624E+05  5.385E+03 -8.251E+03
 24  2   24   25    2  beam -8.413E+03  2.882E+05  2.003E+03 -5.385E+03
 23  2   23   24    2  beam  7.243E+02  2.178E+05  2.396E+03 -2.005E+03
 22  2   22   23    2  beam  4.179E+03  7.996E+04  4.884E+03 -2.393E+03
 21  2   21   22    2  beam  2.902E+03 -3.030E+03  6.709E+03 -4.885E+03
 20  2   20   21    2  beam -3.396E+03  5.596E+03  4.576E+03 -6.710E+03
 19  2   19   20    2  beam -4.519E+03  8.945E+04  1.880E+03 -4.573E+03
 18  2   18   19    2  beam -1.868E+03  2.188E+05  8.704E+02 -1.879E+03
 17  2   17   18    2  beam  1.031E+04  2.779E+05  5.017E+03 -8.735E+02
 16  2   16   17    2  beam  4.578E+03  4.457E+05  6.856E+03 -5.016E+03
 15  2   15   16    2  beam -1.035E+04  5.716E+05  2.496E+03 -6.857E+03
 14  2   14   15    2  beam -2.528E+03  7.514E+05  1.435E+03 -2.500E+03
 13  2   13   14    2  beam -5.343E+03  8.371E+05 -7.126E+02 -1.435E+03
 12  2   12   13    2  beam  2.033E+03  9.393E+05 -8.980E+03  9.798E+03
 11  2   11   12    2  beam  3.794E+04  8.681E+05  2.429E+03  1.806E+04
 10  2   10   11    2  beam  5.168E+03  9.376E+05 -3.574E+03  6.654E+03
  9  2    9   10    2  beam -2.231E+02  9.701E+05 -3.715E+03  3.575E+03
  8  2    8    9    2  beam  1.178E+03  9.666E+05 -2.975E+03  3.715E+03
  7  2    7    8    2  beam -2.511E+02  9.259E+05 -3.126E+03  2.976E+03
  6  2    6    7    2  beam -1.599E+04  8.476E+05 -1.176E+04  3.127E+03
  5  2    5    6    2  beam  1.730E+04  8.952E+05 -4.809E+03  1.176E+04
  4  2    4    5    2  beam  1.511E+04  8.020E+05  1.263E+03  4.811E+03
  3  2    3    4    2  beam  5.194E+03  7.072E+05  3.451E+03 -1.263E+03
  2  2    2    3    2  beam -1.416E+03  5.300E+05  2.855E+03 -3.452E+03
  1  2    1    2    2  beam -7.099E+03  4.667E+05 -7.314E-06 -2.854E+03

Structural Properties ...
 Prop                                             Dynamic      Plastic
 Num.      Area          E            I           Density       Moment
 ----  -----------  -----------  -----------  -----------  -----------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   5.90000E-03  3.27870E+11  4.57800E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.  Stiffness    Strength      Strength       Yield      Stiffness
 ----  -----------  -----------  -----------  -----------  -----------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

> set log off
* log-file recording stopped  7-Aug-95   8:59
```

STATION: **TSW1 @ 18+00**

LOADING: **STATIC: DL+UTIL**

STEEL SET: **W8X31 @ 4'-0" O.C.**

```
.* FLAC log-file opened  5-Aug-95   8:42

From File : m18k250w.sav
>pr stru

 structural node data ...
 Node       X          Y         X-disp      Y-disp     Ang-disp  Xfix  Yfix  Rfix
  48  1.704E+00 -3.408E+00  7.423E-05  1.625E-03 -2.621E-04   no    no    no
  47  1.205E+00 -3.614E+00  3.068E-05  1.744E-03 -1.949E-04   no    no    no
  46  6.264E-01 -3.758E+00  1.017E-05  1.828E-03 -1.012E-04   no    no    no
  45  0.000E+00 -3.810E+00  7.714E-06  1.849E-03  1.268E-05   no    no    no
  44 -6.264E-01 -3.758E+00  3.380E-06  1.813E-03  1.315E-04   no    no    no
  43 -1.205E+00 -3.614E+00 -2.070E-05  1.709E-03  2.165E-04   no    no    no
  42 -1.704E+00 -3.408E+00 -6.614E-05  1.587E-03  2.666E-04   no    no    no
  41 -2.053E+00 -3.209E+00 -1.148E-04  1.487E-03  0.000E+00   no    no    no
  40 -2.380E+00 -2.975E+00 -1.336E-04  1.360E-03  2.772E-04   no    no    no
  39 -2.694E+00 -2.694E+00 -1.634E-04  1.231E-03  2.824E-04   no    no    no
  38 -2.975E+00 -2.380E+00 -1.835E-04  1.076E-03  2.649E-04   no    no    no
  37 -3.209E+00 -2.053E+00 -1.933E-04  9.128E-04  2.686E-04   no    no    no
  36 -3.408E+00 -1.704E+00 -2.120E-04  7.240E-04  2.391E-04   no    no    no
  35 -3.614E+00 -1.205E+00 -2.074E-04  4.695E-04  1.380E-04   no    no    no
  34 -3.758E+00 -6.264E-01 -2.005E-04  1.471E-04  9.709E-05   no    no    no
  33 -3.810E+00  0.000E+00 -2.041E-04 -2.304E-04  3.711E-06   no    no    no
  32 -3.758E+00  6.264E-01 -2.032E-04 -6.049E-04 -9.814E-05   no    no    no
  31 -3.614E+00  1.205E+00 -2.138E-04 -9.372E-04 -1.201E-04   no    no    no
  30 -3.408E+00  1.704E+00 -2.245E-04 -1.189E-03 -2.562E-04   no    no    no
  29 -3.209E+00  2.053E+00 -1.953E-04 -1.392E-03 -3.172E-04   no    no    no
  28 -2.975E+00  2.380E+00 -1.784E-04 -1.564E-03 -2.725E-04   no    no    no
  27 -2.694E+00  2.694E+00 -1.638E-04 -1.719E-03 -2.603E-04   no    no    no
  26 -2.380E+00  2.975E+00 -1.407E-04 -1.843E-03 -2.645E-04   no    no    no
  25 -2.053E+00  3.209E+00 -1.154E-04 -1.959E-03 -2.778E-04   no    no    no
  24 -1.704E+00  3.408E+00 -7.995E-05 -2.053E-03 -2.150E-04   no    no    no
  23 -1.205E+00  3.614E+00 -5.530E-05 -2.155E-03 -2.079E-04   no    no    no
  22 -6.264E-01  3.758E+00 -1.871E-05 -2.298E-03 -2.605E-04   no    no    no
  21  0.000E+00  3.810E+00 -2.584E-06 -2.389E-03  6.708E-06   no    no    no
  20  6.264E-01  3.758E+00  1.590E-05 -2.287E-03  2.889E-04   no    no    no
  19  1.205E+00  3.614E+00  5.725E-05 -2.122E-03  2.560E-04   no    no    no
  18  1.704E+00  3.408E+00  8.134E-05 -2.007E-03  1.993E-04   no    no    no
  17  2.053E+00  3.209E+00  1.032E-04 -1.917E-03  2.533E-04   no    no    no
  16  2.380E+00  2.975E+00  1.253E-04 -1.798E-03  2.601E-04   no    no    no
  15  2.694E+00  2.694E+00  1.495E-04 -1.685E-03  2.447E-04   no    no    no
  14  2.975E+00  2.380E+00  1.621E-04 -1.540E-03  2.452E-04   no    no    no
  13  3.209E+00  2.053E+00  1.786E-04 -1.370E-03  3.780E-04   no    no    no
  12  3.408E+00  1.704E+00  2.132E-04 -1.162E-03  3.150E-04   no    no    no
  11  3.614E+00  1.205E+00  2.151E-04 -9.099E-04  2.188E-04   no    no    no
  10  3.758E+00  6.264E-01  2.096E-04 -5.809E-04  7.447E-05   no    no    no
   9  3.810E+00  0.000E+00  2.076E-04 -2.057E-04  9.770E-07   no    no    no
   8  3.758E+00 -6.264E-01  2.052E-04  1.731E-04 -1.001E-04   no    no    no
   7  3.614E+00 -1.205E+00  2.116E-04  5.039E-04 -1.410E-04   no    no    no
   6  3.408E+00 -1.704E+00  2.152E-04  7.609E-04 -2.494E-04   no    no    no
   5  3.209E+00 -2.053E+00  1.895E-04  9.511E-04 -2.773E-04   no    no    no
   4  2.975E+00 -2.380E+00  1.808E-04  1.112E-03 -2.599E-04   no    no    no
   3  2.694E+00 -2.694E+00  1.645E-04  1.269E-03 -2.706E-04   no    no    no
   2  2.380E+00 -2.975E+00  1.420E-04  1.400E-03 -2.736E-04   no    no    no
   1  2.053E+00 -3.209E+00  1.231E-04  1.524E-03  0.000E+00   no    no    no
 Node    X-load     Y-load     Moment     i  j  Pin   Sh. force    Angle    Bond
  48  0.000E+00  0.000E+00  0.000E+00  39 30  no
  47  0.000E+00  0.000E+00  0.000E+00  38 30  no
  46  0.000E+00  0.000E+00  0.000E+00  37 30  no
  45  0.000E+00  0.000E+00  0.000E+00  36 30  no
```

```
  44   0.000E+00   0.000E+00   0.000E+00   35 30   no
  43   0.000E+00   0.000E+00   0.000E+00   34 30   no
  42   0.000E+00   0.000E+00   0.000E+00   33 30   no
  41   0.000E+00  -9.099E+01   0.000E+00   33 31  yes
  40   0.000E+00  -1.381E+03   0.000E+00   32 31   no
  39   0.000E+00  -2.993E+03   0.000E+00   32 32   no
  38   0.000E+00  -2.988E+03   0.000E+00   31 32   no
  37   0.000E+00  -1.819E+02   0.000E+00   31 33   no
  36   0.000E+00  -2.131E+02   0.000E+00   30 33   no
  35   0.000E+00  -2.571E+02   0.000E+00   30 34   no
  34   0.000E+00  -2.771E+02   0.000E+00   30 35   no
  33   0.000E+00  -2.845E+02   0.000E+00   30 36   no
  32   0.000E+00  -2.771E+02   0.000E+00   30 37   no
  31   0.000E+00  -2.571E+02   0.000E+00   30 38   no
  30   0.000E+00  -2.131E+02   0.000E+00   30 39   no
  29   0.000E+00  -1.819E+02   0.000E+00   31 39   no
  28   0.000E+00  -1.863E+02   0.000E+00   31 40   no
  27   0.000E+00  -1.907E+02   0.000E+00   32 40   no
  26   0.000E+00  -1.863E+02   0.000E+00   32 41   no
  25   0.000E+00  -5.413E+03   0.000E+00   33 41   no
  24   0.000E+00  -2.131E+02   0.000E+00   33 42   no
  23   0.000E+00  -2.571E+02   0.000E+00   34 42   no
  22   0.000E+00  -2.771E+02   0.000E+00   35 42   no
  21   0.000E+00  -1.052E+04   0.000E+00   36 42   no
  20   0.000E+00  -2.771E+02   0.000E+00   37 42   no
  19   0.000E+00  -2.571E+02   0.000E+00   38 42   no
  18   0.000E+00  -2.131E+02   0.000E+00   39 42   no
  17   0.000E+00  -5.413E+03   0.000E+00   39 41   no
  16   0.000E+00  -1.863E+02   0.000E+00   40 41   no
  15   0.000E+00  -1.907E+02   0.000E+00   40 40   no
  14   0.000E+00  -1.863E+02   0.000E+00   41 40   no
  13   0.000E+00  -1.518E+04   9.085E+03   41 39   no
  12   0.000E+00  -1.521E+04   9.085E+03   42 39   no
  11   0.000E+00  -1.525E+04   9.085E+03   42 38   no
  10   0.000E+00  -2.771E+02   0.000E+00   42 37   no
   9   0.000E+00  -2.845E+02   0.000E+00   42 36   no
   8   0.000E+00  -2.771E+02   0.000E+00   42 35   no
   7   0.000E+00  -2.571E+02   0.000E+00   42 34   no
   6   0.000E+00  -2.131E+02   0.000E+00   42 33   no
   5   0.000E+00  -1.819E+02   0.000E+00   41 33   no
   4   0.000E+00  -1.863E+02   0.000E+00   41 32   no
   3   0.000E+00  -1.907E+02   0.000E+00   40 32   no
   2   0.000E+00  -1.863E+02   0.000E+00   40 31   no
   1   0.000E+00  -9.099E+01   0.000E+00   39 31  yes

Structural element data ...
  Elem  ID  Nod1  Nod2   Prop          F-shear     F-axial       Mom-1       Mom-2
    48   1    48     1      3  beam  1.655E+04   1.207E+05   6.651E+03  -7.684E-04
    47   1    47    48      3  beam  5.372E+03   9.402E+04   9.552E+03  -6.650E+03
    46   1    46    47      3  beam  2.290E+03   4.622E+03   1.092E+04  -9.551E+03
    45   1    45    46      3  beam  2.783E+03  -1.150E+04   1.266E+04  -1.092E+04
    44   1    44    45      3  beam -1.164E+03  -1.018E+04   1.193E+04  -1.267E+04
    43   1    43    44      3  beam -8.901E+03   1.712E+04   6.630E+03  -1.194E+04
    42   1    42    43      3  beam -2.174E+03   9.187E+04   5.456E+03  -6.630E+03
    41   1    41    42      3  beam -1.358E+04   1.309E+05   1.105E-04  -5.459E+03
    40   2    40    41      2  beam -1.143E+03   1.442E+05  -4.594E+02  -8.322E-05
    39   2    39    40      2  beam  2.624E+03   1.516E+05   6.461E+02   4.597E+02
    38   2    38    39      2  beam -4.544E+03   2.320E+05  -1.269E+03  -6.461E+02
    37   2    37    38      2  beam  6.660E+03   3.090E+05   1.408E+03   1.269E+03
    36   2    36    37      2  beam -9.749E+03   3.697E+05  -2.511E+03  -1.408E+03
```

```
35  2   35   36     2  beam  4.093E+03  4.258E+05 -2.996E+02  2.510E+03
34  2   34   35     2  beam -7.248E+02  5.141E+05 -7.317E+02  2.997E+02
33  2   33   34     2  beam -1.221E+03  5.794E+05 -1.499E+03  7.317E+02
32  2   32   33     2  beam  8.996E+02  5.767E+05 -9.340E+02  1.499E+03
31  2   31   32     2  beam  2.205E+03  5.289E+05  3.806E+02  9.338E+02
30  2   30   31     2  beam -8.412E+03  4.247E+05 -4.163E+03 -3.802E+02
29  2   29   30     2  beam  1.505E+04  3.925E+05  1.886E+03  4.164E+03
28  2   28   29     2  beam -5.234E+03  3.155E+05 -2.177E+02 -1.886E+03
27  2   27   28     2  beam  2.072E+03  2.436E+05  6.552E+02  2.179E+02
26  2   26   27     2  beam -3.463E+03  1.529E+05 -8.045E+02 -6.549E+02
25  2   25   26     2  beam  2.761E+03  1.190E+05  3.050E+02  8.046E+02
24  2   24   25     2  beam  4.317E+03  3.940E+04  2.040E+03 -3.052E+02
23  2   23   24     2  beam -7.187E+03  2.440E+04 -1.842E+03 -2.040E+03
22  2   22   23     2  beam  3.958E+03 -1.096E+02  5.166E+02  1.842E+03
21  2   21   22     2  beam  8.514E+03 -1.259E+04  5.868E+03 -5.169E+02
20  2   20   21     2  beam -7.947E+03 -1.277E+04  8.734E+02 -5.868E+03
19  2   19   20     2  beam -4.319E+03  1.282E+03 -1.701E+03 -8.729E+02
18  2   18   19     2  beam  3.381E+03  3.830E+04  1.255E+02  1.701E+03
17  2   17   18     2  beam  4.397E+03  6.143E+04  1.893E+03 -1.255E+02
16  2   16   17     2  beam -8.790E+03  1.224E+05 -1.641E+03 -1.892E+03
15  2   15   16     2  beam  6.484E+03  1.301E+05  1.092E+03  1.641E+03
14  2   14   15     2  beam -5.140E+03  2.326E+05 -1.074E+03 -1.092E+03
13  2   13   14     2  beam  1.769E+04  3.142E+05  6.036E+03  1.074E+03
12  2   12   13     2  beam  9.316E+03  3.965E+05  6.957E+02  3.049E+03
11  2   11   12     2  beam  2.611E+04  4.166E+05  5.714E+03  8.389E+03
10  2   10   11     2  beam  5.213E+03  5.225E+05 -2.643E+02  3.371E+03
 9  2    9   10     2  beam -1.954E+03  5.770E+05 -1.492E+03  2.639E+02
 8  2    8    9     2  beam  9.051E+02  5.833E+05 -9.228E+02  1.492E+03
 7  2    7    8     2  beam  1.369E+03  5.259E+05 -1.071E+02  9.233E+02
 6  2    6    7     2  beam -5.181E+03  4.315E+05 -2.906E+03  1.070E+02
 5  2    5    6     2  beam  1.187E+04  3.644E+05  1.864E+03  2.907E+03
 4  2    4    5     2  beam -7.659E+03  3.046E+05 -1.215E+03 -1.863E+03
 3  2    3    4     2  beam  4.871E+03  2.417E+05  8.369E+02  1.216E+03
 2  2    2    3     2  beam -4.223E+03  1.638E+05 -9.428E+02 -8.365E+02
 1  2    1    2     2  beam  2.345E+03  1.462E+05  2.073E-04  9.425E+02
Structural Properties ...
 Prop                                                  Dynamic      Plastic
 Num.     Area           E              I              Density      Moment
 ----  -----------  -----------   ------------   ------------  ------------
   3   3.04800E-01  2.75800E+10   2.36000E-03    0.00000E+00    Not Set
   2   5.90000E-03  1.64000E+11   4.57800E-05    0.00000E+00    Not Set
 Prop.  Cable Bond   Cable Bond      Yield        Compressive    Support
 Num.  Stiffness     Strength       Strength        Yield       Stiffness
 ----  -----------  -----------   ------------   ------------  ------------
   3   0.00000E+00  0.00000E+00   0.00000E+00    0.00000E+00   0.00000E+00
   2   0.00000E+00  0.00000E+00   0.00000E+00    0.00000E+00   0.00000E+00

>set log off
* log-file recording stopped  5-Aug-95   8:42
```

```
* FLAC log-file opened  2-Aug-95  15:44          STATION:    TCW @ 7+00

From File : m07k250w.sav                         LOADING:    STATIC:   DL+UTIL
>pr stru
                                                 STEEL SET: W8X31 @ 4'-0" O.C.
 Structural node data ...
 Node        X           Y         X-disp      Y-disp     Ang-disp   Xfix  Yfix  Rfix
  48   1.704E+00  -3.408E+00   1.027E-04   8.365E-04  -1.537E-04    no    no    no
  47   1.205E+00  -3.614E+00   6.510E-05   9.084E-04  -1.462E-04    no    no    no
  46   6.264E-01  -3.758E+00   3.118E-05   9.848E-04  -1.234E-04    no    no    no
  45   0.000E+00  -3.810E+00   2.577E-07   1.042E-03  -3.798E-05    no    no    no
  44  -6.264E-01  -3.758E+00  -2.723E-05   1.027E-03   7.945E-05    no    no    no
  43  -1.205E+00  -3.614E+00  -6.043E-05   9.648E-04   1.422E-04    no    no    no
  42  -1.704E+00  -3.408E+00  -1.015E-04   8.843E-04   1.868E-04    no    no    no
  41  -2.053E+00  -3.209E+00  -1.424E-04   8.158E-04   0.000E+00    no    no    no
  40  -2.380E+00  -2.975E+00  -1.757E-04   7.431E-04   1.843E-04    no    no    no
  39  -2.694E+00  -2.694E+00  -2.106E-04   6.727E-04   1.901E-04    no    no    no
  38  -2.975E+00  -2.380E+00  -2.453E-04   5.887E-04   1.808E-04    no    no    no
  37  -3.209E+00  -2.053E+00  -2.741E-04   5.132E-04   1.685E-04    no    no    no
  36  -3.408E+00  -1.704E+00  -2.989E-04   4.196E-04   1.575E-04    no    no    no
  35  -3.614E+00  -1.205E+00  -3.246E-04   3.053E-04   1.019E-04    no    no    no
  34  -3.758E+00  -6.264E-01  -3.429E-04   1.775E-04   5.791E-05    no    no    no
  33  -3.810E+00   0.000E+00  -3.495E-04   3.893E-05   1.112E-06    no    no    no
  32  -3.758E+00   6.264E-01  -3.451E-04  -9.878E-05  -5.362E-05    no    no    no
  31  -3.614E+00   1.205E+00  -3.293E-04  -2.245E-04  -9.608E-05    no    no    no
  30  -3.408E+00   1.704E+00  -3.055E-04  -3.347E-04  -1.492E-04    no    no    no
  29  -3.209E+00   2.053E+00  -2.809E-04  -4.251E-04  -1.686E-04    no    no    no
  28  -2.975E+00   2.380E+00  -2.551E-04  -5.013E-04  -1.663E-04    no    no    no
  27  -2.694E+00   2.694E+00  -2.284E-04  -5.788E-04  -1.735E-04    no    no    no
  26  -2.380E+00   2.975E+00  -1.973E-04  -6.490E-04  -1.780E-04    no    no    no
  25  -2.053E+00   3.209E+00  -1.700E-04  -7.202E-04  -1.864E-04    no    no    no
  24  -1.704E+00   3.408E+00  -1.370E-04  -7.843E-04  -1.633E-04    no    no    no
  23  -1.205E+00   3.614E+00  -9.993E-05  -8.547E-04  -1.477E-04    no    no    no
  22  -6.264E-01   3.758E+00  -5.410E-05  -9.304E-04  -1.023E-04    no    no    no
  21   0.000E+00   3.810E+00  -2.157E-06  -9.511E-04   1.188E-05    no    no    no
  20   6.264E-01   3.758E+00   4.947E-05  -9.213E-04   9.767E-05    no    no    no
  19   1.205E+00   3.614E+00   9.371E-05  -8.562E-04   1.294E-04    no    no    no
  18   1.704E+00   3.408E+00   1.297E-04  -7.918E-04   1.525E-04    no    no    no
  17   2.053E+00   3.209E+00   1.643E-04  -7.328E-04   1.861E-04    no    no    no
  16   2.380E+00   2.975E+00   1.924E-04  -6.609E-04   1.826E-04    no    no    no
  15   2.694E+00   2.694E+00   2.232E-04  -5.893E-04   1.767E-04    no    no    no
  14   2.975E+00   2.380E+00   2.501E-04  -5.109E-04   1.523E-04    no    no    no
  13   3.209E+00   2.053E+00   2.772E-04  -4.350E-04   2.281E-04    no    no    no
  12   3.408E+00   1.704E+00   3.054E-04  -3.459E-04   1.900E-04    no    no    no
  11   3.614E+00   1.205E+00   3.323E-04  -2.371E-04   1.849E-04    no    no    no
  10   3.758E+00   6.264E-01   3.522E-04  -1.086E-04   3.376E-05    no    no    no
   9   3.810E+00   0.000E+00   3.543E-04   2.922E-05   1.526E-06    no    no    no
   8   3.758E+00  -6.264E-01   3.469E-04   1.661E-04  -6.308E-05    no    no    no
   7   3.614E+00  -1.205E+00   3.243E-04   2.935E-04  -1.063E-04    no    no    no
   6   3.408E+00  -1.704E+00   2.990E-04   4.055E-04  -1.488E-04    no    no    no
   5   3.209E+00  -2.053E+00   2.739E-04   4.935E-04  -1.733E-04    no    no    no
   4   2.975E+00  -2.380E+00   2.422E-04   5.685E-04  -1.745E-04    no    no    no
   3   2.694E+00  -2.694E+00   2.118E-04   6.487E-04  -1.895E-04    no    no    no
   2   2.380E+00  -2.975E+00   1.716E-04   7.228E-04  -1.889E-04    no    no    no
   1   2.053E+00  -3.209E+00   1.352E-04   7.840E-04   0.000E+00    no    no    no
 Node     X-load      Y-load      Moment     i  j  Pin   Sh. force   Angle    Bond
  48   0.000E+00   0.000E+00   0.000E+00    39 30   no
  47   0.000E+00   0.000E+00   0.000E+00    38 30   no
  46   0.000E+00   0.000E+00   0.000E+00    37 30   no
  45   0.000E+00   0.000E+00   0.000E+00    36 30   no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -9.099E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.381E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.993E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.988E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.819E+02  0.000E+00  31 33  no
 36  0.000E+00 -2.131E+02  0.000E+00  30 33  no
 35  0.000E+00 -2.571E+02  0.000E+00  30 34  no
 34  0.000E+00 -2.771E+02  0.000E+00  30 35  no
 33  0.000E+00 -2.845E+02  0.000E+00  30 36  no
 32  0.000E+00 -2.771E+02  0.000E+00  30 37  no
 31  0.000E+00 -2.571E+02  0.000E+00  30 38  no
 30  0.000E+00 -2.131E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.819E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.863E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.907E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.863E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.413E+03  0.000E+00  33 41  no
 24  0.000E+00 -2.131E+02  0.000E+00  33 42  no
 23  0.000E+00 -2.571E+02  0.000E+00  34 42  no
 22  0.000E+00 -2.771E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.052E+04  0.000E+00  36 42  no
 20  0.000E+00 -2.771E+02  0.000E+00  37 42  no
 19  0.000E+00 -2.571E+02  0.000E+00  38 42  no
 18  0.000E+00 -2.131E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.413E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.863E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.907E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.863E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.518E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.521E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.525E+04  9.085E+03  42 38  no
 10  0.000E+00 -2.771E+02  0.000E+00  42 37  no
  9  0.000E+00 -2.845E+02  0.000E+00  42 36  no
  8  0.000E+00 -2.771E+02  0.000E+00  42 35  no
  7  0.000E+00 -2.571E+02  0.000E+00  42 34  no
  6  0.000E+00 -2.131E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.819E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.863E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.907E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.863E+02  0.000E+00  40 31  no
  1  0.000E+00 -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop         F-shear    F-axial      Mom-1       Mom-2
   48  1   48    1     3  beam -1.270E+03 -5.178E+04 -5.104E+02 -2.539E-04
   47  1   47   48     3  beam  5.260E+03 -1.075E+05  2.324E+03  5.177E+02
   46  1   46   47     3  beam  5.462E+02 -2.109E+05  2.647E+03 -2.321E+03
   45  1   45   46     3  beam  1.974E+04 -3.577E+05  1.505E+04 -2.647E+03
   44  1   44   45     3  beam -9.200E+03 -3.420E+05  9.271E+03 -1.505E+04
   43  1   43   44     3  beam -8.124E+03 -2.519E+05  4.429E+03 -9.271E+03
   42  1   42   43     3  beam  3.520E+03 -1.108E+05  6.332E+03 -4.431E+03
   41  1   41   42     3  beam -1.576E+04 -2.465E+04  9.477E-05 -6.336E+03
   40  2   40   41     2  beam -1.682E+03  3.749E+04 -6.762E+02 -3.738E-06
   39  2   39   40     2  beam  3.699E+03  4.637E+04  8.824E+02  6.761E+02
   38  2   38   39     2  beam -4.972E+03  9.083E+04 -1.213E+03 -8.827E+02
   37  2   37   38     2  beam  4.878E+03  1.098E+05  7.488E+02  1.212E+03
   36  2   36   37     2  beam -4.746E+03  1.650E+05 -1.159E+03 -7.489E+02
```

```
                                           V          F-AXIAL     M-1         M-2
  35  2   35   36     2  beam  1.430E+03  1.711E+05 -3.868E+02  1.159E+03
  34  2   34   35     2  beam -5.591E+02  1.968E+05 -7.201E+02  3.869E+02
  33  2   33   34     2  beam  1.319E+02  2.125E+05 -6.371E+02  7.200E+02
  32  2   32   33     2  beam -5.353E+01  2.105E+05 -6.706E+02  6.370E+02
  31  2   31   32     2  beam  4.558E+02  1.943E+05 -3.990E+02  6.707E+02
  30  2   30   31     2  beam -1.259E+03  1.653E+05 -1.079E+03  3.987E+02
  29  2   29   30     2  beam  3.564E+03  1.591E+05  3.547E+02  1.078E+03
  28  2   28   29     2  beam -1.547E+03  1.178E+05 -2.674E+02 -3.543E+02
  27  2   27   28     2  beam  6.660E+02  9.180E+04  1.131E+01  2.694E+02
  26  2   26   27     2  beam -4.345E+02  5.391E+04 -1.716E+02 -1.148E+01
  25  2   25   26     2  beam  6.988E+01  4.647E+04 -1.427E+02  1.707E+02
  24  2   24   25     2  beam  2.867E+03  7.445E+03  1.008E+03  1.446E+02
  23  2   23   24     2  beam -2.932E+03 -1.291E+04 -5.760E+02 -1.008E+03
  22  2   22   23     2  beam  3.859E+03 -4.303E+04  1.723E+03  5.775E+02
  21  2   21   22     2  beam -1.144E+03 -7.760E+04  1.004E+03 -1.723E+03
  20  2   20   21     2  beam  6.363E+01 -7.503E+04  1.045E+03 -1.005E+03
  19  2   19   20     2  beam -2.163E+03 -4.469E+04 -2.449E+02 -1.044E+03
  18  2   18   19     2  beam  2.097E+03 -1.755E+04  8.878E+02  2.450E+02
  17  2   17   18     2  beam -1.293E+03  1.104E+02  3.682E+02 -8.878E+02
  16  2   16   17     2  beam -2.181E+03  4.829E+04 -5.037E+02 -3.728E+02
  15  2   15   16     2  beam  1.876E+03  5.586E+04  2.890E+02  5.015E+02
  14  2   14   15     2  beam -3.427E+03  9.133E+04 -1.157E+03 -2.873E+02
  13  2   13   14     2  beam  1.282E+04  1.119E+05  3.994E+03  1.160E+03
  12  2   12   13     2  beam  2.178E+04  1.516E+05  3.665E+03  5.091E+03
  11  2   11   12     2  beam  1.980E+04  1.638E+05  5.278E+03  5.419E+03
  10  2   10   11     2  beam  6.390E+03  1.965E+05  7.856E-01  3.808E+03
   9  2    9   10     2  beam -1.230E+03  2.123E+05 -7.715E+02 -1.439E+00
   8  2    8    9     2  beam  3.706E-01  2.105E+05 -7.717E+02  7.719E+02
   7  2    7    8     2  beam  7.654E+02  1.909E+05 -3.163E+02  7.726E+02
   6  2    6    7     2  beam -1.015E+03  1.689E+05 -8.644E+02  3.160E+02
   5  2    5    6     2  beam  2.012E+03  1.574E+05 -5.481E+01  8.633E+02
   4  2    4    5     2  beam  1.660E+02  1.052E+05  1.131E+01  5.543E+01
   3  2    3    4     2  beam -1.314E+03  8.943E+04 -5.432E+02 -1.036E+01
   2  2    2    3     2  beam  2.629E+03  4.419E+04  5.639E+02  5.438E+02
   1  2    1    2     2  beam -1.403E+03  1.379E+04 -1.816E-05 -5.640E+02

Structural Properties ...
 Prop                                           Dynamic      Plastic
 Num.      Area         E            I          Density       Moment
 ----  ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   5.90000E-03  1.64000E+11  4.57800E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.  Stiffness     Strength      Strength      Yield      Stiffness
 ----  ------------ ------------ ------------ ------------ ------------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

>set log off
* log-file recording stopped  2-Aug-95  15:44
```

STATION: TSW2 @ 34+00

LOADING: STATIC: DL+UTIL

STEEL SET: W8X31 @ 2'-0" O.C.

```
* FLAC log-file opened 14-Aug-95  14:08

From File : flac.ini
>pr stru

   m34k250x.sav
The following state has been restored:
                date      time          step         grid     version
            10-Aug-95   13:42          5218       70 X 70       3.22
Title:

>pr stru

 Structural node data ...
  Node         X          Y         X-disp       Y-disp      Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00   2.196E-04   1.784E-03  -4.640E-04    no    no    no
   47   1.205E+00 -3.614E+00   1.287E-04   1.998E-03  -3.870E-04    no    no    no
   46   6.264E-01 -3.758E+00   4.900E-05   2.186E-03  -2.941E-04    no    no    no
   45   0.000E+00 -3.810E+00  -7.204E-06   2.283E-03  -2.191E-05    no    no    no
   44  -6.264E-01 -3.758E+00  -6.003E-05   2.200E-03   2.799E-04    no    no    no
   43  -1.205E+00 -3.614E+00  -1.416E-04   2.019E-03   4.039E-04    no    no    no
   42  -1.704E+00 -3.408E+00  -2.335E-04   1.797E-03   4.547E-04    no    no    no
   41  -2.053E+00 -3.209E+00  -3.215E-04   1.632E-03   0.000E+00    no    no    no
   40  -2.380E+00 -2.975E+00  -3.930E-04   1.441E-03   4.860E-04    no    no    no
   39  -2.694E+00 -2.694E+00  -4.755E-04   1.237E-03   4.947E-04    no    no    no
   38  -2.975E+00 -2.380E+00  -5.572E-04   1.022E-03   4.637E-04    no    no    no
   37  -3.209E+00 -2.053E+00  -6.322E-04   8.199E-04   4.608E-04    no    no    no
   36  -3.408E+00 -1.704E+00  -7.119E-04   5.838E-04   4.212E-04    no    no    no
   35  -3.614E+00 -1.205E+00  -7.859E-04   2.982E-04   2.736E-04    no    no    no
   34  -3.758E+00 -6.264E-01  -8.409E-04  -4.460E-05   1.672E-04    no    no    no
   33  -3.810E+00  0.000E+00  -8.658E-04  -4.173E-04   1.336E-05    no    no    no
   32  -3.758E+00  6.264E-01  -8.567E-04  -7.939E-04  -1.443E-04    no    no    no
   31  -3.614E+00  1.205E+00  -8.145E-04  -1.143E-03  -2.660E-04    no    no    no
   30  -3.408E+00  1.704E+00  -7.486E-04  -1.444E-03  -4.138E-04    no    no    no
   29  -3.209E+00  2.053E+00  -6.778E-04  -1.683E-03  -4.464E-04    no    no    no
   28  -2.975E+00  2.380E+00  -6.084E-04  -1.892E-03  -4.760E-04    no    no    no
   27  -2.694E+00  2.694E+00  -5.312E-04  -2.127E-03  -5.194E-04    no    no    no
   26  -2.380E+00  2.975E+00  -4.500E-04  -2.338E-03  -4.988E-04    no    no    no
   25  -2.053E+00  3.209E+00  -3.801E-04  -2.542E-03  -4.958E-04    no    no    no
   24  -1.704E+00  3.408E+00  -3.068E-04  -2.720E-03  -4.699E-04    no    no    no
   23  -1.205E+00  3.614E+00  -2.172E-04  -2.951E-03  -4.822E-04    no    no    no
   22  -6.264E-01  3.758E+00  -1.134E-04  -3.196E-03  -3.691E-04    no    no    no
   21   0.000E+00  3.810E+00  -1.026E-06  -3.321E-03  -1.173E-05    no    no    no
   20   6.264E-01  3.758E+00   1.111E-04  -3.207E-03   3.702E-04    no    no    no
   19   1.205E+00  3.614E+00   2.126E-04  -2.958E-03   4.814E-04    no    no    no
   18   1.704E+00  3.408E+00   2.983E-04  -2.726E-03   4.560E-04    no    no    no
   17   2.053E+00  3.209E+00   3.718E-04  -2.549E-03   4.935E-04    no    no    no
   16   2.380E+00  2.975E+00   4.427E-04  -2.354E-03   5.060E-04    no    no    no
   15   2.694E+00  2.694E+00   5.231E-04  -2.139E-03   5.156E-04    no    no    no
   14   2.975E+00  2.380E+00   5.971E-04  -1.905E-03   4.622E-04    no    no    no
   13   3.209E+00  2.053E+00   6.670E-04  -1.696E-03   4.932E-04    no    no    no
   12   3.408E+00  1.704E+00   7.443E-04  -1.448E-03   4.488E-04    no    no    no
   11   3.614E+00  1.205E+00   8.154E-04  -1.150E-03   3.052E-04    no    no    no
   10   3.758E+00  6.264E-01   8.546E-04  -8.077E-04   1.248E-04    no    no    no
    9   3.810E+00  0.000E+00   8.632E-04  -4.395E-04  -6.536E-06    no    no    no
    8   3.758E+00 -6.264E-01   8.413E-04  -7.385E-05  -1.639E-04    no    no    no
    7   3.614E+00 -1.205E+00   7.882E-04   2.669E-04  -2.690E-04    no    no    no
    6   3.408E+00 -1.704E+00   7.177E-04   5.497E-04  -4.103E-04    no    no    no
    5   3.209E+00 -2.053E+00   6.357E-04   7.849E-04  -4.736E-04    no    no    no
    4   2.975E+00 -2.380E+00   5.589E-04   9.913E-04  -4.727E-04    no    no    no
```

```
   3  2.694E+00 -2.694E+00  4.774E-04  1.207E-03 -4.952E-04   no   no   no
   2  2.380E+00 -2.975E+00  3.896E-04  1.411E-03 -5.062E-04   no   no   no
   1  2.053E+00 -3.209E+00  3.130E-04  1.614E-03  0.000E+00   no   no   no
Node    X-load     Y-load     Moment    i  j Pin  Sh. force  Angle    Bond
  48  0.000E+00  0.000E+00  0.000E+00  39 30  no
  47  0.000E+00  0.000E+00  0.000E+00  38 30  no
  46  0.000E+00  0.000E+00  0.000E+00  37 30  no
  45  0.000E+00  0.000E+00  0.000E+00  36 30  no
  44  0.000E+00  0.000E+00  0.000E+00  35 30  no
  43  0.000E+00  0.000E+00  0.000E+00  34 30  no
  42  0.000E+00  0.000E+00  0.000E+00  33 30  no
  41  0.000E+00 -9.099E+01  0.000E+00  33 31 yes
  40  0.000E+00 -1.381E+03  0.000E+00  32 31  no
  39  0.000E+00 -2.993E+03  0.000E+00  32 32  no
  38  0.000E+00 -2.988E+03  0.000E+00  31 32  no
  37  0.000E+00 -1.819E+02  0.000E+00  31 33  no
  36  0.000E+00 -2.131E+02  0.000E+00  30 33  no
  35  0.000E+00 -2.571E+02  0.000E+00  30 34  no
  34  0.000E+00 -2.771E+02  0.000E+00  30 35  no
  33  0.000E+00 -2.845E+02  0.000E+00  30 36  no
  32  0.000E+00 -2.771E+02  0.000E+00  30 37  no
  31  0.000E+00 -2.571E+02  0.000E+00  30 38  no
  30  0.000E+00 -2.131E+02  0.000E+00  30 39  no
  29  0.000E+00 -1.819E+02  0.000E+00  31 39  no
  28  0.000E+00 -1.863E+02  0.000E+00  31 40  no
  27  0.000E+00 -1.907E+02  0.000E+00  32 40  no
  26  0.000E+00 -1.863E+02  0.000E+00  32 41  no
  25  0.000E+00 -5.413E+03  0.000E+00  33 41  no
  24  0.000E+00 -2.131E+02  0.000E+00  33 42  no
  23  0.000E+00 -2.571E+02  0.000E+00  34 42  no
  22  0.000E+00 -2.771E+02  0.000E+00  35 42  no
  21  0.000E+00 -1.052E+04  0.000E+00  36 42  no
  20  0.000E+00 -2.771E+02  0.000E+00  37 42  no
  19  0.000E+00 -2.571E+02  0.000E+00  38 42  no
  18  0.000E+00 -2.131E+02  0.000E+00  39 42  no
  17  0.000E+00 -5.413E+03  0.000E+00  39 41  no
  16  0.000E+00 -1.863E+02  0.000E+00  40 41  no
  15  0.000E+00 -1.907E+02  0.000E+00  40 40  no
  14  0.000E+00 -1.863E+02  0.000E+00  41 40  no
  13  0.000E+00 -1.518E+04  9.085E+03  41 39  no
  12  0.000E+00 -1.521E+04  9.085E+03  42 39  no
  11  0.000E+00 -1.525E+04  9.085E+03  42 38  no
  10  0.000E+00 -2.771E+02  0.000E+00  42 37  no
   9  0.000E+00 -2.845E+02  0.000E+00  42 36  no
   8  0.000E+00 -2.771E+02  0.000E+00  42 35  no
   7  0.000E+00 -2.571E+02  0.000E+00  42 34  no
   6  0.000E+00 -2.131E+02  0.000E+00  42 33  no
   5  0.000E+00 -1.819E+02  0.000E+00  41 33  no
   4  0.000E+00 -1.863E+02  0.000E+00  41 32  no
   3  0.000E+00 -1.907E+02  0.000E+00  40 32  no
   2  0.000E+00 -1.863E+02  0.000E+00  40 31  no
   1  0.000E+00 -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop         F-shear    F-axial      Mom-1      Mom-2
   48  1   48    1     3  beam  3.282E+04  1.111E+05  1.319E+04  6.566E-04
   47  1   47   48     3  beam -1.450E+04 -7.535E+04  5.360E+03 -1.319E+04
   46  1   46   47     3  beam  1.604E+04 -3.914E+05  1.492E+04 -5.359E+03
   45  1   45   46     3  beam  4.224E+04 -6.514E+05  4.147E+04 -1.492E+04
   44  1   44   45     3  beam -3.251E+04 -6.602E+05  2.104E+04 -4.147E+04
```

```
 43  1   43   44     3  beam -2.514E+04 -3.961E+05  6.053E+03 -2.104E+04
 42  1   42   43     3  beam  2.438E+02 -5.945E+04  6.183E+03 -6.052E+03
 41  1   41   42     3  beam -1.538E+04  1.082E+05  8.291E-04 -6.183E+03
 40  2   40   41     2  beam -2.068E+03  2.647E+05 -8.314E+02 -1.172E-04
 39  2   39   40     2  beam  5.408E+03  3.220E+05  1.448E+03  8.312E+02
 38  2   38   39     2  beam -1.211E+04  5.061E+05 -3.653E+03 -1.448E+03
 37  2   37   38     2  beam  1.762E+04  5.864E+05  3.430E+03  3.653E+03
 36  2   36   37     2  beam -2.443E+04  7.838E+05 -6.388E+03 -3.430E+03
 35  2   35   36     2  beam  8.470E+03  8.558E+05 -1.813E+03  6.388E+03
 34  2   34   35     2  beam -2.906E+03  1.037E+06 -3.545E+03  1.813E+03
 33  2   33   34     2  beam -4.145E+02  1.145E+06 -3.805E+03  3.544E+03
 32  2   32   33     2  beam  1.297E+02  1.163E+06 -3.723E+03  3.805E+03
 31  2   31   32     2  beam  2.213E+03  1.062E+06 -2.405E+03  3.724E+03
 30  2   30   31     2  beam -6.313E+03  9.208E+05 -5.814E+03  2.404E+03
 29  2   29   30     2  beam  2.288E+04  8.380E+05  3.383E+03  5.815E+03
 28  2   28   29     2  beam -2.234E+04  6.163E+05 -5.596E+03 -3.383E+03
 27  2   27   28     2  beam  1.922E+04  5.719E+05  2.503E+03  5.595E+03
 26  2   26   27     2  beam -8.391E+03  3.806E+05 -1.033E+03 -2.503E+03
 25  2   25   26     2  beam  5.699E+03  2.874E+05  1.258E+03  1.032E+03
 24  2   24   25     2  beam -1.453E+03  1.172E+05  6.735E+02 -1.258E+03
 23  2   23   24     2  beam -3.758E+03  2.373E+04 -1.356E+03 -6.736E+02
 22  2   22   23     2  beam  1.411E+04 -1.283E+05  7.052E+03  1.356E+03
 21  2   21   22     2  beam  4.719E+03 -3.143E+05  1.002E+04 -7.052E+03
 20  2   20   21     2  beam -2.854E+03 -3.188E+05  8.224E+03 -1.002E+04
 19  2   19   20     2  beam -1.819E+04 -1.150E+05 -2.621E+03 -8.224E+03
 18  2   18   19     2  beam  7.088E+03  3.579E+04  1.208E+03  2.621E+03
 17  2   17   18     2  beam  9.514E+02  1.024E+05  1.591E+03 -1.209E+03
 16  2   16   17     2  beam -5.608E+03  2.832E+05 -6.609E+02 -1.593E+03
 15  2   15   16     2  beam  4.778E+03  3.899E+05  1.349E+03  6.640E+02
 14  2   14   15     2  beam -1.542E+04  5.753E+05 -5.150E+03 -1.348E+03
 13  2   13   14     2  beam  3.137E+04  6.281E+05  7.462E+03  5.149E+03
 12  2   12   13     2  beam -1.638E+02  8.448E+05 -1.689E+03  1.623E+03
 11  2   11   12     2  beam  2.511E+04  8.978E+05  2.794E+03  1.077E+04
 10  2   10   11     2  beam  5.869E+03  1.048E+06 -2.794E+03  6.292E+03
  9  2    9   10     2  beam -1.090E+03  1.135E+06 -3.480E+03  2.795E+03
  8  2    8    9     2  beam -8.926E+02  1.124E+06 -4.040E+03  3.479E+03
  7  2    7    8     2  beam  4.681E+03  1.035E+06 -1.249E+03  4.040E+03
  6  2    6    7     2  beam -9.918E+03  8.496E+05 -6.607E+03  1.250E+03
  5  2    5    6     2  beam  2.112E+04  7.863E+05  1.880E+03  6.607E+03
  4  2    4    5     2  beam -9.167E+03  5.898E+05 -1.806E+03 -1.879E+03
  3  2    3    4     2  beam  4.766E+03  4.946E+05  2.012E+02  1.807E+03
  2  2    2    3     2  beam -2.811E+03  3.258E+05 -9.838E+02 -2.008E+02
  1  2    1    2     2  beam  2.449E+03  2.539E+05  4.451E-05  9.842E+02
Structural Properties ...
 Prop                                                 Dynamic      Plastic
 Num.      Area          E             I              Density       Moment
 ----  ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   5.90000E-03  3.27870E+11  4.57800E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive   Support
 Num.  Stiffness     Strength      Strength      Yield      Stiffness
 ----  ------------ ------------ ------------ ------------ ------------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
set log off
 log-file recording stopped 14-Aug-95  14:09
```

STATION: PTN @ 10+00

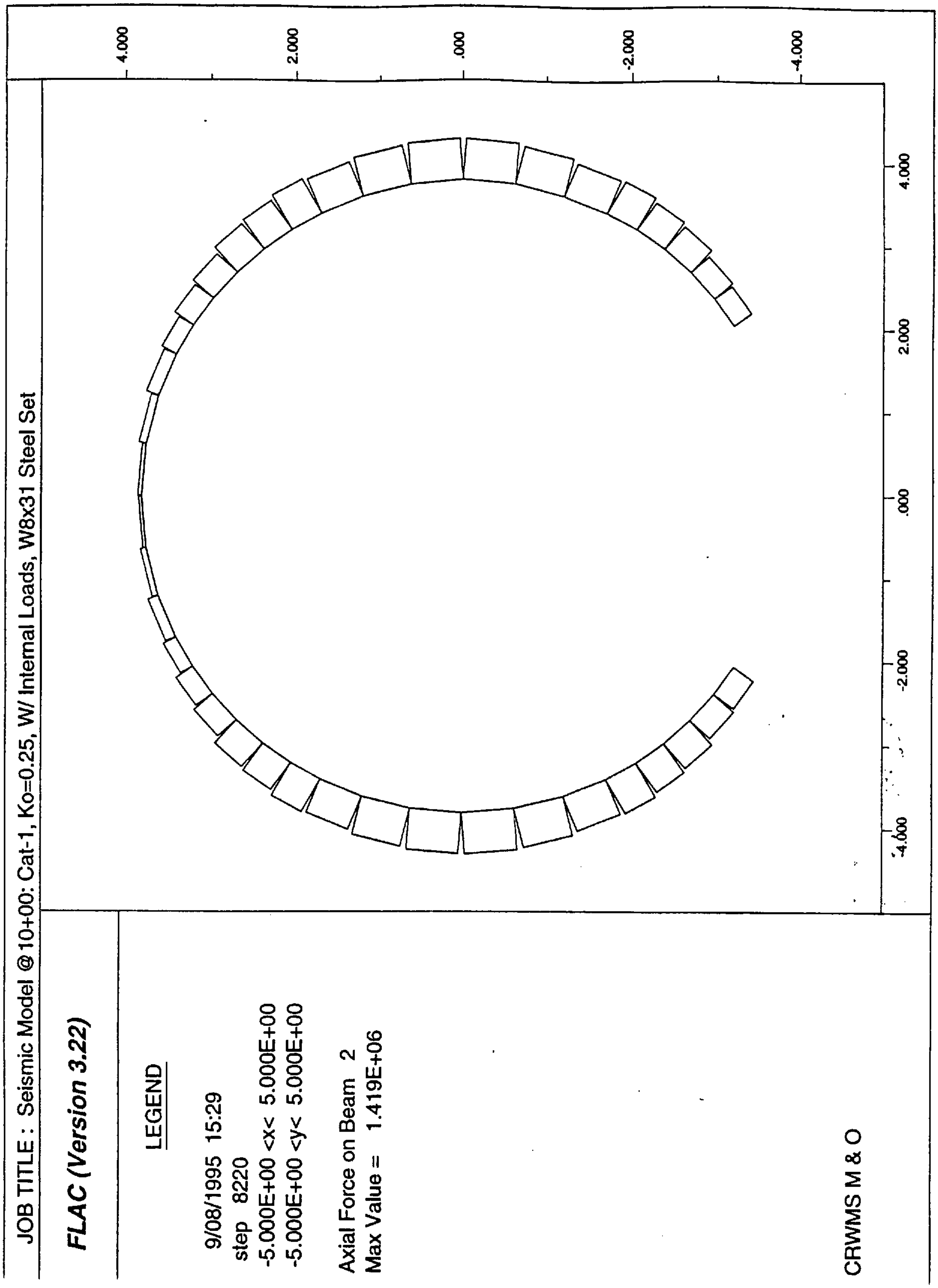
LOADING: SEISMIC + DL+UTIL

STEEL SET: W8X31 @ 2'-0" O.C.

```
* FLAC log-file opened  9-Aug-95  14:17

From File : p10k2dy.sav
>pr stru

 Structural node data ...
  Node           X           Y        X-disp      Y-disp    Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00  2.040E-03 -1.827E-03 -5.381E-04   no    no    no
   47   1.205E+00 -3.614E+00  1.969E-03 -1.569E-03 -4.280E-04   no    no    no
   46   6.264E-01 -3.758E+00  1.942E-03 -1.366E-03 -2.480E-04   no    no    no
   45   0.000E+00 -3.810E+00  1.953E-03 -1.296E-03  2.272E-05   no    no    no
   44  -6.264E-01 -3.758E+00  1.961E-03 -1.401E-03  3.126E-04   no    no    no
   43  -1.205E+00 -3.614E+00  1.927E-03 -1.656E-03  5.199E-04   no    no    no
   42  -1.704E+00 -3.408E+00  1.841E-03 -1.954E-03  6.343E-04   no    no    no
   41  -2.053E+00 -3.209E+00  1.740E-03 -2.198E-03  0.000E+00   no    no    no
   40  -2.380E+00 -2.975E+00  1.647E-03 -2.622E-03  1.039E-03   no    no    no
   39  -2.694E+00 -2.694E+00  1.487E-03 -3.095E-03  1.112E-03   no    no    no
   38  -2.975E+00 -2.380E+00  1.306E-03 -3.580E-03  1.054E-03   no    no    no
   37  -3.209E+00 -2.053E+00  1.125E-03 -4.020E-03  9.308E-04   no    no    no
   36  -3.408E+00 -1.704E+00  9.764E-04 -4.420E-03  6.577E-04   no    no    no
   35  -3.614E+00 -1.205E+00  8.842E-04 -4.844E-03  3.287E-04   no    no    no
   34  -3.758E+00 -6.264E-01  8.375E-04 -5.285E-03  1.669E-04   no    no    no
   33  -3.810E+00  0.000E+00  8.360E-04 -5.748E-03 -3.152E-05   no    no    no
   32  -3.758E+00  6.264E-01  8.811E-04 -6.208E-03 -2.402E-04   no    no    no
   31  -3.614E+00  1.205E+00  9.841E-04 -6.652E-03 -4.495E-04   no    no    no
   30  -3.408E+00  1.704E+00  1.157E-03 -7.095E-03 -8.363E-04   no    no    no
   29  -3.209E+00  2.053E+00  1.378E-03 -7.527E-03 -1.138E-03   no    no    no
   28  -2.975E+00  2.380E+00  1.634E-03 -7.997E-03 -1.244E-03   no    no    no
   27  -2.694E+00  2.694E+00  1.866E-03 -8.517E-03 -1.199E-03   no    no    no
   26  -2.380E+00  2.975E+00  2.043E-03 -8.980E-03 -9.607E-04   no    no    no
   25  -2.053E+00  3.209E+00  2.118E-03 -9.323E-03 -6.802E-04   no    no    no
   24  -1.704E+00  3.408E+00  2.149E-03 -9.577E-03 -5.059E-04   no    no    no
   23  -1.205E+00  3.614E+00  2.147E-03 -9.829E-03 -3.638E-04   no    no    no
   22  -6.264E-01  3.758E+00  2.132E-03 -1.001E-02 -1.919E-04   no    no    no
   21   0.000E+00  3.810E+00  2.103E-03 -1.005E-02  6.558E-05   no    no    no
   20   6.264E-01  3.758E+00  2.071E-03 -9.930E-03  3.031E-04   no    no    no
   19   1.205E+00  3.614E+00  2.054E-03 -9.684E-03  4.808E-04   no    no    no
   18   1.704E+00  3.408E+00  2.058E-03 -9.356E-03  6.432E-04   no    no    no
   17   2.053E+00  3.209E+00  2.098E-03 -9.052E-03  7.986E-04   no    no    no
   16   2.380E+00  2.975E+00  2.182E-03 -8.667E-03  1.014E-03   no    no    no
   15   2.694E+00  2.694E+00  2.342E-03 -8.186E-03  1.161E-03   no    no    no
   14   2.975E+00  2.380E+00  2.546E-03 -7.675E-03  1.164E-03   no    no    no
   13   3.209E+00  2.053E+00  2.771E-03 -7.205E-03  1.111E-03   no    no    no
   12   3.408E+00  1.704E+00  2.966E-03 -6.773E-03  7.932E-04   no    no    no
   11   3.614E+00  1.205E+00  3.103E-03 -6.335E-03  4.288E-04   no    no    no
   10   3.758E+00  6.264E-01  3.171E-03 -5.891E-03  1.747E-04   no    no    no
    9   3.810E+00  0.000E+00  3.179E-03 -5.437E-03 -3.327E-05   no    no    no
    8   3.758E+00 -6.264E-01  3.133E-03 -4.983E-03 -2.273E-04   no    no    no
    7   3.614E+00 -1.205E+00  3.050E-03 -4.549E-03 -3.944E-04   no    no    no
    6   3.408E+00 -1.704E+00  2.914E-03 -4.126E-03 -7.324E-04   no    no    no
    5   3.209E+00 -2.053E+00  2.734E-03 -3.721E-03 -9.993E-04   no    no    no
    4   2.975E+00 -2.380E+00  2.527E-03 -3.288E-03 -1.073E-03   no    no    no
    3   2.694E+00 -2.694E+00  2.345E-03 -2.827E-03 -1.017E-03   no    no    no
    2   2.380E+00 -2.975E+00  2.207E-03 -2.406E-03 -9.031E-04   no    no    no
    1   2.053E+00 -3.209E+00  2.127E-03 -2.041E-03  0.000E+00   no    no    no
 Node      X-load      Y-load      Moment    i  j  Pin  Sh. force   Angle    Bond
   48   0.000E+00   0.000E+00   0.000E+00   39 30  no
   47   0.000E+00   0.000E+00   0.000E+00   38 30  no
   46   0.000E+00   0.000E+00   0.000E+00   37 30  no
   45   0.000E+00   0.000E+00   0.000E+00   36 30  no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -9.099E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.381E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.993E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.988E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.819E+02  0.000E+00  31 33  no
 36  0.000E+00 -2.131E+02  0.000E+00  30 33  no
 35  0.000E+00 -2.571E+02  0.000E+00  30 34  no
 34  0.000E+00 -2.771E+02  0.000E+00  30 35  no
 33  0.000E+00 -2.845E+02  0.000E+00  30 36  no
 32  0.000E+00 -2.771E+02  0.000E+00  30 37  no
 31  0.000E+00 -2.571E+02  0.000E+00  30 38  no
 30  0.000E+00 -2.131E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.819E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.863E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.907E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.863E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.413E+03  0.000E+00  33 41  no
 24  0.000E+00 -2.131E+02  0.000E+00  33 42  no
 23  0.000E+00 -2.571E+02  0.000E+00  34 42  no
 22  0.000E+00 -2.771E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.052E+04  0.000E+00  36 42  no
 20  0.000E+00 -2.771E+02  0.000E+00  37 42  no
 19  0.000E+00 -2.571E+02  0.000E+00  38 42  no
 18  0.000E+00 -2.131E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.413E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.863E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.907E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.863E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.518E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.521E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.525E+04  9.085E+03  42 38  no
 10  0.000E+00 -2.771E+02  0.000E+00  42 37  no
  9  0.000E+00 -2.845E+02  0.000E+00  42 36  no
  8  0.000E+00 -2.771E+02  0.000E+00  42 35  no
  7  0.000E+00 -2.571E+02  0.000E+00  42 34  no
  6  0.000E+00 -2.131E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.819E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.863E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.907E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.863E+02  0.000E+00  40 31  no
  1  0.000E+00 -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop         F-shear    F-axial      Mom-1      Mom-2
   48  1   48    1     3  beam  2.946E+04  5.693E+05  1.184E+04 -3.379E-04
   47  1   47   48     3  beam  5.757E+03  5.106E+05  1.480E+04 -1.169E+04
   46  1   46   47     3  beam  1.654E+04  3.308E+05  2.458E+04 -1.472E+04
   45  1   45   46     3  beam  1.060E+04  2.177E+05  3.136E+04 -2.470E+04
   44  1   44   45     3  beam -5.685E+03  2.312E+05  2.824E+04 -3.182E+04
   43  1   43   44     3  beam -2.058E+04  3.771E+05  1.651E+04 -2.878E+04
   42  1   42   43     3  beam -1.030E+04  5.811E+05  1.100E+04 -1.657E+04
   41  1   41   42     3  beam -2.737E+04  6.597E+05 -2.812E-04 -1.100E+04
   40  2   40   41     2  beam  1.350E+04  8.288E+05  5.425E+03  2.297E-05
   39  2   39   40     2  beam -1.371E+04  9.084E+05 -2.830E+02 -5.494E+03
   38  2   38   39     2  beam -9.147E+03  1.117E+06 -3.974E+03  1.192E+02
   37  2   37   38     2  beam -3.449E+03  1.207E+06 -5.301E+03  3.915E+03
   36  2   36   37     2  beam -2.412E+04  1.324E+06 -1.505E+04  5.357E+03
```

```
 35  2   35   36     2  beam  2.168E+04  1.279E+06 -3.287E+03  1.500E+04
 34  2   34   35     2  beam -2.755E+03  1.375E+06 -4.897E+03  3.255E+03
 33  2   33   34     2  beam  1.843E+02  1.419E+06 -4.682E+03  4.798E+03
 32  2   32   33     2  beam -1.059E+03  1.407E+06 -5.306E+03  4.640E+03
 31  2   31   32     2  beam  9.126E+02  1.340E+06 -5.000E+03  5.544E+03
 30  2   30   31     2  beam -2.100E+04  1.226E+06 -1.642E+04  5.080E+03
 29  2   29   30     2  beam  2.517E+04  1.282E+06 -6.203E+03  1.632E+04
 28  2   28   29     2  beam  1.157E+04  1.131E+06 -1.631E+03  6.280E+03
 27  2   27   28     2  beam  1.511E+04  1.069E+06  4.773E+03  1.593E+03
 26  2   26   27     2  beam  1.761E+04  8.268E+05  1.220E+04 -4.780E+03
 25  2   25   26     2  beam -9.095E+03  6.785E+05  8.650E+03 -1.231E+04
 24  2   24   25     2  beam -1.085E+04  4.625E+05  4.330E+03 -8.689E+03
 23  2   23   24     2  beam -1.245E+03  3.552E+05  3.612E+03 -4.285E+03
 22  2   22   23     2  beam  2.456E+03  1.892E+05  5.064E+03 -3.600E+03
 21  2   21   22     2  beam  3.618E+03  9.972E+04  7.281E+03 -5.007E+03
 20  2   20   21     2  beam -5.310E+03  1.263E+05  4.004E+03 -7.342E+03
 19  2   19   20     2  beam  1.710E+03  2.464E+05  4.981E+03 -3.962E+03
 18  2   18   19     2  beam -2.019E+03  4.368E+05  3.969E+03 -5.060E+03
 17  2   17   18     2  beam  8.646E+03  5.504E+05  7.557E+03 -4.081E+03
 16  2   16   17     2  beam  2.533E+03  7.647E+05  8.524E+03 -7.505E+03
 15  2   15   16     2  beam -1.572E+04  9.190E+05  1.946E+03 -8.570E+03
 14  2   14   15     2  beam -8.992E+03  1.137E+06 -1.782E+03 -2.007E+03
 13  2   13   14     2  beam -7.199E+02  1.215E+06 -2.142E+03  1.853E+03
 12  2   12   13     2  beam -2.814E+03  1.349E+06 -1.243E+04  1.130E+04
 11  2   11   12     2  beam  4.195E+04  1.267E+06  1.210E+03  2.145E+04
 10  2   10   11     2  beam  4.843E+03  1.356E+06 -4.958E+03  7.844E+03
  9  2    9   10     2  beam  2.642E+01  1.397E+06 -4.959E+03  4.976E+03
  8  2    8    9     2  beam  1.227E+03  1.387E+06 -4.254E+03  5.026E+03
  7  2    7    8     2  beam -2.018E+02  1.326E+06 -4.272E+03  4.152E+03
  6  2    6    7     2  beam -1.897E+04  1.218E+06 -1.451E+04  4.261E+03
  5  2    5    6     2  beam  2.258E+04  1.260E+06 -5.428E+03  1.451E+04
  4  2    4    5     2  beam  1.336E+04  1.126E+06 -6.017E+01  5.431E+03
  3  2    3    4     2  beam  9.299E+03  1.026E+06  3.931E+03 -1.232E+01
  2  2    2    3     2  beam  5.240E+02  8.119E+05  4.187E+03 -3.966E+03
  1  2    1    2     2  beam -1.025E+04  7.314E+05  2.214E-04 -4.121E+03

Structural Properties ...
 Prop                                                 Dynamic       Plastic
 Num.       Area           E             I            Density        Moment
 ----  ------------  ------------  ------------  ------------  ------------
   3    3.04800E-01   2.75800E+10   2.36000E-03   0.00000E+00   Not Set
   2    5.90000E-03   3.27870E+11   4.57800E-05   0.00000E+00   Not Set
 Prop.   Cable Bond    Cable Bond      Yield      Compressive     Support
 Num.   Stiffness     Strength      Strength        Yield       Stiffness
 ----  ------------  ------------  ------------  ------------  ------------
   3    0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00
   2    0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00

>set log off
* log-file recording stopped  9-Aug-95  14:17
```



JOB TITLE : Seismic Model @10+00: Cat-1, Ko=0.25, W/ Internal Loads, W8x31 Steel Set

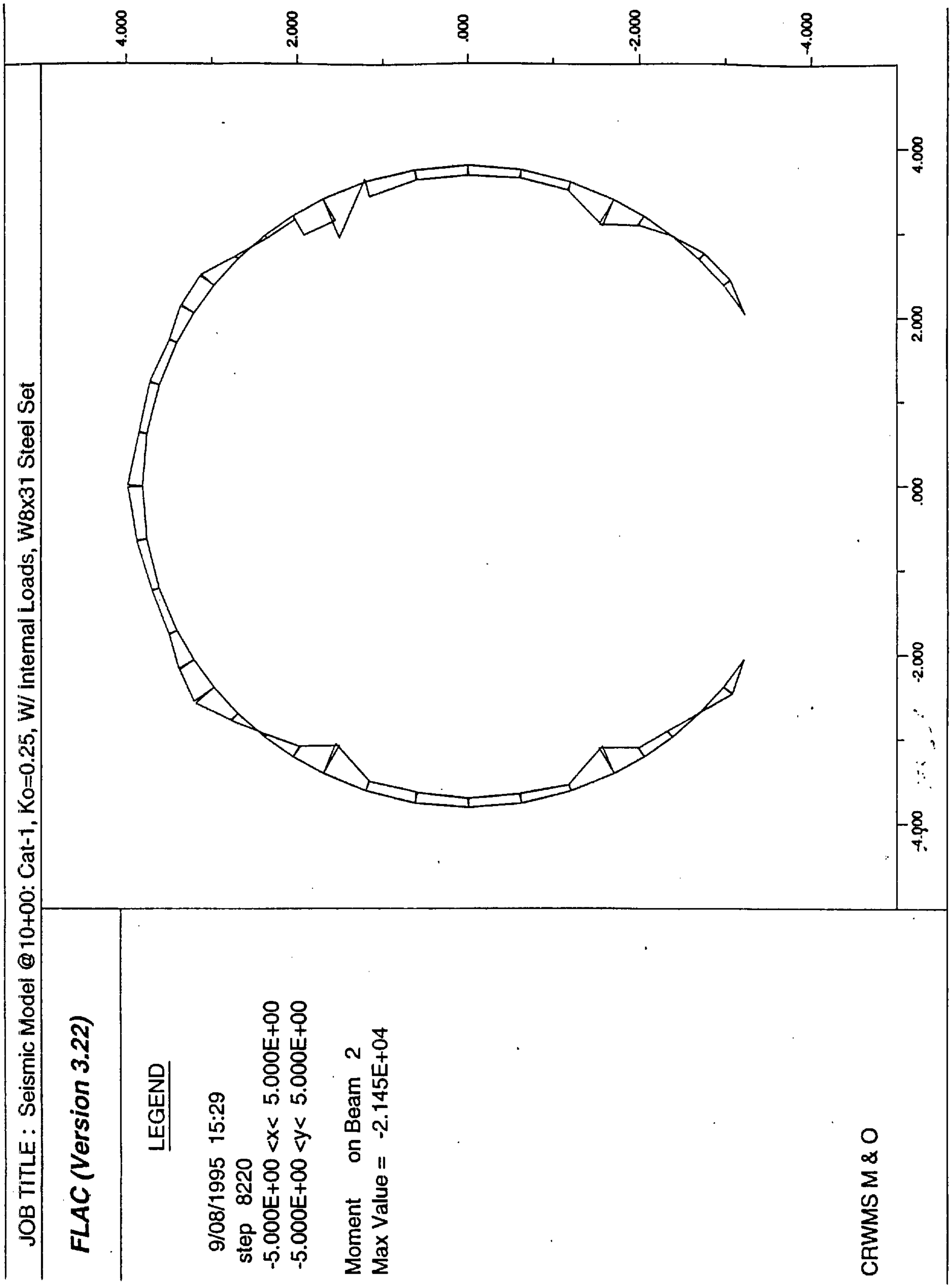
FLAC (Version 3.22)

LEGEND

9/08/1995 15:29
step 8220
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00

Axial Force on Beam 2
Max Value = 1.419E+06

CRWMS M & O



JOB TITLE : Seismic Model @10+00: Cat-1, Ko=0.25, W/ Internal Loads, W8x31 Steel Set

FLAC (Version 3.22)

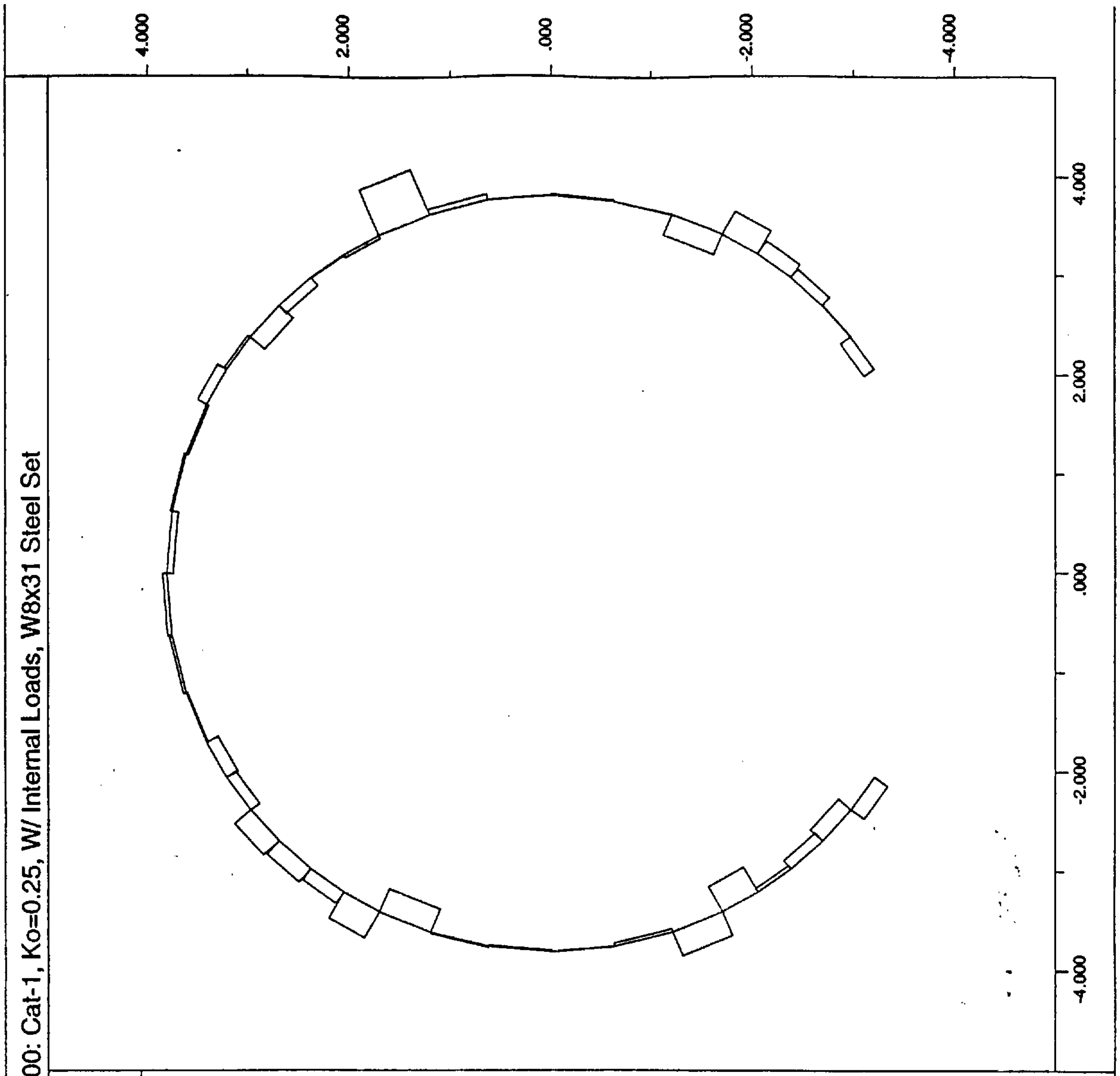
LEGEND

9/08/1995 15:29
step 8220
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00

Moment on Beam 2
Max Value = -2.145E+04

CRWMS M & O

JOB TITLE : Seismic Model @10+00: Cat-1, Ko=0.25, W/ Internal Loads, W8x31 Steel Set



FLAC (Version 3.22)

LEGEND

9/08/1995 15:29
step 8220
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00

Shear Force on Beam 2
Max Value = 4.195E+04

CRWMS M & O

STATION: TCW @ 7+00

LOADING: SEISMIC + DL+UTIL

STEEL SET: W8X31 @ 4'-0" O.C.

```
* FLAC log-file opened  9-Aug-95  14:12

From File : p07k2dy.sav
>pr stru

 Structural node data ...
 Node        X           Y          X-disp      Y-disp     Ang-disp   Xfix  Yfix  Rfix
  48   1.704E+00 -3.408E+00   1.630E-03 -6.819E-03 -2.086E-04   no    no    no
  47   1.205E+00 -3.614E+00   1.590E-03 -6.723E-03 -1.793E-04   no    no    no
  46   6.264E-01 -3.758E+00   1.558E-03 -6.639E-03 -1.002E-04   no    no    no
  45   0.000E+00 -3.810E+00   1.535E-03 -6.615E-03  2.086E-05   no    no    no
  44  -6.264E-01 -3.758E+00   1.509E-03 -6.665E-03  1.360E-04   no    no    no
  43  -1.205E+00 -3.614E+00   1.475E-03 -6.767E-03  2.103E-04   no    no    no
  42  -1.704E+00 -3.408E+00   1.430E-03 -6.881E-03  2.435E-04   no    no    no
  41  -2.053E+00 -3.209E+00   1.384E-03 -6.969E-03  0.000E+00   no    no    no
  40  -2.380E+00 -2.975E+00   1.356E-03 -7.081E-03  2.582E-04   no    no    no
  39  -2.694E+00 -2.694E+00   1.322E-03 -7.195E-03  2.709E-04   no    no    no
  38  -2.975E+00 -2.380E+00   1.288E-03 -7.332E-03  2.595E-04   no    no    no
  37  -3.209E+00 -2.053E+00   1.257E-03 -7.455E-03  2.422E-04   no    no    no
  36  -3.408E+00 -1.704E+00   1.226E-03 -7.599E-03  2.240E-04   no    no    no
  35  -3.614E+00 -1.205E+00   1.197E-03 -7.783E-03  1.525E-04   no    no    no
  34  -3.758E+00 -6.264E-01   1.173E-03 -7.992E-03  8.272E-05   no    no    no
  33  -3.810E+00  0.000E+00   1.169E-03 -8.214E-03 -5.715E-06   no    no    no
  32  -3.758E+00  6.264E-01   1.179E-03 -8.436E-03 -8.582E-05   no    no    no
  31  -3.614E+00  1.205E+00   1.202E-03 -8.638E-03 -1.467E-04   no    no    no
  30  -3.408E+00  1.704E+00   1.232E-03 -8.815E-03 -2.166E-04   no    no    no
  29  -3.209E+00  2.053E+00   1.262E-03 -8.953E-03 -2.341E-04   no    no    no
  28  -2.975E+00  2.380E+00   1.292E-03 -9.069E-03 -2.402E-04   no    no    no
  27  -2.694E+00  2.694E+00   1.323E-03 -9.193E-03 -2.531E-04   no    no    no
  26  -2.380E+00  2.975E+00   1.359E-03 -9.298E-03 -2.451E-04   no    no    no
  25  -2.053E+00  3.209E+00   1.387E-03 -9.402E-03 -2.428E-04   no    no    no
  24  -1.704E+00  3.408E+00   1.421E-03 -9.487E-03 -2.077E-04   no    no    no
  23  -1.205E+00  3.614E+00   1.455E-03 -9.582E-03 -1.799E-04   no    no    no
  22  -6.264E-01  3.758E+00   1.498E-03 -9.673E-03 -1.188E-04   no    no    no
  21   0.000E+00  3.810E+00   1.546E-03 -9.701E-03  2.158E-05   no    no    no
  20   6.264E-01  3.758E+00   1.594E-03 -9.650E-03  1.327E-04   no    no    no
  19   1.205E+00  3.614E+00   1.635E-03 -9.559E-03  1.943E-04   no    no    no
  18   1.704E+00  3.408E+00   1.668E-03 -9.446E-03  2.357E-04   no    no    no
  17   2.053E+00  3.209E+00   1.700E-03 -9.349E-03  2.627E-04   no    no    no
  16   2.380E+00  2.975E+00   1.724E-03 -9.236E-03  2.574E-04   no    no    no
  15   2.694E+00  2.694E+00   1.752E-03 -9.120E-03  2.540E-04   no    no    no
  14   2.975E+00  2.380E+00   1.776E-03 -8.991E-03  2.220E-04   no    no    no
  13   3.209E+00  2.053E+00   1.803E-03 -8.868E-03  2.993E-04   no    no    no
  12   3.408E+00  1.704E+00   1.833E-03 -8.723E-03  2.547E-04   no    no    no
  11   3.614E+00  1.205E+00   1.857E-03 -8.541E-03  2.206E-04   no    no    no
  10   3.758E+00  6.264E-01   1.874E-03 -8.332E-03  5.434E-05   no    no    no
   9   3.810E+00  0.000E+00   1.877E-03 -8.107E-03  2.913E-06   no    no    no
   8   3.758E+00 -6.264E-01   1.870E-03 -7.884E-03 -8.511E-05   no    no    no
   7   3.614E+00 -1.205E+00   1.848E-03 -7.677E-03 -1.456E-04   no    no    no
   6   3.408E+00 -1.704E+00   1.821E-03 -7.495E-03 -2.193E-04   no    no    no
   5   3.209E+00 -2.053E+00   1.792E-03 -7.352E-03 -2.375E-04   no    no    no
   4   2.975E+00 -2.380E+00   1.762E-03 -7.235E-03 -2.435E-04   no    no    no
   3   2.694E+00 -2.694E+00   1.730E-03 -7.107E-03 -2.511E-04   no    no    no
   2   2.380E+00 -2.975E+00   1.697E-03 -7.001E-03 -2.420E-04   no    no    no
   1   2.053E+00 -3.209E+00   1.671E-03 -6.896E-03  0.000E+00   no    no    no
 Node    X-load      Y-load      Moment     i  j  Pin   Sh. force   Angle   Bond
  48   0.000E+00   0.000E+00   0.000E+00  39 30   no
  47   0.000E+00   0.000E+00   0.000E+00  38 30   no
  46   0.000E+00   0.000E+00   0.000E+00  37 30   no
  45   0.000E+00   0.000E+00   0.000E+00  36 30   no
```

```
   44  0.000E+00  0.000E+00  0.000E+00  35 30  no
   43  0.000E+00  0.000E+00  0.000E+00  34 30  no
   42  0.000E+00  0.000E+00  0.000E+00  33 30  no
   41  0.000E+00 -9.099E+01  0.000E+00  33 31 yes
   40  0.000E+00 -1.381E+03  0.000E+00  32 31  no
   39  0.000E+00 -2.993E+03  0.000E+00  32 32  no
   38  0.000E+00 -2.988E+03  0.000E+00  31 32  no
   37  0.000E+00 -1.819E+02  0.000E+00  31 33  no
   36  0.000E+00 -2.131E+02  0.000E+00  30 33  no
   35  0.000E+00 -2.571E+02  0.000E+00  30 34  no
   34  0.000E+00 -2.771E+02  0.000E+00  30 35  no
   33  0.000E+00 -2.845E+02  0.000E+00  30 36  no
   32  0.000E+00 -2.771E+02  0.000E+00  30 37  no
   31  0.000E+00 -2.571E+02  0.000E+00  30 38  no
   30  0.000E+00 -2.131E+02  0.000E+00  30 39  no
   29  0.000E+00 -1.819E+02  0.000E+00  31 39  no
   28  0.000E+00 -1.863E+02  0.000E+00  31 40  no
   27  0.000E+00 -1.907E+02  0.000E+00  32 40  no
   26  0.000E+00 -1.863E+02  0.000E+00  32 41  no
   25  0.000E+00 -5.413E+03  0.000E+00  33 41  no
   24  0.000E+00 -2.131E+02  0.000E+00  33 42  no
   23  0.000E+00 -2.571E+02  0.000E+00  34 42  no
   22  0.000E+00 -2.771E+02  0.000E+00  35 42  no
   21  0.000E+00 -1.052E+04  0.000E+00  36 42  no
   20  0.000E+00 -2.771E+02  0.000E+00  37 42  no
   19  0.000E+00 -2.571E+02  0.000E+00  38 42  no
   18  0.000E+00 -2.131E+02  0.000E+00  39 42  no
   17  0.000E+00 -5.413E+03  0.000E+00  39 41  no
   16  0.000E+00 -1.863E+02  0.000E+00  40 41  no
   15  0.000E+00 -1.907E+02  0.000E+00  40 40  no
   14  0.000E+00 -1.863E+02  0.000E+00  41 40  no
   13  0.000E+00 -1.518E+04  9.085E+03  41 39  no
   12  0.000E+00 -1.521E+04  9.085E+03  42 39  no
   11  0.000E+00 -1.525E+04  9.085E+03  42 38  no
   10  0.000E+00 -2.771E+02  0.000E+00  42 37  no
    9  0.000E+00 -2.845E+02  0.000E+00  42 36  no
    8  0.000E+00 -2.771E+02  0.000E+00  42 35  no
    7  0.000E+00 -2.571E+02  0.000E+00  42 34  no
    6  0.000E+00 -2.131E+02  0.000E+00  42 33  no
    5  0.000E+00 -1.819E+02  0.000E+00  41 33  no
    4  0.000E+00 -1.863E+02  0.000E+00  41 32  no
    3  0.000E+00 -1.907E+02  0.000E+00  40 32  no
    2  0.000E+00 -1.863E+02  0.000E+00  40 31  no
    1  0.000E+00 -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop           F-shear    F-axial      Mom-1      Mom-2
   48  1   48    1     3  beam  6.615E+03  4.946E+04  2.659E+03  2.891E-04
   47  1   47   48     3  beam  3.295E+03 -3.546E+03  4.401E+03 -2.621E+03
   46  1   46   47     3  beam  1.356E+04 -1.582E+05  1.269E+04 -4.613E+03
   45  1   45   46     3  beam -3.830E+02 -2.858E+05  1.241E+04 -1.265E+04
   44  1   44   45     3  beam -2.592E+03 -2.812E+05  1.112E+04 -1.275E+04
   43  1   43   44     3  beam -9.723E+03 -1.324E+05  5.211E+03 -1.101E+04
   42  1   42   43     3  beam -2.983E+03  2.392E+04  3.186E+03 -4.797E+03
   41  1   41   42     3  beam -6.926E+03  7.383E+04 -2.296E-05 -2.784E+03
   40  2   40   41     2  beam -1.342E+03  1.048E+05 -5.393E+02  9.698E-05
   39  2   39   40     2  beam  3.775E+03  1.172E+05  1.021E+03  5.700E+02
   38  2   38   39     2  beam -5.586E+03  1.808E+05 -1.384E+03 -9.701E+02
   37  2   37   38     2  beam  5.482E+03  1.975E+05  7.788E+02  1.425E+03
   36  2   36   37     2  beam -5.770E+03  2.665E+05 -1.496E+03 -8.231E+02
```

```
 35  2   35   36      2  beam  1.782E+03  2.857E+05 -5.119E+02  1.474E+03
 34  2   34   35      2  beam -1.230E+03  3.199E+05 -1.245E+03  5.118E+02
 33  2   33   34      2  beam  7.088E+02  3.416E+05 -8.317E+02  1.277E+03
 32  2   32   33      2  beam -2.091E+02  3.402E+05 -1.024E+03  8.931E+02
 31  2   31   32      2  beam  9.684E+02  3.113E+05 -4.792E+02  1.056E+03
 30  2   30   31      2  beam -2.015E+03  2.710E+05 -1.517E+03  4.285E+02
 29  2   29   30      2  beam  5.780E+03  2.523E+05  8.340E+02  1.489E+03
 28  2   28   29      2  beam -4.414E+03  1.886E+05 -9.993E+02 -7.748E+02
 27  2   27   28      2  beam  3.264E+03  1.653E+05  4.561E+02  9.193E+02
 26  2   26   27      2  beam -1.575E+03  1.006E+05 -1.826E+02 -4.811E+02
 25  2   25   26      2  beam  1.944E+03  8.876E+04  4.321E+02  3.495E+02
 24  2   24   25      2  beam  1.239E+03  3.161E+04  8.999E+02 -4.018E+02
 23  2   23   24      2  beam -2.441E+03  8.560E+03 -2.714E+02 -1.047E+03
 22  2   22   23      2  beam  3.536E+03 -3.293E+04  1.825E+03  2.827E+02
 21  2   21   22      2  beam -1.989E+02 -7.116E+04  1.612E+03 -1.737E+03
 20  2   20   21      2  beam -8.895E+02 -6.683E+04  1.045E+03 -1.604E+03
 19  2   19   20      2  beam -1.003E+03 -2.862E+04  4.775E+02 -1.075E+03
 18  2   18   19      2  beam  1.282E+02  2.052E+04  6.174E+02 -5.481E+02
 17  2   17   18      2  beam -3.545E+02  4.992E+04  4.357E+02 -5.782E+02
 16  2   16   17      2  beam -1.732E+03  1.146E+05 -4.462E+02 -2.499E+02
 15  2   15   16      2  beam  2.426E+03  1.284E+05  4.459E+02  5.764E+02
 14  2   14   15      2  beam -4.737E+03  1.842E+05 -1.568E+03 -4.285E+02
 13  2   13   14      2  beam  1.542E+04  2.068E+05  4.533E+03  1.663E+03
 12  2   12   13      2  beam  1.857E+04  2.666E+05  2.904E+03  4.562E+03
 11  2   11   12      2  beam  2.092E+04  2.825E+05  5.177E+03  6.124E+03
 10  2   10   11      2  beam  6.119E+03  3.255E+05 -2.712E+02  3.918E+03
  9  2    9   10      2  beam -1.077E+03  3.449E+05 -9.490E+02  2.723E+02
  8  2    8    9      2  beam -2.388E+02  3.425E+05 -1.130E+03  9.802E+02
  7  2    7    8      2  beam  1.123E+03  3.198E+05 -4.257E+02  1.095E+03
  6  2    6    7      2  beam -2.392E+03  2.800E+05 -1.669E+03  3.771E+02
  5  2    5    6      2  beam  7.011E+03  2.687E+05  1.066E+03  1.752E+03
  4  2    4    5      2  beam -5.819E+03  1.894E+05 -1.281E+03 -1.059E+03
  3  2    3    4      2  beam  5.606E+03  1.697E+05  1.049E+03  1.314E+03
  2  2    2    3      2  beam -3.172E+03  1.053E+05 -5.019E+02 -8.347E+02
  1  2    1    2      2  beam  1.695E+03  9.691E+04 -1.222E-05  6.813E+02
Structural Properties ...
 Prop                                                Dynamic       Plastic
 Num.      Area           E             I            Density        Moment
 ----  ------------  ------------  ------------  ------------  ------------
   3   3.04800E-01   2.75800E+10   2.36000E-03   0.00000E+00    Not Set
   2   5.90000E-03   1.64000E+11   4.57800E-05   0.00000E+00    Not Set
 Prop.  Cable Bond    Cable Bond      Yield       Compressive     Support
 Num.   Stiffness     Strength       Strength        Yield       Stiffness
 ----  ------------  ------------  ------------  ------------  ------------
   3   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00
   2   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00

>set log off
* log-file recording stopped  9-Aug-95  14:12

* FLAC log-file opened  9-Aug-95  14:13

rom File : p07k2dy.sav
 stru

Structural node data ...
 Node          X           Y        X-disp     Y-disp    Ang-disp  Xfix Yfix Rfix
  48  1.704E+00 -3.408E+00  1.630E-03 -6.819E-03 -2.086E-04   no   no   no
```

```
* FLAC log-file opened  9-Aug-95  14:12        STATION:   TSW1 @ 18+00
From File : p18k2dy.sav                         LOADING:   SEISMIC + DL+UTIL
>pr stru
                                                STEEL SET: W8X31 @ 4'-0" O.C.
Structural node data ...
 Node       X          Y        X-disp     Y-disp    Ang-disp  Xfix Yfix Rfix
  48  1.704E+00 -3.408E+00  1.620E-03 -2.294E-03 -2.920E-04   no   no   no
  47  1.205E+00 -3.614E+00  1.579E-03 -2.160E-03 -2.132E-04   no   no   no
  46  6.264E-01 -3.758E+00  1.568E-03 -2.070E-03 -9.266E-05   no   no   no
  45  0.000E+00 -3.810E+00  1.579E-03 -2.063E-03  5.219E-05   no   no   no
  44 -6.264E-01 -3.758E+00  1.586E-03 -2.132E-03  1.891E-04   no   no   no
  43 -1.205E+00 -3.614E+00  1.567E-03 -2.274E-03  2.826E-04   no   no   no
  42 -1.704E+00 -3.408E+00  1.519E-03 -2.438E-03  3.468E-04   no   no   no
  41 -2.053E+00 -3.209E+00  1.461E-03 -2.572E-03  0.000E+00   no   no   no
  40 -2.380E+00 -2.975E+00  1.461E-03 -2.762E-03  3.450E-04   no   no   no
  39 -2.694E+00 -2.694E+00  1.461E-03 -2.943E-03  3.302E-04   no   no   no
  38 -2.975E+00 -2.380E+00  1.464E-03 -3.165E-03  3.326E-04   no   no   no
  37 -3.209E+00 -2.053E+00  1.476E-03 -3.403E-03  3.397E-04   no   no   no
  36 -3.408E+00 -1.704E+00  1.470E-03 -3.674E-03  2.994E-04   no   no   no
  35 -3.614E+00 -1.205E+00  1.496E-03 -4.031E-03  1.628E-04   no   no   no
  34 -3.758E+00 -6.264E-01  1.519E-03 -4.476E-03  1.178E-04   no   no   no
  33 -3.810E+00  0.000E+00  1.521E-03 -4.981E-03 -9.893E-06   no   no   no
  32 -3.758E+00  6.264E-01  1.534E-03 -5.475E-03 -1.453E-04   no   no   no
  31 -3.614E+00  1.205E+00  1.528E-03 -5.912E-03 -1.727E-04   no   no   no
  30 -3.408E+00  1.704E+00  1.518E-03 -6.249E-03 -3.339E-04   no   no   no
  29 -3.209E+00  2.053E+00  1.549E-03 -6.521E-03 -4.093E-04   no   no   no
  28 -2.975E+00  2.380E+00  1.563E-03 -6.754E-03 -3.432E-04   no   no   no
  27 -2.694E+00  2.694E+00  1.569E-03 -6.954E-03 -2.982E-04   no   no   no
  26 -2.380E+00  2.975E+00  1.587E-03 -7.100E-03 -2.939E-04   no   no   no
  25 -2.053E+00  3.209E+00  1.606E-03 -7.236E-03 -3.105E-04   no   no   no
  24 -1.704E+00  3.408E+00  1.638E-03 -7.345E-03 -2.352E-04   no   no   no
  23 -1.205E+00  3.614E+00  1.653E-03 -7.459E-03 -2.138E-04   no   no   no
  22 -6.264E-01  3.758E+00  1.677E-03 -7.602E-03 -2.484E-04   no   no   no
  21  0.000E+00  3.810E+00  1.679E-03 -7.679E-03  4.575E-05   no   no   no
  20  6.264E-01  3.758E+00  1.680E-03 -7.545E-03  3.464E-04   no   no   no
  19  1.205E+00  3.614E+00  1.704E-03 -7.337E-03  3.236E-04   no   no   no
  18  1.704E+00  3.408E+00  1.713E-03 -7.176E-03  2.622E-04   no   no   no
  17  2.053E+00  3.209E+00  1.723E-03 -7.049E-03  3.279E-04   no   no   no
  16  2.380E+00  2.975E+00  1.729E-03 -6.883E-03  3.094E-04   no   no   no
  15  2.694E+00  2.694E+00  1.721E-03 -6.725E-03  2.763E-04   no   no   no
  14  2.975E+00  2.380E+00  1.707E-03 -6.519E-03  3.043E-04   no   no   no
  13  3.209E+00  2.053E+00  1.703E-03 -6.276E-03  4.536E-04   no   no   no
  12  3.408E+00  1.704E+00  1.726E-03 -5.985E-03  3.784E-04   no   no   no
  11  3.614E+00  1.205E+00  1.711E-03 -5.637E-03  2.462E-04   no   no   no
  10  3.758E+00  6.264E-01  1.693E-03 -5.195E-03  9.286E-05   no   no   no
   9  3.810E+00  0.000E+00  1.682E-03 -4.701E-03 -1.470E-05   no   no   no
   8  3.758E+00 -6.264E-01  1.670E-03 -4.204E-03 -1.412E-04   no   no   no
   7  3.614E+00 -1.205E+00  1.677E-03 -3.765E-03 -1.802E-04   no   no   no
   6  3.408E+00 -1.704E+00  1.690E-03 -3.423E-03 -3.118E-04   no   no   no
   5  3.209E+00 -2.053E+00  1.671E-03 -3.162E-03 -3.516E-04   no   no   no
   4  2.975E+00 -2.380E+00  1.674E-03 -2.939E-03 -3.190E-04   no   no   no
   3  2.694E+00 -2.694E+00  1.674E-03 -2.734E-03 -2.984E-04   no   no   no
   2  2.380E+00 -2.975E+00  1.673E-03 -2.573E-03 -3.067E-04   no   no   no
   1  2.053E+00 -3.209E+00  1.670E-03 -2.409E-03  0.000E+00   no   no   no
 Node    X-load     Y-load      Moment      i  j  Pin   Sh. force   Angle   Bond
  48  0.000E+00  0.000E+00  0.000E+00   39 30  no
  47  0.000E+00  0.000E+00  0.000E+00   38 30  no
  46  0.000E+00  0.000E+00  0.000E+00   37 30  no
  45  0.000E+00  0.000E+00  0.000E+00   36 30  no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -9.099E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.381E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.993E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.988E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.819E+02  0.000E+00  31 33  no
 36  0.000E+00 -2.131E+02  0.000E+00  30 33  no
 35  0.000E+00 -2.571E+02  0.000E+00  30 34  no
 34  0.000E+00 -2.771E+02  0.000E+00  30 35  no
 33  0.000E+00 -2.845E+02  0.000E+00  30 36  no
 32  0.000E+00 -2.771E+02  0.000E+00  30 37  no
 31  0.000E+00 -2.571E+02  0.000E+00  30 38  no
 30  0.000E+00 -2.131E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.819E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.863E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.907E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.863E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.413E+03  0.000E+00  33 41  no
 24  0.000E+00 -2.131E+02  0.000E+00  33 42  no
 23  0.000E+00 -2.571E+02  0.000E+00  34 42  no
 22  0.000E+00 -2.771E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.052E+04  0.000E+00  36 42  no
 20  0.000E+00 -2.771E+02  0.000E+00  37 42  no
 19  0.000E+00 -2.571E+02  0.000E+00  38 42  no
 18  0.000E+00 -2.131E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.413E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.863E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.907E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.863E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.518E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.521E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.525E+04  9.085E+03  42 38  no
 10  0.000E+00 -2.771E+02  0.000E+00  42 37  no
  9  0.000E+00 -2.845E+02  0.000E+00  42 36  no
  8  0.000E+00 -2.771E+02  0.000E+00  42 35  no
  7  0.000E+00 -2.571E+02  0.000E+00  42 34  no
  6  0.000E+00 -2.131E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.819E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.863E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.907E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.863E+02  0.000E+00  40 31  no
  1  0.000E+00 -9.099E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem  ID  Nod1  Nod2   Prop          F-shear      F-axial       Mom-1       Mom-2
   48   1    48     1      3  beam  1.809E+04    2.272E+05   7.269E+03  -7.848E-04
   47   1    47    48      3  beam  7.143E+03    2.314E+05   1.141E+04  -7.551E+03
   46   1    46    47      3  beam  3.216E+03    1.493E+05   1.417E+04  -1.225E+04
   45   1    45    46      3  beam  3.323E+03    1.541E+05   1.604E+04  -1.396E+04
   44   1    44    45      3  beam -4.808E+03    1.768E+05   1.265E+04  -1.567E+04
   43   1    43    44      3  beam -8.403E+03    2.201E+05   7.700E+03  -1.271E+04
   42   1    42    43      3  beam -1.098E+03    3.095E+05   7.480E+03  -8.073E+03
   41   1    41    42      3  beam -1.776E+04    3.082E+05   1.119E-04  -7.139E+03
   40   2    40    41      2  beam -5.996E+03    2.688E+05  -2.410E+03  -1.524E-04
   39   2    39    40      2  beam  1.044E+04    2.827E+05   1.936E+03   2.465E+03
   38   2    38    39      2  beam -9.304E+03    3.816E+05  -1.917E+03  -2.003E+03
   37   2    37    38      2  beam  1.026E+04    4.851E+05   2.196E+03   1.928E+03
   36   2    36    37      2  beam -1.440E+04    5.577E+05  -3.650E+03  -2.139E+03
```

```
  35  2   35   36     2  beam  6.202E+03  6.099E+05 -2.223E+02  3.573E+03
  34  2   34   35     2  beam -1.174E+03  7.132E+05 -9.163E+02  2.167E+02
  33  2   33   34     2  beam -1.870E+03  7.761E+05 -2.113E+03  9.377E+02
  32  2   32   33     2  beam  1.626E+03  7.586E+05 -1.106E+03  2.128E+03
  31  2   31   32     2  beam  2.501E+03  6.928E+05  3.987E+02  1.092E+03
  30  2   30   31     2  beam -9.900E+03  5.649E+05 -4.912E+03 -4.360E+02
  29  2   29   30     2  beam  1.777E+04  5.357E+05  2.159E+03  4.983E+03
  28  2   28   29     2  beam -4.405E+03  4.393E+05  3.546E+02 -2.125E+03
  27  2   27   28     2  beam  2.629E+03  3.324E+05  1.355E+03 -2.468E+02
  26  2   26   27     2  beam -5.559E+03  1.955E+05 -1.102E+03 -1.241E+03
  25  2   25   26     2  beam  3.339E+03  1.588E+05  3.622E+02  9.799E+02
  24  2   24   25     2  beam  5.143E+03  6.551E+04  2.447E+03 -3.796E+02
  23  2   23   24     2  beam -7.343E+03  4.819E+04 -1.686E+03 -2.280E+03
  22  2   22   23     2  beam  4.068E+03  1.904E+04  7.730E+02  1.652E+03
  21  2   21   22     2  beam  8.501E+03  8.056E+03  6.179E+03 -8.362E+02
  20  2   20   21     2  beam -8.201E+03  1.750E+04  1.019E+03 -6.173E+03
  19  2   19   20     2  beam -4.311E+03  4.508E+04 -1.561E+03 -1.008E+03
  18  2   18   19     2  beam  2.710E+03  9.596E+04 -1.248E+02  1.588E+03
  17  2   17   18     2  beam  7.151E+03  1.271E+05  2.659E+03  2.149E+02
  16  2   16   17     2  beam -1.487E+04  2.226E+05 -3.339E+03 -2.638E+03
  15  2   15   16     2  beam  1.297E+04  2.521E+05  2.140E+03  3.324E+03
  14  2   14   15     2  beam -7.851E+03  3.783E+05 -1.152E+03 -2.156E+03
  13  2   13   14     2  beam  1.937E+04  4.879E+05  6.688E+03  1.098E+03
  12  2   12   13     2  beam  4.946E+03  5.821E+05 -4.131E+02  2.401E+03
  11  2   11   12     2  beam  2.847E+04  5.875E+05  5.854E+03  9.528E+03
  10  2   10   11     2  beam  4.623E+03  7.060E+05 -5.523E+02  3.308E+03
   9  2    9   10     2  beam -2.120E+03  7.603E+05 -1.956E+03  6.237E+02
   8  2    8    9     2  beam  1.311E+03  7.636E+05 -1.094E+03  1.918E+03
   7  2    7    8     2  beam  2.036E+03  6.962E+05  1.120E+02  1.101E+03
   6  2    6    7     2  beam -7.187E+03  5.792E+05 -3.772E+03 -1.107E+02
   5  2    5    6     2  beam  1.497E+04  5.193E+05  2.271E+03  3.747E+03
   4  2    4    5     2  beam -8.096E+03  4.425E+05 -1.020E+03 -2.234E+03
   3  2    3    4     2  beam  6.783E+03  3.506E+05  1.792E+03  1.066E+03
   2  2    2    3     2  beam -9.694E+03  2.448E+05 -2.187E+03  1.066E+03
   1  2    1    2     2  beam  5.482E+03  2.344E+05  1.652E-04  2.203E+03
Structural Properties ...
 Prop                                               Dynamic       Plastic
 Num.     Area          E             I             Density        Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3  3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2  5.90000E-03  1.64000E+11  4.57800E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield      Compressive    Support
 Num.  Stiffness     Strength      Strength      Yield       Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

>set log off
* log-file recording stopped  9-Aug-95  14:12

* FLAC log-file opened  9-Aug-95  14:17

From File : p18k2dy.sav
  stru

Structural node data ...
 Node      X          Y        X-disp      Y-disp    Ang-disp  Xfix Yfix Rfix
  48  1.704E+00 -3.408E+00  1.620E-03 -2.294E-03 -2.920E-04   no   no   no
```

STATION: TSW2 @ 34+00

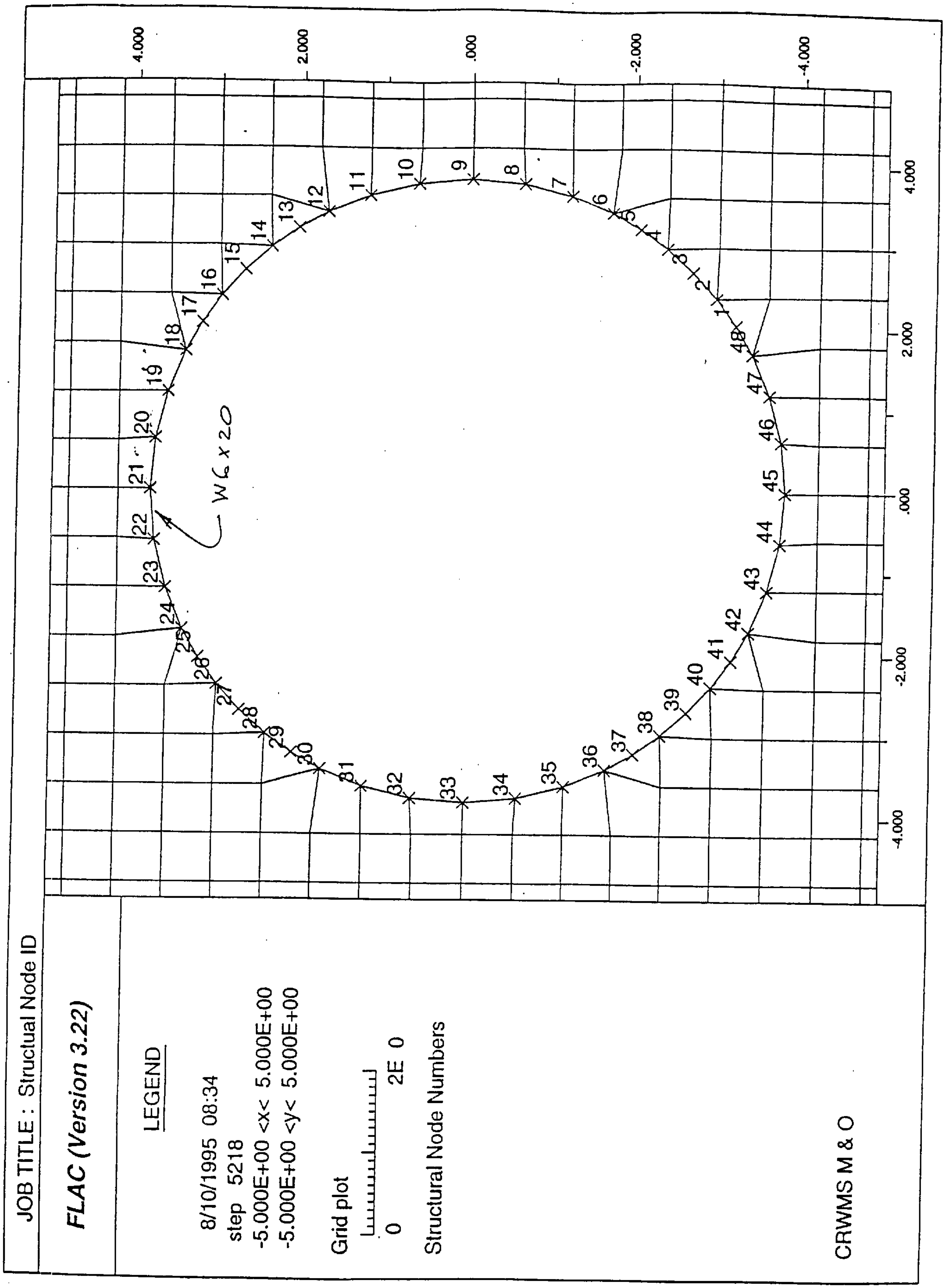
LOADING: SEISMIC + DL+UTIL

STEEL SET: W8X31 @ 2'-0" O.C.

```
* FLAC log-file opened 11-Aug-95   0:34

From File :
>res p34k2dyx.sav
   following state has been restored:
                date    time          step          grid    version
           10-Aug-95   15:10          8218       70 X 70       3.22
Title:

>pr stru

 Structural node data ...
  Node           X            Y        X-disp       Y-disp     Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00  -3.408E+00   1.806E-03  -2.554E-03  -5.189E-04    no    no    no
   47   1.205E+00  -3.614E+00   1.712E-03  -2.316E-03  -4.219E-04    no    no    no
   46   6.264E-01  -3.758E+00   1.634E-03  -2.112E-03  -3.067E-04    no    no    no
   45   0.000E+00  -3.810E+00   1.582E-03  -2.017E-03  -5.976E-06    no    no    no
   44  -6.264E-01  -3.758E+00   1.533E-03  -2.118E-03   3.218E-04    no    no    no
   43  -1.205E+00  -3.614E+00   1.449E-03  -2.332E-03   4.691E-04    no    no    no
   42  -1.704E+00  -3.408E+00   1.349E-03  -2.595E-03   5.465E-04    no    no    no
   41  -2.053E+00  -3.209E+00   1.247E-03  -2.799E-03   0.000E+00    no    no    no
   40  -2.380E+00  -2.975E+00   1.171E-03  -3.047E-03   6.014E-04    no    no    no
   39  -2.694E+00  -2.694E+00   1.082E-03  -3.308E-03   6.042E-04    no    no    no
   38  -2.975E+00  -2.380E+00   9.950E-04  -3.582E-03   5.551E-04    no    no    no
   37  -3.209E+00  -2.053E+00   9.172E-04  -3.839E-03   5.478E-04    no    no    no
   36  -3.408E+00  -1.704E+00   8.311E-04  -4.136E-03   5.009E-04    no    no    no
   35  -3.614E+00  -1.205E+00   7.564E-04  -4.499E-03   3.147E-04    no    no    no
   34  -3.758E+00  -6.264E-01   7.045E-04  -4.930E-03   1.837E-04    no    no    no
   33  -3.810E+00   0.000E+00   6.867E-04  -5.397E-03   3.353E-06    no    no    no
   32  -3.758E+00   6.264E-01   7.020E-04  -5.867E-03  -1.815E-04    no    no    no
   31  -3.614E+00   1.205E+00   7.543E-04  -6.297E-03  -3.247E-04    no    no    no
   30  -3.408E+00   1.704E+00   8.338E-04  -6.665E-03  -5.034E-04    no    no    no
   29  -3.209E+00   2.053E+00   9.182E-04  -6.959E-03  -5.377E-04    no    no    no
   28  -2.975E+00   2.380E+00   9.990E-04  -7.211E-03  -5.663E-04    no    no    no
   27  -2.694E+00   2.694E+00   1.087E-03  -7.495E-03  -6.117E-04    no    no    no
   26  -2.380E+00   2.975E+00   1.179E-03  -7.744E-03  -5.813E-04    no    no    no
   25  -2.053E+00   3.209E+00   1.255E-03  -7.985E-03  -5.735E-04    no    no    no
   24  -1.704E+00   3.408E+00   1.335E-03  -8.190E-03  -5.258E-04    no    no    no
   23  -1.205E+00   3.614E+00   1.428E-03  -8.444E-03  -5.112E-04    no    no    no
   22  -6.264E-01   3.758E+00   1.532E-03  -8.700E-03  -3.749E-04    no    no    no
   21   0.000E+00   3.810E+00   1.644E-03  -8.819E-03   9.925E-06    no    no    no
   20   6.264E-01   3.758E+00   1.753E-03  -8.684E-03   4.169E-04    no    no    no
   19   1.205E+00   3.614E+00   1.852E-03  -8.400E-03   5.456E-04    no    no    no
   18   1.704E+00   3.408E+00   1.936E-03  -8.126E-03   5.323E-04    no    no    no
   17   2.053E+00   3.209E+00   2.011E-03  -7.911E-03   5.870E-04    no    no    no
   16   2.380E+00   2.975E+00   2.081E-03  -7.667E-03   5.979E-04    no    no    no
   15   2.694E+00   2.694E+00   2.163E-03  -7.405E-03   6.054E-04    no    no    no
   14   2.975E+00   2.380E+00   2.238E-03  -7.115E-03   5.448E-04    no    no    no
   13   3.209E+00   2.053E+00   2.309E-03  -6.856E-03   5.721E-04    no    no    no
   12   3.408E+00   1.704E+00   2.390E-03  -6.549E-03   5.180E-04    no    no    no
   11   3.614E+00   1.205E+00   2.460E-03  -6.179E-03   3.398E-04    no    no    no
   10   3.758E+00   6.264E-01   2.494E-03  -5.753E-03   1.371E-04    no    no    no
    9   3.810E+00   0.000E+00   2.494E-03  -5.292E-03  -1.553E-05    no    no    no
    8   3.758E+00  -6.264E-01   2.469E-03  -4.835E-03  -1.920E-04    no    no    no
    7   3.614E+00  -1.205E+00   2.413E-03  -4.411E-03  -3.156E-04    no    no    no
    6   3.408E+00  -1.704E+00   2.337E-03  -4.058E-03  -4.879E-04    no    no    no
    5   3.209E+00  -2.053E+00   2.247E-03  -3.766E-03  -5.592E-04    no    no    no
    4   2.975E+00  -2.380E+00   2.164E-03  -3.513E-03  -5.549E-04    no    no    no
    3   2.694E+00  -2.694E+00   2.078E-03  -3.248E-03  -5.797E-04    no    no    no
    2   2.380E+00  -2.975E+00   1.986E-03  -3.001E-03  -5.982E-04    no    no    no
```

```
  1  2.053E+00 -3.209E+00  1.907E-03 -2.749E-03   0.000E+00    no    no    no
Node   X-load     Y-load      Moment    i   j  Pin  Sh. force    Angle    Bond
 48  0.000E+00  0.000E+00  0.000E+00  39  30  no
 47  0.000E+00  0.000E+00  0.000E+00  38  30  no
 46  0.000E+00  0.000E+00  0.000E+00  37  30  no
 45  0.000E+00  0.000E+00  0.000E+00  36  30  no
 44  0.000E+00  0.000E+00  0.000E+00  35  30  no
 43  0.000E+00  0.000E+00  0.000E+00  34  30  no
 42  0.000E+00  0.000E+00  0.000E+00  33  30  no
 41  0.000E+00 -9.099E+01  0.000E+00  33  31 yes
 40  0.000E+00 -1.381E+03  0.000E+00  32  31  no
 39  0.000E+00 -2.993E+03  0.000E+00  32  32  no
 38  0.000E+00 -2.988E+03  0.000E+00  31  32  no
 37  0.000E+00 -1.819E+02  0.000E+00  31  33  no
 36  0.000E+00 -2.131E+02  0.000E+00  30  33  no
 35  0.000E+00 -2.571E+02  0.000E+00  30  34  no
 34  0.000E+00 -2.771E+02  0.000E+00  30  35  no
 33  0.000E+00 -2.845E+02  0.000E+00  30  36  no
 32  0.000E+00 -2.771E+02  0.000E+00  30  37  no
 31  0.000E+00 -2.571E+02  0.000E+00  30  38  no
 30  0.000E+00 -2.131E+02  0.000E+00  30  39  no
 29  0.000E+00 -1.819E+02  0.000E+00  31  39  no
 28  0.000E+00 -1.863E+02  0.000E+00  31  40  no
 27  0.000E+00 -1.907E+02  0.000E+00  32  40  no
 26  0.000E+00 -1.863E+02  0.000E+00  32  41  no
 25  0.000E+00 -5.413E+03  0.000E+00  33  41  no
 24  0.000E+00 -2.131E+02  0.000E+00  33  42  no
 23  0.000E+00 -2.571E+02  0.000E+00  34  42  no
 22  0.000E+00 -2.771E+02  0.000E+00  35  42  no
 21  0.000E+00 -1.052E+04  0.000E+00  36  42  no
 20  0.000E+00 -2.771E+02  0.000E+00  37  42  no
 19  0.000E+00 -2.571E+02  0.000E+00  38  42  no
 18  0.000E+00 -2.131E+02  0.000E+00  39  42  no
 17  0.000E+00 -5.413E+03  0.000E+00  39  41  no
 16  0.000E+00 -1.863E+02  0.000E+00  40  41  no
 15  0.000E+00 -1.907E+02  0.000E+00  40  40  no
 14  0.000E+00 -1.863E+02  0.000E+00  41  40  no
 13  0.000E+00 -1.518E+04  9.085E+03  41  39  no
 12  0.000E+00 -1.521E+04  9.085E+03  42  39  no
 11  0.000E+00 -1.525E+04  9.085E+03  42  38  no
 10  0.000E+00 -2.771E+02  0.000E+00  42  37  no
  9  0.000E+00 -2.845E+02  0.000E+00  42  36  no
  8  0.000E+00 -2.771E+02  0.000E+00  42  35  no
  7  0.000E+00 -2.571E+02  0.000E+00  42  34  no
  6  0.000E+00 -2.131E+02  0.000E+00  42  33  no
  5  0.000E+00 -1.819E+02  0.000E+00  41  33  no
  4  0.000E+00 -1.863E+02  0.000E+00  41  32  no
  3  0.000E+00 -1.907E+02  0.000E+00  40  32  no
  2  0.000E+00 -1.863E+02  0.000E+00  40  31  no
  1  0.000E+00 -9.099E+01  0.000E+00  39  31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop          F-shear     F-axial       Mom-1       Mom-2
  48  1   48    1     3  beam  4.106E+04  2.219E+05   1.650E+04   5.261E-04
  47  1   47   48     3  beam -1.887E+04  2.905E+04   6.640E+03  -1.683E+04
  46  1   46   47     3  beam  1.935E+04 -3.223E+05   1.838E+04  -6.844E+03
  45  1   45   46     3  beam  4.075E+04 -5.881E+05   4.394E+04  -1.832E+04
  44  1   44   45     3  beam -3.089E+04 -5.958E+05   2.421E+04  -4.363E+04
  43  1   43   44     3  beam -2.820E+04 -3.101E+05   7.691E+03  -2.450E+04
  42  1   42   43     3  beam  5.901E+03  6.768E+04   1.091E+04  -7.725E+03
```

```
 41  1   41   42    3  beam -2.736E+04   2.459E+05  2.122E-07 -1.100E+04
 40  2   40   41    2  beam -3.537E+03   4.062E+05 -1.422E+03 -8.372E-05
 39  2   39   40    2  beam  7.992E+03   4.743E+05  1.777E+03  1.591E+03
 38  2   38   39    2  beam -1.588E+04   6.949E+05 -5.093E+03 -1.600E+03
 37  2   37   38    2  beam  2.351E+04   7.896E+05  4.448E+03  5.000E+03
 36  2   36   37    2  beam -3.135E+04   1.027E+06 -8.042E+03 -4.557E+03
 35  2   35   36    2  beam  1.141E+04   1.110E+06 -2.088E+03  8.249E+03
 34  2   34   35    2  beam -3.750E+03   1.317E+06 -4.426E+03  2.191E+03
 33  2   33   34    2  beam  4.248E+02   1.437E+06 -4.179E+03  4.446E+03
 32  2   32   33    2  beam -7.024E+02   1.446E+06 -4.630E+03  4.189E+03
 31  2   31   32    2  beam  2.995E+03   1.311E+06 -2.709E+03  4.494E+03
 30  2   30   31    2  beam -8.295E+03   1.125E+06 -7.202E+03  2.721E+03
 29  2   29   30    2  beam  2.950E+04   1.033E+06  4.653E+03  7.202E+03
 28  2   28   29    2  beam -2.772E+04   7.550E+05 -6.655E+03 -4.488E+03
 27  2   27   28    2  beam  2.423E+04   7.060E+05  3.482E+03  6.727E+03
 26  2   26   27    2  beam -1.119E+04   4.579E+05 -1.281E+03 -3.434E+03
 25  2   25   26    2  beam  8.441E+03   3.686E+05  2.005E+03  1.388E+03
 24  2   24   25    2  beam -1.313E+03   1.531E+05  1.511E+03 -2.039E+03
 23  2   23   24    2  beam -4.978E+03   4.384E+04 -9.515E+02 -1.737E+03
 22  2   22   23    2  beam  1.459E+04  -1.227E+05  7.797E+03  8.971E+02
 21  2   21   22    2  beam  4.819E+03  -3.122E+05  1.071E+04 -7.683E+03
 20  2   20   21    2  beam -2.750E+03  -3.057E+05  8.846E+03 -1.057E+04
 19  2   19   20    2  beam -1.897E+04  -7.934E+04 -2.415E+03 -8.893E+03
 18  2   18   19    2  beam  7.572E+03   1.010E+05  1.677E+03  2.413E+03
 17  2   17   18    2  beam  1.591E+03   1.874E+05  2.350E+03 -1.711E+03
 16  2   16   17    2  beam -1.078E+04   4.235E+05 -1.762E+03 -2.570E+03
 15  2   15   16    2  beam  9.068E+03   5.272E+05  2.179E+03  1.642E+03
 14  2   14   15    2  beam -2.042E+04   7.649E+05 -6.456E+03 -2.149E+03
 13  2   13   14    2  beam  3.731E+04   8.182E+05  8.533E+03  6.463E+03
 12  2   12   13    2  beam -6.273E+03   1.082E+06 -3.294E+03  7.722E+02
 11  2   11   12    2  beam  2.710E+04   1.137E+06  2.363E+03  1.227E+04
 10  2   10   11    2  beam  5.223E+03   1.317E+06 -3.540E+03  6.653E+03
  9  2    9   10    2  beam -4.550E+01   1.420E+06 -3.661E+03  3.632E+03
  8  2    8    9    2  beam -1.746E+03   1.404E+06 -4.767E+03  3.670E+03
  7  2    7    8    2  beam  5.207E+03   1.294E+06 -1.556E+03  4.660E+03
  6  2    6    7    2  beam -1.184E+04   1.075E+06 -7.978E+03  1.581E+03
  5  2    5    6    2  beam  2.797E+04   1.004E+06  2.945E+03  8.300E+03
  4  2    4    5    2  beam -1.379E+04   7.548E+05 -2.612E+03 -2.932E+03
  3  2    3    4    2  beam  7.540E+03   6.494E+05  6.999E+02  2.477E+03
  2  2    2    3    2  beam -6.711E+03   4.458E+05 -2.064E+03 -7.635E+02
  1  2    1    2    2  beam  5.026E+03   3.794E+05  1.074E-04  2.020E+03
Structural Properties ...
 Prop                                               Dynamic      Plastic
 Num.     Area           E            I             Density       Moment
 ----  -----------  -----------  -----------  -----------  -----------
  3    3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
  2    5.90000E-03  3.27870E+11  4.57800E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.   Stiffness     Strength     Strength      Yield       Stiffness
 ----  -----------  -----------  -----------  -----------  -----------
  3    0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
  2    0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
set log off
log-file recording stopped 11-Aug-95   0:34
```


JOB TITLE : Structual Node ID
FLAC (Version 3.22)
LEGEND
8/10/1995 08:34
step 5218
-5.000E+00 <x< 5.000E+00
-5.000E+00 <y< 5.000E+00
Grid plot
0 2E 0
Structural Node Numbers
CRWMS M & O
4.000
2.000
.000
-2.000
-4.000
4.000
2.000
.000
-2.000
-4.000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
W6 x 20

STATION: TCW @ 7+00
LOADING: SEISMIC + DL+UTI
STEEL SET: W6X20 @ 4'-0" O.

```
* FLAC log-file opened 10-Aug-95  12:09
 Seismic Model @07+00: Ctg-3, Ko=0.25, W6x20 Steel Set
From File : m07_k2dy.sav
>pr stru

 Structural node data ...
  Node        X          Y        X-disp     Y-disp    Ang-disp  Xfix Yfix Rfix
   48  1.704E+00 -3.408E+00  9.613E-04 -6.995E-03 -1.010E-04   no   no   no
   47  1.205E+00 -3.614E+00  9.417E-04 -6.951E-03 -8.028E-05   no   no   no
   46  6.264E-01 -3.758E+00  9.231E-04 -6.910E-03 -5.913E-05   no   no   no
   45  0.000E+00 -3.810E+00  9.055E-04 -6.893E-03 -1.576E-06   no   no   no
   44 -6.264E-01 -3.758E+00  8.869E-04 -6.910E-03  6.338E-05   no   no   no
   43 -1.205E+00 -3.614E+00  8.654E-04 -6.957E-03  1.022E-04   no   no   no
   42 -1.704E+00 -3.408E+00  8.407E-04 -7.014E-03  1.259E-04   no   no   no
   41 -2.053E+00 -3.209E+00  8.159E-04 -7.060E-03  0.000E+00   no   no   no
   40 -2.380E+00 -2.975E+00  8.010E-04 -7.116E-03  1.373E-04   no   no   no
   39 -2.694E+00 -2.694E+00  7.786E-04 -7.176E-03  1.450E-04   no   no   no
   38 -2.975E+00 -2.380E+00  7.627E-04 -7.248E-03  1.298E-04   no   no   no
   37 -3.209E+00 -2.053E+00  7.471E-04 -7.310E-03  1.281E-04   no   no   no
   36 -3.408E+00 -1.704E+00  7.311E-04 -7.387E-03  1.191E-04   no   no   no
   35 -3.614E+00 -1.205E+00  7.174E-04 -7.486E-03  7.614E-05   no   no   no
   34 -3.758E+00 -6.264E-01  7.076E-04 -7.600E-03  4.468E-05   no   no   no
   33 -3.810E+00  0.000E+00  7.034E-04 -7.723E-03  1.033E-06   no   no   no
   32 -3.758E+00  6.264E-01  7.065E-04 -7.843E-03 -4.321E-05   no   no   no
   31 -3.614E+00  1.205E+00  7.158E-04 -7.953E-03 -6.896E-05   no   no   no
   30 -3.408E+00  1.704E+00  7.260E-04 -8.043E-03 -1.054E-04   no   no   no
   29 -3.209E+00  2.053E+00  7.405E-04 -8.115E-03 -1.212E-04   no   no   no
   28 -2.975E+00  2.380E+00  7.558E-04 -8.175E-03 -1.217E-04   no   no   no
   27 -2.694E+00  2.694E+00  7.695E-04 -8.238E-03 -1.232E-04   no   no   no
   26 -2.380E+00  2.975E+00  7.878E-04 -8.289E-03 -1.197E-04   no   no   no
   25 -2.053E+00  3.209E+00  8.003E-04 -8.341E-03 -1.193E-04   no   no   no
   24 -1.704E+00  3.408E+00  8.188E-04 -8.382E-03 -1.068E-04   no   no   no
   23 -1.205E+00  3.614E+00  8.383E-04 -8.431E-03 -8.973E-05   no   no   no
   22 -6.264E-01  3.758E+00  8.644E-04 -8.470E-03 -5.858E-05   no   no   no
   21  0.000E+00  3.810E+00  8.949E-04 -8.485E-03  7.502E-06   no   no   no
   20  6.264E-01  3.758E+00  9.252E-04 -8.460E-03  7.443E-05   no   no   no
   19  1.205E+00  3.614E+00  9.504E-04 -8.411E-03  1.059E-04   no   no   no
   18  1.704E+00  3.408E+00  9.687E-04 -8.353E-03  1.198E-04   no   no   no
   17  2.053E+00  3.209E+00  9.853E-04 -8.305E-03  1.281E-04   no   no   no
   16  2.380E+00  2.975E+00  9.960E-04 -8.249E-03  1.239E-04   no   no   no
   15  2.694E+00  2.694E+00  1.012E-03 -8.191E-03  1.410E-04   no   no   no
   14  2.975E+00  2.380E+00  1.023E-03 -8.123E-03  7.989E-05   no   no   no
   13  3.209E+00  2.053E+00  1.036E-03 -8.062E-03  2.683E-04   no   no   no
   12  3.408E+00  1.704E+00  1.050E-03 -7.987E-03  2.062E-04   no   no   no
   11  3.614E+00  1.205E+00  1.061E-03 -7.893E-03  2.868E-04   no   no   no
   10  3.758E+00  6.264E-01  1.070E-03 -7.782E-03 -1.664E-05   no   no   no
    9  3.810E+00  0.000E+00  1.072E-03 -7.662E-03  1.586E-05   no   no   no
    8  3.758E+00 -6.264E-01  1.070E-03 -7.541E-03 -4.601E-05   no   no   no
    7  3.614E+00 -1.205E+00  1.062E-03 -7.429E-03 -6.708E-05   no   no   no
    6  3.408E+00 -1.704E+00  1.052E-03 -7.335E-03 -1.092E-04   no   no   no
    5  3.209E+00 -2.053E+00  1.039E-03 -7.262E-03 -1.170E-04   no   no   no
    4  2.975E+00 -2.380E+00  1.026E-03 -7.204E-03 -1.163E-04   no   no   no
    3  2.694E+00 -2.694E+00  1.013E-03 -7.137E-03 -1.309E-04   no   no   no
    2  2.380E+00 -2.975E+00  9.936E-04 -7.084E-03 -1.222E-04   no   no   no
       2.053E+00 -3.209E+00  9.820E-04 -7.033E-03  0.000E+00   no   no   no
Node     X-load     Y-load     Moment     i  j Pin  Sh. force  Angle  Bond
  48  0.000E+00  0.000E+00  0.000E+00   39 30  no
  47  0.000E+00  0.000E+00  0.000E+00   38 30  no
  46  0.000E+00  0.000E+00  0.000E+00   37 30  no
  45  0.000E+00  0.000E+00  0.000E+00   36 30  no
```

```
  44  0.000E+00  0.000E+00  0.000E+00  35 30  no
  43  0.000E+00  0.000E+00  0.000E+00  34 30  no
  42  0.000E+00  0.000E+00  0.000E+00  33 30  no
  41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
  40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
  39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
  38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
  37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
  36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
  35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
  34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
  33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
  32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
  31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
  30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
  29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
  28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
  27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
  26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
  25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
  24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
  23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
  22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
  21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
  20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
  19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
  18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
  17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
  16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
  15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
  14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
  13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
  12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
  11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
  10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
   9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
   8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
   7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
   6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
   5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
   4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
   3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
   2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
   1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes
Structural element data ...
 Elem  ID Nod1 Nod2  Prop
                                    F-shear    F-axial       Mom-1       Mom-2
  48   1   48    1    3  beam  9.245E+03  2.151E+04  3.716E+03 -2.881E-04
  47   1   47   48    3  beam -3.887E+03 -1.651E+04  1.443E+03 -3.542E+03
  46   1   46   47    3  beam  2.837E+03 -1.234E+05  3.155E+03 -1.464E+03
  45   1   45   46    3  beam  9.133E+03 -2.129E+05  8.828E+03 -3.088E+03
  44   1   44   45    3  beam -7.120E+03 -2.254E+05  4.504E+03 -8.979E+03
  43   1   43   44    3  beam -1.390E+03 -1.388E+05  3.821E+03 -4.649E+03
  42   1   42   43    3  beam -2.746E+03 -1.262E+04  2.101E+03 -3.584E+03
  41   1   41   42    3  beam -4.998E+03  2.083E+04 -4.564E-04 -2.009E+03
  40   2   40   41    2  beam  1.162E+02  3.195E+04  4.672E+01  2.388E-05
  39   2   39   40    2  beam -1.815E+01  3.393E+04  4.781E+01 -5.546E+01
  38   2   38   39    2  beam -7.887E+02  6.347E+04 -2.679E+02 -6.442E+01
  37   2   37   38    2  beam  1.220E+03  6.496E+04  2.335E+02  2.569E+02
  36   2   36   37    2  beam -1.424E+03  9.104E+04 -3.489E+02 -2.233E+02
```

```
 35  2   35   36    2  beam  4.953E+02  9.929E+04 -9.082E+01  3.584E+02
 34  2   34   35    2  beam -1.677E+02  1.131E+05 -1.994E+02  9.946E+01
 33  2   33   34    2  beam  1.793E+00  1.213E+05 -1.963E+02  1.974E+02
 32  2   32   33    2  beam -4.232E+01  1.183E+05 -2.116E+02  1.850E+02
 31  2   31   32    2  beam  3.156E+02  1.084E+05 -2.778E+01  2.159E+02
 30  2   30   31    2  beam -5.650E+02  9.198E+04 -3.443E+02  3.910E+01
 29  2   29   30    2  beam  1.073E+03  8.448E+04  1.054E+02  3.258E+02
 28  2   28   29    2  beam -5.206E+02  6.159E+04 -1.081E+02 -1.012E+02
 27  2   27   28    2  beam  5.152E+02  5.633E+04  9.829E+01  1.188E+02
 26  2   26   27    2  beam -3.720E+02  3.058E+04 -5.306E+01 -1.037E+02
 25  2   25   26    2  beam  3.318E+02  2.969E+04  6.780E+01  6.558E+01
 24  2   24   25    2  beam  1.436E+02  7.402E+03  1.160E+02 -5.833E+01
 23  2   23   24    2  beam -1.358E+02  7.612E+02  5.271E+01 -1.261E+02
 22  2   22   23    2  beam  2.718E+02 -1.574E+04  2.281E+02 -6.608E+01
 21  2   21   22    2  beam  1.891E+02 -2.919E+04  3.579E+02 -2.390E+02
 20  2   20   21    2  beam -1.414E+02 -2.816E+04  2.568E+02 -3.457E+02
 19  2   19   20    2  beam -3.124E+02 -1.242E+04  5.497E+01 -2.412E+02
 18  2   18   19    2  beam  4.295E+01  6.534E+03  8.461E+01 -6.141E+01
 17  2   17   18    2  beam -1.874E+02  1.416E+04  2.126E+01 -9.659E+01
 16  2   16   17    2  beam -2.972E+02  3.626E+04 -8.909E+01 -3.035E+01
 15  2   15   16    2  beam  1.008E+03  3.966E+04  3.271E+02  9.757E+01
 14  2   14   15    2  beam -3.426E+03  6.366E+04 -1.132E+03 -3.113E+02
 13  2   13   14    2  beam  1.217E+04  6.558E+04  3.771E+03  1.121E+03
 12  2   12   13    2  beam  2.426E+04  8.984E+04  4.439E+03  5.311E+03
 11  2   11   12    2  beam  1.877E+04  9.530E+04  5.490E+03  4.647E+03
 10  2   10   11    2  beam  7.221E+03  1.107E+05  7.136E+02  3.590E+03
  9  2    9   10    2  beam -1.797E+03  1.186E+05 -4.185E+02 -7.107E+02
  8  2    8    9    2  beam  4.710E+02  1.189E+05 -1.305E+02  4.266E+02
  7  2    7    8    2  beam  9.385E+01  1.114E+05 -7.181E+01  1.278E+02
  6  2    6    7    2  beam -5.809E+02  9.599E+04 -3.779E+02  6.407E+01
  5  2    5    6    2  beam  1.576E+03  8.739E+04  2.632E+02  3.705E+02
  4  2    4    5    2  beam -1.251E+03  6.219E+04 -2.464E+02 -2.566E+02
  3  2    3    4    2  beam  7.421E+02  6.067E+04  5.804E+01  2.547E+02
  2  2    2    3    2  beam -1.758E+00  3.136E+04  5.797E+01 -5.871E+01
  1  2    1    2    2  beam -1.525E+02  3.071E+04 -9.769E-06 -6.130E+01

Structural Properties ...
 Prop                                              Dynamic      Plastic
 Num.      Area          E             I           Density      Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.  Stiffness     Strength     Strength       Yield      Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

set log off
 log-file recording stopped 10-Aug-95  12:09
```

~~FLAC log-file opened 10-Aug-95 12:22~~
~~Seismic Model @07+00: Ctg-3, Ko=0.25, W6x20 Steel Set~~
~~FromFile : m07_k2dy.sav~~
~~stru~~

~~Structural node data ...~~
~~Node   X   Y   X-disp   Y-disp   Ang-disp Xfix Yfix Rfix~~
~~48 1.704E+00 -3.408E+00 9.613E-04 -6.995E-03 -1.010E-04   no   no   no~~

MA
11-10-95

STATION: TSW1 @ 18+00

LOADING: SEISMIC + DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 10-Aug-95  12:22
 Seismic Model @18+00: Ctg-3, Ko=0.25, W6x20 Steel Set
From File : m18_k2dy.sav
>pr stru

 Structural node data ...
  Node        X          Y        X-disp     Y-disp    Ang-disp  Xfix  Yfix  Rfix
   48  1.704E+00 -3.408E+00  7.685E-04 -1.136E-03 -1.164E-04   no    no    no
   47  1.205E+00 -3.614E+00  7.564E-04 -1.086E-03 -8.744E-05   no    no    no
   46  6.264E-01 -3.758E+00  7.475E-04 -1.037E-03 -6.602E-05   no    no    no
   45  0.000E+00 -3.810E+00  7.476E-04 -1.020E-03  1.716E-05   no    no    no
   44 -6.264E-01 -3.758E+00  7.475E-04 -1.056E-03  9.793E-05   no    no    no
   43 -1.205E+00 -3.614E+00  7.378E-04 -1.125E-03  1.151E-04   no    no    no
   42 -1.704E+00 -3.408E+00  7.231E-04 -1.189E-03  1.423E-04   no    no    no
   41 -2.053E+00 -3.209E+00  6.982E-04 -1.251E-03  0.000E+00   no    no    no
   40 -2.380E+00 -2.975E+00  6.984E-04 -1.333E-03  1.648E-04   no    no    no
   39 -2.694E+00 -2.694E+00  6.862E-04 -1.415E-03  1.746E-04   no    no    no
   38 -2.975E+00 -2.380E+00  6.742E-04 -1.509E-03  1.491E-04   no    no    no
   37 -3.209E+00 -2.053E+00  6.603E-04 -1.590E-03  1.790E-04   no    no    no
   36 -3.408E+00 -1.704E+00  6.422E-04 -1.717E-03  1.538E-04   no    no    no
   35 -3.614E+00 -1.205E+00  6.638E-04 -1.864E-03  2.666E-05   no    no    no
   34 -3.758E+00 -6.264E-01  7.025E-04 -2.082E-03  1.906E-05   no    no    no
   33 -3.810E+00  0.000E+00  7.208E-04 -2.362E-03 -4.517E-06   no    no    no
   32 -3.758E+00  6.264E-01  7.092E-04 -2.634E-03 -2.913E-05   no    no    no
   31 -3.614E+00  1.205E+00  6.815E-04 -2.834E-03 -3.729E-05   no    no    no
   30 -3.408E+00  1.704E+00  6.727E-04 -2.966E-03 -1.671E-04   no    no    no
   29 -3.209E+00  2.053E+00  6.953E-04 -3.091E-03 -1.743E-04   no    no    no
   28 -2.975E+00  2.380E+00  7.140E-04 -3.156E-03 -1.437E-04   no    no    no
   27 -2.694E+00  2.694E+00  7.248E-04 -3.253E-03 -1.682E-04   no    no    no
   26 -2.380E+00  2.975E+00  7.421E-04 -3.321E-03 -1.428E-04   no    no    no
   25 -2.053E+00  3.209E+00  7.509E-04 -3.387E-03 -1.449E-04   no    no    no
   24 -1.704E+00  3.408E+00  7.621E-04 -3.445E-03 -1.353E-04   no    no    no
   23 -1.205E+00  3.614E+00  7.724E-04 -3.514E-03 -1.011E-04   no    no    no
   22 -6.264E-01  3.758E+00  7.837E-04 -3.560E-03 -8.994E-05   no    no    no
   21  0.000E+00  3.810E+00  7.980E-04 -3.605E-03  5.750E-06   no    no    no
   20  6.264E-01  3.758E+00  8.115E-04 -3.548E-03  1.278E-04   no    no    no
   19  1.205E+00  3.614E+00  8.200E-04 -3.472E-03  1.349E-04   no    no    no
   18  1.704E+00  3.408E+00  8.248E-04 -3.389E-03  1.507E-04   no    no    no
   17  2.053E+00  3.209E+00  8.331E-04 -3.323E-03  1.642E-04   no    no    no
   16  2.380E+00  2.975E+00  8.373E-04 -3.246E-03  1.459E-04   no    no    no
   15  2.694E+00  2.694E+00  8.460E-04 -3.172E-03  1.740E-04   no    no    no
   14  2.975E+00  2.380E+00  8.469E-04 -3.067E-03  9.743E-05   no    no    no
   13  3.209E+00  2.053E+00  8.614E-04 -2.996E-03  3.284E-04   no    no    no
   12  3.408E+00  1.704E+00  8.805E-04 -2.859E-03  2.667E-04   no    no    no
   11  3.614E+00  1.205E+00  8.641E-04 -2.721E-03  2.407E-04   no    no    no
   10  3.758E+00  6.264E-01  8.287E-04 -2.517E-03 -4.453E-05   no    no    no
    9  3.810E+00  0.000E+00  8.058E-04 -2.243E-03  7.715E-06   no    no    no
    8  3.758E+00 -6.264E-01  8.184E-04 -1.968E-03 -3.301E-05   no    no    no
    7  3.614E+00 -1.205E+00  8.494E-04 -1.758E-03 -3.195E-05   no    no    no
    6  3.408E+00 -1.704E+00  8.646E-04 -1.619E-03 -1.599E-04   no    no    no
    5  3.209E+00 -2.053E+00  8.423E-04 -1.494E-03 -1.847E-04   no    no    no
    4  2.975E+00 -2.380E+00  8.227E-04 -1.420E-03 -1.548E-04   no    no    no
    3  2.694E+00 -2.694E+00  8.086E-04 -1.325E-03 -1.683E-04   no    no    no
    2  2.380E+00 -2.975E+00  7.954E-04 -1.253E-03 -1.407E-04   no    no    no
    1  2.053E+00 -3.209E+00  7.908E-04 -1.186E-03  0.000E+00   no    no    no
Node     X-load      Y-load      Moment     i  j Pin  Sh. force   Angle    Bond
  48  0.000E+00   0.000E+00   0.000E+00   39 30  no
  47  0.000E+00   0.000E+00   0.000E+00   38 30  no
  46  0.000E+00   0.000E+00   0.000E+00   37 30  no
  45  0.000E+00   0.000E+00   0.000E+00   36 30  no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31  yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 32  no
 36  0.000E+00 -1.375E+02  0.000E+00  31 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 33  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 34  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 35  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 36  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 37  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 38  no
 29  0.000E+00 -1.174E+02  0.000E+00  30 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 39  no
 27  0.000E+00 -1.230E+02  0.000E+00  31 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 40  no
 25  0.000E+00 -5.366E+03  0.000E+00  32 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 41  no
 23  0.000E+00 -1.659E+02  0.000E+00  33 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  34 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  35 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  36 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  37 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  38 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 42  no
 16  0.000E+00 -1.202E+02  0.000E+00  39 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 41  no
 14  0.000E+00 -1.202E+02  0.000E+00  40 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 40  no
 12  0.000E+00 -1.513E+04  9.085E+03  41 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 39  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 38  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 37  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 36  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 35  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 34  no
  5  0.000E+00 -1.174E+02  0.000E+00  42 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 33  no
  3  0.000E+00 -1.230E+02  0.000E+00  41 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 32  no
  1  0.000E+00 -5.870E+01  0.000E+00  40 31  no
                                      39 31  yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop          F-shear      F-axial       Mom-1       Mom-2
  48  1   48    1    3  beam   2.114E+04   1.051E+05   8.496E+03  -4.947E-05
  47  1   47   48    3  beam  -1.825E+04   1.247E+05  -1.466E+03  -8.395E+03
  46  1   46   47    3  beam   1.235E+04   3.590E+04   6.037E+03   1.327E+03
  45  1   45   46    3  beam   8.771E+03   2.244E+04   1.139E+04  -5.876E+03
  44  1   44   45    3  beam  -8.593E+03   4.643E+04   5.649E+03  -1.105E+04
  43  1   43   44    3  beam  -1.319E+04   8.965E+04  -2.074E+03  -5.786E+03
  42  1   42   43    3  beam   1.915E+04   1.792E+05   8.464E+03   1.878E+03
  41  1   41   42    3  beam  -2.202E+04   1.531E+05   8.363E-05  -8.849E+03
  40  2   40   41    2  beam  -2.530E+02   7.635E+04  -1.017E+02   1.897E-05
  39  2   39   40    2  beam   8.506E+02   6.820E+04   2.456E+02   1.129E+02
  38  2   38   39    2  beam  -1.899E+03   9.264E+04  -5.713E+02  -2.290E+02
  37  2   37   38    2  beam   3.990E+03   8.863E+04   1.011E+03   5.926E+02
  36  2   36   37    2  beam  -6.063E+03   1.564E+05  -1.394E+03  -1.043E+03
```

```
  35  2   35   36     2  beam  2.690E+03  1.674E+05  6.106E+01  1.392E+03
  34  2   34   35     2  beam -2.697E+02  2.301E+05 -1.173E+02 -4.344E+01
  33  2   33   34     2  beam -2.990E+01  2.779E+05 -1.141E+02  9.531E+01
  32  2   32   33     2  beam  5.310E+01  2.698E+05 -9.496E+01  1.283E+02
  31  2   31   32     2  beam  2.500E+02  2.103E+05  3.458E+01  1.144E+02
  30  2   30   31     2  beam -2.769E+03  1.436E+05 -1.425E+03 -7.034E+01
  29  2   29   30     2  beam  6.849E+03  1.516E+05  1.326E+03  1.427E+03
  28  2   28   29     2  beam -5.447E+03  6.572E+04 -8.814E+02 -1.308E+03
  27  2   27   28     2  beam  3.400E+03  9.634E+04  5.541E+02  8.787E+02
  26  2   26   27     2  beam -1.772E+03  4.858E+04 -2.031E+02 -5.435E+02
  25  2   25   26     2  beam  9.993E+02  4.756E+04  1.866E+02  2.151E+02
  24  2   24   25     2  beam -4.766E+02  2.919E+04 -2.842E+01 -1.632E+02
  23  2   23   24     2  beam  7.762E+02  1.931E+04  3.857E+02  3.358E+01
  22  2   22   23     2  beam -1.200E+03  5.690E+02 -3.030E+02 -4.124E+02
  21  2   21   22     2  beam  2.329E+03 -1.043E+04  1.162E+03  3.014E+02
  20  2   20   21     2  beam -1.919E+03 -8.451E+03 -5.519E+01 -1.151E+03
  19  2   19   20     2  beam  2.375E+02  1.047E+04  1.056E+02  3.592E+01
  18  2   18   19     2  beam -1.306E+02  3.106E+04  4.782E+01 -1.184E+02
  17  2   17   18     2  beam  2.014E+02  4.026E+04  1.331E+02 -5.211E+01
  16  2   16   17     2  beam -1.355E+03  6.308E+04 -3.986E+02 -1.459E+02
  15  2   15   16     2  beam  2.972E+03  6.445E+04  8.146E+02  4.377E+02
  14  2   14   15     2  beam -6.271E+03  1.145E+05 -1.837E+03 -8.058E+02
  13  2   13   14     2  beam  1.713E+04  7.636E+04  5.068E+03  1.818E+03
  12  2   12   13     2  beam  1.799E+04  1.705E+05  3.181E+03  4.049E+03
  11  2   11   12     2  beam  2.143E+04  1.534E+05  5.651E+03  5.926E+03
  10  2   10   11     2  beam  6.971E+03  2.168E+05  7.275E+02  3.428E+03
   9  2    9   10     2  beam -1.558E+03  2.715E+05 -2.555E+02 -7.235E+02
   8  2    8    9     2  beam  2.665E+02  2.729E+05 -1.012E+02  2.687E+02
   7  2    7    8     2  beam  2.581E+02  2.204E+05  8.542E+01  6.843E+01
   6  2    6    7     2  beam -2.746E+03  1.553E+05 -1.412E+03 -7.175E+01
   5  2    5    6     2  beam  6.242E+03  1.515E+05  1.078E+03  1.431E+03
   4  2    4    5     2  beam -4.382E+03  7.561E+04 -6.698E+02 -1.091E+03
   3  2    3    4     2  beam  2.849E+03  9.097E+04  5.096E+02  6.909E+02
   2  2    2    3     2  beam -1.478E+03  5.658E+04 -1.268E+02 -4.960E+02
   1  2    1    2     2  beam  2.872E+02  5.643E+04  1.383E-05  1.155E+02

Structural Properties ...
 Prop                                                  Dynamic       Plastic
 Num.      Area          E              I              Density        Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3  3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2  3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield       Compressive    Support
 Num.  Stiffness     Strength      Strength        Yield      Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

>set log off
* log-file recording stopped 10-Aug-95  12:22
```

STATION: TSW2 @ 27+00

LOADING: SEISMIC + DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 10-Aug-95  12:22
 Seismic Model @27+00: Ctg-3, Ko=0.25, W6x20 Steel Set
From File : m27_k2dy.sav
>pr stru

 Structural node data ...
  Node          X          Y         X-disp     Y-disp     Ang-disp  Xfix Yfix Rfix
   48   1.704E+00 -3.408E+00   9.567E-04 -1.137E-03 -2.504E-04   no   no   no
   47   1.205E+00 -3.614E+00   9.055E-04 -1.028E-03 -2.029E-04   no   no   no
   46   6.264E-01 -3.758E+00   8.548E-04 -9.256E-04 -1.920E-04   no   no   no
   45   0.000E+00 -3.810E+00   8.044E-04 -8.514E-04  3.425E-06   no   no   no
   44  -6.264E-01 -3.758E+00   7.541E-04 -9.338E-04  2.122E-04   no   no   no
   43  -1.205E+00 -3.614E+00   7.013E-04 -1.050E-03  2.251E-04   no   no   no
   42  -1.704E+00 -3.408E+00   6.486E-04 -1.168E-03  2.688E-04   no   no   no
   41  -2.053E+00 -3.209E+00   5.910E-04 -1.271E-03  0.000E+00   no   no   no
   40  -2.380E+00 -2.975E+00   5.597E-04 -1.400E-03  2.964E-04   no   no   no
   39  -2.694E+00 -2.694E+00   5.188E-04 -1.528E-03  3.060E-04   no   no   no
   38  -2.975E+00 -2.380E+00   4.838E-04 -1.684E-03  2.764E-04   no   no   no
   37  -3.209E+00 -2.053E+00   4.510E-04 -1.813E-03  2.705E-04   no   no   no
   36  -3.408E+00 -1.704E+00   4.173E-04 -1.989E-03  2.685E-04   no   no   no
   35  -3.614E+00 -1.205E+00   3.837E-04 -2.195E-03  1.622E-04   no   no   no
   34  -3.758E+00 -6.264E-01   3.638E-04 -2.436E-03  8.985E-05   no   no   no
   33  -3.810E+00  0.000E+00   3.608E-04 -2.710E-03 -3.924E-06   no   no   no
   32  -3.758E+00  6.264E-01   3.700E-04 -2.976E-03 -9.629E-05   no   no   no
   31  -3.614E+00  1.205E+00   3.929E-04 -3.213E-03 -1.624E-04   no   no   no
   30  -3.408E+00  1.704E+00   4.270E-04 -3.408E-03 -2.537E-04   no   no   no
   29  -3.209E+00  2.053E+00   4.622E-04 -3.575E-03 -2.745E-04   no   no   no
   28  -2.975E+00  2.380E+00   4.970E-04 -3.704E-03 -2.660E-04   no   no   no
   27  -2.694E+00  2.694E+00   5.328E-04 -3.841E-03 -2.816E-04   no   no   no
   26  -2.380E+00  2.975E+00   5.790E-04 -3.953E-03 -2.808E-04   no   no   no
   25  -2.053E+00  3.209E+00   6.108E-04 -4.071E-03 -2.682E-04   no   no   no
   24  -1.704E+00  3.408E+00   6.530E-04 -4.161E-03 -2.355E-04   no   no   no
   23  -1.205E+00  3.614E+00   6.961E-04 -4.275E-03 -2.085E-04   no   no   no
   22  -6.264E-01  3.758E+00   7.543E-04 -4.379E-03 -1.726E-04   no   no   no
   21   0.000E+00  3.810E+00   8.303E-04 -4.429E-03  4.943E-06   no   no   no
   20   6.264E-01  3.758E+00   9.063E-04 -4.372E-03  1.916E-04   no   no   no
   19   1.205E+00  3.614E+00   9.630E-04 -4.255E-03  2.243E-04   no   no   no
   18   1.704E+00  3.408E+00   1.004E-03 -4.132E-03  2.514E-04   no   no   no
   17   2.053E+00  3.209E+00   1.044E-03 -4.033E-03  2.786E-04   no   no   no
   16   2.380E+00  2.975E+00   1.073E-03 -3.911E-03  2.833E-04   no   no   no
   15   2.694E+00  2.694E+00   1.113E-03 -3.788E-03  3.059E-04   no   no   no
   14   2.975E+00  2.380E+00   1.145E-03 -3.643E-03  2.151E-04   no   no   no
   13   3.209E+00  2.053E+00   1.173E-03 -3.514E-03  4.217E-04   no   no   no
   12   3.408E+00  1.704E+00   1.206E-03 -3.337E-03  3.591E-04   no   no   no
   11   3.614E+00  1.205E+00   1.235E-03 -3.138E-03  3.612E-04   no   no   no
   10   3.758E+00  6.264E-01   1.250E-03 -2.904E-03  2.714E-05   no   no   no
    9   3.810E+00  0.000E+00   1.253E-03 -2.634E-03  1.420E-05   no   no   no
    8   3.758E+00 -6.264E-01   1.248E-03 -2.362E-03 -9.538E-05   no   no   no
    7   3.614E+00 -1.205E+00   1.228E-03 -2.124E-03 -1.619E-04   no   no   no
    6   3.408E+00 -1.704E+00   1.194E-03 -1.919E-03 -2.636E-04   no   no   no
    5   3.209E+00 -2.053E+00   1.160E-03 -1.748E-03 -2.685E-04   no   no   no
    4   2.975E+00 -2.380E+00   1.126E-03 -1.621E-03 -2.741E-04   no   no   no
    3   2.694E+00 -2.694E+00   1.088E-03 -1.472E-03 -2.955E-04   no   no   no
    2   2.380E+00 -2.975E+00   1.044E-03 -1.355E-03 -2.861E-04   no   no   no
    1   2.053E+00 -3.209E+00   1.011E-03 -1.230E-03  0.000E+00   no   no   no
Node     X-load      Y-load      Moment     i  j  Pin  Sh. force   Angle   Bond
 48   0.000E+00   0.000E+00   0.000E+00   39 30   no
 47   0.000E+00   0.000E+00   0.000E+00   38 30   no
 46   0.000E+00   0.000E+00   0.000E+00   37 30   no
 45   0.000E+00   0.000E+00   0.000E+00   36 30   no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31  yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31  yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop            F-shear     F-axial      Mom-1       Mom-2
  48   1   48    1     3  beam  2.517E+04   1.300E+04  1.012E+04  -6.228E-04
  47   1   47   48     3  beam -1.623E+04  -9.084E+04  1.345E+03  -1.011E+04
  46   1   46   47     3  beam -8.478E+02  -3.252E+05  9.166E+02  -1.422E+03
  45   1   45   46     3  beam  6.151E+04  -6.061E+05  3.955E+04  -8.946E+02
  44   1   44   45     3  beam -5.715E+04  -5.975E+05  3.683E+03  -3.960E+04
  43   1   43   44     3  beam -7.453E+03  -3.142E+05 -8.160E+02  -3.626E+03
  42   1   42   43     3  beam  2.329E+04  -5.331E+04  1.155E+04   1.029E+03
  41   1   41   42     3  beam -2.845E+04   3.529E+04  6.196E-04  -1.144E+04
  40   2   40   41     2  beam -1.020E+03   8.315E+04 -4.099E+02   1.170E-05
  39   2   39   40     2  beam  2.291E+03   7.949E+04  5.471E+02   4.182E+02
  38   2   38   39     2  beam -3.465E+03   1.359E+05 -9.287E+02  -5.313E+02
  37   2   37   38     2  beam  4.392E+03   1.346E+05  8.427E+02   9.226E+02
  36   2   36   37     2  beam -4.333E+03   2.104E+05 -8.861E+02  -8.557E+02
```

```
  35   2   35   36     2  beam  1.229E+03   2.024E+05 -2.241E+02  8.880E+02
  34   2   34   35     2  beam -3.878E+02   2.418E+05 -4.588E+02  2.277E+02
  33   2   33   34     2  beam  1.100E+02   2.705E+05 -3.869E+02  4.560E+02
  32   2   32   33     2  beam -7.586E+01   2.620E+05 -4.386E+02  3.909E+02
  31   2   31   32     2  beam  4.598E+02   2.354E+05 -1.774E+02  4.514E+02
  30   2   30   31     2  beam -1.147E+03   1.937E+05 -7.869E+02  1.673E+02
  29   2   29   30     2  beam  3.136E+03   1.951E+05  4.841E+02  7.765E+02
  28   2   28   29     2  beam -2.161E+03   1.329E+05 -3.754E+02 -4.932E+02
  27   2   27   28     2  beam  1.260E+03   1.158E+05  1.622E+02  3.689E+02
  26   2   26   27     2  beam -6.152E+02   6.116E+04 -1.231E+02 -1.361E+02
  25   2   25   26     2  beam  1.254E+03   6.446E+04  3.397E+02  1.643E+02
  24   2   24   25     2  beam -6.645E+02   1.290E+04  9.495E+01 -3.620E+02
  23   2   23   24     2  beam  5.238E+01   4.353E+03  1.545E+02 -1.262E+02
  22   2   22   23     2  beam  9.373E+01  -3.359E+04  1.994E+02 -1.435E+02
  21   2   21   22     2  beam  1.926E+03  -7.019E+04  1.404E+03 -1.939E+02
  20   2   20   21     2  beam -1.811E+03  -6.894E+04  2.697E+02 -1.408E+03
  19   2   19   20     2  beam -2.919E+02  -2.841E+04  6.690E+01 -2.409E+02
  18   2   18   19     2  beam  2.661E+02   1.034E+04  2.135E+02 -6.976E+01
  17   2   17   18     2  beam -3.061E+02   2.252E+04  1.299E+02 -2.529E+02
  16   2   16   17     2  beam -6.545E+02   7.210E+04 -9.768E+01 -1.654E+02
  15   2   15   16     2  beam  1.234E+03   7.790E+04  4.123E+02  1.077E+02
  14   2   14   15     2  beam -4.629E+03   1.284E+05 -1.584E+03 -3.663E+02
  13   2   13   14     2  beam  1.515E+04   1.393E+05  4.497E+03  1.591E+03
  12   2   12   13     2  beam  2.080E+04   2.119E+05  3.739E+03  4.621E+03
  11   2   11   12     2  beam  1.993E+04   1.982E+05  5.392E+03  5.375E+03
  10   2   10   11     2  beam  6.991E+03   2.349E+05  5.019E+02  3.665E+03
   9   2    9   10     2  beam -1.748E+03   2.662E+05 -6.079E+02 -4.906E+02
   8   2    8    9     2  beam  3.819E+02   2.681E+05 -3.730E+02  6.131E+02
   7   2    7    8     2  beam  1.547E+02   2.377E+05 -2.682E+02  3.604E+02
   6   2    6    7     2  beam -9.483E+02   2.032E+05 -7.904E+02  2.782E+02
   5   2    5    6     2  beam  3.763E+03   2.034E+05  7.230E+02  7.895E+02
   4   2    4    5     2  beam -3.865E+03   1.298E+05 -8.157E+02 -7.379E+02
   3   2    3    4     2  beam  3.170E+03   1.261E+05  5.258E+02  8.099E+02
   2   2    2    3     2  beam -2.043E+03   6.751E+04 -3.689E+02 -4.920E+02
   1   2    1    2     2  beam  8.836E+02   7.251E+04  2.242E-05  3.551E+02
Structural Properties ...
 Prop                                                Dynamic      Plastic
 Num.      Area           E             I            Density      Moment
 ---- ------------  ------------  ------------  ------------  ------------
   3   3.04800E-01   2.75800E+10   2.36000E-03   0.00000E+00    Not Set
   2   3.78700E-03   1.64000E+11   1.72300E-05   0.00000E+00    Not Set
Prop.   Cable Bond    Cable Bond      Yield       Compressive    Support
Num.    Stiffness      Strength      Strength        Yield       Stiffness
 ---- ------------  ------------  ------------  ------------  ------------
   3   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00
   2   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00

set log off
 log-file recording stopped 10-Aug-95  12:22
```

STATION: TSW2 @ 34+00

LOADING: SEISMIC + DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened  1-Sep-95  13:48

From File : m34c2k2d.sav
>pr stru

 Structural node data ...
  Node          X           Y       X-disp      Y-disp    Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00  1.303E-03 -1.607E-03 -3.877E-04   no    no    no
   47   1.205E+00 -3.614E+00  1.225E-03 -1.430E-03 -3.139E-04   no    no    no
   46   6.264E-01 -3.758E+00  1.154E-03 -1.290E-03 -1.987E-04   no    no    no
   45   0.000E+00 -3.810E+00  1.098E-03 -1.246E-03  4.405E-05   no    no    no
   44  -6.264E-01 -3.758E+00  1.044E-03 -1.347E-03  2.788E-04   no    no    no
   43  -1.205E+00 -3.614E+00  9.712E-04 -1.524E-03  3.501E-04   no    no    no
   42  -1.704E+00 -3.408E+00  8.923E-04 -1.711E-03  3.933E-04   no    no    no
   41  -2.053E+00 -3.209E+00  8.158E-04 -1.852E-03  0.000E+00   no    no    no
   40  -2.380E+00 -2.975E+00  7.701E-04 -2.023E-03  4.156E-04   no    no    no
   39  -2.694E+00 -2.694E+00  7.069E-04 -2.206E-03  4.301E-04   no    no    no
   38  -2.975E+00 -2.380E+00  6.550E-04 -2.407E-03  3.555E-04   no    no    no
   37  -3.209E+00 -2.053E+00  6.088E-04 -2.575E-03  4.088E-04   no    no    no
   36  -3.408E+00 -1.704E+00  5.506E-04 -2.835E-03  3.799E-04   no    no    no
   35  -3.614E+00 -1.205E+00  5.197E-04 -3.101E-03  1.800E-04   no    no    no
   34  -3.758E+00 -6.264E-01  5.050E-04 -3.450E-03  1.182E-04   no    no    no
   33  -3.810E+00  0.000E+00  5.088E-04 -3.843E-03 -1.366E-05   no    no    no
   32  -3.758E+00  6.264E-01  5.167E-04 -4.228E-03 -1.182E-04   no    no    no
   31  -3.614E+00  1.205E+00  5.295E-04 -4.562E-03 -1.727E-04   no    no    no
   30  -3.408E+00  1.704E+00  5.605E-04 -4.823E-03 -3.754E-04   no    no    no
   29  -3.209E+00  2.053E+00  6.137E-04 -5.079E-03 -3.910E-04   no    no    no
   28  -2.975E+00  2.380E+00  6.635E-04 -5.241E-03 -3.644E-04   no    no    no
   27  -2.694E+00  2.694E+00  7.113E-04 -5.452E-03 -4.199E-04   no    no    no
   26  -2.380E+00  2.975E+00  7.721E-04 -5.614E-03 -3.651E-04   no    no    no
   25  -2.053E+00  3.209E+00  8.177E-04 -5.765E-03 -3.685E-04   no    no    no
   24  -1.704E+00  3.408E+00  8.747E-04 -5.896E-03 -3.471E-04   no    no    no
   23  -1.205E+00  3.614E+00  9.365E-04 -6.064E-03 -3.150E-04   no    no    no
   22  -6.264E-01  3.758E+00  1.020E-03 -6.219E-03 -2.690E-04   no    no    no
   21   0.000E+00  3.810E+00  1.129E-03 -6.315E-03 -1.613E-05   no    no    no
   20   6.264E-01  3.758E+00  1.237E-03 -6.229E-03  2.744E-04   no    no    no
   19   1.205E+00  3.614E+00  1.324E-03 -6.057E-03  3.601E-04   no    no    no
   18   1.704E+00  3.408E+00  1.389E-03 -5.870E-03  3.769E-04   no    no    no
   17   2.053E+00  3.209E+00  1.442E-03 -5.721E-03  4.041E-04   no    no    no
   16   2.380E+00  2.975E+00  1.483E-03 -5.550E-03  3.877E-04   no    no    no
   15   2.694E+00  2.694E+00  1.537E-03 -5.378E-03  4.170E-04   no    no    no
   14   2.975E+00  2.380E+00  1.576E-03 -5.170E-03  3.013E-04   no    no    no
   13   3.209E+00  2.053E+00  1.618E-03 -5.009E-03  5.404E-04   no    no    no
   12   3.408E+00  1.704E+00  1.671E-03 -4.738E-03  4.840E-04   no    no    no
   11   3.614E+00  1.205E+00  1.701E-03 -4.472E-03  3.949E-04   no    no    no
   10   3.758E+00  6.264E-01  1.713E-03 -4.126E-03  4.581E-05   no    no    no
    9   3.810E+00  0.000E+00  1.704E-03 -3.739E-03  1.002E-05   no    no    no
    8   3.758E+00 -6.264E-01  1.706E-03 -3.345E-03 -1.188E-04   no    no    no
    7   3.614E+00 -1.205E+00  1.691E-03 -2.998E-03 -1.880E-04   no    no    no
    6   3.408E+00 -1.704E+00  1.656E-03 -2.726E-03 -3.855E-04   no    no    no
    5   3.209E+00 -2.053E+00  1.598E-03 -2.470E-03 -3.978E-04   no    no    no
    4   2.975E+00 -2.380E+00  1.554E-03 -2.302E-03 -3.625E-04   no    no    no
    3   2.694E+00 -2.694E+00  1.499E-03 -2.092E-03 -4.417E-04   no    no    no
    2   2.380E+00 -2.975E+00  1.431E-03 -1.916E-03 -4.110E-04   no    no    no
    1   2.053E+00 -3.209E+00  1.381E-03 -1.749E-03  0.000E+00   no    no    no
 Node     X-load      Y-load      Moment    i  j Pin  Sh. force   Angle    Bond
   48  0.000E+00  0.000E+00  0.000E+00  39 30  no
   47  0.000E+00  0.000E+00  0.000E+00  38 30  no
   46  0.000E+00  0.000E+00  0.000E+00  37 30  no
   45  0.000E+00  0.000E+00  0.000E+00  36 30  no
```

```
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.233E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.233E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop         F-shear    F-axial      Mom-1      Mom-2
   48  1   48    1     3  beam  1.224E+04  3.408E+04  4.920E+03  7.436E-04
   47  1   47   48     3  beam  1.471E+04 -8.274E+04  1.284E+04 -4.891E+03
   46  1   46   47     3  beam -4.140E+02 -4.607E+05  1.248E+04 -1.273E+04
   45  1   45   46     3  beam  4.180E+04 -6.958E+05  3.826E+04 -1.199E+04
   44  1   44   45     3  beam -4.524E+04 -6.383E+05  1.009E+04 -3.853E+04
   43  1   43   44     3  beam -8.835E+03 -3.679E+05  5.164E+03 -1.043E+04
   42  1   42   43     3  beam  7.250E+02 -2.962E+04  5.407E+03 -5.015E+03
   41  1   41   42     3  beam -1.283E+04  7.048E+04 -6.804E-04 -5.156E+03
   40  2   40   41     2  beam  2.859E+02  9.673E+04  1.149E+02 -9.523E-06
   39  2   39   40     2  beam -3.852E+01  1.086E+05  8.724E+01 -1.035E+02
   38  2   38   39     2  beam -3.044E+03  1.700E+05 -1.139E+03 -1.440E+02
   37  2   37   38     2  beam  7.595E+03  1.746E+05  1.904E+03  1.149E+03
   36  2   36   37     2  beam -1.045E+04  3.030E+05 -2.308E+03 -1.894E+03
```

```
   35  2   35   36     2  beam  4.502E+03  2.683E+05  1.685E+02  2.263E+03
   34  2   34   35     2  beam -1.577E+03  3.511E+05 -7.597E+02 -1.805E+02
   33  2   33   34     2  beam  5.959E+02  3.889E+05 -4.072E+02  7.817E+02
   32  2   32   33     2  beam -2.776E+02  3.808E+05 -5.575E+02  3.830E+02
   31  2   31   32     2  beam  9.520E+02  3.342E+05  2.836E+01  5.391E+02
   30  2   30   31     2  beam -4.007E+03  2.647E+05 -2.145E+03 -1.966E+01
   29  2   29   30     2  beam  1.021E+04  3.059E+05  1.944E+03  2.160E+03
   28  2   28   29     2  beam -8.473E+03  1.555E+05 -1.517E+03 -1.889E+03
   27  2   27   28     2  beam  5.533E+03  1.859E+05  7.916E+02  1.540E+03
   26  2   26   27     2  beam -2.190E+03  9.413E+04 -9.109E+01 -8.318E+02
   25  2   25   26     2  beam  3.659E+02  7.653E+04  4.763E+01  9.945E+01
   24  2   24   25     2  beam  3.598E+02  2.497E+04  2.202E+02 -7.559E+01
   23  2   23   24     2  beam -4.343E+02  6.712E+03  5.334E+01 -2.880E+02
   22  2   22   23     2  beam  5.869E+02 -4.162E+04  3.940E+02 -4.415E+01
   21  2   21   22     2  beam  2.349E+03 -9.944E+04  1.873E+03 -3.964E+02
   20  2   20   21     2  beam -1.784E+03 -1.022E+05  7.469E+02 -1.868E+03
   19  2   19   20     2  beam -1.101E+03 -4.084E+04  7.766E+01 -7.337E+02
   18  2   18   19     2  beam -1.918E+01  1.497E+04  8.330E+01 -9.366E+01
   17  2   17   18     2  beam  5.881E+02  4.057E+04  3.106E+02 -7.421E+01
   16  2   16   17     2  beam -2.079E+03  1.010E+05 -5.359E+02 -2.998E+02
   15  2   15   16     2  beam  3.358E+03  1.086E+05  9.029E+02  5.121E+02
   14  2   14   15     2  beam -7.922E+03  1.926E+05 -2.441E+03 -8.967E+02
   13  2   13   14     2  beam  2.055E+04  1.666E+05  5.809E+03  2.452E+03
   12  2   12   13     2  beam  1.408E+04  3.208E+05  2.432E+03  3.228E+03
   11  2   11   12     2  beam  2.279E+04  2.714E+05  5.693E+03  6.618E+03
   10  2   10   11     2  beam  5.969E+03  3.466E+05  1.226E+02  3.435E+03
    9  2    9   10     2  beam -9.118E+02  3.837E+05 -4.487E+02 -1.244E+02
    8  2    8    9     2  beam -4.532E+02  3.887E+05 -7.193E+02  4.344E+02
    7  2    7    8     2  beam  1.353E+03  3.501E+05  7.453E+01  7.318E+02
    6  2    6    7     2  beam -4.106E+03  2.741E+05 -2.143E+03 -7.483E+01
    5  2    5    6     2  beam  1.029E+04  2.975E+05  1.981E+03  2.155E+03
    4  2    4    5     2  beam -8.626E+03  1.738E+05 -1.484E+03 -1.983E+03
    3  2    3    4     2  beam  4.496E+03  1.747E+05  4.160E+02  1.479E+03
    2  2    2    3     2  beam -9.207E+02  1.012E+05  1.164E+01 -3.996E+02
    1  2    1    2     2  beam  3.147E+01  8.650E+04  6.371E-05  1.265E+01

Structural Properties ...
 Prop                                            Dynamic       Plastic
 Num.     Area          E             I          Density        Moment
 ----  ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond      Yield     Compressive    Support
 Num.  Stiffness    Strength     Strength       Yield       Stiffness
 ----  ------------ ------------ ------------ ------------ ------------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

>set log off
* log-file recording stopped  1-Sep-95  13:48


* FLAC log-file opened  1-Sep-95  13:52

From File : m34c2k2d.sav
>pr stru

 Structural node data ...
  Node           X          Y      X-disp      Y-disp    Ang-disp Xfix Yfix Rfix
```

```
* FLAC log-file opened  7-Sep-95   8:48

From File : m34c2k2d.sav
>pr x y i 28 44 j 28 44
   x coordinate

    I 28    29    30    31    32    33    34    35    36    37    38    39
 J
 44 -4.800-4.200-3.600-3.000-2.400-1.800-1.200 -.600  .000  .600 1.200 1.800
 43 -4.800-4.200-3.600-3.000-2.400-1.800-1.200 -.600  .000  .600 1.200 1.800
 42 -4.800-4.200-3.600-3.000-2.400-1.704-1.205 -.626  .000  .626 1.205 1.704
 41 -4.800-4.200-3.600-3.000-2.380-2.053                               2.053
 40 -4.800-4.200-3.600-2.975-2.694
 39 -4.800-4.200-3.408-3.209
 38 -4.800-4.200-3.614
 37 -4.800-4.200-3.758
 36 -4.800-4.200-3.810
 35 -4.800-4.200-3.758
 34 -4.800-4.200-3.614
 33 -4.800-4.200-3.408-3.209
 32 -4.800-4.200-3.600-2.975-2.694
 31 -4.800-4.200-3.600-3.000-2.380-2.053                               2.053
 30 -4.800-4.200-3.600-3.000-2.400-1.704-1.205 -.626  .000  .626 1.205 1.704
 29 -4.800-4.200-3.600-3.000-2.400-1.800-1.200 -.600  .000  .600 1.200 1.800
 28 -4.800-4.200-3.600-3.000-2.400-1.800-1.200 -.600  .000  .600 1.200 1.800

   x coordinate

    I 40    41    42    43    44
 J
 44  2.400 3.000 3.600 4.200 4.800
 43  2.400 3.000 3.600 4.200 4.800
 42  2.400 3.000 3.600 4.200 4.800
 41  2.380 3.000 3.600 4.200 4.800
 40  2.694 2.975 3.600 4.200 4.800
 39        3.209 3.408 4.200 4.800
 38              3.614 4.200 4.800
 37              3.758 4.200 4.800
 36              3.810 4.200 4.800
 35              3.758 4.200 4.800
 34              3.614 4.200 4.800
 33        3.209 3.408 4.200 4.800
 32  2.694 2.975 3.600 4.200 4.800
 31  2.380 3.000 3.600 4.200 4.800
 30  2.400 3.000 3.600 4.200 4.800
 29  2.400 3.000 3.600 4.200 4.800
 28  2.400 3.000 3.600 4.200 4.800

   y coordinate

    I 28    29    30    31    32    33    34    35    36    37    38    39
 J
 44  4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800 4.800
 43  4.200 4.200 4.200 4.200 4.200 4.200 4.200 4.200 4.200 4.200 4.200 4.200
 42  3.600 3.600 3.600 3.600 3.600 3.408 3.614 3.758 3.810 3.758 3.614 3.408
 41  3.000 3.000 3.000 3.000 2.975 3.209                               3.209
 40  2.400 2.400 2.400 2.380 2.694
 39  1.800 1.800 1.704 2.053
 38  1.200 1.200 1.205
 37   .600  .600  .626
```

STATION: TSW2 @ 53+00

LOADING: SEISMIC + DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 10-Aug-95  12:23
 Seismic Model @53+00: Ctg-3, Ko=0.25, W6x20 Steel Set
From File : m53_k2dy.sav
>pr stru

 Structural node data ...
  Node         X            Y         X-disp      Y-disp    Ang-disp Xfix Yfix Rfix
   48  1.704E+00 -3.408E+00  9.579E-04 -1.127E-03 -2.457E-04   no   no   no
   47  1.205E+00 -3.614E+00  9.082E-04 -1.020E-03 -1.987E-04   no   no   no
   46  6.264E-01 -3.758E+00  8.575E-04 -9.185E-04 -1.893E-04   no   no   no
   45  0.000E+00 -3.810E+00  8.077E-04 -8.474E-04  4.899E-06   no   no   no
   44 -6.264E-01 -3.758E+00  7.583E-04 -9.285E-04  2.073E-04   no   no   no
   43 -1.205E+00 -3.614E+00  7.062E-04 -1.042E-03  2.227E-04   no   no   no
   42 -1.704E+00 -3.408E+00  6.532E-04 -1.159E-03  2.639E-04   no   no   no
   41 -2.053E+00 -3.209E+00  5.977E-04 -1.257E-03  0.000E+00   no   no   no
   40 -2.380E+00 -2.975E+00  5.648E-04 -1.390E-03  3.026E-04   no   no   no
   39 -2.694E+00 -2.694E+00  5.199E-04 -1.515E-03  3.116E-04   no   no   no
   38 -2.975E+00 -2.380E+00  4.834E-04 -1.671E-03  2.765E-04   no   no   no
   37 -3.209E+00 -2.053E+00  4.495E-04 -1.801E-03  2.756E-04   no   no   no
   36 -3.408E+00 -1.704E+00  4.157E-04 -1.979E-03  2.721E-04   no   no   no
   35 -3.614E+00 -1.205E+00  3.826E-04 -2.190E-03  1.628E-04   no   no   no
   34 -3.758E+00 -6.264E-01  3.647E-04 -2.433E-03  8.601E-05   no   no   no
   33 -3.810E+00  0.000E+00  3.637E-04 -2.707E-03 -6.605E-06   no   no   no
   32 -3.758E+00  6.264E-01  3.729E-04 -2.978E-03 -9.557E-05   no   no   no
   31 -3.614E+00  1.205E+00  3.942E-04 -3.212E-03 -1.561E-04   no   no   no
   30 -3.408E+00  1.704E+00  4.271E-04 -3.407E-03 -2.576E-04   no   no   no
   29 -3.209E+00  2.053E+00  4.618E-04 -3.578E-03 -2.753E-04   no   no   no
   28 -2.975E+00  2.380E+00  4.957E-04 -3.708E-03 -2.684E-04   no   no   no
   27 -2.694E+00  2.694E+00  5.306E-04 -3.851E-03 -2.863E-04   no   no   no
   26 -2.380E+00  2.975E+00  5.705E-04 -3.972E-03 -2.886E-04   no   no   no
   25 -2.053E+00  3.209E+00  6.012E-04 -4.098E-03 -3.017E-04   no   no   no
   24 -1.704E+00  3.408E+00  6.466E-04 -4.205E-03 -2.719E-04   no   no   no
   23 -1.205E+00  3.614E+00  6.923E-04 -4.336E-03 -2.327E-04   no   no   no
   22 -6.264E-01  3.758E+00  7.599E-04 -4.444E-03 -1.591E-04   no   no   no
   21  0.000E+00  3.810E+00  8.393E-04 -4.478E-03  2.132E-05   no   no   no
   20  6.264E-01  3.758E+00  9.147E-04 -4.418E-03  1.970E-04   no   no   no
   19  1.205E+00  3.614E+00  9.717E-04 -4.291E-03  2.266E-04   no   no   no
   18  1.704E+00  3.408E+00  1.011E-03 -4.173E-03  2.507E-04   no   no   no
   17  2.053E+00  3.209E+00  1.054E-03 -4.069E-03  3.035E-04   no   no   no
   16  2.380E+00  2.975E+00  1.081E-03 -3.940E-03  2.828E-04   no   no   no
   15  2.694E+00  2.694E+00  1.118E-03 -3.820E-03  2.895E-04   no   no   no
   14  2.975E+00  2.380E+00  1.149E-03 -3.677E-03  2.187E-04   no   no   no
   13  3.209E+00  2.053E+00  1.179E-03 -3.547E-03  4.307E-04   no   no   no
   12  3.408E+00  1.704E+00  1.214E-03 -3.363E-03  3.676E-04   no   no   no
   11  3.614E+00  1.205E+00  1.244E-03 -3.161E-03  3.669E-04   no   no   no
   10  3.758E+00  6.264E-01  1.260E-03 -2.917E-03  2.764E-05   no   no   no
    9  3.810E+00  0.000E+00  1.260E-03 -2.642E-03  1.063E-05   no   no   no
    8  3.758E+00 -6.264E-01  1.255E-03 -2.368E-03 -9.623E-05   no   no   no
    7  3.614E+00 -1.205E+00  1.234E-03 -2.123E-03 -1.657E-04   no   no   no
    6  3.408E+00 -1.704E+00  1.199E-03 -1.914E-03 -2.709E-04   no   no   no
    5  3.209E+00 -2.053E+00  1.164E-03 -1.738E-03 -2.784E-04   no   no   no
    4  2.975E+00 -2.380E+00  1.126E-03 -1.612E-03 -2.781E-04   no   no   no
    3  2.694E+00 -2.694E+00  1.089E-03 -1.460E-03 -2.952E-04   no   no   no
    2  2.380E+00 -2.975E+00  1.046E-03 -1.345E-03 -2.856E-04   no   no   no
    1  2.053E+00 -3.209E+00  1.011E-03 -1.218E-03  0.000E+00   no   no   no
 Node     X-load      Y-load       Moment     i  j Pin  Sh. force   Angle    Bond
   48  0.000E+00   0.000E+00   0.000E+00   39 30  no
   47  0.000E+00   0.000E+00   0.000E+00   38 30  no
   46  0.000E+00   0.000E+00   0.000E+00   37 30  no
   45  0.000E+00   0.000E+00   0.000E+00   36 30  no
```

```
  44  0.000E+00  0.000E+00  0.000E+00  35 30  no
  43  0.000E+00  0.000E+00  0.000E+00  34 30  no
  42  0.000E+00  0.000E+00  0.000E+00  33 30  no
  41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
  40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
  39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
  38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
  37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
  36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
  35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
  34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
  33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
  32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
  31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
  30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
  29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
  28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
  27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
  26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
  25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
  24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
  23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
  22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
  21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
  20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
  19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
  18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
  17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
  16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
  15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
  14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
  13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
  12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
  11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
  10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
   9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
   8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
   7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
   6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
   5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
   4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
   3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
   2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
   1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem  ID Nodl  Nod2   Prop          F-shear    F-axial      Mom-1      Mom-2
   48   1   48     1      3  beam  2.456E+04  1.328E+04  9.870E+03 -9.821E-04
   47   1   47    48      3  beam -1.650E+04 -9.763E+04  1.204E+03 -1.012E+04
   46   1   46    47      3  beam -1.485E+03 -3.244E+05  6.037E+02 -1.489E+03
   45   1   45    46      3  beam  6.224E+04 -5.979E+05  3.964E+04 -5.273E+02
   44   1   44    45      3  beam -5.935E+04 -5.905E+05  2.343E+03 -3.965E+04
   43   1   43    44      3  beam -1.590E+03 -3.004E+05  1.214E+03 -2.162E+03
   42   1   42    43      3  beam  1.476E+04 -7.188E+04  8.908E+03 -9.359E+02
   41   1   41    42      3  beam -2.250E+04  4.287E+04 -6.072E-04 -9.045E+03
   40   2   40    41      2  beam -5.696E+02  7.827E+04 -2.289E+02 -2.570E-05
   39   2   39    40      2  beam  1.379E+03  7.542E+04  3.514E+02  2.298E+02
   38   2   38    39      2  beam -2.703E+03  1.348E+05 -8.057E+02 -3.334E+02
   37   2   37    38      2  beam  4.039E+03  1.346E+05  8.039E+02  8.195E+02
   36   2   36    37      2  beam -4.199E+03  2.138E+05 -8.667E+02 -8.209E+02
```

```
 35  2   35   36      2  beam  1.104E+03   2.102E+05 -2.731E+02  8.692E+02
 34  2   34   35      2  beam -2.609E+02   2.421E+05 -4.421E+02  2.866E+02
 33  2   33   34      2  beam  8.347E+01   2.708E+05 -3.911E+02  4.435E+02
 32  2   32   33      2  beam -5.726E+01   2.672E+05 -4.174E+02  3.814E+02
 31  2   31   32      2  beam  4.537E+02   2.332E+05 -1.518E+02  4.223E+02
 30  2   30   31      2  beam -1.400E+03   1.930E+05 -9.094E+02  1.533E+02
 29  2   29   30      2  beam  3.878E+03   2.014E+05  6.564E+02  9.022E+02
 28  2   28   29      2  beam -2.745E+03   1.358E+05 -5.045E+02 -5.988E+02
 27  2   27   28      2  beam  1.740E+03   1.213E+05  2.450E+02  4.881E+02
 26  2   26   27      2  beam -1.440E+03   7.437E+04 -3.158E+02 -2.910E+02
 25  2   25   26      2  beam  1.239E+03   7.659E+04  1.570E+02  3.412E+02
 24  2   24   25      2  beam  3.245E+02   2.170E+04  2.745E+02 -1.441E+02
 23  2   23   24      2  beam -1.883E+02   7.873E+03  1.531E+02 -2.548E+02
 22  2   22   23      2  beam  6.731E+02  -4.108E+04  5.497E+02 -1.484E+02
 21  2   21   22      2  beam  7.895E+02  -7.525E+04  1.059E+03 -5.627E+02
 20  2   20   21      2  beam -9.206E+02  -6.806E+04  5.002E+02 -1.079E+03
 19  2   19   20      2  beam -1.217E+03  -2.736E+04 -2.208E+02 -5.043E+02
 18  2   18   19      2  beam  1.338E+03   9.211E+03  4.863E+02  2.367E+02
 17  2   17   18      2  beam -6.803E+02   2.407E+04  2.353E+02 -5.088E+02
 16  2   16   17      2  beam -1.924E+03   8.265E+04 -5.297E+02 -2.434E+02
 15  2   15   16      2  beam  2.903E+03   7.583E+04  6.557E+02  5.677E+02
 14  2   14   15      2  beam -5.312E+03   1.275E+05 -1.595E+03 -6.437E+02
 13  2   13   14      2  beam  1.540E+04   1.398E+05  4.586E+03  1.605E+03
 12  2   12   13      2  beam  2.026E+04   2.172E+05  3.628E+03  4.516E+03
 11  2   11   12      2  beam  2.021E+04   2.024E+05  5.454E+03  5.463E+03
 10  2   10   11      2  beam  6.737E+03   2.452E+05  4.013E+02  3.614E+03
  9  2    9   10      2  beam -1.510E+03   2.712E+05 -5.517E+02 -3.973E+02
  8  2    8    9      2  beam  2.513E+02   2.694E+05 -4.023E+02  5.602E+02
  7  2    7    8      2  beam  2.391E+02   2.437E+05 -2.570E+02  3.995E+02
  6  2    6    7      2  beam -1.002E+03   2.081E+05 -8.227E+02  2.817E+02
  5  2    5    6      2  beam  3.776E+03   2.078E+05  7.077E+02  8.100E+02
  4  2    4    5      2  beam -3.676E+03   1.291E+05 -7.356E+02 -7.419E+02
  3  2    3    4      2  beam  3.033E+03   1.280E+05  5.228E+02  7.551E+02
  2  2    2    3      2  beam -2.105E+03   6.810E+04 -3.791E+02 -5.080E+02
  1  2    1    2      2  beam  9.359E+02   7.082E+04 -2.541E-05  3.762E+02

Structural Properties ...
 Prop                                                Dynamic      Plastic
 Num.      Area          E             I             Density      Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.  Stiffness    Strength      Strength       Yield      Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

>set log off
* log-file recording stopped 10-Aug-95  12:23
```

STATION: TCW @ 07+00

LOADING: STATIC; DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 11-Aug-95  14:31

From File : flac.ini
>res m07_k2.sav
 e following state has been restored:
                    date     time        step       grid     version
               8-Aug-95   10:18        5220      70 X 70       3.22
Title:

>pr stru

 Structural node data ...
  Node         X           Y        X-disp      Y-disp    Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00  5.018E-05   4.332E-04 -6.863E-05   no    no    no
   47   1.205E+00 -3.614E+00  3.413E-05   4.638E-04 -5.933E-05   no    no    no
   46   6.264E-01 -3.758E+00  1.791E-05   4.952E-04 -5.040E-05   no    no    no
   45   0.000E+00 -3.810E+00  2.110E-06   5.117E-04 -9.144E-06   no    no    no
   44  -6.264E-01 -3.758E+00 -1.408E-05   5.054E-04  3.975E-05   no    no    no
   43  -1.205E+00 -3.614E+00 -3.136E-05   4.761E-04  6.507E-05   no    no    no
   42  -1.704E+00 -3.408E+00 -4.940E-05   4.408E-04  7.672E-05   no    no    no
   41  -2.053E+00 -3.209E+00 -6.530E-05   4.147E-04  0.000E+00   no    no    no
   40  -2.380E+00 -2.975E+00 -7.822E-05   3.852E-04  8.145E-05   no    no    no
   39  -2.694E+00 -2.694E+00 -9.550E-05   3.527E-04  8.723E-05   no    no    no
   38  -2.975E+00 -2.380E+00 -1.078E-04   3.136E-04  7.657E-05   no    no    no
   37  -3.209E+00 -2.053E+00 -1.200E-04   2.806E-04  7.741E-05   no    no    no
   36  -3.408E+00 -1.704E+00 -1.317E-04   2.377E-04  7.276E-05   no    no    no
   35  -3.614E+00 -1.205E+00 -1.423E-04   1.817E-04  4.610E-05   no    no    no
   34  -3.758E+00 -6.264E-01 -1.491E-04   1.178E-04  2.664E-05   no    no    no
   33  -3.810E+00  0.000E+00 -1.521E-04   4.832E-05  9.577E-07   no    no    no
   32  -3.758E+00  6.264E-01 -1.496E-04  -1.995E-05 -2.688E-05   no    no    no
   31  -3.614E+00  1.205E+00 -1.429E-04  -8.366E-05 -4.262E-05   no    no    no
   30  -3.408E+00  1.704E+00 -1.354E-04  -1.363E-04 -6.593E-05   no    no    no
   29  -3.209E+00  2.053E+00 -1.242E-04  -1.789E-04 -7.875E-05   no    no    no
   28  -2.975E+00  2.380E+00 -1.126E-04  -2.156E-04 -7.943E-05   no    no    no
   27  -2.694E+00  2.694E+00 -1.020E-04  -2.540E-04 -7.866E-05   no    no    no
   26  -2.380E+00  2.975E+00 -8.889E-05  -2.866E-04 -7.974E-05   no    no    no
   25  -2.053E+00  3.209E+00 -7.910E-05  -3.208E-04 -8.314E-05   no    no    no
   24  -1.704E+00  3.408E+00 -6.548E-05  -3.498E-04 -7.733E-05   no    no    no
   23  -1.205E+00  3.614E+00 -4.967E-05  -3.859E-04 -7.142E-05   no    no    no
   22  -6.264E-01  3.758E+00 -2.788E-05  -4.187E-04 -5.288E-05   no    no    no
   21   0.000E+00  3.810E+00 -1.787E-06  -4.354E-04 -2.273E-06   no    no    no
   20   6.264E-01  3.758E+00  2.444E-05  -4.209E-04  4.993E-05   no    no    no
   19   1.205E+00  3.614E+00  4.654E-05  -3.894E-04  7.074E-05   no    no    no
   18   1.704E+00  3.408E+00  6.292E-05  -3.536E-04  7.809E-05   no    no    no
   17   2.053E+00  3.209E+00  7.655E-05  -3.248E-04  8.123E-05   no    no    no
   16   2.380E+00  2.975E+00  8.661E-05  -2.918E-04  7.702E-05   no    no    no
   15   2.694E+00  2.694E+00  1.002E-04  -2.580E-04  9.209E-05   no    no    no
   14   2.975E+00  2.380E+00  1.106E-04  -2.200E-04  3.531E-05   no    no    no
   13   3.209E+00  2.053E+00  1.222E-04  -1.856E-04  2.264E-04   no    no    no
   12   3.408E+00  1.704E+00  1.344E-04  -1.418E-04  1.676E-04   no    no    no
   11   3.614E+00  1.205E+00  1.442E-04  -8.857E-05  2.619E-04   no    no    no
   10   3.758E+00  6.264E-01  1.516E-04  -2.438E-05 -3.258E-05   no    no    no
    9   3.810E+00  0.000E+00  1.533E-04   4.428E-05  1.440E-05   no    no    no
    8   3.758E+00 -6.264E-01  1.502E-04   1.136E-04 -3.247E-05   no    no    no
    7   3.614E+00 -1.205E+00  1.428E-04   1.782E-04 -4.391E-05   no    no    no
    6   3.408E+00 -1.704E+00  1.329E-04   2.329E-04 -7.335E-05   no    no    no
    5   3.209E+00 -2.053E+00  1.202E-04   2.760E-04 -7.847E-05   no    no    no
    4   2.975E+00 -2.380E+00  1.080E-04   3.088E-04 -7.580E-05   no    no    no
    3   2.694E+00 -2.694E+00  9.540E-05   3.475E-04 -8.764E-05   no    no    no
    2   2.380E+00 -2.975E+00  7.760E-05   3.795E-04 -8.119E-05   no    no    no
```

```
  1  2.053E+00 -3.209E+00  6.523E-05  4.088E-04  0.000E+00   no   no   no
Node    X-load     Y-load     Moment    i  j  Pin  Sh. force   Angle    Bond
 48  0.000E+00  0.000E+00  0.000E+00  39 30  no
 47  0.000E+00  0.000E+00  0.000E+00  38 30  no
 46  0.000E+00  0.000E+00  0.000E+00  37 30  no
 45  0.000E+00  0.000E+00  0.000E+00  36 30  no
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop          F-shear    F-axial      Mom-1      Mom-2
  48  1   48    1     3  beam  4.352E+03 -1.685E+04  1.749E+03  6.234E-05
  47  1   47   48     3  beam -2.327E+03 -4.802E+04  4.921E+02 -1.749E+03
  46  1   46   47     3  beam  1.619E+03 -1.211E+05  1.457E+03 -4.923E+02
  45  1   45   46     3  beam  8.959E+03 -1.896E+05  7.089E+03 -1.458E+03
  44  1   44   45     3  beam -6.443E+03 -2.038E+05  3.039E+03 -7.088E+03
  43  1   43   44     3  beam -9.190E+02 -1.411E+05  2.491E+03 -3.039E+03
  42  1   42   43     3  beam -4.028E+03 -4.895E+04  3.149E+02 -2.491E+03
```

```
 41  1   41   42     3  beam -7.839E+02 -1.633E+04 -2.540E-05 -3.151E+02
 40  2   40   41     2  beam  2.307E+02  9.822E+03  9.271E+01  1.183E-05
 39  2   39   40     2  beam -2.562E+02  1.326E+04 -1.522E+01 -9.276E+01
 38  2   38   39     2  beam -2.671E+02  3.095E+04 -1.278E+02  1.521E+01
 37  2   37   38     2  beam  6.654E+02  3.138E+04  1.397E+02  1.278E+02
 36  2   36   37     2  beam -8.577E+02  4.836E+04 -2.051E+02 -1.397E+02
 35  2   35   36     2  beam  2.427E+02  5.474E+04 -7.394E+01  2.050E+02
 34  2   34   35     2  beam -6.132E+01  6.323E+04 -1.105E+02  7.394E+01
 33  2   33   34     2  beam -1.580E+01  6.861E+04 -1.205E+02  1.105E+02
 32  2   32   33     2  beam -1.504E+01  6.744E+04 -1.299E+02  1.204E+02
 31  2   31   32     2  beam  1.854E+02  6.256E+04 -1.936E+01  1.299E+02
 30  2   30   31     2  beam -3.798E+02  5.309E+04 -2.245E+02  1.937E+01
 29  2   29   30     2  beam  6.687E+02  4.811E+04  4.424E+01  2.245E+02
 28  2   28   29     2  beam -2.437E+02  3.595E+04 -5.376E+01 -4.420E+01
 27  2   27   28     2  beam  2.800E+02  3.215E+04  6.420E+01  5.378E+01
 26  2   26   27     2  beam -3.392E+02  1.746E+04 -7.874E+01 -6.419E+01
 25  2   25   26     2  beam  2.730E+02  1.780E+04  3.097E+01  7.875E+01
 24  2   24   25     2  beam  4.905E+01  4.289E+03  5.071E+01 -3.099E+01
 23  2   23   24     2  beam -7.348E+01 -6.132E+02  1.104E+01 -5.074E+01
 22  2   22   23     2  beam  2.579E+02 -1.302E+04  1.648E+02 -1.106E+01
 21  2   21   22     2  beam  1.996E+02 -2.466E+04  2.902E+02 -1.648E+02
 20  2   20   21     2  beam -1.767E+02 -2.502E+04  1.792E+02 -2.902E+02
 19  2   19   20     2  beam -2.700E+02 -1.378E+04  1.819E+01 -1.792E+02
 18  2   18   19     2  beam  7.496E+01 -1.087E+03  5.868E+01 -1.819E+01
 17  2   17   18     2  beam -1.819E+02  3.830E+03 -1.445E+01 -5.865E+01
 16  2   16   17     2  beam -7.518E+01  1.619E+04 -4.469E+01  1.447E+01
 15  2   15   16     2  beam  6.914E+02  1.844E+04  2.467E+02  4.464E+01
 14  2   14   15     2  beam -2.978E+03  3.191E+04 -1.008E+03 -2.467E+02
 13  2   13   14     2  beam  1.170E+04  3.297E+04  3.695E+03  1.008E+03
 12  2   12   13     2  beam  2.476E+04  4.925E+04  4.562E+03  5.390E+03
 11  2   11   12     2  beam  1.857E+04  5.252E+04  5.510E+03  4.523E+03
 10  2   10   11     2  beam  7.311E+03  6.301E+04  7.827E+02  3.575E+03
  9  2    9   10     2  beam -1.818E+03  6.798E+04 -3.602E+02 -7.827E+02
  8  2    8    9     2  beam  4.754E+02  6.833E+04 -6.137E+01  3.601E+02
  7  2    7    8     2  beam  2.408E+01  6.391E+04 -4.703E+01  6.138E+01
  6  2    6    7     2  beam -3.960E+02  5.384E+04 -2.610E+02  4.706E+01
  5  2    5    6     2  beam  1.119E+03  4.763E+04  1.889E+02  2.610E+02
  4  2    4    5     2  beam -8.466E+02  3.111E+04 -1.514E+02 -1.889E+02
  3  2    3    4     2  beam  3.420E+02  3.044E+04 -7.293E+00  1.514E+02
  2  2    2    3     2  beam  2.395E+02  1.206E+04  9.366E+01  7.255E+00
  1  2    1    2     2  beam -2.331E+02  1.043E+04  4.395E-06 -9.371E+01

Structural Properties ...
 Prop                                               Dynamic      Plastic
 Num.      Area           E             I           Density       Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3  3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2  3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
Num.  Stiffness     Strength     Strength       Yield      Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

set log off
log-file recording stopped 11-Aug-95  14:31
```

STATION: TSW1 @ 18+00

LOADING: STATIC: DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 11-Aug-95  14:23

From File : flac.ini
>res m18_k2.sav
 e following state has been restored:
                date    time          step         grid    version
            8-Aug-95   11:16          5210      70 X 70       3.22
Title:

>pr stru

 Structural node data ...
 Node          X          Y      X-disp      Y-disp   Ang-disp  Xfix  Yfix  Rfix
   48  1.704E+00 -3.408E+00  3.192E-05   7.437E-04 -9.968E-05    no    no    no
   47  1.205E+00 -3.614E+00  1.753E-05   7.855E-04 -7.790E-05    no    no    no
   46  6.264E-01 -3.758E+00  5.011E-06   8.302E-04 -6.525E-05    no    no    no
   45  0.000E+00 -3.810E+00 -1.251E-06   8.509E-04  1.199E-07    no    no    no
   44 -6.264E-01 -3.758E+00 -7.676E-06   8.304E-04  6.979E-05    no    no    no
   43 -1.205E+00 -3.614E+00 -2.081E-05   7.814E-04  8.182E-05    no    no    no
   42 -1.704E+00 -3.408E+00 -3.607E-05   7.387E-04  1.032E-04    no    no    no
   41 -2.053E+00 -3.209E+00 -5.695E-05   6.941E-04  0.000E+00    no    no    no
   40 -2.380E+00 -2.975E+00 -6.520E-05   6.420E-04  1.234E-04    no    no    no
   39 -2.694E+00 -2.694E+00 -8.349E-05   5.853E-04  1.394E-04    no    no    no
   38 -2.975E+00 -2.380E+00 -1.001E-04   5.172E-04  1.218E-04    no    no    no
   37 -3.209E+00 -2.053E+00 -1.176E-04   4.598E-04  1.421E-04    no    no    no
   36 -3.408E+00 -1.704E+00 -1.374E-04   3.692E-04  1.307E-04    no    no    no
   35 -3.614E+00 -1.205E+00 -1.362E-04   2.633E-04  3.985E-05    no    no    no
   34 -3.758E+00 -6.264E-01 -1.161E-04   1.093E-04  2.063E-05    no    no    no
   33 -3.810E+00  0.000E+00 -1.061E-04  -9.443E-05  4.901E-07    no    no    no
   32 -3.758E+00  6.264E-01 -1.165E-04  -2.953E-04 -2.018E-05    no    no    no
   31 -3.614E+00  1.205E+00 -1.353E-04  -4.411E-04 -3.546E-05    no    no    no
   30 -3.408E+00  1.704E+00 -1.349E-04  -5.415E-04 -1.394E-04    no    no    no
   29 -3.209E+00  2.053E+00 -1.153E-04  -6.387E-04 -1.354E-04    no    no    no
   28 -2.975E+00  2.380E+00 -1.008E-04  -6.894E-04 -1.160E-04    no    no    no
   27 -2.694E+00  2.694E+00 -8.783E-05  -7.659E-04 -1.430E-04    no    no    no
   26 -2.380E+00  2.975E+00 -7.077E-05  -8.217E-04 -1.230E-04    no    no    no
   25 -2.053E+00  3.209E+00 -6.107E-05  -8.774E-04 -1.246E-04    no    no    no
   24 -1.704E+00  3.408E+00 -4.947E-05  -9.259E-04 -1.210E-04    no    no    no
   23 -1.205E+00  3.614E+00 -3.586E-05  -9.886E-04 -9.684E-05    no    no    no
   22 -6.264E-01  3.758E+00 -1.975E-05  -1.034E-03 -9.291E-05    no    no    no
   21  0.000E+00  3.810E+00 -2.681E-07  -1.083E-03 -1.005E-05    no    no    no
   20  6.264E-01  3.758E+00  1.984E-05  -1.040E-03  1.021E-04    no    no    no
   19  1.205E+00  3.614E+00  3.584E-05  -9.845E-04  1.036E-04    no    no    no
   18  1.704E+00  3.408E+00  4.790E-05  -9.238E-04  1.181E-04    no    no    no
   17  2.053E+00  3.209E+00  6.050E-05  -8.751E-04  1.272E-04    no    no    no
   16  2.380E+00  2.975E+00  6.998E-05  -8.201E-04  1.166E-04    no    no    no
   15  2.694E+00  2.694E+00  8.604E-05  -7.650E-04  1.501E-04    no    no    no
   14  2.975E+00  2.380E+00  9.718E-05  -6.899E-04  7.139E-05    no    no    no
   13  3.209E+00  2.053E+00  1.133E-04  -6.409E-04  2.886E-04    no    no    no
   12  3.408E+00  1.704E+00  1.349E-04  -5.404E-04  2.453E-04    no    no    no
   11  3.614E+00  1.205E+00  1.386E-04  -4.393E-04  2.560E-04    no    no    no
   10  3.758E+00  6.264E-01  1.208E-04  -2.930E-04 -4.138E-05    no    no    no
    9  3.810E+00  0.000E+00  1.079E-04  -9.282E-05  1.350E-05    no    no    no
    8  3.758E+00 -6.264E-01  1.184E-04   1.103E-04 -2.456E-05    no    no    no
    7  3.614E+00 -1.205E+00  1.383E-04   2.643E-04 -3.588E-05    no    no    no
    6  3.408E+00 -1.704E+00  1.403E-04   3.696E-04 -1.364E-04    no    no    no
    5  3.209E+00 -2.053E+00  1.182E-04   4.644E-04 -1.499E-04    no    no    no
    4  2.975E+00 -2.380E+00  9.944E-05   5.228E-04 -1.311E-04    no    no    no
    3  2.694E+00 -2.694E+00  8.039E-05   5.952E-04 -1.445E-04    no    no    no
    2  2.380E+00 -2.975E+00  6.312E-05   6.520E-04 -1.191E-04    no    no    no
```

```
   1  2.053E+00  -3.209E+00   5.266E-05   7.019E-04   0.000E+00    no    no    no
Node    X-load      Y-load      Moment     i  j Pin   Sh. force    Angle    Bond
  48  0.000E+00  0.000E+00   0.000E+00   39 30  no
  47  0.000E+00  0.000E+00   0.000E+00   38 30  no
  46  0.000E+00  0.000E+00   0.000E+00   37 30  no
  45  0.000E+00  0.000E+00   0.000E+00   36 30  no
  44  0.000E+00  0.000E+00   0.000E+00   35 30  no
  43  0.000E+00  0.000E+00   0.000E+00   34 30  no
  42  0.000E+00  0.000E+00   0.000E+00   33 30  no
  41  0.000E+00 -5.870E+01   0.000E+00   33 31 yes
  40  0.000E+00 -1.321E+03   0.000E+00   32 31  no
  39  0.000E+00 -2.925E+03   0.000E+00   32 32  no
  38  0.000E+00 -2.922E+03   0.000E+00   31 32  no
  37  0.000E+00 -1.174E+02   0.000E+00   31 33  no
  36  0.000E+00 -1.375E+02   0.000E+00   30 33  no
  35  0.000E+00 -1.659E+02   0.000E+00   30 34  no
  34  0.000E+00 -1.788E+02   0.000E+00   30 35  no
  33  0.000E+00 -1.835E+02   0.000E+00   30 36  no
  32  0.000E+00 -1.788E+02   0.000E+00   30 37  no
  31  0.000E+00 -1.659E+02   0.000E+00   30 38  no
  30  0.000E+00 -1.375E+02   0.000E+00   30 39  no
  29  0.000E+00 -1.174E+02   0.000E+00   31 39  no
  28  0.000E+00 -1.202E+02   0.000E+00   31 40  no
  27  0.000E+00 -1.230E+02   0.000E+00   32 40  no
  26  0.000E+00 -1.202E+02   0.000E+00   32 41  no
  25  0.000E+00 -5.366E+03   0.000E+00   33 41  no
  24  0.000E+00 -1.375E+02   0.000E+00   33 42  no
  23  0.000E+00 -1.659E+02   0.000E+00   34 42  no
  22  0.000E+00 -1.788E+02   0.000E+00   35 42  no
  21  0.000E+00 -1.041E+04   0.000E+00   36 42  no
  20  0.000E+00 -1.788E+02   0.000E+00   37 42  no
  19  0.000E+00 -1.659E+02   0.000E+00   38 42  no
  18  0.000E+00 -1.375E+02   0.000E+00   39 42  no
  17  0.000E+00 -5.366E+03   0.000E+00   39 41  no
  16  0.000E+00 -1.202E+02   0.000E+00   40 41  no
  15  0.000E+00 -1.230E+02   0.000E+00   40 40  no
  14  0.000E+00 -1.202E+02   0.000E+00   41 40  no
  13  0.000E+00 -1.511E+04   9.085E+03   41 39  no
  12  0.000E+00 -1.513E+04   9.085E+03   42 39  no
  11  0.000E+00 -1.516E+04   9.085E+03   42 38  no
  10  0.000E+00 -1.788E+02   0.000E+00   42 37  no
   9  0.000E+00 -1.835E+02   0.000E+00   42 36  no
   8  0.000E+00 -1.788E+02   0.000E+00   42 35  no
   7  0.000E+00 -1.659E+02   0.000E+00   42 34  no
   6  0.000E+00 -1.375E+02   0.000E+00   42 33  no
   5  0.000E+00 -1.174E+02   0.000E+00   41 33  no
   4  0.000E+00 -1.202E+02   0.000E+00   41 32  no
   3  0.000E+00 -1.230E+02   0.000E+00   40 32  no
   2  0.000E+00 -1.202E+02   0.000E+00   40 31  no
   1  0.000E+00 -5.870E+01   0.000E+00   39 31 yes

Structural element data ...
 Elem  ID Nod1 Nod2   Prop           F-shear     F-axial       Mom-1       Mom-2
   48   1   48    1      3  beam   1.645E+04   4.356E+04   6.611E+03  -2.174E-04
   47   1   47   48      3  beam  -1.476E+04   4.555E+04  -1.362E+03  -6.611E+03
   46   1   46   47      3  beam   9.212E+03  -3.098E+04   4.127E+03   1.363E+03
   45   1   45   46      3  beam   8.416E+03  -5.682E+04   9.414E+03  -4.125E+03
   44   1   44   45      3  beam  -6.996E+03  -5.556E+04   5.016E+03  -9.414E+03
   43   1   43   44      3  beam  -1.243E+04  -2.457E+04  -2.391E+03  -5.017E+03
   42   1   42   43      3  beam   1.841E+04   4.486E+04   7.554E+03   2.390E+03
```

```
 41  1   41   42      3  beam -1.879E+04  4.925E+04  1.211E-04 -7.553E+03
 40  2   40   41      2  beam  1.172E+02  3.892E+04  4.709E+01  1.409E-05
 39  2   39   40      2  beam  2.833E+02  3.647E+04  1.666E+02 -4.724E+01
 38  2   38   39      2  beam -1.352E+03  5.880E+04 -4.031E+02 -1.667E+02
 37  2   37   38      2  beam  2.720E+03  5.640E+04  6.901E+02  4.034E+02
 36  2   36   37      2  beam -3.835E+03  1.068E+05 -8.513E+02 -6.901E+02
 35  2   35   36      2  beam  1.392E+03  1.147E+05 -9.922E+01  8.511E+02
 34  2   34   35      2  beam  2.748E+01  1.607E+05 -8.294E+01  9.932E+01
 33  2   33   34      2  beam -2.416E+01  2.021E+05 -9.813E+01  8.294E+01
 32  2   32   33      2  beam  1.659E+01  1.992E+05 -8.770E+01  9.813E+01
 31  2   31   32      2  beam  5.135E+01  1.532E+05 -5.714E+01  8.775E+01
 30  2   30   31      2  beam -1.802E+03  1.062E+05 -1.031E+03  5.718E+01
 29  2   29   30      2  beam  5.268E+03  1.165E+05  1.087E+03  1.030E+03
 28  2   28   29      2  beam -4.729E+03  5.092E+04 -8.138E+02 -1.087E+03
 27  2   27   28      2  beam  3.004E+03  7.170E+04  4.518E+02  8.139E+02
 26  2   26   27      2  beam -1.511E+03  3.734E+04 -1.846E+02 -4.519E+02
 25  2   25   26      2  beam  8.653E+02  3.661E+04  1.633E+02  1.846E+02
 24  2   24   25      2  beam -6.877E+02  2.209E+04 -1.133E+02 -1.631E+02
 23  2   23   24      2  beam  8.893E+02  1.310E+04  3.667E+02  1.137E+02
 22  2   22   23      2  beam -1.168E+03 -4.622E+03 -3.294E+02 -3.667E+02
 21  2   21   22      2  beam  2.233E+03 -1.524E+04  1.074E+03  3.293E+02
 20  2   20   21      2  beam -1.815E+03 -1.615E+04 -6.607E+01 -1.074E+03
 19  2   19   20      2  beam  2.466E+02 -2.000E+03  8.075E+01  6.622E+01
 18  2   18   19      2  beam -1.867E+01  1.355E+04  7.063E+01 -8.071E+01
 17  2   17   18      2  beam -3.371E+01  2.080E+04  5.712E+01 -7.067E+01
 16  2   16   17      2  beam -6.536E+02  3.680E+04 -2.057E+02 -5.697E+01
 15  2   15   16      2  beam  2.041E+03  3.775E+04  6.544E+02  2.056E+02
 14  2   14   15      2  beam -5.610E+03  7.192E+04 -1.709E+03 -6.545E+02
 13  2   13   14      2  beam  1.610E+04  4.742E+04  4.763E+03  1.710E+03
 12  2   12   13      2  beam  1.999E+04  1.191E+05  3.714E+03  4.322E+03
 11  2   11   12      2  beam  2.009E+04  1.056E+05  5.483E+03  5.371E+03
 10  2   10   11      2  beam  7.356E+03  1.535E+05  7.824E+02  3.602E+03
  9  2    9   10      2  beam -1.704E+03  1.988E+05 -2.888E+02 -7.822E+02
  8  2    8    9      2  beam  3.745E+02  2.018E+05 -5.344E+01  2.888E+02
  7  2    7    8      2  beam -8.566E-01  1.608E+05 -5.389E+01  5.338E+01
  6  2    6    7      2  beam -1.747E+03  1.140E+05 -9.977E+02  5.386E+01
  5  2    5    6      2  beam  4.490E+03  1.112E+05  8.070E+02  9.977E+02
  4  2    4    5      2  beam -3.356E+03  5.675E+04 -5.420E+02 -8.069E+02
  3  2    3    4      2  beam  2.146E+03  6.081E+04  3.621E+02  5.420E+02
  2  2    2    3      2  beam -9.113E+02  3.770E+04 -2.161E+01 -3.624E+02
  1  2    1    2      2  beam  5.369E+01  3.370E+04  4.256E-06  2.158E+01

Structural Properties ...
 Prop                                                Dynamic      Plastic
 Num.      Area          E             I             Density       Moment
 ----  ------------ ------------ ------------ ------------ ------------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2   3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield     Compressive    Support
 Num.  Stiffness    Strength     Strength       Yield       Stiffness
 ----  ------------ ------------ ------------ ------------ ------------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

set log off
 log-file recording stopped 11-Aug-95  14:24
```

STATION: TSW2 @ 27+00

LOADING: STATIC: DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 11-Aug-95  14:24

From File : flac.ini
>res m27_k2.sav
 e following state has been restored:
                    date     time        step      grid    version
                  8-Aug-95  11:40        5210    70 X 70     3.22
Title:

>pr stru

 Structural node data ...
  Node          X           Y       X-disp      Y-disp    Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00  1.471E-04   1.053E-03 -2.200E-04    no    no    no
   47   1.205E+00 -3.614E+00  9.827E-05   1.149E-03 -1.854E-04    no    no    no
   46   6.264E-01 -3.758E+00  4.858E-05   1.244E-03 -1.820E-04    no    no    no
   45   0.000E+00 -3.810E+00 -1.381E-06   1.316E-03 -5.148E-06    no    no    no
   44  -6.264E-01 -3.758E+00 -5.121E-05   1.246E-03  1.846E-04    no    no    no
   43  -1.205E+00 -3.614E+00 -1.018E-04   1.148E-03  1.903E-04    no    no    no
   42  -1.704E+00 -3.408E+00 -1.500E-04   1.051E-03  2.233E-04    no    no    no
   41  -2.053E+00 -3.209E+00 -2.002E-04   9.672E-04  0.000E+00    no    no    no
   40  -2.380E+00 -2.975E+00 -2.322E-04   8.653E-04  2.454E-04    no    no    no
   39  -2.694E+00 -2.694E+00 -2.714E-04   7.636E-04  2.530E-04    no    no    no
   38  -2.975E+00 -2.380E+00 -3.053E-04   6.408E-04  2.296E-04    no    no    no
   37  -3.209E+00 -2.053E+00 -3.378E-04   5.396E-04  2.257E-04    no    no    no
   36  -3.408E+00 -1.704E+00 -3.693E-04   3.995E-04  2.251E-04    no    no    no
   35  -3.614E+00 -1.205E+00 -4.030E-04   2.352E-04  1.420E-04    no    no    no
   34  -3.758E+00 -6.264E-01 -4.261E-04   4.360E-05  8.076E-05    no    no    no
   33  -3.810E+00  0.000E+00 -4.320E-04  -1.739E-04  1.846E-07    no    no    no
   32  -3.758E+00  6.264E-01 -4.255E-04  -3.857E-04 -7.822E-05    no    no    no
   31  -3.614E+00  1.205E+00 -4.054E-04  -5.794E-04 -1.387E-04    no    no    no
   30  -3.408E+00  1.704E+00 -3.757E-04  -7.400E-04 -2.033E-04    no    no    no
   29  -3.209E+00  2.053E+00 -3.455E-04  -8.700E-04 -2.281E-04    no    no    no
   28  -2.975E+00  2.380E+00 -3.142E-04  -9.807E-04 -2.318E-04    no    no    no
   27  -2.694E+00  2.694E+00 -2.816E-04  -1.095E-03 -2.392E-04    no    no    no
   26  -2.380E+00  2.975E+00 -2.404E-04  -1.190E-03 -2.443E-04    no    no    no
   25  -2.053E+00  3.209E+00 -2.110E-04  -1.291E-03 -2.330E-04    no    no    no
   24  -1.704E+00  3.408E+00 -1.733E-04  -1.369E-03 -2.086E-04    no    no    no
   23  -1.205E+00  3.614E+00 -1.329E-04  -1.473E-03 -1.951E-04    no    no    no
   22  -6.264E-01  3.758E+00 -7.694E-05  -1.572E-03 -1.697E-04    no    no    no
   21   0.000E+00  3.810E+00 -3.057E-06  -1.625E-03 -5.893E-06    no    no    no
   20   6.264E-01  3.758E+00  7.174E-05  -1.579E-03  1.653E-04    no    no    no
   19   1.205E+00  3.614E+00  1.277E-04  -1.481E-03  1.898E-04    no    no    no
   18   1.704E+00  3.408E+00  1.690E-04  -1.380E-03  2.128E-04    no    no    no
   17   2.053E+00  3.209E+00  2.081E-04  -1.299E-03  2.350E-04    no    no    no
   16   2.380E+00  2.975E+00  2.383E-04  -1.201E-03  2.405E-04    no    no    no
   15   2.694E+00  2.694E+00  2.792E-04  -1.101E-03  2.611E-04    no    no    no
   14   2.975E+00  2.380E+00  3.120E-04  -9.839E-04  1.841E-04    no    no    no
   13   3.209E+00  2.053E+00  3.424E-04  -8.781E-04  3.819E-04    no    no    no
   12   3.408E+00  1.704E+00  3.759E-04  -7.407E-04  3.156E-04    no    no    no
   11   3.614E+00  1.205E+00  4.059E-04  -5.784E-04  3.482E-04    no    no    no
   10   3.758E+00  6.264E-01  4.251E-04  -3.900E-04  1.860E-05    no    no    no
    9   3.810E+00  0.000E+00  4.313E-04  -1.730E-04  1.669E-05    no    no    no
    8   3.758E+00 -6.264E-01  4.265E-04   4.476E-05 -8.147E-05    no    no    no
    7   3.614E+00 -1.205E+00  4.058E-04   2.369E-04 -1.403E-04    no    no    no
    6   3.408E+00 -1.704E+00  3.732E-04   4.050E-04 -2.241E-04    no    no    no
    5   3.209E+00 -2.053E+00  3.413E-04   5.437E-04 -2.277E-04    no    no    no
    4   2.975E+00 -2.380E+00  3.080E-04   6.471E-04 -2.356E-04    no    no    no
    3   2.694E+00 -2.694E+00  2.712E-04   7.705E-04 -2.533E-04    no    no    no
    2   2.380E+00 -2.975E+00  2.301E-04   8.669E-04 -2.471E-04    no    no    no
```

```
  1  2.053E+00 -3.209E+00  1.957E-04   9.720E-04   0.000E+00    no    no    no
Node    X-load      Y-load     Moment     i   j  Pin   Sh. force    Angle    Bond
 48  0.000E+00  0.000E+00  0.000E+00  39 30  no
 47  0.000E+00  0.000E+00  0.000E+00  38 30  no
 46  0.000E+00  0.000E+00  0.000E+00  37 30  no
 45  0.000E+00  0.000E+00  0.000E+00  36 30  no
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem ID Nod1 Nod2  Prop          F-shear    F-axial       Mom-1      Mom-2
   48  1   48    1     3  beam  2.040E+04 -2.092E+04  8.201E+03  2.263E-05
   47  1   47   48     3  beam -1.491E+04 -1.307E+05  1.464E+02 -8.202E+03
   46  1   46   47     3  beam  7.590E+02 -3.389E+05  5.993E+02 -1.469E+02
   45  1   45   46     3  beam  5.638E+04 -6.023E+05  3.603E+04 -5.970E+02
   44  1   44   45     3  beam -5.213E+04 -6.055E+05  3.265E+03 -3.603E+04
   43  1   43   44     3  beam -8.864E+03 -3.460E+05 -2.018E+03 -3.266E+03
   42  1   42   43     3  beam  2.221E+04 -1.157E+05  9.979E+03  2.019E+03
```

```
 41  1   41   42     3  beam -2.483E+04  -2.027E+04   5.002E-04  -9.979E+03
 40  2   40   41     2  beam -8.040E+02   5.721E+04  -3.232E+02  -1.031E-05
 39  2   39   40     2  beam  1.776E+03   5.546E+04   4.253E+02   3.233E+02
 38  2   38   39     2  beam -2.762E+03   1.014E+05  -7.386E+02  -4.251E+02
 37  2   37   38     2  beam  3.538E+03   9.945E+04   6.833E+02   7.387E+02
 36  2   36   37     2  beam -3.423E+03   1.639E+05  -6.922E+02  -6.836E+02
 35  2   35   36     2  beam  9.537E+02   1.580E+05  -1.770E+02   6.922E+02
 34  2   34   35     2  beam -3.798E+02   1.910E+05  -4.034E+02   1.770E+02
 33  2   33   34     2  beam  1.309E+02   2.150E+05  -3.211E+02   4.034E+02
 32  2   32   33     2  beam -9.939E+01   2.089E+05  -3.837E+02   3.213E+02
 31  2   31   32     2  beam  3.250E+02   1.916E+05  -1.901E+02   3.838E+02
 30  2   30   31     2  beam -5.466E+02   1.594E+05  -4.852E+02   1.900E+02
 29  2   29   30     2  beam  1.542E+03   1.496E+05   1.352E+02   4.847E+02
 28  2   28   29     2  beam -8.025E+02   1.128E+05  -1.872E+02  -1.353E+02
 27  2   27   28     2  beam  6.548E+02   9.421E+04   8.851E+01   1.874E+02
 26  2   26   27     2  beam -5.823E+02   4.904E+04  -1.568E+02  -8.852E+01
 25  2   25   26     2  beam  1.176E+03   5.298E+04   3.162E+02   1.566E+02
 24  2   24   25     2  beam -7.169E+02   9.906E+03   2.739E+01  -3.155E+02
 23  2   23   24     2  beam  1.614E+02   2.604E+03   1.139E+02  -2.671E+01
 22  2   22   23     2  beam  2.263E+01  -3.238E+04   1.275E+02  -1.140E+02
 21  2   21   22     2  beam  1.937E+03  -6.791E+04   1.345E+03  -1.277E+02
 20  2   20   21     2  beam -1.831E+03  -6.873E+04   1.944E+02  -1.345E+03
 19  2   19   20     2  beam -2.616E+02  -3.249E+04   3.805E+01  -1.940E+02
 18  2   18   19     2  beam  3.055E+02   2.172E+02   2.031E+02  -3.810E+01
 17  2   17   18     2  beam -2.330E+02   9.407E+03   1.094E+02  -2.030E+02
 16  2   16   17     2  beam -3.534E+02   4.982E+04  -3.300E+01  -1.090E+02
 15  2   15   16     2  beam  8.122E+02   5.474E+04   3.092E+02   3.303E+01
 14  2   14   15     2  beam -3.921E+03   9.601E+04  -1.342E+03  -3.100E+02
 13  2   13   14     2  beam  1.360E+04   1.083E+05   4.123E+03   1.342E+03
 12  2   12   13     2  beam  2.237E+04   1.593E+05   4.030E+03   4.962E+03
 11  2   11   12     2  beam  1.935E+04   1.582E+05   5.396E+03   5.055E+03
 10  2   10   11     2  beam  7.133E+03   1.881E+05   5.633E+02   3.688E+03
  9  2    9   10     2  beam -1.820E+03   2.132E+05  -5.804E+02  -5.632E+02
  8  2    8    9     2  beam  4.418E+02   2.150E+05  -3.025E+02   5.802E+02
  7  2    7    8     2  beam  7.897E+01   1.913E+05  -2.555E+02   3.025E+02
  6  2    6    7     2  beam -6.758E+02   1.645E+05  -6.205E+02   2.554E+02
  5  2    5    6     2  beam  2.958E+03   1.620E+05   5.687E+02   6.204E+02
  4  2    4    5     2  beam -3.103E+03   1.013E+05  -6.789E+02  -5.686E+02
  3  2    3    4     2  beam  2.658E+03   9.849E+04   4.412E+02   6.787E+02
  2  2    2    3     2  beam -1.897E+03   4.989E+04  -3.584E+02  -4.412E+02
  1  2    1    2     2  beam  8.914E+02   5.366E+04   2.011E-05   3.583E+02

Structural Properties ...
 Prop                                              Dynamic      Plastic
 Num.     Area          E             I            Density      Moment
 ---- ------------ ------------ ------------ ------------ ------------
   3  3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00   Not Set
   2  3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00   Not Set
 Prop.  Cable Bond   Cable Bond     Yield    Compressive   Support
 Num.   Stiffness     Strength     Strength     Yield      Stiffness
 ---- ------------ ------------ ------------ ------------ ------------
   3  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

set log off
 log-file recording stopped 11-Aug-95  14:24
```

STATION: **TSW2 @ 34+00**

LOADING: **STATIC: DL+UTIL**

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 11-Aug-95  14:24

From File : flac.ini
>res m34_k2.sav
 e following state has been restored:
                  date    time        step       grid    version
               8-Aug-95  12:04        5210     70 X 70     3.22
Title:

>pr stru

 Structural node data ...
  Node       X           Y         X-disp      Y-disp     Ang-disp  Xfix  Yfix  Rfix
   48  1.704E+00 -3.408E+00  1.441E-04  1.093E-03 -2.515E-04   no    no    no
   47  1.205E+00 -3.614E+00  8.922E-05  1.211E-03 -2.180E-04   no    no    no
   46  6.264E-01 -3.758E+00  3.737E-05  1.303E-03 -1.049E-04   no    no    no
   45  0.000E+00 -3.810E+00 -9.367E-06  1.315E-03  5.615E-05   no    no    no
   44 -6.264E-01 -3.758E+00 -5.336E-05  1.242E-03  1.727E-04   no    no    no
   43 -1.205E+00 -3.614E+00 -1.013E-04  1.126E-03  2.243E-04   no    no    no
   42 -1.704E+00 -3.408E+00 -1.504E-04  1.015E-03  2.292E-04   no    no    no
   41 -2.053E+00 -3.209E+00 -1.957E-04  9.329E-04  0.000E+00   no    no    no
   40 -2.380E+00 -2.975E+00 -2.288E-04  8.273E-04  2.504E-04   no    no    no
   39 -2.694E+00 -2.694E+00 -2.722E-04  7.278E-04  2.598E-04   no    no    no
   38 -2.975E+00 -2.380E+00 -3.116E-04  6.053E-04  2.408E-04   no    no    no
   37 -3.209E+00 -2.053E+00 -3.474E-04  5.012E-04  2.347E-04   no    no    no
   36 -3.408E+00 -1.704E+00 -3.809E-04  3.642E-04  2.253E-04   no    no    no
   35 -3.614E+00 -1.205E+00 -4.145E-04  1.979E-04  1.430E-04   no    no    no
   34 -3.758E+00 -6.264E-01 -4.375E-04  3.843E-06  8.348E-05   no    no    no
   33 -3.810E+00  0.000E+00 -4.478E-04 -2.182E-04  1.055E-05   no    no    no
   32 -3.758E+00  6.264E-01 -4.467E-04 -4.435E-04 -7.992E-05   no    no    no
   31 -3.614E+00  1.205E+00 -4.261E-04 -6.486E-04 -1.423E-04   no    no    no
   30 -3.408E+00  1.704E+00 -3.959E-04 -8.148E-04 -2.228E-04   no    no    no
   29 -3.209E+00  2.053E+00 -3.625E-04 -9.615E-04 -2.501E-04   no    no    no
   28 -2.975E+00  2.380E+00 -3.302E-04 -1.078E-03 -2.390E-04   no    no    no
   27 -2.694E+00  2.694E+00 -2.988E-04 -1.200E-03 -2.488E-04   no    no    no
   26 -2.380E+00  2.975E+00 -2.598E-04 -1.306E-03 -2.692E-04   no    no    no
   25 -2.053E+00  3.209E+00 -2.304E-04 -1.426E-03 -2.737E-04   no    no    no
   24 -1.704E+00  3.408E+00 -1.911E-04 -1.518E-03 -2.336E-04   no    no    no
   23 -1.205E+00  3.614E+00 -1.501E-04 -1.634E-03 -2.366E-04   no    no    no
   22 -6.264E-01  3.758E+00 -8.510E-05 -1.766E-03 -1.968E-04   no    no    no
   21  0.000E+00  3.810E+00 -4.011E-06 -1.816E-03 -1.336E-05   no    no    no
   20  6.264E-01  3.758E+00  7.888E-05 -1.781E-03  1.803E-04   no    no    no
   19  1.205E+00  3.614E+00  1.471E-04 -1.655E-03  2.347E-04   no    no    no
   18  1.704E+00  3.408E+00  1.917E-04 -1.540E-03  2.352E-04   no    no    no
   17  2.053E+00  3.209E+00  2.317E-04 -1.448E-03  2.809E-04   no    no    no
   16  2.380E+00  2.975E+00  2.620E-04 -1.322E-03  2.786E-04   no    no    no
   15  2.694E+00  2.694E+00  3.002E-04 -1.208E-03  2.763E-04   no    no    no
   14  2.975E+00  2.380E+00  3.307E-04 -1.077E-03  1.947E-04   no    no    no
   13  3.209E+00  2.053E+00  3.616E-04 -9.651E-04  4.023E-04   no    no    no
   12  3.408E+00  1.704E+00  3.973E-04 -8.086E-04  3.370E-04   no    no    no
   11  3.614E+00  1.205E+00  4.258E-04 -6.364E-04  3.487E-04   no    no    no
   10  3.758E+00  6.264E-01  4.429E-04 -4.344E-04  1.812E-05   no    no    no
    9  3.810E+00  0.000E+00  4.452E-04 -2.059E-04  1.093E-05   no    no    no
    8  3.758E+00 -6.264E-01  4.380E-04  2.091E-05 -8.338E-05   no    no    no
    7  3.614E+00 -1.205E+00  4.184E-04  2.197E-04 -1.439E-04   no    no    no
    6  3.408E+00 -1.704E+00  3.850E-04  3.931E-04 -2.294E-04   no    no    no
    5  3.209E+00 -2.053E+00  3.507E-04  5.349E-04 -2.441E-04   no    no    no
    4  2.975E+00 -2.380E+00  3.145E-04  6.493E-04 -2.620E-04   no    no    no
    3  2.694E+00 -2.694E+00  2.754E-04  7.863E-04 -2.745E-04   no    no    no
    2  2.380E+00 -2.975E+00  2.328E-04  8.923E-04 -2.647E-04   no    no    no
```

```
  1  2.053E+00 -3.209E+00  1.962E-04  1.005E-03  0.000E+00   no   no   no
Node    X-load     Y-load     Moment   i  j Pin  Sh. force   Angle   Bond
 48  0.000E+00  0.000E+00  0.000E+00  39 30  no
 47  0.000E+00  0.000E+00  0.000E+00  38 30  no
 46  0.000E+00  0.000E+00  0.000E+00  37 30  no
 45  0.000E+00  0.000E+00  0.000E+00  36 30  no
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem  ID Nod1 Nod2   Prop          F-shear    F-axial      Mom-1      Mom-2
   48  1   48    1     3   beam  8.100E+03 -2.764E+04  3.256E+03  7.747E-04
   47  1   47   48     3   beam  2.901E+03 -9.395E+04  4.826E+03 -3.259E+03
   46  1   46   47     3   beam  2.527E+04 -3.998E+05  1.988E+04 -4.823E+03
   45  1   45   46     3   beam -1.021E+04 -5.963E+05  1.347E+04 -1.988E+04
   44  1   44   45     3   beam -4.449E+03 -5.213E+05  1.067E+04 -1.347E+04
   43  1   43   44     3   beam -1.692E+04 -2.766E+05  5.904E+02 -1.067E+04
   42  1   42   43     3   beam -7.777E+00 -3.478E+04  5.865E+02 -5.907E+02
```

```
 41  1   41   42     3  beam -1.458E+03  2.165E+04  7.710E-04 -5.860E+02
 40  2   40   41     2  beam -5.700E+02  5.361E+04 -2.291E+02 -3.635E-05
 39  2   39   40     2  beam  1.387E+03  4.903E+04  3.556E+02  2.291E+02
 38  2   38   39     2  beam -2.292E+03  9.586E+04 -6.101E+02 -3.556E+02
 37  2   37   38     2  beam  2.820E+03  1.013E+05  5.232E+02  6.102E+02
 36  2   36   37     2  beam -2.929E+03  1.580E+05 -6.544E+02 -5.231E+02
 35  2   35   36     2  beam  8.277E+02  1.643E+05 -2.072E+02  6.543E+02
 34  2   34   35     2  beam -2.513E+02  1.906E+05 -3.570E+02  2.072E+02
 33  2   33   34     2  beam  9.230E+01  2.188E+05 -2.989E+02  3.569E+02
 32  2   32   33     2  beam -3.434E+02  2.216E+05 -5.147E+02  2.988E+02
 31  2   31   32     2  beam  7.353E+02  2.033E+05 -7.644E+01  5.147E+02
 30  2   30   31     2  beam -1.277E+03  1.658E+05 -7.661E+02  7.643E+01
 29  2   29   30     2  beam  2.856E+03  1.692E+05  3.818E+02  7.661E+02
 28  2   28   29     2  beam -1.511E+03  1.193E+05 -2.254E+02 -3.818E+02
 27  2   27   28     2  beam  7.603E+02  1.033E+05  9.480E+01  2.256E+02
 26  2   26   27     2  beam -1.102E+03  6.191E+04 -3.696E+02 -9.480E+01
 25  2   25   26     2  beam  1.682E+03  6.779E+04  3.071E+02  3.691E+02
 24  2   24   25     2  beam -1.284E+02  2.115E+04  2.557E+02 -3.073E+02
 23  2   23   24     2  beam -1.004E+03  7.381E+03 -2.868E+02 -2.554E+02
 22  2   22   23     2  beam  1.597E+03 -3.367E+04  6.648E+02  2.869E+02
 21  2   21   22     2  beam  5.079E+02 -7.529E+04  9.842E+02 -6.650E+02
 20  2   20   21     2  beam -3.605E+02 -7.864E+04  7.576E+02 -9.842E+02
 19  2   19   20     2  beam -1.676E+03 -3.736E+04 -2.417E+02 -7.574E+02
 18  2   18   19     2  beam  9.033E+02  2.939E+03  2.462E+02  2.417E+02
 17  2   17   18     2  beam  3.743E+02  2.034E+04  3.968E+02 -2.464E+02
 16  2   16   17     2  beam -2.058E+03  7.131E+04 -4.299E+02 -3.972E+02
 15  2   15   16     2  beam  1.970E+03  7.185E+04  4.001E+02  4.301E+02
 14  2   14   15     2  beam -4.496E+03  1.123E+05 -1.495E+03 -4.000E+02
 13  2   13   14     2  beam  1.470E+04  1.160E+05  4.413E+03  1.495E+03
 12  2   12   13     2  beam  2.096E+04  1.813E+05  3.754E+03  4.672E+03
 11  2   11   12     2  beam  1.996E+04  1.709E+05  5.453E+03  5.331E+03
 10  2   10   11     2  beam  6.930E+03  2.010E+05  4.982E+02  3.632E+03
  9  2    9   10     2  beam -1.688E+03  2.261E+05 -5.629E+02 -4.982E+02
  8  2    8    9     2  beam  4.418E+02  2.240E+05 -2.852E+02  5.628E+02
  7  2    7    8     2  beam -6.844E+00  1.970E+05 -2.892E+02  2.851E+02
  6  2    6    7     2  beam -5.833E+02  1.696E+05 -6.045E+02  2.894E+02
  5  2    5    6     2  beam  2.494E+03  1.649E+05  3.982E+02  6.045E+02
  4  2    4    5     2  beam -2.612E+03  1.123E+05 -6.513E+02 -3.985E+02
  3  2    3    4     2  beam  2.694E+03  1.078E+05  4.841E+02  6.513E+02
  2  2    2    3     2  beam -1.984E+03  5.906E+04 -3.522E+02 -4.838E+02
  1  2    1    2     2  beam  8.765E+02  5.838E+04 -4.022E-05  3.523E+02

Structural Properties ...
 Prop                                                  Dynamic      Plastic
 Num.     Area          E             I              Density       Moment
 ----  -----------  -----------  -----------  -----------  -----------
   3   3.04800E-01  2.75800E+10  2.36000E-03  0.00000E+00    Not Set
   2   3.78700E-03  1.64000E+11  1.72300E-05  0.00000E+00    Not Set
 Prop.  Cable Bond   Cable Bond     Yield      Compressive    Support
 Num.  Stiffness    Strength      Strength       Yield      Stiffness
 ----  -----------  -----------  -----------  -----------  -----------
   3   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
   2   0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

Set log off
 log-file recording stopped 11-Aug-95   14:24
```

STATION: TSW2 @ 53+00

LOADING: STATIC: DL+UTIL

STEEL SET: W6X20 @ 4'-0" O.C.

```
* FLAC log-file opened 11-Aug-95  14:24

From File : flac.ini
>res m53_k2.sav
    following state has been restored:
                  date     time          step          grid     version
             8-Aug-95  12:27          5210       70 X 70       3.22
Title:

>pr stru

 Structural node data ...
  Node        X          Y        X-disp       Y-disp     Ang-disp  Xfix  Yfix  Rfix
   48   1.704E+00 -3.408E+00  1.438E-04   1.062E-03 -2.145E-04   no    no    no
   47   1.205E+00 -3.614E+00  9.692E-05   1.155E-03 -1.794E-04   no    no    no
   46   6.264E-01 -3.758E+00  4.759E-05   1.248E-03 -1.781E-04   no    no    no
   45   0.000E+00 -3.810E+00 -1.428E-06   1.317E-03 -3.590E-06   no    no    no
   44  -6.264E-01 -3.758E+00 -4.986E-05   1.249E-03  1.794E-04   no    no    no
   43  -1.205E+00 -3.614E+00 -9.957E-05   1.153E-03  1.875E-04   no    no    no
   42  -1.704E+00 -3.408E+00 -1.479E-04   1.058E-03  2.174E-04   no    no    no
   41  -2.053E+00 -3.209E+00 -1.957E-04   9.785E-04  0.000E+00   no    no    no
   40  -2.380E+00 -2.975E+00 -2.295E-04   8.741E-04  2.503E-04   no    no    no
   39  -2.694E+00 -2.694E+00 -2.722E-04   7.758E-04  2.579E-04   no    no    no
   38  -2.975E+00 -2.380E+00 -3.079E-04   6.525E-04  2.296E-04   no    no    no
   37  -3.209E+00 -2.053E+00 -3.415E-04   5.516E-04  2.304E-04   no    no    no
   36  -3.408E+00 -1.704E+00 -3.735E-04   4.089E-04  2.289E-04   no    no    no
   35  -3.614E+00 -1.205E+00 -4.063E-04   2.401E-04  1.418E-04   no    no    no
   34  -3.758E+00 -6.264E-01 -4.276E-04   4.756E-05  7.668E-05   no    no    no
   33  -3.810E+00  0.000E+00 -4.312E-04  -1.696E-04 -2.761E-06   no    no    no
   32  -3.758E+00  6.264E-01 -4.244E-04  -3.857E-04 -7.753E-05   no    no    no
   31  -3.614E+00  1.205E+00 -4.057E-04  -5.749E-04 -1.320E-04   no    no    no
   30  -3.408E+00  1.704E+00 -3.771E-04  -7.346E-04 -2.082E-04   no    no    no
   29  -3.209E+00  2.053E+00 -3.468E-04  -8.693E-04 -2.305E-04   no    no    no
   28  -2.975E+00  2.380E+00 -3.163E-04  -9.797E-04 -2.330E-04   no    no    no
   27  -2.694E+00  2.694E+00 -2.843E-04  -1.100E-03 -2.420E-04   no    no    no
   26  -2.380E+00  2.975E+00 -2.494E-04  -1.202E-03 -2.508E-04   no    no    no
   25  -2.053E+00  3.209E+00 -2.212E-04  -1.312E-03 -2.670E-04   no    no    no
   24  -1.704E+00  3.408E+00 -1.797E-04  -1.406E-03 -2.440E-04   no    no    no
   23  -1.205E+00  3.614E+00 -1.365E-04  -1.525E-03 -2.159E-04   no    no    no
   22  -6.264E-01  3.758E+00 -7.162E-05  -1.627E-03 -1.536E-04   no    no    no
   21   0.000E+00  3.810E+00  4.960E-06  -1.662E-03  1.159E-05   no    no    no
   20   6.264E-01  3.758E+00  7.839E-05  -1.614E-03  1.725E-04   no    no    no
   19   1.205E+00  3.614E+00  1.344E-04  -1.505E-03  1.924E-04   no    no    no
   18   1.704E+00  3.408E+00  1.734E-04  -1.408E-03  2.102E-04   no    no    no
   17   2.053E+00  3.209E+00  2.148E-04  -1.323E-03  2.586E-04   no    no    no
   16   2.380E+00  2.975E+00  2.428E-04  -1.216E-03  2.387E-04   no    no    no
   15   2.694E+00  2.694E+00  2.788E-04  -1.121E-03  2.435E-04   no    no    no
   14   2.975E+00  2.380E+00  3.112E-04  -1.006E-03  1.859E-04   no    no    no
   13   3.209E+00  2.053E+00  3.430E-04  -8.999E-04  3.888E-04   no    no    no
   12   3.408E+00  1.704E+00  3.774E-04  -7.562E-04  3.217E-04   no    no    no
   11   3.614E+00  1.205E+00  4.080E-04  -5.928E-04  3.521E-04   no    no    no
   10   3.758E+00  6.264E-01  4.282E-04  -3.959E-04  1.997E-05   no    no    no
    9   3.810E+00  0.000E+00  4.323E-04  -1.759E-04  1.473E-05   no    no    no
    8   3.758E+00 -6.264E-01  4.279E-04   4.273E-05 -8.171E-05   no    no    no
    7   3.614E+00 -1.205E+00  4.073E-04   2.405E-04 -1.425E-04   no    no    no
    6   3.408E+00 -1.704E+00  3.748E-04   4.123E-04 -2.302E-04   no    no    no
    5   3.209E+00 -2.053E+00  3.420E-04   5.559E-04 -2.359E-04   no    no    no
    4   2.975E+00 -2.380E+00  3.062E-04   6.585E-04 -2.384E-04   no    no    no
    3   2.694E+00 -2.694E+00  2.691E-04   7.832E-04 -2.534E-04   no    no    no
    2   2.380E+00 -2.975E+00  2.275E-04   8.779E-04 -2.464E-04   no    no    no
```

```
  1  2.053E+00 -3.209E+00  1.922E-04  9.834E-04  0.000E+00    no   no   no
Node    X-load    Y-load     Moment    i  j Pin  Sh. force  Angle  Bond
 48  0.000E+00  0.000E+00  0.000E+00  39 30  no
 47  0.000E+00  0.000E+00  0.000E+00  38 30  no
 46  0.000E+00  0.000E+00  0.000E+00  37 30  no
 45  0.000E+00  0.000E+00  0.000E+00  36 30  no
 44  0.000E+00  0.000E+00  0.000E+00  35 30  no
 43  0.000E+00  0.000E+00  0.000E+00  34 30  no
 42  0.000E+00  0.000E+00  0.000E+00  33 30  no
 41  0.000E+00 -5.870E+01  0.000E+00  33 31 yes
 40  0.000E+00 -1.321E+03  0.000E+00  32 31  no
 39  0.000E+00 -2.925E+03  0.000E+00  32 32  no
 38  0.000E+00 -2.922E+03  0.000E+00  31 32  no
 37  0.000E+00 -1.174E+02  0.000E+00  31 33  no
 36  0.000E+00 -1.375E+02  0.000E+00  30 33  no
 35  0.000E+00 -1.659E+02  0.000E+00  30 34  no
 34  0.000E+00 -1.788E+02  0.000E+00  30 35  no
 33  0.000E+00 -1.835E+02  0.000E+00  30 36  no
 32  0.000E+00 -1.788E+02  0.000E+00  30 37  no
 31  0.000E+00 -1.659E+02  0.000E+00  30 38  no
 30  0.000E+00 -1.375E+02  0.000E+00  30 39  no
 29  0.000E+00 -1.174E+02  0.000E+00  31 39  no
 28  0.000E+00 -1.202E+02  0.000E+00  31 40  no
 27  0.000E+00 -1.230E+02  0.000E+00  32 40  no
 26  0.000E+00 -1.202E+02  0.000E+00  32 41  no
 25  0.000E+00 -5.366E+03  0.000E+00  33 41  no
 24  0.000E+00 -1.375E+02  0.000E+00  33 42  no
 23  0.000E+00 -1.659E+02  0.000E+00  34 42  no
 22  0.000E+00 -1.788E+02  0.000E+00  35 42  no
 21  0.000E+00 -1.041E+04  0.000E+00  36 42  no
 20  0.000E+00 -1.788E+02  0.000E+00  37 42  no
 19  0.000E+00 -1.659E+02  0.000E+00  38 42  no
 18  0.000E+00 -1.375E+02  0.000E+00  39 42  no
 17  0.000E+00 -5.366E+03  0.000E+00  39 41  no
 16  0.000E+00 -1.202E+02  0.000E+00  40 41  no
 15  0.000E+00 -1.230E+02  0.000E+00  40 40  no
 14  0.000E+00 -1.202E+02  0.000E+00  41 40  no
 13  0.000E+00 -1.511E+04  9.085E+03  41 39  no
 12  0.000E+00 -1.513E+04  9.085E+03  42 39  no
 11  0.000E+00 -1.516E+04  9.085E+03  42 38  no
 10  0.000E+00 -1.788E+02  0.000E+00  42 37  no
  9  0.000E+00 -1.835E+02  0.000E+00  42 36  no
  8  0.000E+00 -1.788E+02  0.000E+00  42 35  no
  7  0.000E+00 -1.659E+02  0.000E+00  42 34  no
  6  0.000E+00 -1.375E+02  0.000E+00  42 33  no
  5  0.000E+00 -1.174E+02  0.000E+00  41 33  no
  4  0.000E+00 -1.202E+02  0.000E+00  41 32  no
  3  0.000E+00 -1.230E+02  0.000E+00  40 32  no
  2  0.000E+00 -1.202E+02  0.000E+00  40 31  no
  1  0.000E+00 -5.870E+01  0.000E+00  39 31 yes

Structural element data ...
 Elem  ID Nod1 Nod2  Prop         F-shear    F-axial      Mom-1      Mom-2
   48   1   48    1     3  beam  2.058E+04 -2.727E+04  8.271E+03 -9.727E-04
   47   1   47   48     3  beam -1.499E+04 -1.365E+05  1.723E+02 -8.271E+03
   46   1   46   47     3  beam -7.394E+01 -3.360E+05  1.271E+02 -1.711E+02
   45   1   45   46     3  beam  5.710E+04 -5.907E+05  3.601E+04 -1.274E+02
   44   1   44   45     3  beam -5.430E+04 -5.918E+05  1.884E+03 -3.601E+04
   43   1   43   44     3  beam -3.358E+03 -3.295E+05 -1.156E+02 -1.886E+03
   42   1   42   43     3  beam  1.376E+04 -1.333E+05  7.317E+03  1.129E+02
```

```
 41  1   41   42      3  beam -1.820E+04 -1.464E+04 -5.853E-04 -7.317E+03
 40  2   40   41      2  beam -4.445E+02  5.212E+04 -1.786E+02 -3.660E-05
 39  2   39   40      2  beam  1.091E+03  5.117E+04  2.812E+02  1.787E+02
 38  2   38   39      2  beam -2.235E+03  9.969E+04 -6.605E+02 -2.812E+02
 37  2   37   38      2  beam  3.314E+03  9.885E+04  6.717E+02  6.603E+02
 36  2   36   37      2  beam -3.398E+03  1.671E+05 -6.938E+02 -6.718E+02
 35  2   35   36      2  beam  8.822E+02  1.656E+05 -2.172E+02  6.938E+02
 34  2   34   35      2  beam -3.065E+02  1.909E+05 -4.000E+02  2.173E+02
 33  2   33   34      2  beam  1.363E+02  2.143E+05 -3.143E+02  4.000E+02
 32  2   32   33      2  beam -6.954E+01  2.128E+05 -3.580E+02  3.143E+02
 31  2   31   32      2  beam  3.341E+02  1.884E+05 -1.589E+02  3.580E+02
 30  2   30   31      2  beam -8.863E+02  1.579E+05 -6.376E+02  1.589E+02
 29  2   29   30      2  beam  2.392E+03  1.559E+05  3.239E+02  6.377E+02
 28  2   28   29      2  beam -1.700E+03  1.141E+05 -3.594E+02 -3.241E+02
 27  2   27   28      2  beam  1.420E+03  9.885E+04  2.388E+02  3.594E+02
 26  2   26   27      2  beam -1.412E+03  6.172E+04 -3.562E+02 -2.387E+02
 25  2   25   26      2  beam  1.203E+03  6.485E+04  1.276E+02  3.559E+02
 24  2   24   25      2  beam  1.680E+02  1.744E+04  1.951E+02 -1.276E+02
 23  2   23   24      2  beam -1.768E+02  5.300E+03  9.929E+01 -1.948E+02
 22  2   22   23      2  beam  6.576E+02 -3.989E+04  4.914E+02 -9.946E+01
 21  2   21   22      2  beam  7.998E+02 -7.235E+04  9.941E+02 -4.914E+02
 20  2   20   21      2  beam -8.607E+02 -6.711E+04  4.530E+02 -9.940E+02
 19  2   19   20      2  beam -1.204E+03 -3.067E+04 -2.647E+02 -4.531E+02
 18  2   18   19      2  beam  1.325E+03 -2.179E+02  4.511E+02  2.644E+02
 17  2   17   18      2  beam -5.508E+02  1.195E+04  2.297E+02 -4.511E+02
 16  2   16   17      2  beam -1.835E+03  6.147E+04 -5.089E+02 -2.287E+02
 15  2   15   16      2  beam  2.566E+03  5.255E+04  5.725E+02  5.089E+02
 14  2   14   15      2  beam -4.552E+03  9.505E+04 -1.345E+03 -5.734E+02
 13  2   13   14      2  beam  1.379E+04  1.088E+05  4.197E+03  1.345E+03
 12  2   12   13      2  beam  2.198E+04  1.633E+05  3.945E+03  4.888E+03
 11  2   11   12      2  beam  1.962E+04  1.608E+05  5.458E+03  5.140E+03
 10  2   10   11      2  beam  6.887E+03  1.965E+05  4.777E+02  3.627E+03
  9  2    9   10      2  beam -1.595E+03  2.166E+05 -5.247E+02 -4.776E+02
  8  2    8    9      2  beam  2.900E+02  2.152E+05 -3.425E+02  5.247E+02
  7  2    7    8      2  beam  1.814E+02  1.963E+05 -2.343E+02  3.424E+02
  6  2    6    7      2  beam -8.307E+02  1.690E+05 -6.830E+02  2.342E+02
  5  2    5    6      2  beam  3.200E+03  1.672E+05  6.034E+02  6.830E+02
  4  2    4    5      2  beam -3.090E+03  1.003E+05 -6.388E+02 -6.032E+02
  3  2    3    4      2  beam  2.554E+03  9.902E+04  4.372E+02  6.389E+02
  2  2    2    3      2  beam -1.851E+03  4.919E+04 -3.426E+02 -4.373E+02
  1  2    1    2      2  beam  8.523E+02  5.076E+04 -2.051E-05  3.426E+02

Structural Properties ...
 Prop                                                 Dynamic      Plastic
 Num.      Area          E              I             Density       Moment
 ----  ------------  ------------  ------------  ------------  ------------
  3    3.04800E-01   2.75800E+10   2.36000E-03   0.00000E+00    Not Set
  2    3.78700E-03   1.64000E+11   1.72300E-05   0.00000E+00    Not Set
 Prop.  Cable Bond    Cable Bond      Yield       Compressive    Support
 Num.   Stiffness     Strength       Strength        Yield       Stiffness
 ----  ------------  ------------  ------------  ------------  ------------
  3    0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00
  2    0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00   0.00000E+00

set log off
 log-file recording stopped 11-Aug-95  14:24
```

ATTACHMENT III
STEEL SET MEMBER AND COMPONENT DESIGN

PURPOSE III. A STEEL SET CALCULATION

NOTE: REFER TO ATTACHMENT IX, PAGE IX-3 & IX-5 FOR STEEL SET SKETCHES.

CRITICAL STRESS COMBINATIONS

{LOOK @ WORST COMBINATIONS OF HIGH AXIAL COMPRESSION & HIGH MOMENTS. NOTE: AXIAL COMPRESSION GIVES GREATEST CONTRIBUTION TO INTERACTION EQUATIONS OF AISC CHAPTER H}

FILE: P10K2dy = WITH SEISMIC LOAD STEEL SETS @ 2'-0

W8x31

F-axial N	MOMENT N-M.	ELEM. NO.
1,324,000	15,050	36
1,282,000	16,320	29
1,349,000	12,430	12
KIPS $(*2.2481\times10^{-4})$	Ft-K $(.73756\times10^{-3})$	
297.65	11.10	
288.21	12.04	
303.27	9.17	

a) MULTIPLY FORCE IN (N) by $2.2481*10^{-4}$ TO obtain FORCE IN KIPS.

b) MULTIPLY MOMENTS IN (N-M) by $0.73756*10^{-3}$ TO OBTAIN MOMENTS IN FT-K.

THE STEEL SETS IN THIS RUN ARE AT 2'-0 c/c * .3048$^{m/ft}$ = .61 M.

MULTIPLY STRESSES IN PREVIOUS TABLES - given for one METER! by .61 TO OBTAIN STRESSES PER ONE STEEL SET

F-axial K/STEEL SET	MOMENT FT-K/STEEL SET	CASE
181.57	6.77	1
175.81	7.34	2
185.00	5.60	3

CHECK INTERACTION COEFFICIENT FOR EACH OF THE ABOVE.

UNBRACED LENGTH — ALLOWABLE STRESS

L_x = DISTANCE BETW BLOCKING (SUPPORT) = 4 ELEMENTS ≅ 75" < L_Y — NOT GOVERN.

$L_Y = \pi\left(12.42' - \frac{45"}{12}\right)\left(\frac{35°}{360°}\right)(2) = 7.36' = 88.29"$ --- TIE ROD SPACING

Length used is a conservative assurance against buckling. W-shape used when fully loaded is braced by contact with the tunnel wall. (BABEAB000-01717-2100-41101, A Rev.03

$F_a = \underline{18.89 \text{ KSI}}$ — (AISC 3-16, TABLE C-36)

$$\frac{KL_y}{r_y} = \frac{1.0 \times 88.29}{2.02} = 43.71$$

$L_c = 8.4'$ --- AISC PAGE 2-12, $L_y = 7.36' < L_c \Rightarrow F_{bx} = 0.66 F_y = 24^{KSI}$

$F_b = 24.0$ KSI

@ ELEM 36 & 29, $KL_b/r_b = \frac{(1.0)(18.66)(12)}{3.47} = 64.5 \Rightarrow F_e' = 35.9$

@ ELEM 12, $KL_b/r_b = \frac{(1.0)(17.54)(12)}{3.47} = 60.7 \Rightarrow F_e' = 40.54$

$F_e' = 35.9$ --- AISC PAGE 5-122, TABLE 8

Case 3 AISC 5-54 H1-1.

$$f_a = \frac{185}{9.13} = \underline{20.26}^{\text{KSI}}$$

$$f_b = \frac{5.60 \times 12}{27.5} = 2.44$$

$$\frac{20.26}{18.89} + \frac{2.44}{\left(1 - \frac{20.26}{40.54}\right) \times 24} =$$

$$1.073 + .203 = 1.276 < 1.33 \quad \text{OK}$$

CASE 2

$f_a = \frac{175.81}{9.13} = \underline{19.26}^{\text{ksi}}$

$f_b = \frac{7.34 \times 12}{27.5} = \underline{3.2}^{\text{ksi}}$

$\frac{19.26}{18.89} + \frac{3.2}{\left(1 - \frac{19.26}{35.9}\right) \times 24.0}$

$1.02 + .288 = \underline{1.31 < 1.33}$ OK

CASE 1

$f_a = \frac{181.57}{9.13} = \underline{19.89}^{\text{ksi}}$

$f_b = \frac{6.77 \times 12}{27.5} = \underline{2.95}^{\text{ksi}}$

$\frac{19.89}{16.89} + \frac{2.95}{\left[1 - \left(\frac{19.89}{35.9}\right)\right] \times 24.0} = 1.053 + 0.276 = \underline{1.328}$

$\underline{\leq 1.33}$

FILE: P34K2dy. W8x31 @ 4'-0
W/SEISMIC.

CASE	Faxial (N)	M (N-M)	ELEM. NO
1	603,100	10,110	11
2	869,000	1,849	33

4' SPACING x 0.3048 m/ft = 1.22

	Faxial (K)	M (Ft-K)
1	135.58 * 1.22 = 165.41	7.46 * 1.22 = 9.10
2	195.36 * 1.22 = 238.34	1.36 * 1.22 = 1.66

$$C = \frac{fa}{Fa} + \frac{fb}{(1-\frac{fa}{F'e})Fb}$$

↳*

	fa	fb	C
1	18.117	3.971	.96 + .242 = 1.202
2	26.11	.724	1.382 + .053 = 1.433

1.4 > 1.33 W8x31 NOT GOOD
@ 4'-0 IN THIS AREA

RERUN FOR 2'-0 c/c.

* @ ELEM 11 : $K\ell_b/r_b = \frac{(1.0)(12.91)(12)}{3.47} = 44.6$, $F'_e = 75.09$

@ ELEM 33 : $K\ell_b/r_b = \frac{(1.0)(13.23)(12)}{3.47} = 45.8$, $F'_e = 71.20$

NEW FILE : p34k2dyx

W 8x31 @2'-0
W/ SEISMIC.

CASE	Faxial (N)	M (N-M)	ELEM. No
1	1,446,000	4,630	32
2	1,125,000	7,202	30
3	1,137,000	12,270	11

	Faxial (K)	M (Ft-K)
1	325.08 *.61 = 198.30	3.415 *.61 = 2.083
2	252.91 *.61 = 154.28	5.312 *.61 = 3.24
3	255.61 * .61 = 155.92	9.050 * .61 = 5.52

	f_a	f_b	$C = \frac{f_a}{F_a} + \frac{f_b}{\left(1-\frac{f_a}{\underset{*}{F'_e}}\right)F_b}$
1	21.72	0.909	1.150 +.06 = 1.210 < 1.33
2	16.90	1.414	0.89 +.086 = .980 < 1.33
3	17.08	2.409	0.904 + 0.144 = 1.048 < 1.33

W8 x 31 - OK FOR 2'-0 c/c

* ELEM 32 & 30 kl_b/r_b = 45.8 , F'_e = 71.2
ELEM 11 , F'_e = 75.1

FILE : P07K2dy. W8×31 @ 4'-0
W/ SEISMIC.

	Faxial (N)	M (N-M)	ELEM. No
1	341,600	1,277	33
2	344,900	949	9
3	280,000	1,669	6
4	282,500	6,124	11

	Faxial (K)	M (Ft-K)
1	76.80 * 1.22 = 93.70	.942 * 1.22 = 1.15
2	77.54 * 1.22 = 94.60	.700 * 1.22 = .854
3	62.95 * 1.22 = 76.80	1.231 * 1.22 = 1.50
4	63.51 * 1.22 = 77.48	4.517 * 1.22 = 5.51

	fa	fb	C
1	10.26	0.50	.543 + .028 = .571
2	10.36	0.37	.548 + .018 = .566
3	8.41	0.65	.445 + .032 = .477
4	8.49	2.40	0.449 + 0.122 = 0.571

all < 1.33

F_e' ; @ ELEM 33 $kl_b/r_b = \frac{13.30 \times 12}{3.47} = 46.0$, $F_e' = 70.6$

@ ELEM 6, 9 & 11 $kl_b/r_b = \frac{8.96 \times 12}{3.47} = 30.3$, $F_e' = 162.8$

FILE: P18K2dy – SEISMIC W8x31 @ 4'-0

CASE	Faxial (N)	M (N-M)	ELEM. No
1	557,700	3,650	36
2	776,100	2,113	33
3	587,500	9,528	11
4	706,000	3,308	10

@ ELEM. 36 & 33 : $K\ell_b/r_b = \frac{(1.0)(10.12)(12)}{3.47} = 35.0$, $F_e' = 121.9$

ELEM 11 & 10 : $K\ell_b/r_b = \frac{(1.0)(6.07)(12)}{3.47} = 21.0$, $F_e' = 338.6$

	Faxial (K)	M (Ft-K)
1	125.38 x 1.22 = 152.96	2.69 x 1.22 = 3.28
2	174.48 x " = 212.86	1.56 " = 1.90
3	132.08 x " = 161.14	7.03 " = 8.58
4	158.72 x " = 193.64	2.44 " = 2.98

CASE 2 $\quad f_a = \frac{212.86}{9.13} = 23.31$; $f_b = \frac{1.9 \times 12}{27.5} = .83$

$$\frac{23.31}{18.89} + \frac{.83}{\left(1 - \frac{23.31}{121.9}\right) 21.6} = 1.23 + .048$$

$$= \underline{1.278 < 1.33}$$

CASE 3 $\quad f_a = \frac{161.13}{9.13} = 17.65$; $f_b = \frac{8.58 \times 12}{27.5} = 3.74$

$$\frac{17.65}{18.89} + \frac{3.74}{\left(1 - \frac{17.65}{338.6}\right) 21.6} = .934 + .183$$

$$= \underline{1.117 < 1.33}$$

OTHER CASES ARE LESS CRITICAL

BY INSPECTION -

FILE m34k250x. W8x31 @ 2'
NO SEISMIC.

CASE	Faxial (N)	M (N-M)	ELEM. NO
1	1,163,000	3,805	32
2	897,800	10,770	11
3	1,048,000	6,292	10

	Faxial (K)	M (Ft-K)
1.	261.45 * .61 = 159.48	2.81 * .61 = 1.72
2.	201.83 * .61 = 123.12	7.94 * .61 = 4.84
3.	235.60 * .61 = 143.7	4.64 * .61 = 2.83

F_e' : @ ELEM 32, L = 13.27 Kl_b/r_b = 45.9, F_e' = 70.9
@ ELEM 10, 11 L = 9.86 Kl_b/r_b = 34.1, F_e' = 128.5

	fa	fb	C
1	17.47	.75	.925 + .046 = .971 < 1
3	13.49	2.11	.714 + .109 = .823 < 1
4	15.74	1.235	.833 + .065 = .898 < 1

OK

FILE M10 K 250 W. W8×31 @ 2'-0

NO SEISMIC

CASE	Faxial (N)	M (N-M).	ELEM No
1	922,000	12,840	29
2	868,100	18,060	11

	Faxial (K)	M (Ft-K).
1	207.27 * .61 = 126.43	9.47 * .61 = 5.78
2	195.16 * .61 = 119.05	13.32 * .61 = 8.13

	fa	fb	C
1	13.85	2.52	0.733 + 0.176 = .909
2	13.04	3.55	0.690 + 0.221 = .911

all < 1.00 OK.

F_e' : @ ELEM 29, $Kl_b/r_b = \frac{(1.0)(17.48)(12)}{3.47} = 60.4$, $F_e' = 40.94$

@ ELEM 11, $Kl_b/r_b = \frac{(1.0)(15.70)(12)}{3.47} = 54.3$, $F_e' = 50.66$

FILE: M 18 K 250 W8x31 4'-0 c/c NO SEISMIC

CASE	F axial (N)	M (N-M)	ELEM No
1	522,500	3,371	10
2	416,600	8,389	11
3	583,300	1,492	8

CASE	F (K)	M (Ft-K)
1	117.46 * 1.22 = 143.3	2.49 * 1.22 = 3.04
2	93.66 * 1.22 = 114.3	6.19 * 1.22 = 7.55
3	131.13 * 1.22 = 160.0	1.10 * 1.22 = 1.34

CASE	$f_a = \frac{F}{A}$	$f_b = \frac{M}{S}$	$C = \frac{f_a}{F_a} + \frac{f_b}{\left(1 - \frac{f_a}{F'_e}\right)F_b}$
$Kl/r = 8.74 \times 12 / 3.47 = 30.2$, $F'_e = 163.8$			
1	15.696	1.33	.831 + .068 = .899
2	12.515	3.29	.662 + .165 = .827
3	17.525	.59	.928 + .031 = .959

< 1. O.K.

FILE M07K250W W8x31 @ 4'-0

NO SEISMIC

	Faxial (N)	M (N-M)	ELEM. No
1	212,500	720	33
2	163,800	5,419	11
3	196,500	3,808	10

	Faxial (K)	M (Ft-K)
1	47.77 * 1.22 = 58.28	.53 * 1.22 = .65
2	36.82 * 1.22 = 44.92	4.00 * 1.22 = 4.88
3	44.18 * 1.22 = 53.90	2.81 * 1.22 = 3.43

	fa	fb	C
1	6.38	.28	.338 + .014 = .352
2	4.92	2.13	.260 + .100 = .360
3	5.90	1.50	.312 + .071 = .383

F_e' ; @ ELEM 33, $Kl/r = \frac{13.37(12)}{3.47} = 46.3$, $F_e' = 69.7$ ALL < 1.0

@ ELEM 10 & 11, $\frac{Kl}{r} = \frac{6.62(12)}{3.47} = 21.6$, $F_e' = 320.6$

FILE M18_K2dy W6×20 @ 4'-0

W/SEISMIC

CASE	Faxial (N)	M (N-M)	ELEM. No
1	170,500	4,049	12
2	153,400	5,926	11
3	271,500	724	9

	Faxial (K)	M (FT-K)
1	38.33 * 1.22 = 46.76	2.99 * 1.22 = 3.65
2	34.49 * 1.22 = 42.08	4.37 * 1.22 = 5.33
3	61.04 * 1.22 = 74.47	.534 × 1.22 = .652

<u>W6×20</u> $A = 5.87\,in^2$ $S = 13.4\,in^3$ $\frac{Kl_y}{r_y} = \frac{88.29}{1.46} = 58.9$

$F_a = 17.54$, $\frac{Kl_b}{r_b} = \frac{7.54 \times 12}{2.66} = 34.0$, $F'_e = 129.18$ $L_c : 6.4'$

	fa	fb	C
1	7.96	3.27	.454 + .161 = .615
2	7.17	4.77	.409 + .234 = .643
3	12.69	.584	.723 + .044 = .767

ALL < 1.33 OK.

FILE : M 07- K2 dy W6×20 @ 4-0

W/SEISMIC

CASE	Faxial (N)	M (N-M)	ELEM No
1	121,300	197	33
2	95,300	5,490	11
3	118,900	427	8

	Faxial (K)	M (Ft-K)
1	27.27 × 1.22 = 33.27	.15 × 1.22 = .183
2	21.42 × 1.22 = 26.13	4.05 × 1.22 = 4.94
3	26.73 × 1.22 = 32.61	.32 × 1.22 = .39

	fa	fb	C
1	5.67	.164	.323 + .009 = .332
2	4.45	4.42	.254 + .212 = .466
3	5.56	.135	.317 + .017 = .334

ALL < 1.0 --- O.K.

F_e' : @ ELEM 33 $Kl_b/r_b = \frac{12.68(12)}{2.66} = 57.2$, $F_e' = 45.6$

@ ELEM 11 $Kl_b/r_b = \frac{7.36(12)}{2.66} = 33.2$, $F_e' = 135.5$

@ ELEM 8 $Kl_b/r_b = \frac{7.33 \times 12}{2.66} = 33.0$, $F_e' = 137.13$

FILE M27_ K2dy W6×20 @ 4'-0

W/ SEISMIC.

Case	Faxial (N)	M (N·M)	ELEM. No
1	202,400	888	35
2	270,500	436	33
3	268,100	613	8

	Faxial (K)	M (Ft-K)
1	45.50 * 1.22 = 55.51	.655 * 1.22 = .80
2	60.81 * 1.22 = 74.19	.336 * 1.22 = .41
3	60.27 * 1.22 = 73.53	.452 * 1.22 = .55

	fa	fb	C
1	9.46	.716	.539 + .043 = .582
2	12.64	.367	.721 + .021 = .745
3	12.53	.493	.714 + .025 = $\underline{.739}$

ALL < 1.33 --- O.K.

F_e' : @ ELEM 33 & 35 , $Kl_b/r_b = \frac{13.07 \times (12)}{2.66} = 59.0$, $F_e' = 42.9$

@ ELEM 8 , $Kl_b/r_b = \frac{7.61 \times 12}{2.66} = 34.3$, $F_e' = 127.0$

FILE M34-C2K2d. W6x20 @ 4'-0
WITH SEISMIC.

CASE	FAXIAL (N)	M (N-M)	ELEM.
1	303,000	2,308	36
2	388,900	782	33
3	320, 800	3228	12

	FAXIAL (K)	M (FT-K)
1	68.12 * 1.22 = 83.11	1.70 * 1.22 = 2.074
2	87.43 * 1.22 = 106.66	0.58 * 1.22 = 0.708
3.	72.13 * 1.22 = 88.00	2.38 * 1.22 = 2.904

	f_a	f_b	C
1	14.16	1.86	0.807 + 0.128 = 0.94
2	18.17	0.63	1.036 + 0.051 = $\underline{\underline{1.087}}$
3	15.00	2.60	0.855 + 0.123 = 0.978

ALL ARE < 1.33 ∴ OK

FROM PAGE III-17 (SIMILAR)

@ NODES 33 & 36 : $F_e' = 42.9$ @ $l_x = 13.1'$

@ NODE 12 ; $F_e' = 127.0$ @ $l_x = 7.54'$

FILE: M53_K2dy W6 x 20 @ 4'-0
W/ SEISMIC

CASE	Faxial (N)	M (N-M)	ELEM. NO
1	202,400	5,463	11
2	245,200	3,614	10
3	271,200	552	9

	Faxial (K)	M (Ft-K)
1	45.50 × 1.22 = 55.51	4.03 × 1.22 = 4.92
2	55.12 × 1.22 = 67.25	2.67 × 1.22 = 3.26
3	60.97 × 1.22 = 74.38	.407 × 1.22 = .497

	fa	fb	C
1	9.46	4.41	0.593 + 0.217 = 0.756
2	11.46	2.92	0.653 + 0.146 = 0.800
3	12.67	.445	0.722 + 0.022 = 0.744

ALL < 1.33 --- O.K.

F_e' : @ ELEM. 9, 10 & 11 $kl_b/r_b = \frac{6.89(12)}{2.66} = 31.1$, $F_e' = 154.4$

FILE M18_K2. W6×20 @ 4'-0

NO SEISMIC

	Faxial (N)	M (N-M)	ELEM. No
1	153,500	3,602	10
2	198,800	782	9

	Faxial (K)	M (Ft-K)
1	34.51 * 1.22 = 42.10	2.66 * 1.22 = 3.25
2	44.69 * 1.22 = 54.52	.58 * 1.22 = .71

	fa	fb	C
1	7.17	2.91	.409 + .143 = .552
2	9.29	.64	.530 + .032 = .562

ALL < 1.0 --- O.K.

$F_e' : Kl_b/r_b = \frac{(7.52)(12)}{2.66} = 34$, $F_e' = 129.2$

FILE m07_K2. W6x20 @ 4'-0

NO SEISMIC

CASE	Faxial (N)	M (N-M)	ELEM. No
1	49,250	5,390	12
2	63,010	3,575	10
3	67,980	783	9

	Faxial (K)	M (Ft-K)
1	11.07 * 1.22 = 13.51	3.98 * 1.22 = 4.86
2	14.17 * 1.22 = 17.29	2.64 * 1.22 = 3.22
3	15.28 * 1.22 = 18.64	.578 * 1.22 = .705

	fa	fb	C
1	2.30	4.35	.131 + .205 = .336
2	2.95	2.88	.168 + .136 = .304
3	3.18	.63	.181 + .030 = .211

F'_e : $K l_b / r_b = \frac{7.5 \times 12}{2.66} = 34$, $F'_e = 129.2$

ALL < 1.0 ---- O.K.

FILE M27-K2 W6x20 @ 4'-0

NO SEISMIC

CASE	Faxial (N)	M (N-M)	ELEM NO
1	215,000	404	33
2	159,300	4,962	12
3	158,200	5,396	11
4	188,100	3,688	10

	Faxial (K)	M (Ft-K)
1	48.33 * 1.22 = 58.96	0.30 * 1.22 = .366
2	35.81 * 1.22 = 43.69	3.66 * 1.22 = 4.46
3	35.56 * 1.22 = 43.38	3.98 * 1.22 = 4.86
4	42.29 * 1.22 = 51.59	2.72 * 1.22 = 3.32

F_e' : @ ELEM 33, $kl_b/r_b = 13.20 \times 12/2.66 = 60$. $F_e' = 41.5$

@ ELEM 10,12, $kl_b/r_b = 32$, $F_e' = 145.8$

	fa	fb	C
1	10.04	.328	.572 + .020 = .592 < 1 OK
2	7.44	3.99	.424 + .195 = .619 < 1
3	7.39	4.35	.421 + .212 = .633 < 1
4	8.79	2.97	.501 + .146 = .647 < 1 OK

FILE M34-K2. W6x20 @ 4'-0
-NO SEISMIC.

CASE	Faxial (N)	M (N-M)	ELEM. No
1	181,300	4,672	12
2	170,900	5,453	11
3	201,000	3,632	10
4	226,100	533	9

	Faxial (K)	M (Ft-K)
1	40.76 * 1.22 = 49.74	3.45 * 1.22 = 4.21
2	38.42 * 1.22 = 46.87	4.02 * 1.22 = 4.90
3	45.19 * 1.22 = 55.13	2.68 * 1.22 = 3.27
4	50.83 * 1.22 = 62.01	.415 * 1.22 = 0.506

F_e': $Kl_b/r_b = 32$, $F_e' = 145.8$

	fa	f_b	C
1	8.47	3.77	.483 + .185 = .668 < 1
2	7.98	4.39	.455 + .215 = .670 < 1
3	9.39	2.93	.535 + .145 = .68 < 1
4	10.56	.453	.602 + .023 = .625 < 1

OK

FILE M53K2. W6x20 @ 4'-0
NO SEISMC

CASE	F axial (N)	M (N-M)	ELEM. No
1	163,300	4,888	12
2	160,800	5,458	11
3	196,500	3,627	10

	F axial (K)	M (Ft-K)
1	36.71 * 1.22 = 44.79	3.61 * 1.22 = 4.40
2	36.15 * 1.22 = 44.10	4.03 * 1.22 = 4.92
3	44.18 * 1.22 = 53.90	2.68 * 1.22 = 3.27

	fa	fb	C
1	7.63	3.94	.435 + 0.192 = .627
2	7.51	4.41	.428 + .215 = .643
3	9.18	2.93	.523 + .145 = .668

all < 1.0 OK

F'_e : $Kl_b/r_b = 32$, $F'_e = 145.8$

STEEL SET CALCULATION FOR
DETERMINING JACK SIZE

CHECK W8x31 FOR 30T JACK.

FROM COMPUTER OUTPUT FILE ; STLRV 2
LOAD COMBINATION 6 CORRESPONDS
TO 30T JACKING LOAD -
(SEE ATTACHMENT I, PAGE I-29 THRU I-34)

COMPUTER INTERACTION COEFF. FROM AISC
CODE CHECK = 0.892 @ MEMBERS 4, 41, 42 AND
= 0.893 @ MEMBER 3

MEMBER	P_{max}	M_{max}
3	55.08	33.42 GOVERNS
4	54.91	33.42
41	54.95	33.38
42	55.10	33.38

MEMBER 3 IS CRITICAL

$P = 55.08$ $M = 33.42$

$f_a = \frac{55.08}{9.13} = \underline{6.03}$ ksi $f_b = \frac{33.42 \times 12}{27.5} = \underline{14.58}$ ksi

UNBRACED LENGTHS

$L_y = 88.29'' = 35^{\circ}$ TIE ROD SPACING

$L_x \cong 3.5 * 18.79'' = 65.77''$

(FROM MOMENT DIAGRAM, PAGE I-43)
FOR LOADCOMB. № 7 - ASSUME SIMILAR FOR L.C. № 6

ALLOWABLE STRESSES

TABLE C-36 AISC P. 3-16.

$$\frac{K L_y}{r_y} = \frac{88.29}{2.02} = 43.71 \qquad F_a = \underline{18.89}^{KSI}$$

$$\frac{K l_x}{r_x} = \frac{65.77}{3.47} = 18.95 \qquad F'_{e_x} = 338.62$$

AISC 5-45 F1-2

$$L_c = \frac{76\ b_f}{\sqrt{F_y}} = \frac{76 \times 8}{6} = \underline{101.33''} \text{ GOVERNS}$$

$$L_c = \frac{20{,}000}{\frac{d}{A_f} F_y} = \frac{20{,}000}{2.3 \times 3.6} = \underline{241}$$

$$L_c = 101.33'' > 65.67'' = l_x$$

$\therefore$ FROM AISC 5-45 F1-1 $\rightarrow F_b = \underline{\underline{24}}^{KSI}$

$(= .66 F_y)$ -

DETERMINE INTERACTION COEFFICIENTS

AISC 5-54, H1

H1-1 $$\frac{6.03}{18.89} + \frac{14.58}{\underbrace{\left(1-\frac{6.03}{338.62}\right)}_{.982} 24}$$

$.319 + .619 = \underline{.938} < 1.$ but too close.

H1-2 DOES NOT GOVERN - BY INSPECTION

USE 25 TON JACK ± 2 TON

HAND CALCULATIONS FOR 27 TON JACK
ARE NOT REQUIRED SINCE
ALL COMPUTER INTERACTION
COEFFICIENTS ARE LOWER
SEE ATTACHMENT I -
SUMMARY OF COMPUTER ANALYSES
FOR JACKING LOADS -

STEEL SET CALCULATIONS FOR 25^T
JACKING WITHOUT FOOT SEGMENTS.

1) STZRV4C - MEMBER 3 GOVERNS
SEE ATTACHMENT I, PAGE I-163 THRU I-171

$F_{axial} = \underline{45.84^K}$ $M = \underline{27.95}^{\prime\prime K}$

$L_y = 88.29'' = 35^\circ$ TIE ROD SPACING

$L_x \cong 3.5 \times 18.79'' = 65.77''$

(FROM MOMENT DIAGRAM).
ATTACHMENT I, PAGE I-170

$$\frac{K l_y}{r_y} = \frac{88.29}{2.02} = 43.71 \longrightarrow F_a = \underline{18.89}^{ksi}$$

$$\frac{K l_x}{r_x} = \frac{65.77}{3.47} = 18.92 \longrightarrow F_e' = 338.62^{ksi}$$

$$F_b = 21.6$$

$$f_a = \frac{45.84}{9.13} = 5.02 \qquad f_b = \frac{27.95 \times 12}{27.5}$$

AISC 5-54 H1-1 $= 14.76$

$$\frac{5.02}{18.89} + \frac{12.20}{\left(1 - \frac{5.02}{338.62}\right) 21.6} = .266 + .573$$

$$= .839 < 1.0 \; \text{OK}$$

*25 TON JACKING BOTH ENDS @ 47°

2) STZRV3A2 MEMBERS 3 & 42 GOVERN
SEE ATTACHMENT I, PAGE I-108 THRU I-119

$M = \underline{25}^{1K}$.

$F_{axial} = 60.65^{K}$

$$f_a = \frac{57.94}{9.13} = \underline{6.64}\ \text{Ksi}$$

$$f_b = \frac{25 \times 12}{27.5} = \underline{10.91}\ \text{Ksi}$$

AISC 5-54 . H1-1.

$$\frac{6.64}{18.89} + \frac{10.01}{\left(1 - \frac{6.64}{251}\right) 21.6} = .352 + .473$$

$$= .825 < 1.0 \text{ --- O.K.}$$

W6X20 STEEL SET @ 1.8 m (6 ft) SPACING:

FLAC Runs for a W6x20 steel set at 1.83 meter (6 ft) spacing using Welded Wire Fabric (WWF) and no lagging for Support Class I and Rock Property Category 5 (Ref 5.20, Table 14) produced the following max. reaction forces per meter in the steel sets (values from Ref 5.20, Pages 283-286):

Load Case	Axial (N)	Moment (N-m)	Shear (N)	Axial[1] (kip)	Moment[2] (kip-ft)	Shear[1] (kip)
Static	7762	5585	24770	3.19	7.53	10.18
Dynamic	9670	5580	24560	3.97	7.53	10.09

Footnotes:

[1] N x 6 ft spacing/3.2808 ft/m x .0002248 kip/N = N x .000411 = Force (kip)

[2] N-m x 6 ft spacing /3.2808 ft/m x .0007376 k-ft/N-m = N-m x .001349 = Moment (k-ft)

By inspection, the maximum values from the above table will result in interaction values less than unity since the combined axial forces and moments are less than the combined axial forces and moments used from the worst case W6x20 static & seismic load calcs of Attachment III.A (Pages III-18 & 23) and the jacking loads of Attachment VIII (Page VIII-2). Therefore, the W6x20 at 6 ft spacing with WWF (no lagging) is adequate for the above rock load reaction forces from Ref 5.20.

PURPOSE III. B.

STEEL SET LAGGING CALCULATION.

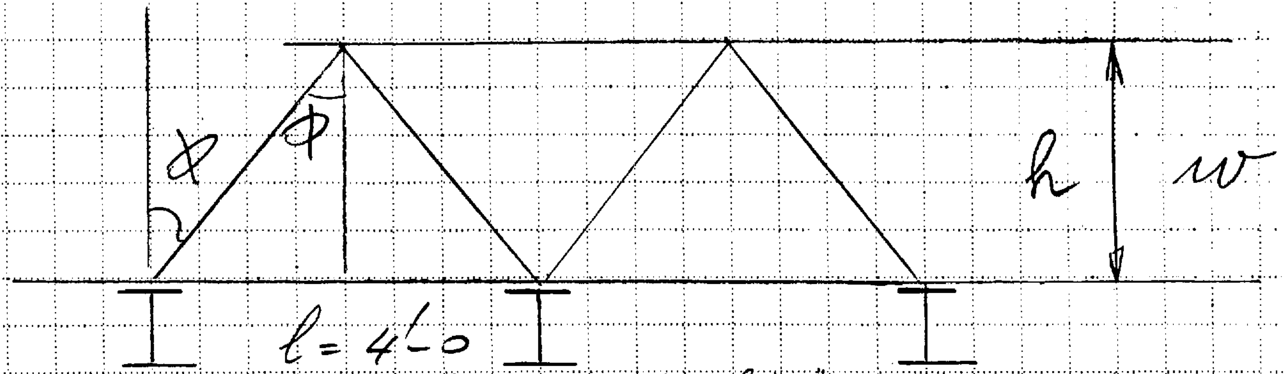
FROM: ESF GROUND SUPPORT DESIGN-ANALYSIS
BABEE0000-01717-0200-00002, REV.00 (REF. 5,20)

The following data are available

UNIT	MEAN DENSITY		MINIMUM-FRICTION ANGLE ϕ
	Kg/m^3	$\#/FT^3$	
TCw	2150	134	53°
PTn	1299	81	40°
TSw1	2162	135	41°
TSw2	2274	142	49°

THE MINIMUM FRICTION ANGLE IS USED because a larger angle will give a smaller value for w (SEE LOAD DIAGRAM NEXT PAGE)

BY INSPECTION TSw1 OR TSw2 WILL DETERMINE THE LARGER w



NOTE: l + CONSTRUCTION TOLERANCE = $l \pm 2'' = 4.33'$ MAX.
EFFECT OF TOLERANCE ON DESIGN IS FACTORED IN f_b

$$w = h * \text{DENSITY } (D)$$

$$\frac{2'}{h} = tg\,\phi$$

FOR $TS_{w}1$

$$\frac{2'}{h} = tg\,41^\circ = .8692867$$

$$h = \frac{2'}{.8692867} = 2.3'$$

$$w = 2.3' * D = 2.3' * 140 = \underline{\underline{322}}\ \#/'$$

($D = 135\ \#/\text{CU FT} \longrightarrow = 140\ \#/ft^3$ FOR BOUNDING.)

FOR TSw2

$$\frac{2'}{h} = tg\ 49^{0} = 1.15$$

$$h = \frac{2'}{1.15} = 1.74'$$

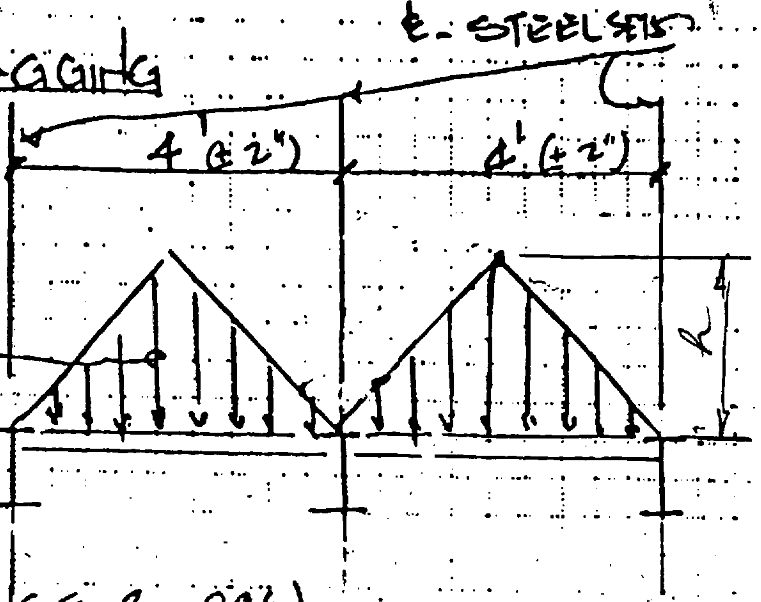
$$W = 1.74 * D = 1.74 * 145 = \underline{\underline{252^{\#/'}}}$$

$$\left(D = 142\ ^{\#}/FT^{3} - USE\ 145\ ^{\#}/ft^{3}\ FOR\ BOUNDING. \right)$$

$$W = \underline{\underline{322}}^{\#/'}\ GOVERNS -$$

CALCULATE MOMENT AND SHEAR IN LAGGING MEMBER with W=322

DESIGN STEEL LAGGING



ROCK LONG TERM LOADS FOR LAGGING w

$M_{max} = \frac{WL}{6} \rightarrow$ (AISC 2-296)

α = ROCK DENSITY

h = RAVELING ROCK HIEGHT

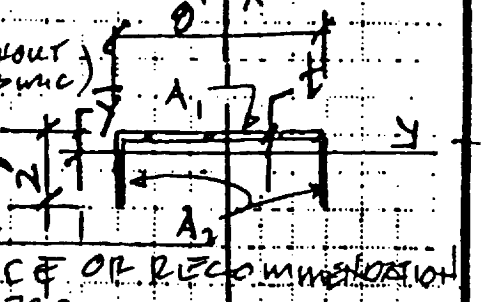
$w = h * D$; $w = 2.3' \times 140 = 322$ #/'

$W = \frac{322(4)}{2} = 644$

$M_{max} = \frac{644(4)}{6} = 429$ FT-lb

$V = R = \frac{W}{2} = \frac{644}{2} = 322$ lb (WITHOUT SEISMIC)

Try standard cold formed section with GAGE 7 METAL



GAGE 7 = t = 0.1793 IN (CONSTRUCTOR STANDARD PRACTICE OR RECOMMENDATION (6-2, AISC))

$A_1 = 0.1793(8)$ $\quad \bar{Y}_1 = \frac{0.1793}{2}$

$A_2 = 0.1793(*)(2)\underset{2-0.1793}{}$ $\quad \bar{Y}_2 = \frac{1}{2}(2-0.1793) + 0.1793 = 1.09$

$A_2 = 0.653$

$$\bar{y} = \frac{A_1\bar{y}_1 + A_2\bar{y}_2}{A_1 + A_2}$$

$$\bar{y} \cong \frac{0.1793(8)\left(\frac{0.1793}{2}\right) + 0.653 \times 1.09}{0.1793(8) + 0.653}$$

$$\bar{Y} = \frac{0.84}{2.087} = 0.403''$$

$$I_Y = \left[\frac{(0.1793)^3(8)}{12} + 0.1793(8)\left(0.403 - \frac{0.1793}{2}\right)^2\right] +$$

$$\left[\frac{(2-.1793)^3(0.1793)(2)}{12} + 0.1793(\overset{0.1793}{2})(2)(1.09)^2\right]$$

$$= 0.0038 + 0.141 + 0.18 + 0.7757$$

$$= 1.1 \text{ in}^4$$

$F_{by} = 21{,}600$ psi ALLOWABLE ---(F2-2 AISC) (Worse case: LAGGING WILL BE INSTALLED CONTINUOUS ON THE ENTIRE STEEL SET)

$f_{b_1} = \frac{Mc}{I_Y}$, $c = 2 - 0.403 = 1.6''$

429 FT-lb IS PER ONE FOOT. BENT ℞ IS 8" WIDE.

M_y = MOMENT IN ⊓ PLATE

$$= 429\left(\frac{8}{12}\right) = 286 \text{ FT-lb}$$

$$f_{b_1} = \frac{286(1.6)(12)}{1.1} \times \left(\frac{4.33}{4}\right) = 5404 \text{ psi} < 21{,}600 \text{ psi}$$

∴ GAGE 7 IS O.K.

TRY C 8 × 11.5 (ASTM A36)

$t_w = 0.22''$ $S_Y = 0.781 \text{ in}^3$ (AISC p1-40441)

$$f_{b_1} = \frac{M}{S_Y} = \frac{286 \times 12}{0.781} \times \left(\frac{4.33}{4}\right) = 4{,}757 \text{ psi}$$

$f_{b_1} < 21{,}600$ psi

CHECK CONNECTION DETAIL $\frac{B}{IX-12}$, ATTACHMENT IX, Option-1, p.IX-12

a. CHECK CARRIAGE BOLT ~

T = MAX. BOLT TENSION

$= 322^{lb}$ --- D.L.

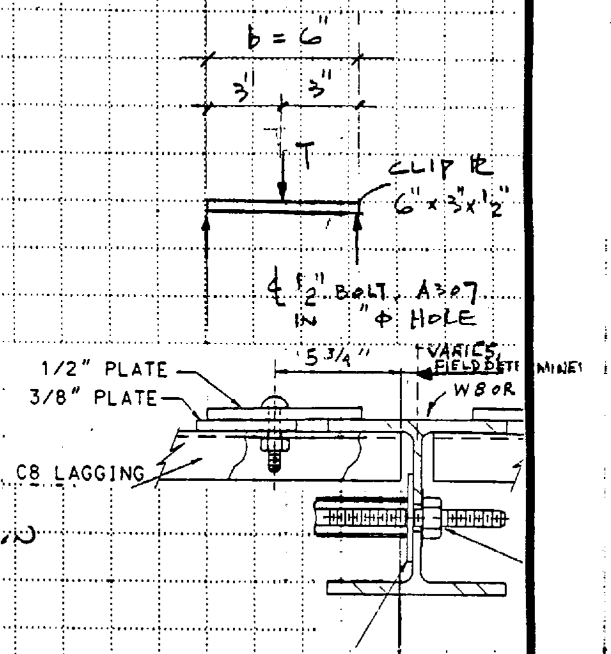
T_a = ALLOWABLE BOLT TENSION

= 20 (0.142 in² TENSILE STRESS AREA)

$= 2.8^k$ ---- AISC 5-73 & 4-147

$\gg T = 0.322^k$ --- O.K.

USE 1/2" Φ A307 BOLT MINIMUM.



b. CHECK CLIP PLATE ~

TRY PLATE SIZE 6" x 3" x t

S_x = SECTION MODULUS AT CRITICAL SECTION

$= (3" - 9/16 \Phi \text{ HOLE}) \times (t)^2/6 = 0.406 t^2$

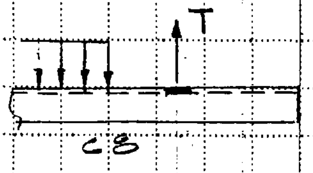
M = MAX. MOMENT

$= T \times 6/4 = 0.322 \times 6/4 = 0.483^{"k}$

$S_x = \frac{M}{F_b}$, $F_b = 0.75 F_y = 27^{ksi}$ - - AISC F2-1

$0.406 t^2 = \frac{0.483}{27}$

t = 0.211" USE 1/2"



c. CHECK C8 WEB ~

NUT PERIMETER ≅ 4 x (3/4) = 3"

ν = SHEAR IN C8 WEB = $\frac{0.322^k}{3" \times 0.22} = 0.488^{ksi}$

ν_a = ALLOWABLE SHEAR = $0.4 F_y$ ---- AISC 5-49

$= 14.4^{ksi} \gg 0.488^{ksi}$ --- O.K.

USE 6"x3"x1/2 CLIP PL 1/2" Φ CARRIGE BOLT, A307 AND ASME B 18.5

3/8" FILLER PL (COMPATIBLE WITH W8x31 FLG) AS SHOWN IN DETAL $\frac{B}{IX-12}$

CHECK (INCLUDE SEISMIC)

$S_V = 0.37W$ (TBV-193) — (REF. 5.16, APPENDIX A.5)

$S_V = 0.37(644) = 238$ lb

$M = \frac{(644 + 238)4}{6} = 588$ FT-lb/PER FT., $S_y = 0.781$ IN^2 (AISC 1-41)

M_c = BENDING MOMENT IN C8

$M_c = 588 \left(\frac{8''}{12''}\right) = 392$ FT-lb

$\therefore f_b = \frac{392(12)}{0.781} \times \left(\frac{4.33}{4}\right) = 6{,}522$ psi $= 6.52$ ksi $< 27.0^{\text{ksi}} \times 1.33$

USE C8 × 11.5 FOR LAGGING

AND FILLER PLATE 3/8" × 4" × 4"

USE 9/16" SQUARE HOLES IN 1/2" AND 3/8" PLATES W/SLOTTED HOLE IN C8 - FOR TOLERANCE ADJUSTMENT

T_2 = BOLT TENSION WITH SEISMIC (PAGE III-35)

$T_2 = 322(1.37)\left(\frac{8}{12}\right) \times \left(\frac{4.33}{4}\right) = 318^{\text{lb}} = 0.318^{\text{k}} < T_a = 2.8^{\text{k}} \times 1.33$

f_{b_2} = BENDING STRESS WITH 1/2" PLATE & W = 3"

$S = \frac{(3 - 9/16)t^2}{6} = \frac{2.44(0.5)^2}{6} = 0.102$ IN^3

$f_{b_2} = \frac{318^{\text{lb}} \times 3''}{0.102} = 9352.9^{\text{PSI}} = 9.35^{\text{ksi}} < 27.0^{\text{ksi}} \times 1.33$

1/2" DIA BOLT AND 1/2" PLATE IS OK

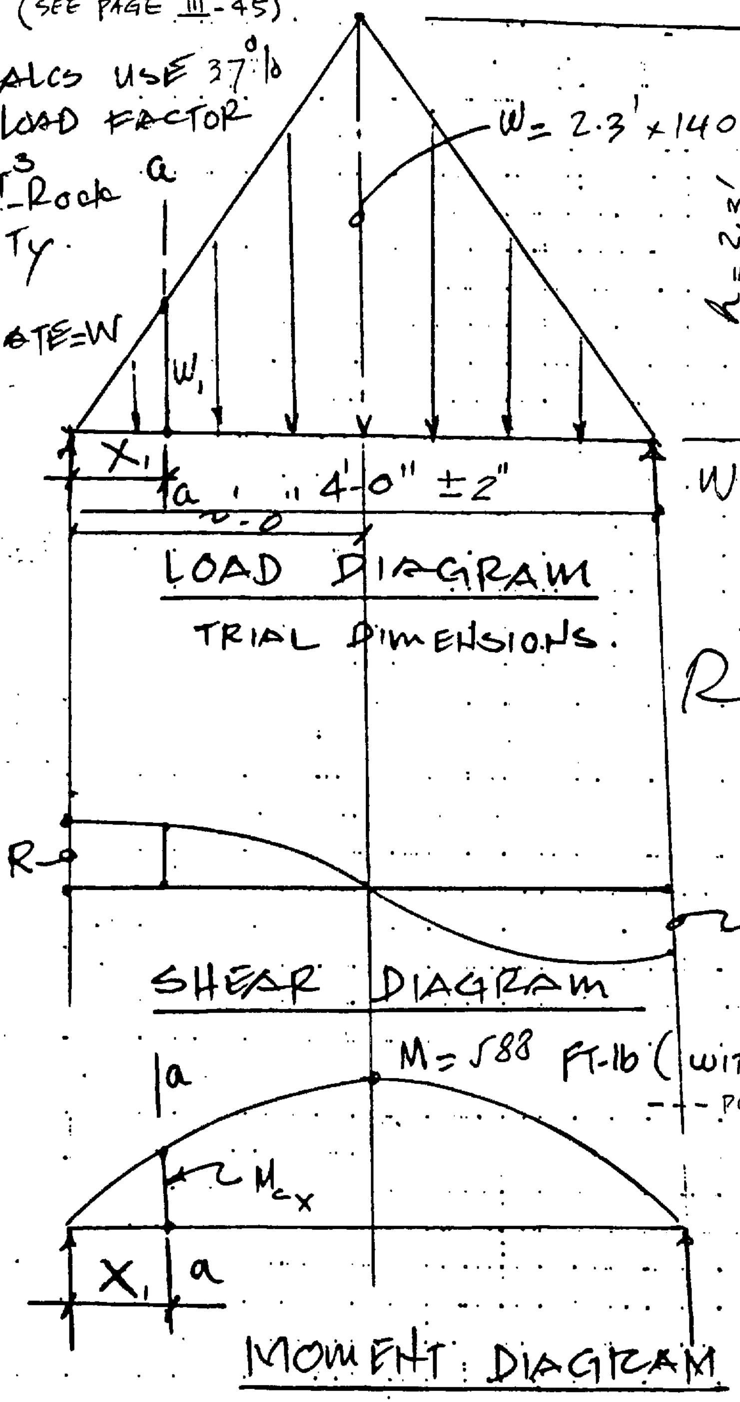
Option-2 (p.III 44) is Constructor's option and subject to A/E review. For Option-3 see Attachment IX, p.IX 12 & p.III-45

CALCS. FOR OPTION-3 (LAGGING CONNECTION TO STEEL SET)
(SEE PAGE III-45)

FOR THIS CALCS USE 37% SEISMIC LOAD FACTOR

$\alpha = 140\ \text{lb/FT}^3$ Rock DENSITY

LOAD ORDINATE=W



$140 \times 1.37 = 191.8$

$W = 2.3' \times 140 \times 1.37 = 2.3 \times 168$
$= 441\ \text{lb/FT.}$
WITH SEISMIC

$W = \frac{441 \times 4'}{2}$
$= 882\ \text{lb/FT}$

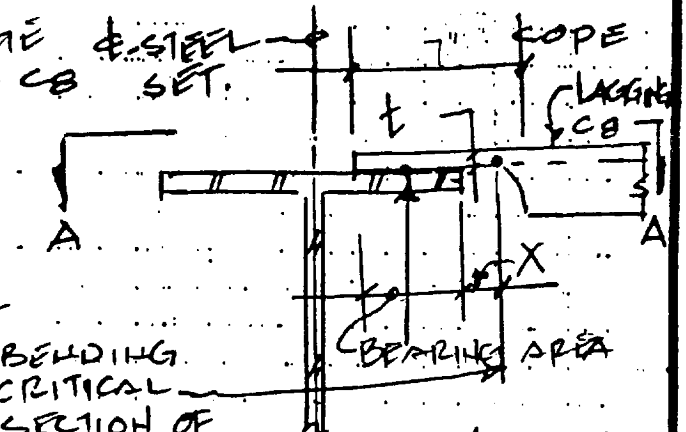
$R = \frac{882}{2} = 441\ \text{lb/FT}$

R = 441 lb/FT
(WITH SEISMIC)

M = 588 FT-lb (WITH SEISMIC)
-- PG III-36

$t_w = .22''$ (AISC 1-40)

X = DISTANCE FROM EDGE OF BEARING AREA OF C8 TO BENDING MOMENT CRITICAL SECTION OF THE COPE (a-a).



ELEVATION
TRIAL DIMENSIONS

M_{cx} = BENDING MOMENT ON C8 AT CRITICAL SECTION.

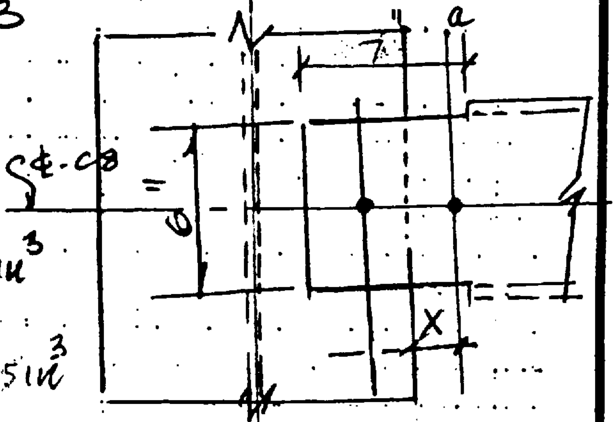
S_6 = SECTION MODULUS AT CRITICAL SECTION FOR COPE AT THE WEB (ALTERNATE 1)

S_8 = SECTION MODULUS AT CRITICAL SECTION FOR COPE AT FLANGES (ALTERNATE 2)

CONSIDER CRITICAL CASE BY LETTING BOLT HOLE AT CRITICAL SECTION.

$$S_6 = \frac{(6-\frac{3}{4})(t)^2}{6} = \frac{5.25 \times (0.22)^2}{6} = 0.0424 \text{ in}^3$$

$$S_8 = \frac{(8-\frac{3}{4}) \times (t)^2}{6} = \frac{7.25 \times (0.22)^2}{6} = 0.0585 \text{ in}^3$$

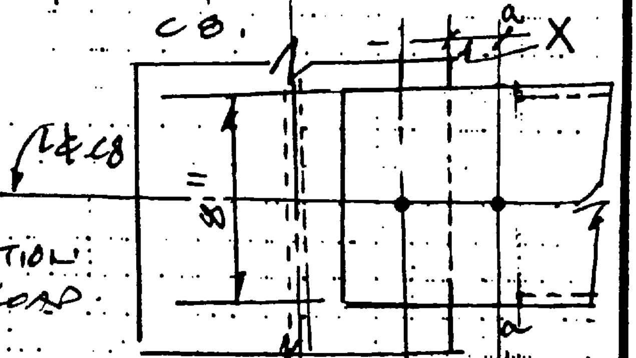


SECTION A (ALTERNATE
COPE AT THE WEB OF C8.

CHECK BENDING STRESS AT CRITICAL SECTION FOR THE FOLLOWING VALUE OF X

X = 3" , X = 3½" , X = 4"

AND X = 7" − ¾" = 6.25"
MIN BEARING LENGTH.



SECTION A (ALTERNATE-2
COPE AT THE FLANGES OF C8

w_1 = LOAD AT CRITICAL SECTION OF THE COPE. SEISMIC LOAD.

IF X = 3" = 0.25'

$$w_1 = \frac{2.3(191.8)}{2}(0.25) = 55 \text{ lb/FT}$$

IF $X = 3\frac{1}{2}'' = 0.29'$

$$w_1 = \frac{2.3(191.8)}{2}(0.29) = 64 \text{ lb}$$

IF $X = 4'' = 0.33'$

$$w_1 = \frac{2.3(191.8)}{2}(0.33) = 72.8 \text{ lb}$$

IF $X = 6\frac{1}{4}'' = 0.521'$

$$w_1 = \frac{2.3(191.8)}{2}(0.521) = 114.88 \text{ lb}$$

$$\Sigma M_{a\text{-}a} = 0$$

$$M_{c_3} = \left[441(3) - \frac{55(3)}{2}\left(\frac{3}{3}\right)\right]\frac{8}{12}$$

$$= 827 \text{ in-lb}$$

$$M_{c_{3\frac{1}{2}}} = \left[441(3.5) - \frac{64}{2}(3.5)\left(\frac{3.5}{3}\right)\right]\frac{8}{12}$$

$$= 942.0 \text{ in-lb}$$

$$M_{c_4} = \left[441(4) - \frac{72.8}{2}(4)\left(\frac{4}{3}\right)\right]\frac{8}{12}$$

$$= 1046.6 \text{ in-lb}$$

$$M_{c_{4\frac{1}{2}}} = \left[441 \times (6.25) - \frac{114.88}{2}\underbrace{(6.25)\left(\frac{6.25}{3}\right)}_{747.92}\right]\frac{8}{12}$$

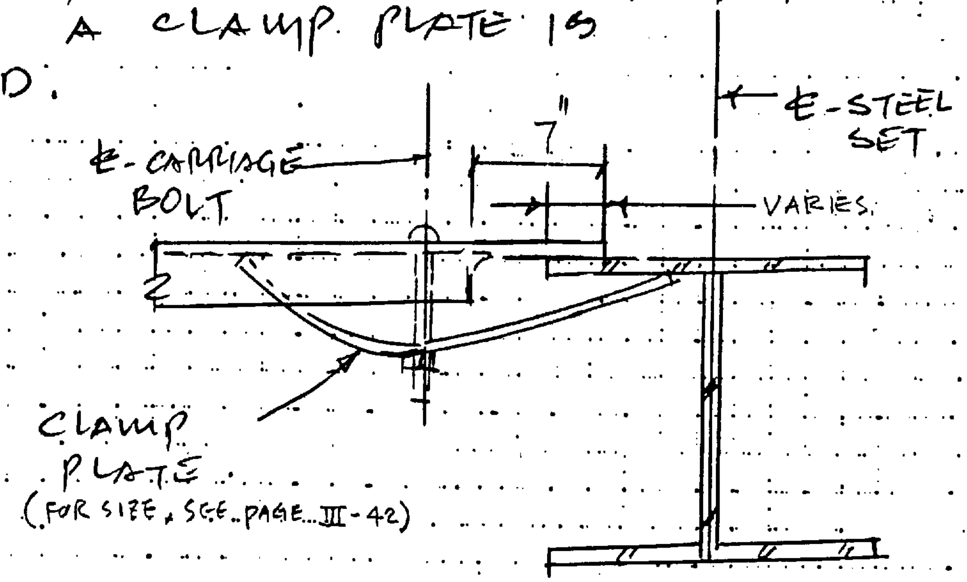
$$= 2008.3 \text{ in-lb}$$

CALCULATE BENDING STRESS AT CRITICAL SECTION & USE 0.75 Fy FOR ALLOWABLE STRESS AISC (F2-1)

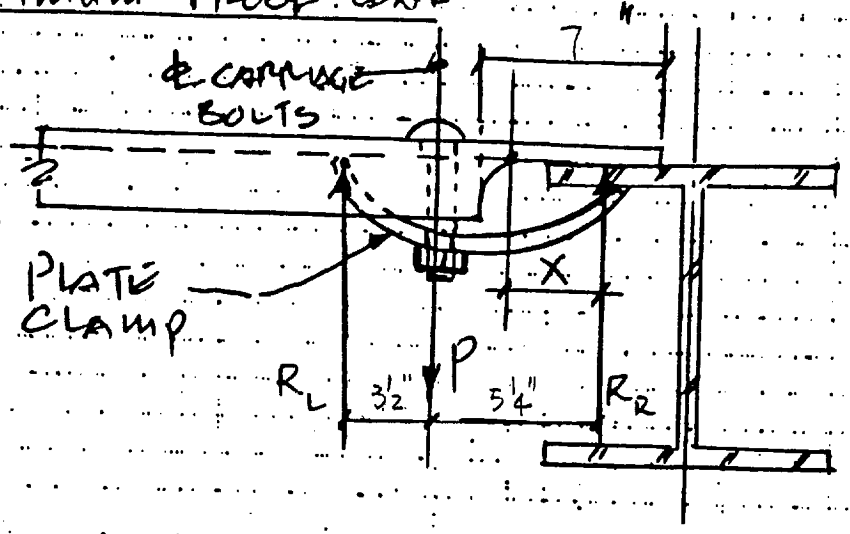
C8×11.5		BENDING STRESS @ CRITICAL SECTION $\frac{M}{S}$	
X	M_{cx}	SECTION 6"-COPE AT WEB S_o = 0.0424 in^3	SECTION 8" COPE AT FLANGES S_o = 0.0585 in^3
3"	827 in-lb	19.5 ksi < 1.33×0.75 Fy = 35.9 ksi	14.14 ksi < 1.33 × 0.75 Fy = 35.9 ksi
3½"	942 in-lb	22.2 ksi < 1.33×0.75 Fy	16.1 ksi < 1.33 × 0.75 Fy
4"	1046.6 in-lb	24.7 ksi < 1.33×0.75 Fy	17.9 ksi < 1.33×0.75 Fy
6¼"	2008.3 in-lb	47.4 ksi > 1.33×0.75 Fy	34.3 ksi < 1.33×0.75 Fy *
		--- N.G.	---- O.K.

* ∴ USE C8X11.5 WITH 7" MAX COPE AT THE FLANGES AND SHALL BE INSTALLED AS SHOWN BELOW.

FOR SAFETY DURING CONSTRUCTION OF THE LAGGING A CLAMP PLATE IS REQUIRED.



CHECK MAXIMUM PROOF LOAD



CLAMP DETAIL

TRIAL DIMENSIONS.

P = PROOF LOAD THAT CRITICAL SECTION CAN WITHSTAND.

$\Sigma M_{R_L} = 0$

$8 R_R = 3P$

$R_R = 0.375P$

$M_{MAX} = R_R \left(5\tfrac{1}{4}\right)$ ---- MAX. BENDING MOMENT IN CHANNEL AT CRITICAL SECTION OF THE CHANNEL.

$= 0.375\,P(5.25) = 1.97\,P$ in-lb

$F_b = 27.0^{ksi} = 0.75 F_y$ ALLOWABLE BENDING STRESS

$= 27{,}000$ psi (AISC F2-1, p. 5-48)

$F_b = \dfrac{M_{c_4}}{S_B}$

$27{,}000 = \dfrac{1.97P}{0.0585}$

$P = 801.8$ lb $\therefore M_{MAX} = 1.97(801.8) = 1579.5^{\text{in-lb}}$

FROM PREVIOUS PAGE, IT DEMONSTRATES THAT BOLT TENSION IS LIMITED TO 1579.5 lb TO ENSURE THAT THE BENDING IN CLAMP PL IS WITHIN ALLOWABLE, THE CARRIEAGE BOLT SHALL BE SNUG TIGHT AND NOT ~~BE~~ TIGHTENED TO A BOLT PRETENSION.

THE CLAMP PLATE STIFFNESS SHALL NOT EXCEED THE STIFFNESS OF C8 CRITICAL SECTION SO THAT THE BACK OF CHANNEL WILL NOT BEND AWAY FROM ROCK SURFACE.

TRY $3/16 \times 8''^{+} \times 3''$

$$S = \frac{3\times(\frac{3}{16})^2}{6}$$

$$= 0.0176 \text{ in}^3$$

$$f_b = \frac{M_{3/16}}{S_{3/16}}$$, $M_{3/16}$ = MOMENT CAPACITY FOR CLAMP PLATE

$$27{,}000 = \frac{M_{3/16}}{0.0176}$$

$$M_{\frac{3}{16}} = 475.0 \text{ in-lb}$$

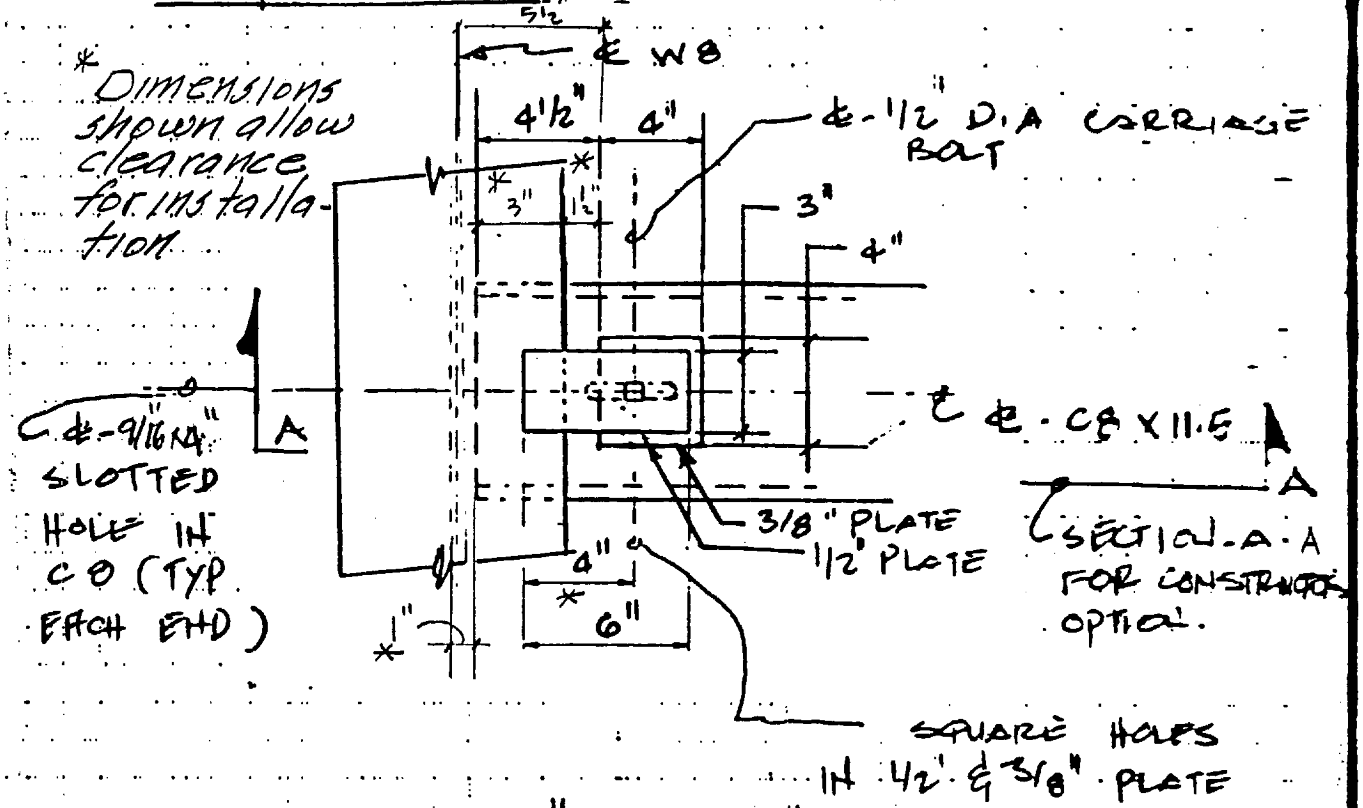
$$\therefore M_{\frac{3}{16}} < M_{c4} \quad , \text{RATIO} = \frac{1579.5}{475.0} = 3.3 \ \underline{\text{ok}}$$

USE CURVE $3/16'' \times 8^{+} \times 3''$ PLATE, Option-3

OR 8"×3" PIECE CUT FROM 20"φ SCH 10 PIPE (WALL THICKNESS = 0.25")

SUMMARY

PURPOSE - III.B



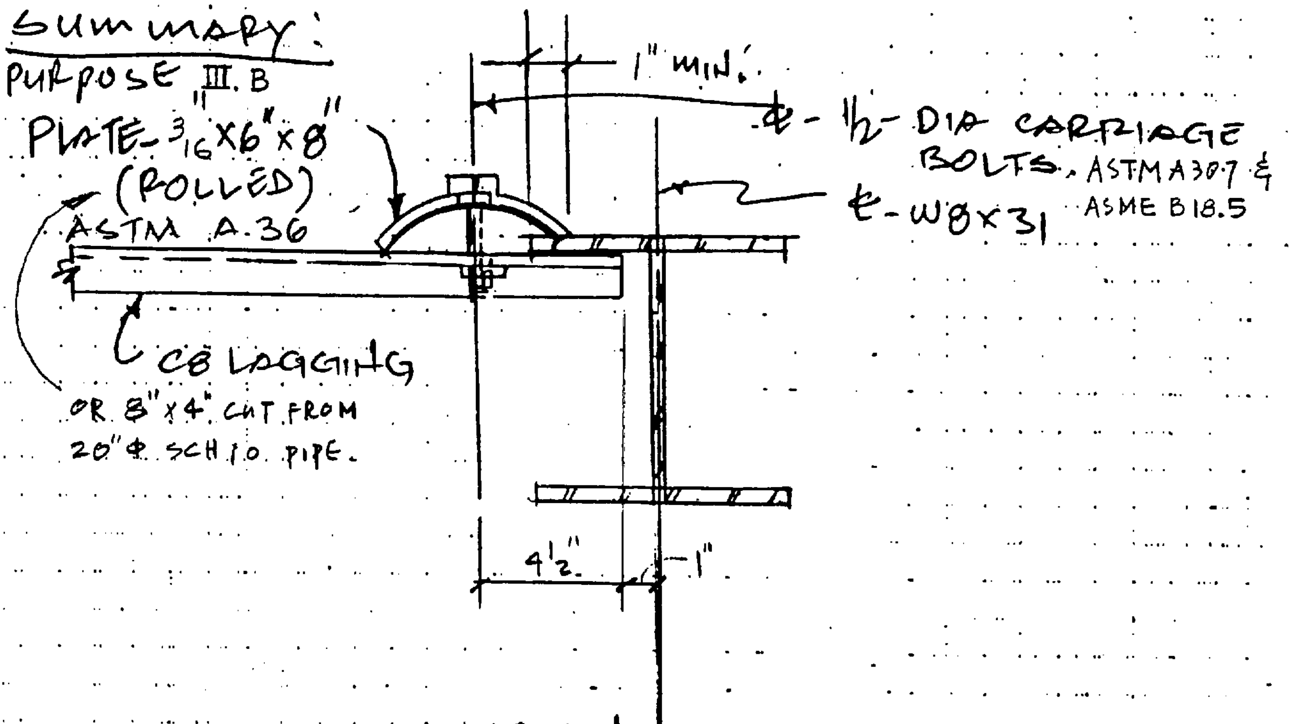
C8x11.5, ½" AND 3/8" PLATES SHALL BE IN ACCORDANCE WITH ASTM A36

½" CARRIAGE BOLT SHALL BE IN ACCORDANCE WITH ASTM A 307 AND ASME-B 18.5

OPTION - 1 (p. III-35)

SUMMARY:

PURPOSE III.B



SECTION - A - A

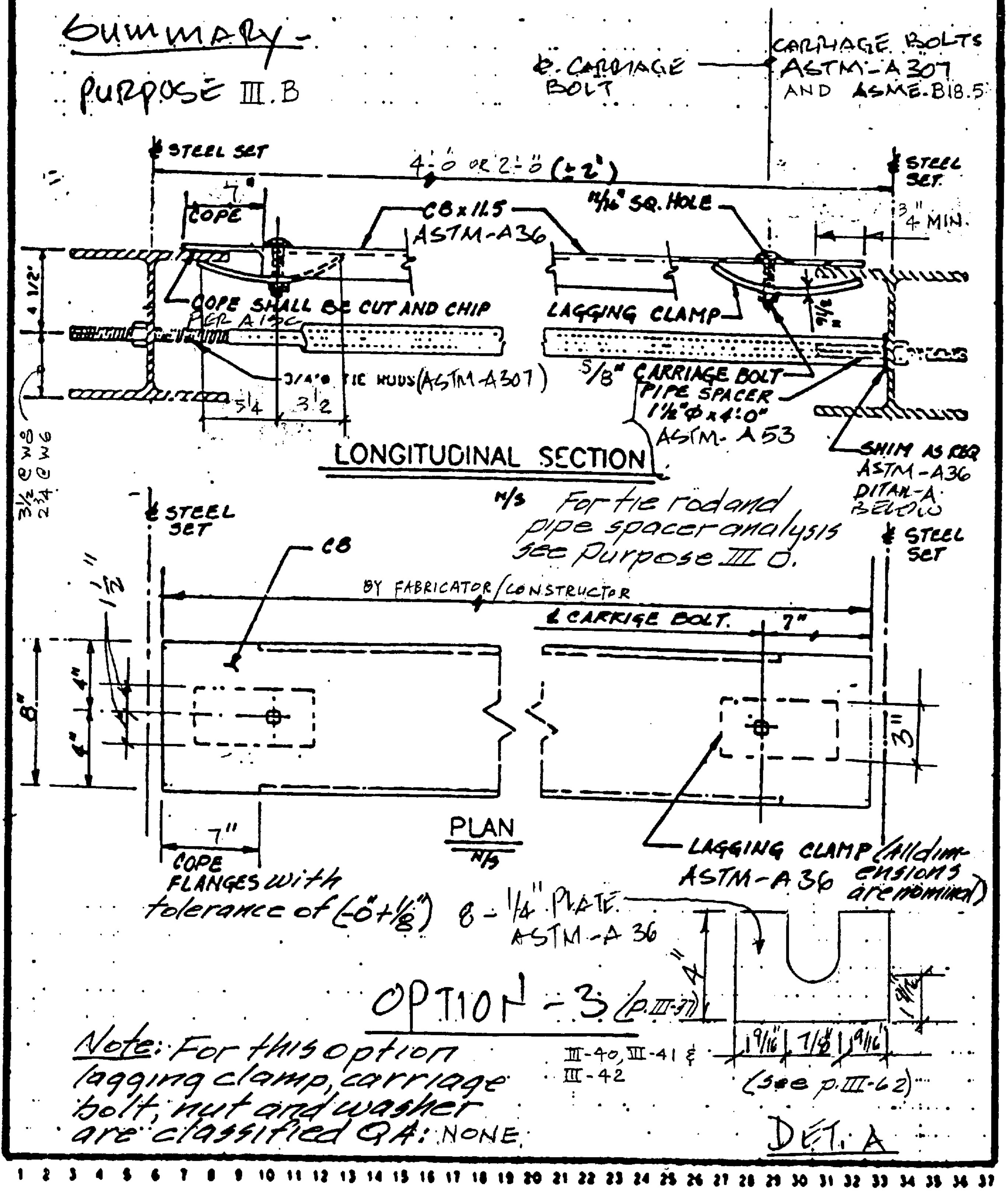
(CONSTRUCTOR OPTION)

CONSTRUCTORS SHALL SUBMIT SHOP DRAWING FOR THIS OPTIONAL - 2 OF LAGGING AND PLATE CONNECTION AND SHALL BE REVIEWED BY THE A/E.

OPTION - 2 (p. III-37)

Summary -

Purpose III.B



For tie rod and pipe spacer analysis see Purpose III D.

OPTION - 3 (p.III-37)

III-40, III-41 & III-42

Note: For this option lagging clamp, carriage bolt, nut and washer are classified QA: NONE.

PURPOSE III.C A)JACKING BRACKET ASSEMBLY CALCULATION FoR W8x31 STEEL SETS

DESIGN JACKING BRACKET : (25 TON JACK CAPACITY) DESIGN FOR 27 TON FORCE.

1. DESIGN OF CONNECTION BOLTS TO STEEL SET:

JACKING BRACKET SHALL BE REMOVED AFTER A COMPLETE RING OR SEGMENTS ASSEMBLY OF STEEL SET IS IN PLACE.

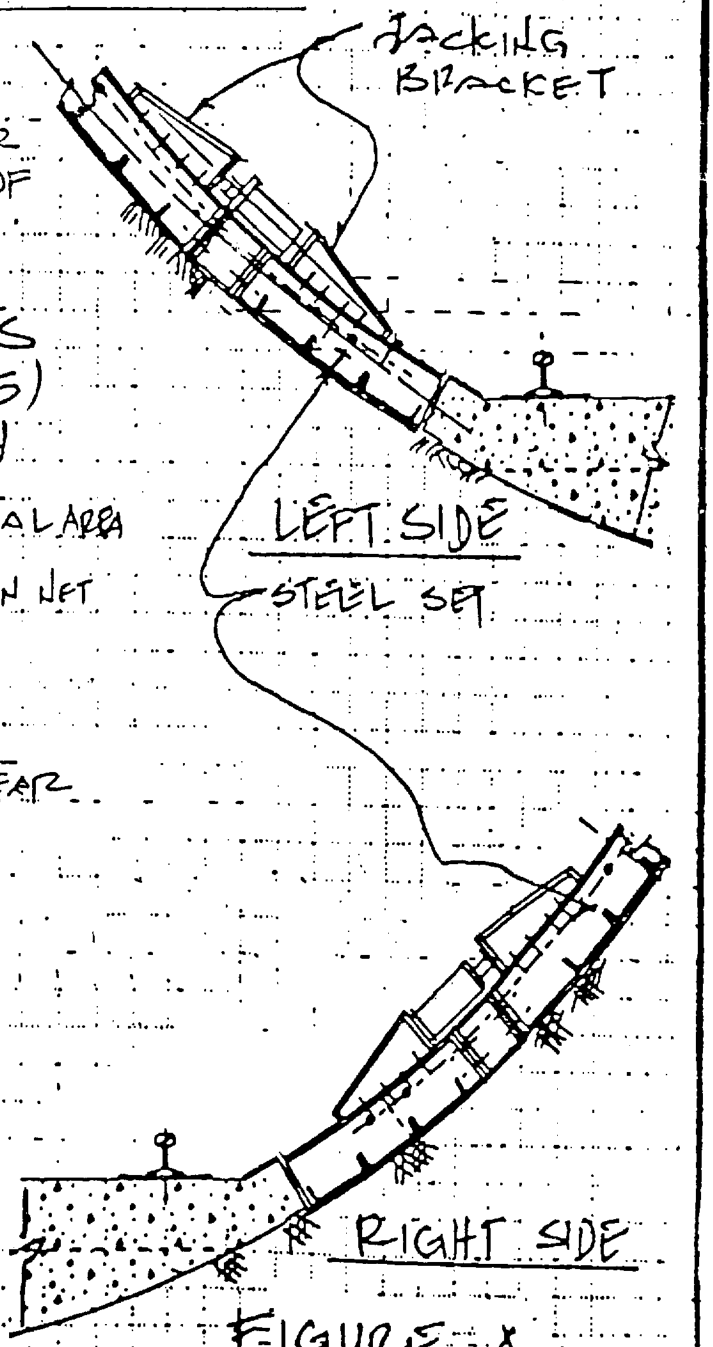


FIGURE-A

TRY 8-1" A307 BOLTS
(SEE AISC 4-3 & 4-5)

T_a = ALLOWABLE BOLT TENSION

$= 15.70^k \rightarrow$ TENSION ON NOMINAL AREA - AISC 4-3

OR $20(.606) = 12.12^k$ TENSION ON NET AREA - AISC 4-147

∴ USE $T_a = 12.12^k$ ALLOWABLE

V_a = ALLOWABLE BOLT SHEAR

$V_a = 7.9^k$ - AISC 4-5.

a = ℄ JACK TO W8 FLANGE
= 1/2 JACK BODY DIAMETER --- ATTACHMENT VI
= 1 11/16", USE 2"

DESIGN CAPACITY $= P_J = 54^K$

M = MOMENT ON THE BRACKET

$M = 54(2) = 108^{in\text{-}k}$

V_a = SHEAR FORCE ON EACH BOLT

$$V_a = \frac{54}{8} = 6.75^{k/\text{BOLT}} \angle \; V_a = 7.9^K$$

T_a = TENSION ON THE TOP MOST BOLT

$$T_a = \frac{Mc_1}{I}$$

$$c_1 = 4.5'' \quad \begin{cases} I_o = \frac{\pi}{4}(.5)^4 = 0.049 \text{ IN}^4 \\ A = 0.7854 \text{ in}^2 \end{cases}$$

$$\Sigma \bar{c}^2 = (\bar{1.5}^2 + \bar{4.5}^2) = 22.50 \text{ in}^2$$

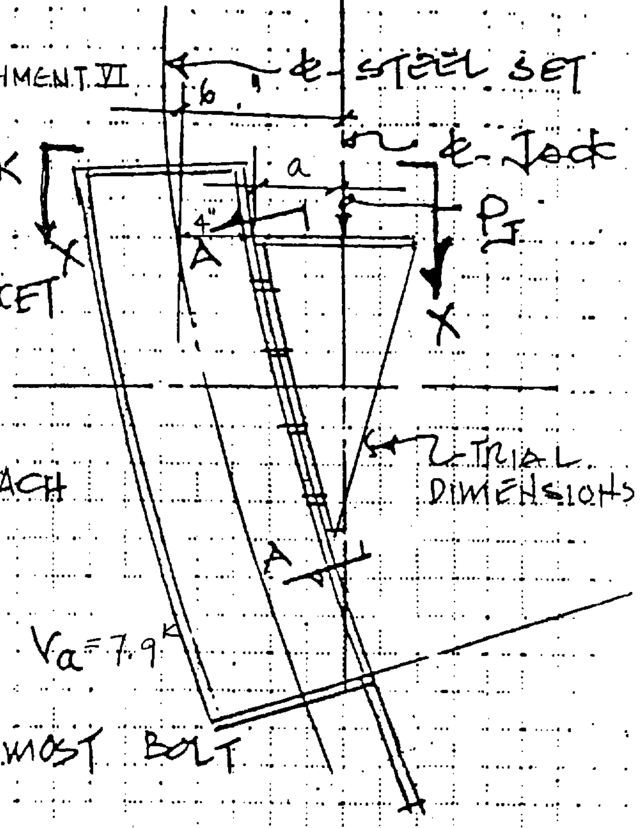
$$I = 4[I_o + A\Sigma\bar{c}^2]$$

$$I = 4[0.049 + 0.7854(22.5)]$$

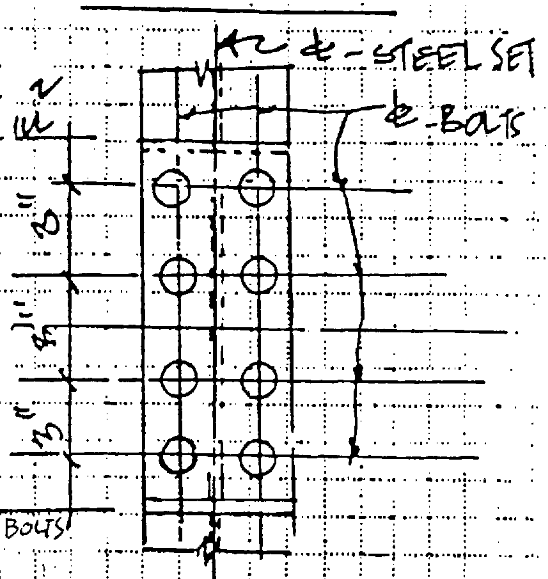
$$= 70.88 \text{ in}^4$$

$$T_a = \frac{108(4.5)}{70.88} = 6.86^K \text{ FOR (2)-BOLTS}$$

$= 3.43^K$ PER BOLT $< 12.12^K$ --- O.K.
(SEE NEXT PAGE)



FIGURE_B



SECTION A-A

$V_a = 7.9^k$ --- AISC 4-5

$T = 20^{ksi} \times 0.606 = 12.12^k$ --- AISC 4-3 & 4-147

$f_v = 6.75^k / 0.7854 = 8.6^{ksi}$

$26 - 1.8 f_v = 10.5^{ksi} < 20^{ksi}$ --- O.K. (AISC 5-74, TABLE J3.3)

USE 8 - 1" φ ASTM A307 (60,000 PSI) MINIMUM WITH ASTM A563, GRADE DH HEAVY HEX NUTS AND ASTM F436 WASHERS, TYPE 1, UNLESS SHOWN OTHERWISE. ALL BOLTS SHALL BE SNUG TIGHT.

2. DESIG OF JACK PLATE :

(ALTERNATE DESIGN BY CONTRACTORS OPTION.)

REPRESENTATIVE PARAMETERS SHOWN ON SECT X-X

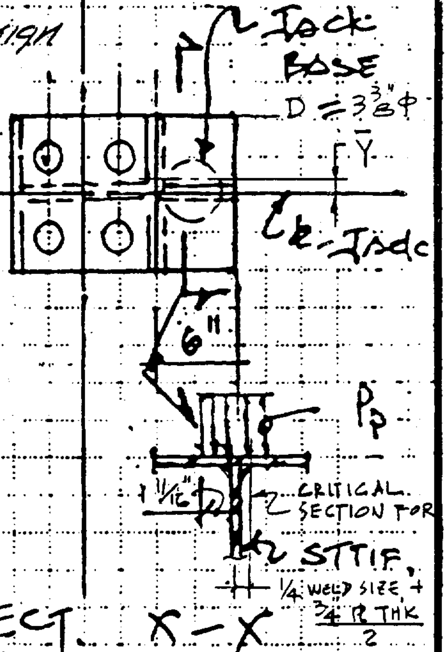
For details of jack see Section 4.1.5, Design Inputs.

A_J = JACK CROSS SECTIONAL AREA @ BASE

$A_J = \frac{\pi (3\frac{3}{8})^2}{4} = 8.95 \text{ in}^2$

P_p = PRESSURE FROM JACK ON PLATE UNDER JACK BASE

$P_p = \frac{54}{A_J} = 6.04$ ksi



PAGE VI: 3

SECT. X-X FROM FIG. B

M_J = MOMENT IN TOP JACKING PLATE (6"-STRIP)

$= P_p \left(\frac{A}{2}\right)(\bar{Y})$; $\bar{Y} = R - R\left(1 - \frac{4}{3\pi}\right) = 0.72''$ --- (AISC 6-20)

$M_J = 6.04\left(\frac{8.95}{2}\right)\left(0.72'' - \underset{0.095}{0.25} - \frac{0.75}{2}\right) = 2.57^{\text{IN-K}} / 6''$ STRIP

DETERMINE THICKNESS OF CAP PLATE,

t = THICKNESS OF CAP PLATE.

$$S = \frac{b t^2}{6} = \frac{6 t^2}{6} = t^2$$

$$S = \frac{M_J}{F_b}$$

$$t^2 = \frac{M_J}{F_b}$$

$$F_b = 0.75 F_y = 27^{KSI}$$ --- (AISC PAGE 5-48, F2-1)

$$t^2 = \frac{2.57}{27} = 0.095''$$

$$t = 0.308''$$

USE 3/4" PL – HORIZONTAL PLATE FOR JACKING BRACKET.

DESIGN OF VERTICAL PLATE OF THE JACKING BRACKET.

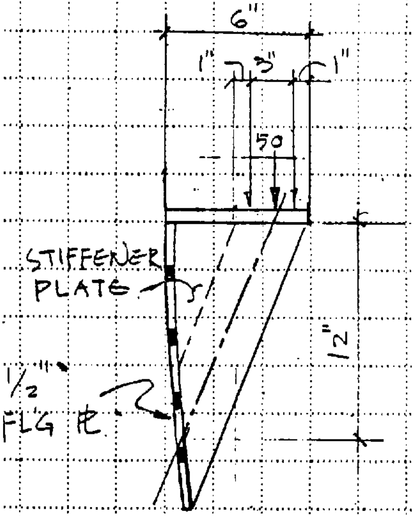
(a) STIFFENER PLATE ~

WIDTH TO THICKNESS RATIO

$d/t \le 127/\sqrt{F_y}$ --- (AISC, p 5-36)

$d = 6''$ MAX.

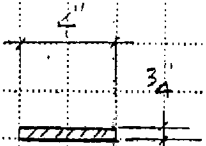
$t_{MIN} = \dfrac{d}{127/\sqrt{F_y}} = \dfrac{6}{21.17} = 0.283''$



TRY 3/4" STIFFENER PLATE W/
1/2" FLANGE PLATE.

CHECK STIFFENER PL FOR JACK LOAD.
THE STIFFENER PLATE CAN BE IDEALIZED
AS A COMPRESSION ELEMENT 3/4" x 4" x 12" LG

$I_{STIFF\ PL} = \dfrac{4 \times (0.75)^3}{12} = 0.14 \ \text{IN}^4$



$A = 0.75 \times 4 = 3.0 \ \text{IN}^2$

$r = \sqrt{\dfrac{0.14}{3.0}} = 0.216$

$Kl = \frac{3}{4} \times 12'' = 9''$ --- EFFECTIVE LENGTH
(AISC K1.8, PAGE 5-82)

$Kl/r = 9.0/0.216 = 41.67 \Rightarrow F_a = 19.0^{ksi}$ --- AISC, TABLE C-36

$P_a = 19.0^{ksi} \times 3.0 = 57^{k} > 54^{k}$ --- O.K.

USE 3/4" STIFFENER PL AS SHOWN.

(b) WELDING OF STIFFENER PL TO FLG PLATE OF JACKING BRACKET ~

TRY 1/4" FILLET WELD $\frac{1/4}{1/4}$ 14" LG.

A_w = WELD AREA $= (2 \times 1/4)(14) = 7'' \ in^2$

$M = 54^k \times 4'' = 216''^k$

$P/A = 54/7 = 7.71^{ksi}$

$S_w = \frac{bd^2}{6} = (2 \times 1/4) \times \frac{14^2}{6} = 16.33 \ in^2$

$\frac{M}{S_w} = 216''^k / 16.33 = 13.23^{ksi}$

RESULTANT STRESS IN WELD

$= [(7.71)^2 + (13.23)^2]^{1/2} = 15.3^{ksi}$

ALLOWABLE WELD STRESS $= 0.3 \times 70^{ksi}$ ---(AISC PAGE 5-70)

$= 21.0^{ksi} > 15.3^{ksi}$ ---- O.K.

MINIMUM SIZE OF FILLET WELD FOR BASE METAL PLATE OF 1/2 TO 3/4" IS 1/4" WELD --- O.K. (AISC TABLE J2.4)

USE $\frac{1/4}{1/4}$ FILLET WELD E70XX MINIMUM ELECTRODES.

<C> FLG PL OF JACKING BRACKET IN CONTACT WITH W8x31 FLG :

TRY 1/2" PLATE, ASTM A36 MATERIAL,

MIN. BOLT EDGE DISTANCE l
PARALLEL TO THE LINE OF
FORCE = 3" > $1\frac{1}{2}d$ = 1.5"
AND BOLT SPACING
= 3" ≮ 3d = 3" (AISC P. 5-75)

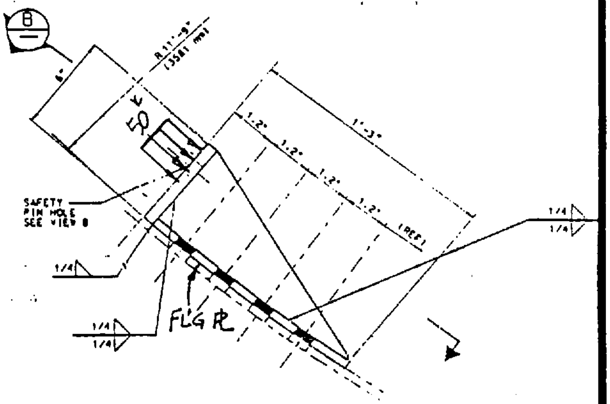
ALLOWABLE BEARING
$F_p = 1.2 F_u$ ---- AISC J3-1, P. 5-74
$= 1.2 \times 58^{ksi} = 69.6^{ksi}$

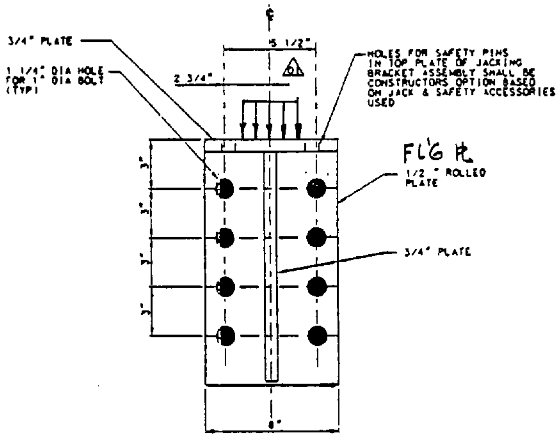
BEARING AREA
$= 1" \times 1/2" = 0.5 \text{ IN}^2$

SHEAR ON EACH BOLT
$= \frac{54^k}{8} = 6.75^k$

BEARING STRESS
$= \frac{6.75}{0.5} = 13.5^{ksi} < F_p = 69.6^{ksi}$
---- O.K.

USE 1/2" FLG PLATE
ASTM A36 MATERIAL





N VIEW B
SCALE: 3" = 1'-0"

PURPOSE III.C B) JACKING BRACKET ASSEMBLY CALCULATION FOR W6X20 STEEL SETS

DESIGN JACKING BRACKET : (15 TON JACK FORCE)

1. DESIGN OF CONNECTION BOLTS TO STEEL SET : (DESIGN FOR 17 TONS)

JACKING BRACKET SHALL BE REMOVED AFTER
A. COMPLETE RING OR SEGMENTS ASSEMBLY OF STEEL SET IS IN PLACE.

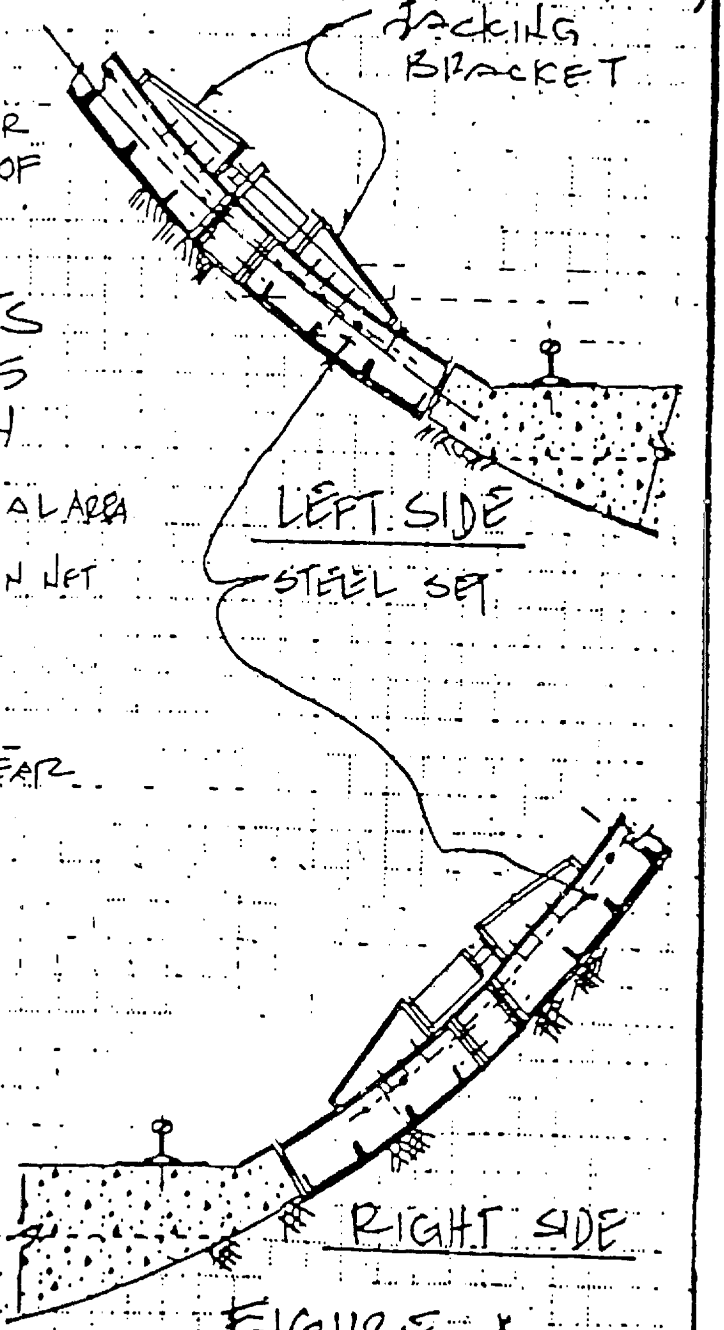


FIGURE-A

TRY 6-1" A 307 BOLTS
(SEE AISC 4-3 & 4-5

T_a = ALLOWABLE BOLT TENSION

= 15.70^k → TENSION ON NOMINAL AREA - AISC 4-3

OR 20(.606) = 12.12^k TENSION ON NET AREA - AISC 4-147

∴ USE $T_a = 12.12^k$ ALLOWABLE

V_a = ALLOWABLE BOLT SHEAR

$V_a = 7.9^k$ — AISC 4-5

a = ℄ JACK TO W6 FLANGE
= 1/2 JACK BODY DIAMETER --- ATTACHMENT VI
= $1\frac{3}{8}''$ ∴ USE 2"

DESIGN CAPACITY = $P_J = 34^k$

M = MOMENT ON THE BRACKET

$M = 34(2) = 68^{in\text{-}k}$

V_6 = SHEAR FORCE ON EACH BOLT

$$V_6 = \frac{34}{6} = 5.67^{k/BOLT} < V_a$$

T_6 = TENSION ON THE TOP MOST BOLT

$$T_6 = \frac{Mc_1}{I}$$

$$\begin{cases} I_o = \frac{\pi}{4}(.5)^4 = 0.049 \text{ in}^4 \\ A = 0.7854 \text{ in}^2 \end{cases}$$

$c_1 = 3''$

$\Sigma c^2 = (\overline{0.0}^2 + \overline{3.0}^2) = 9.0 \text{ in}^2$

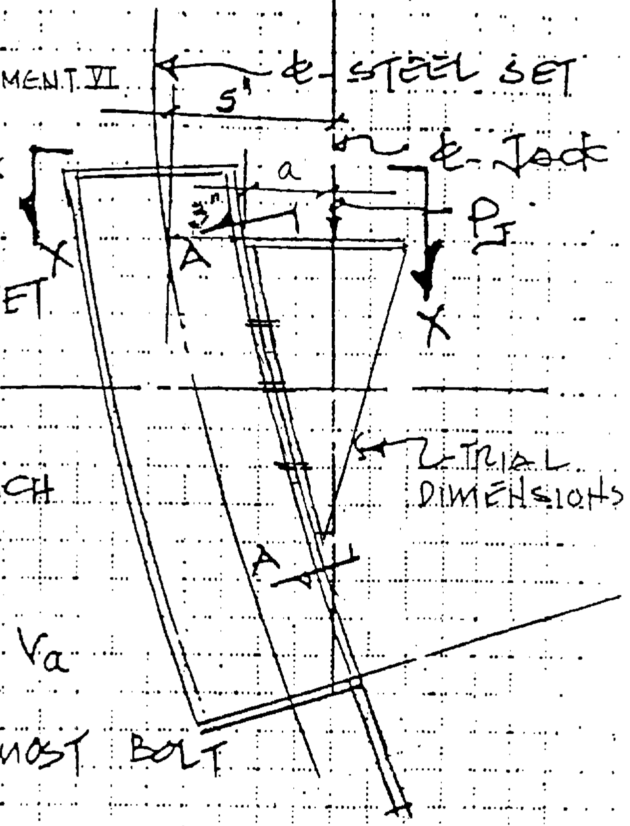
$I = 2[I_o + A\Sigma \overline{c}^2]$

$I = 2[0.049 + 0.7854(9.0)]$

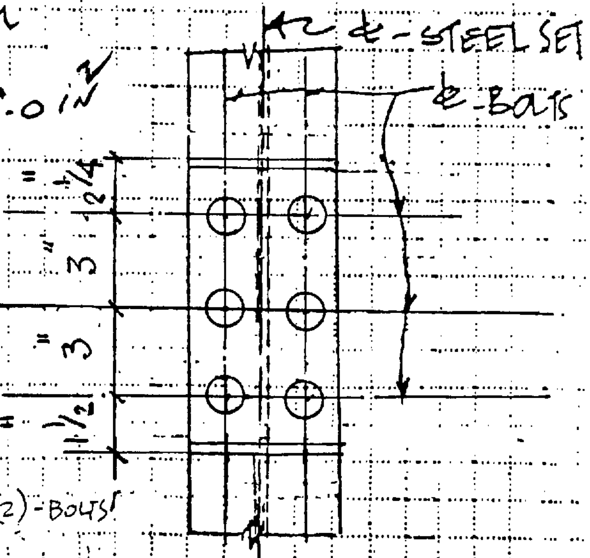
$= 14.24 \text{ in}^4$

$$T_6 = \frac{68(3.0)}{14.24} = 14.36^k \text{ FOR (2)-BOLTS}$$

$= 7.16^k$ PER BOLT < 12.12^k --- O.K.
(SEE NEXT PAGE)



FIGURE_B



SECTION A-A

$V_a = 7.9^k$ --- AISC 4-5

$T_a = 20^{ksi} \times 0.606 = 12.12^k$ --- AISC 4-3 & 4-147

$f_v = 5.67^k / 0.7854 = 7.22^{ksi}$

$26 - 1.8 f_v = 13.0^{ksi} < 20^{ksi}$ --- O.K. (AISC 5-74, TABLE J3.3)

USE 6 - 1" φ ASTM A307 (60,000 PSI) MINIMUM WITH ASTM A563, GRADE DH HEAVY HEX NUTS AND ASTM F436 WASHERS, TYPE 1, UNLESS SHOWN OTHERWISE. ALL BOLTS SHALL BE SNUG TIGHT.

2. DESIGN OF JACK PLATE:

(ALTERNATE DESIGN BY CONTRACTORS OPTION.)

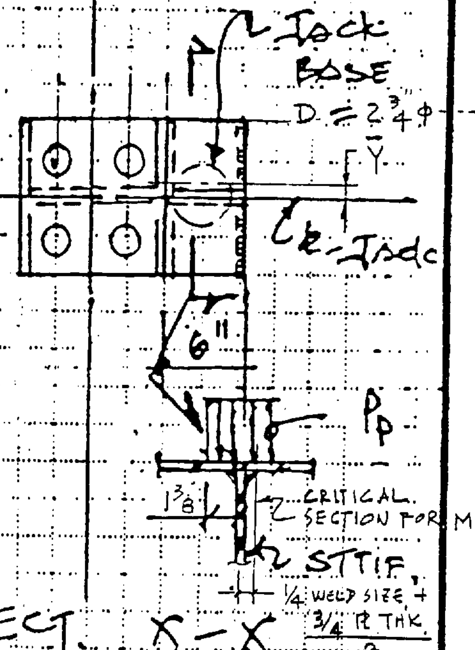
REPRESENTATIVE PARAMETERS SHOWN ON SECT X-X

A_J = JACK CROSS SECTIONAL AREA @ BASE

$A_J = \frac{\pi (2.75)^2}{4} = 5.94 \text{ in}^2$

P_p = PRESSURE FROM JACK ON PLATE UNDER JACK BASE

$P_p = \frac{34}{A_J} = 5.72$ KSI



SECT. X-X

M_J = MOMENT IN TOP JACKING PLATE (6" STRIP) FROM FIG. B

$= P_p \left(\frac{A_J}{2}\right)(\bar{Y})$, $\bar{Y} = R - R\left(1 - \frac{4}{3\pi}\right) = 0.584"$ --- (AISC 6-20)

$M_J = 5.72 \times \left(\frac{5.94}{2}\right)\left(0.584 - \underset{-0.041}{0.25} - \frac{0.75}{2}\right) \cong 0$ "-K / 6" STRIP

DETERMINE THICKNESS OF CAP PLATE,

t = THICKNESS OF CAP PLATE.

$$S = \frac{b\,t^2}{6} = \frac{6\,t^2}{6} = t^2$$

$$S = \frac{M_J}{F_b}$$

$$t^2 = \frac{M_J}{F_b}$$

$F_b = 0.75 F_y = 27^{KSI}$ ---- (AISC PAGE 5-48, F2-1)

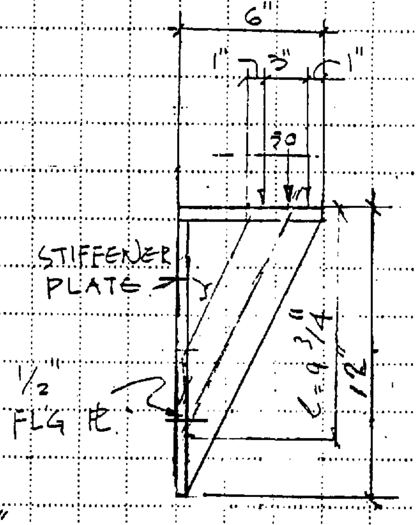
$$t^2 = \frac{0.0}{27} = 0''$$

$t = 0''$

USE 3/4" PL - HORIZONTAL PLATE FOR JACKING BRACKET.

DESIGN OF VERTICAL PLATE OF THE JACKING BRACKET

(a) STIFFENER PLATE ~



WIDTH TO THICKNESS RATIO

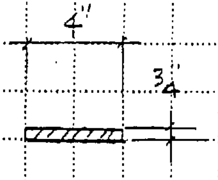
$d/t \le 127/\sqrt{F_y}$ --- (AISC, P 5-36)

$d = 6''$ MAX.

$$t_{MIN} = \frac{d}{127/\sqrt{F_y}} = \frac{6}{21.17} = 0.283''$$

TRY $\frac{3}{4}''$ STIFFENER PLATE W/
$\frac{1}{2}''$ FLANGE PLATE.

CHECK STIFFENER PL FOR JACK LOAD.
THE STIFFENER PLATE CAN BE IDEALIZED
AS A COMPRESSION ELEMENT $\frac{3}{4}'' \times 4'' \times 9\frac{3}{4}''$ LG



$$I_{STIFF.\ PL} = \frac{4 \times (0.75)^3}{12} = 0.14 \text{ IN}^4$$

$A = 0.75 \times 4 = 3.0 \text{ IN}^2$

$$r = \sqrt{\frac{0.14}{3.0}} = 0.216$$

$Kl = \frac{3}{4} \times 9.75'' = 7.31$ --- EFFECTIVE LENGTH
(AISC K1.8, PAGE 5-82)

$Kl/r = 7.31/0.216 = 33.85 \Rightarrow F_a = 19.6^{KSI}$ --- AISC, TABLE C-36

$P_a = 19.6^{KSI} \times 3.0 = 58.8^K > 34^K$ --- O.K.

USE $\frac{3}{4}''$ STIFFENER PL AS SHOWN.

(b) WELDING OF STIFFENER PL TO FLG PLATE OF JACKING BRACKET ~

TRY $\frac{1}{4}$" FILLET WELD $\overset{1/4}{\underset{1/4}{\triangleright}}$ 14" LG.

A_w = WELD AREA $= (2 \times \frac{1}{4})(12") = 6"\ \text{in}^2$

$M = 34^k \times 4" = 68"^k$

$P/A = 34/6 = 5.67^{ksi}$

$S_w = \frac{bd^2}{6} = (2 \times \frac{1}{4}) \times \frac{12^2}{6} = 12.0\ \text{in}^2$

$\frac{M}{S_w} = 68"^k/12 = 5.67^{ksi}$

RESULTANT STRESS IN WELD

$= [(5.67)^2 + (5.67)^2]^{1/2} = 8.02^{ksi}$

ALLOWABLE WELD STRESS ≐ BASE METAL ---(AISC PAGE 5-70)

$= 21.6^{ksi} > 8.02^{ksi}$ ---- O.K.

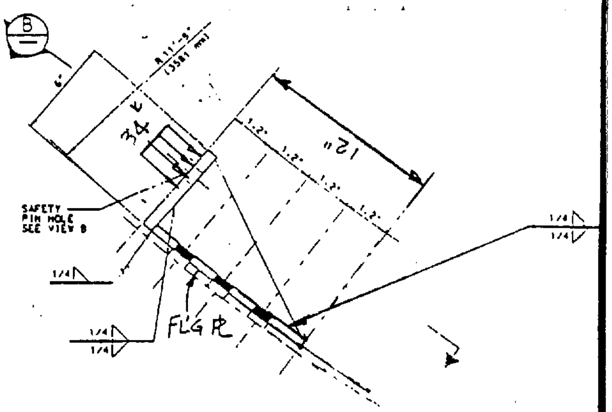
MINIMUM SIZE OF FILLET WELD FOR BASE METAL PLATE OF $\frac{1}{2}$ TO $\frac{3}{4}$" IS $\frac{1}{4}$" WELD ---- O.K. (AISC TABLE J2.4)

USE $\overset{1/4}{\underset{1/4}{\triangleright}}$ FILLET WELD E70XX MINIMUM ELECTRODES.

<C> FLG ⅊ OF JACKING BRACKET IN CONTACT WITH W6×20 FLG :

TRY 1/2" PLATE, ASTM A36 MATERIAL,

∴ MIN. BOLT EDGE DISTANCE ℓ
PARALLEL TO THE LINE OF
FORCE $= 3'' > 1\frac{1}{2}d = 1.5''$
AND BOLT SPACING
$= 3'' \not< 3d = 3''$



ALLOWABLE BEARING

$F_p = 1.2 F_u$ ---- AISC P.4-6

$= 1.2 \times 58^{ksi} = 69.6^{ksi}$

BEARING AREA

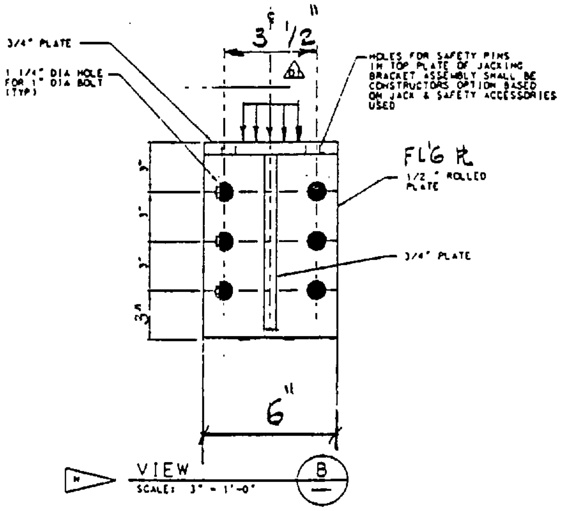
$= 1'' \times \frac{1}{2}'' = 0.5\ in^2$

SHEAR ON EACH BOLT

$= \frac{34^k}{6} = 5.67^k$

BEARING STRESS

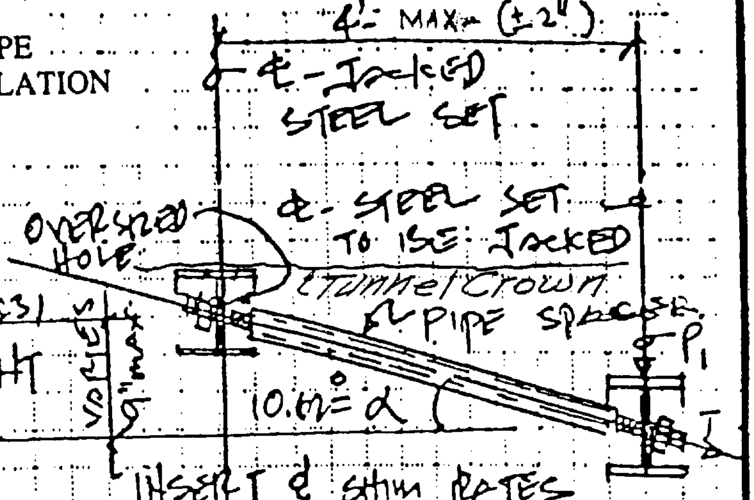
$= \frac{5.67}{0.5} = 11.34^{ksi} < F_p = 69.6^{ksi}$ ---o.k.



USE 1/2" FLG PLATE
ASTM A36 MATERIAL

PURPOSE III.D

TIE ROD AND PIPE SPACER CALCULATION



DESIGN TIE ROD

P_1 = CONSTRUCTION/ERECTION DEAD LOAD OF W8x31 STEEL SET SEGMENT THAT COULD INDUCE MAXIMUM TENSION TO TIE ROD. (3-TIE RODS PER SETS FOR CALCS ONLY.)

WORST CASE FOR TIE ROD

$P_1 = 19(31)(\underline{1.25})$ ← INCREASED FOR ATTACHMENTS

$= 736.25^{lb}$

T = ROD TENSION = $P_1 / \sin\alpha$

$$T = \frac{736.25^{lb}}{\sin 10.62^\circ} = \underline{3{,}995\ lb}$$

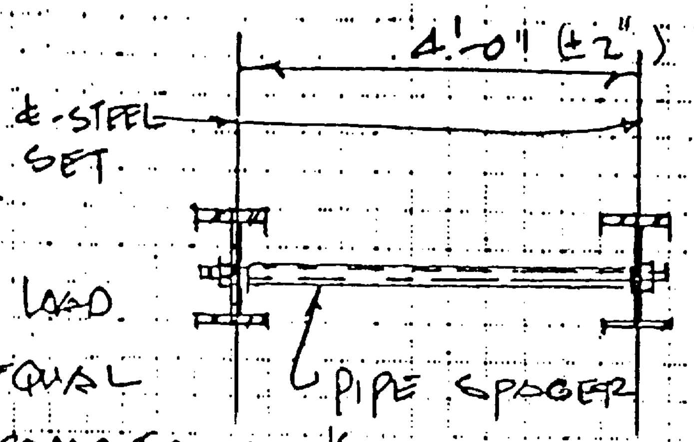
USE 3/4" DIA TIE ROD A-307 MINIMUM

T_A = ALLOWABLE TENSION FOR 3/4" A-307

$T_A = 8.8^k \rightarrow$ (AISC 4-3)
OR $20(0.334) = 6.68^k$ (AISC 4-147)

$T < T_A = 6.68^k$

USE MAXIMUM 15/16" φ OVERSIZED HOLES IN W8 OR W6 WEB FOR TIE ROD 3/4" TO AVOID THE BENDING OF RODS.



DESIGN PIPE SPACER

MAXIMUM AXIAL LOAD
TO PIPE SPACER EQUAL
TO BOLT TENSION CAPACITY $= 6.68^k$

$P_a = 6.68^k$

$L = 4'\text{-}4"$

TRY 1½" φ PIPE SCHEDULE 40

$A = 0.799 \text{ in}^2$ } AISC P 1-93
$r = 0.623$

$$\frac{KL}{r} = \frac{(1)4.33 \times 12}{0.623} = 83.4$$

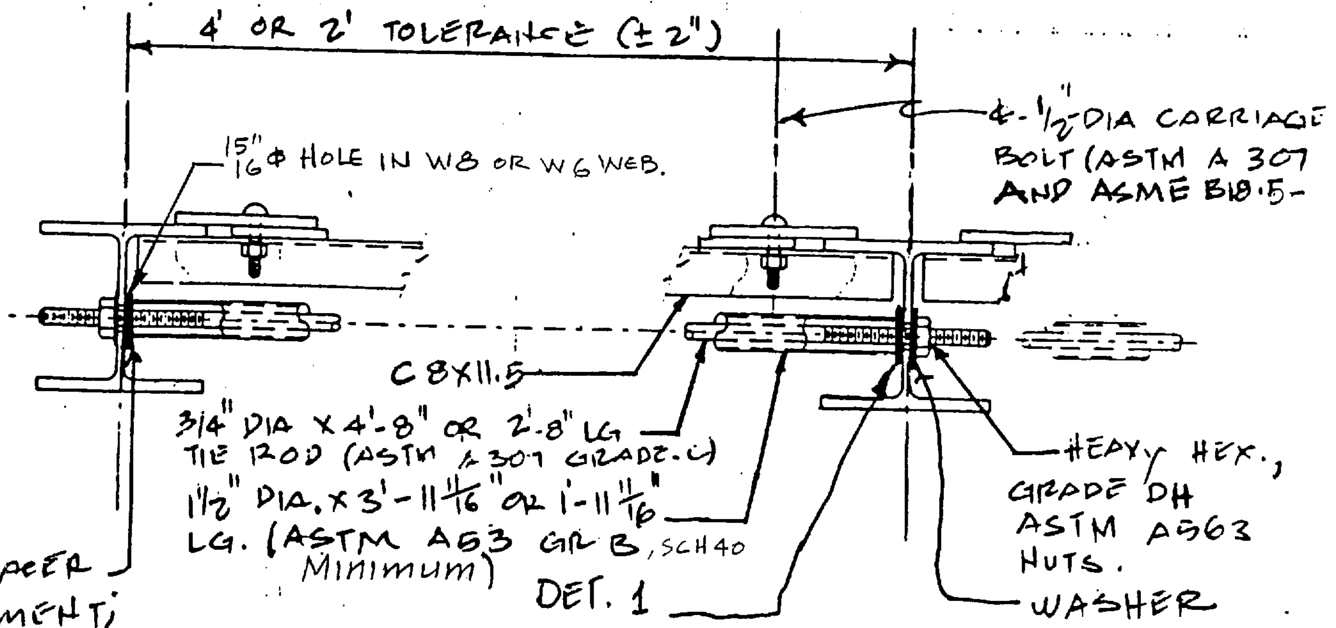
$\therefore F_a = 14.97^{ksi}$ ---- AISC P3-16, TABLE C-36

$P_c =$ CAPACITY FOR 1½" φ pipe

$= 0.799\ (14.97) = 11.96^k > P_a = 6.68^k$

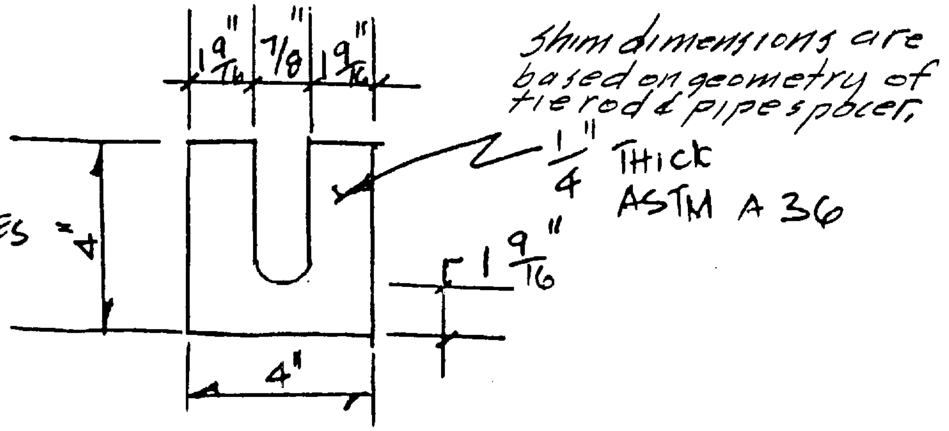
USE 1½" φ SCH 40 PIPE -- ASTM - A 53 GR B, MIN.

SUMMARY III.D



PIPE SPACER ADJUSTMENT; FIELD CUT THE PIPE TO MATCH THE ACTUAL STEEL SET SPACING FOR (-) TOLERANCE AND INSTALL SHIM PLATES FOR (+) TOLERANCE AS PER DET. 1.

TIE ROD & PIPE SPACER



Shim dimensions are based on geometry of tie rod & pipe spacer.

USE UP TO 8-1/4" SHIM PLATES AS REQUIRED FOR EACH PIPE SPACER (FOR "+" TOLERANCE CASES)

DET. 1 (PIPE SPACER SHIM PLATES)

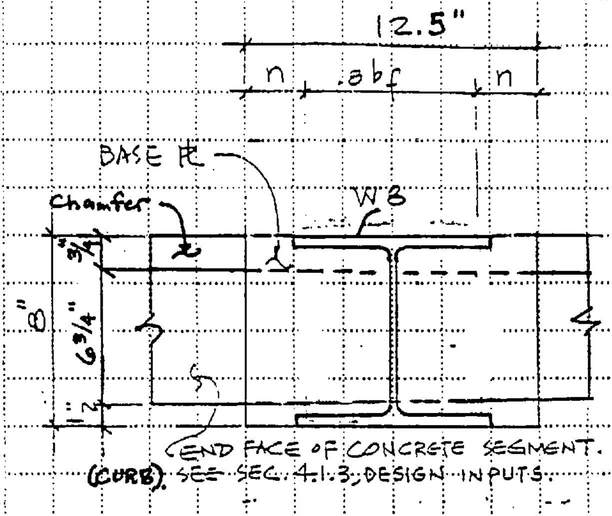
(NOT USED) Replaced by page III-65. Previous analysis on pages III-63 & III-64 developed rectangular dimensions of the foot plate based on element axial loads ($P_a = 113.6^k$ at Node 41). Subsequent analysis use the average axial load of 121.8 from File piokzdy.sav (see page III-108) to design the foot plate.

(NOT USED) Replaced by page III-65.

Purpose III.E Steel Set Foot Plate Calculation

Design of Foot Plate

(a) W8×31



For the W8×31, max $P_{a(ave)}$ > max P_a @ foot PL (See pages III-108 & III-78) ⇒ Design using $P_a = 121.8$ k (D+R+U+Seismic). Static Axial Ave. = 79.36^k (Page III-108) is 65% of P_a. P_a will control.

A_b ≡ Bearing Area = 12.5" * 6.75"
= 84.38 in^2

f_p ≡ Actual bearing pressure

$$= \frac{P_a}{A_b} = \frac{121.8\,(1000)}{84.38} = 1443.6 \text{ psi.}$$

F_p ≡ Allowable bearing pressure = $0.35 f_c'$ (AISC 3-107)

$f_c' = 5000$ psi (Ref. 5.21) ⇒ $F_p = 0.35(5000) = 1750$ psi

$f_p < F_p$ ⇒ OK for bearing

Thickness of plate = 3/4" to match existing design

The base plate is not fully supported by the invert curb and cannot be analyzed by the conventional AISC methods (AISC 3-106). Therefore, a finite element analysis was performed (see Attachment X) to check the actual stresses developed in the plate. As shown in Attachment X, the actual stresses developed are within the 36 ksi allowable stress:

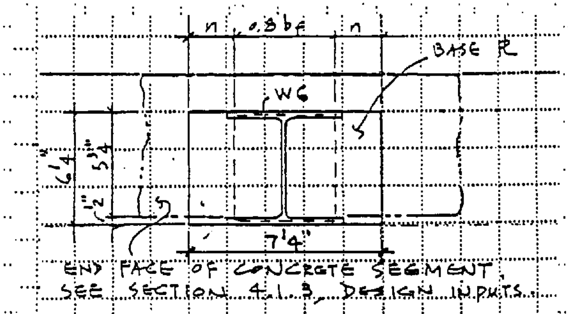
$F_b = 0.75\,F_y = 0.75\,(36) = 27$ ksi (AISC 5-48)

Seismic increase = $1.33\overline{3}\,F_b = 1.33\overline{3} * 27 = 36$ ksi

⇒ $\boxed{\text{Use } 12.5\text{"} \times 8\text{"} \times 3/4\text{" PL, ASTM A36}}$

Purpose III.E (con't)

(b) W6x20



END FACE OF CONCRETE SEGMENT, SEE SECTION 4.1.3, DESIGN INPUTS.

For the W6x20, max $P_{a(ave)}$ < max P_a @ foot ℞ (See pages III-109 & III-79) ⇒ Design using max @ foot ℞ :

$P_a = 41.96$ k (D+R+U+Seismic)

$A_b = 7.25" \times 5.75" = 41.69$ in^2

(Dimensions match connection ℞ design, pages III-102 & IX-15)

$f_p = \frac{P_a}{A_b} = \frac{41.96\,(1000)}{41.69} = 1006$ psi < $F_p = 1750$ psi ⇒ OK

Check bending (AISC 3-106):

$m \cong 0$; $n = (7.25 - 0.8 \times 6)/2 = 1.225"$

$t_p = 2n\sqrt{\frac{f_p}{F_y}} = 2(1.225)\sqrt{\frac{1.006}{36}} = 0.41"$ ⇒ Use 5/8" to match existing design

Since 1/3 allowable seismic increase not used, no need to check static case.

⇒ $\boxed{\text{Use } 5/8" \times 6\,1/4" \times 7\,1/4" \text{ ℞, ASTM A36}}$

DETERMINE WELD $\overset{1/4}{\underset{1/4}{\triangleright}}$ LENGTH REQ'D AT STEEL SET WEB :

MAXIMUM SHEAR = $P_v = 7.8^k$ --- w/SEISMIC

TRY 3" $\overset{1/4}{\underset{1/4}{\triangleright}}$ OF WELD ON STEEL SET WEB.

ALLOWABLE SHEAR = $(0.3 \times 70^{ksi}) \times (0.25" \cos 45°) \times (2 \times 3") \times 1.33$

$= 29.6^k > P_v = 7.8^k$ --- O.K.

BY INSPECTION, WELD IS ADEQUATE FOR $P_v = 6.81^k$ w/o SEISMIC

1/4" IS THE MINIMUM WELD SIZE ALLOWED

AISC 5-67 TABLE J2.4

TRY 4" OF 1/4" FILLET WELD ON ONE SIDE

$(13 \times 70)(.25 \cos 45)(\times 4") \times 1.33 = \underline{19.24^k >}$

$\underline{7.8^k}$ (OK)

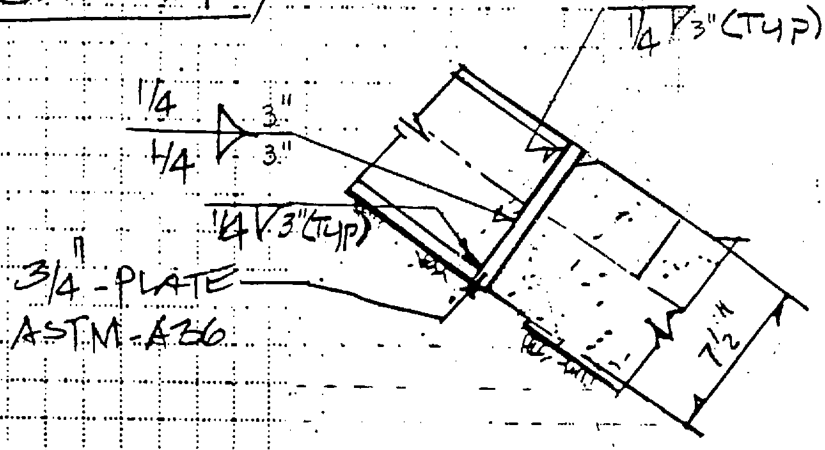
MINIMUM WELD SIZE GOVERNS

PURPOSE III. E. – ALTERNATE I, ... (SEE ATTACHMENT IX)

SINCE PRIMARY FORCES INDUCED TO FOOT PLATE ARE COMPRESSIVE, THE WELD REQUIREMENT IS MINIMUM

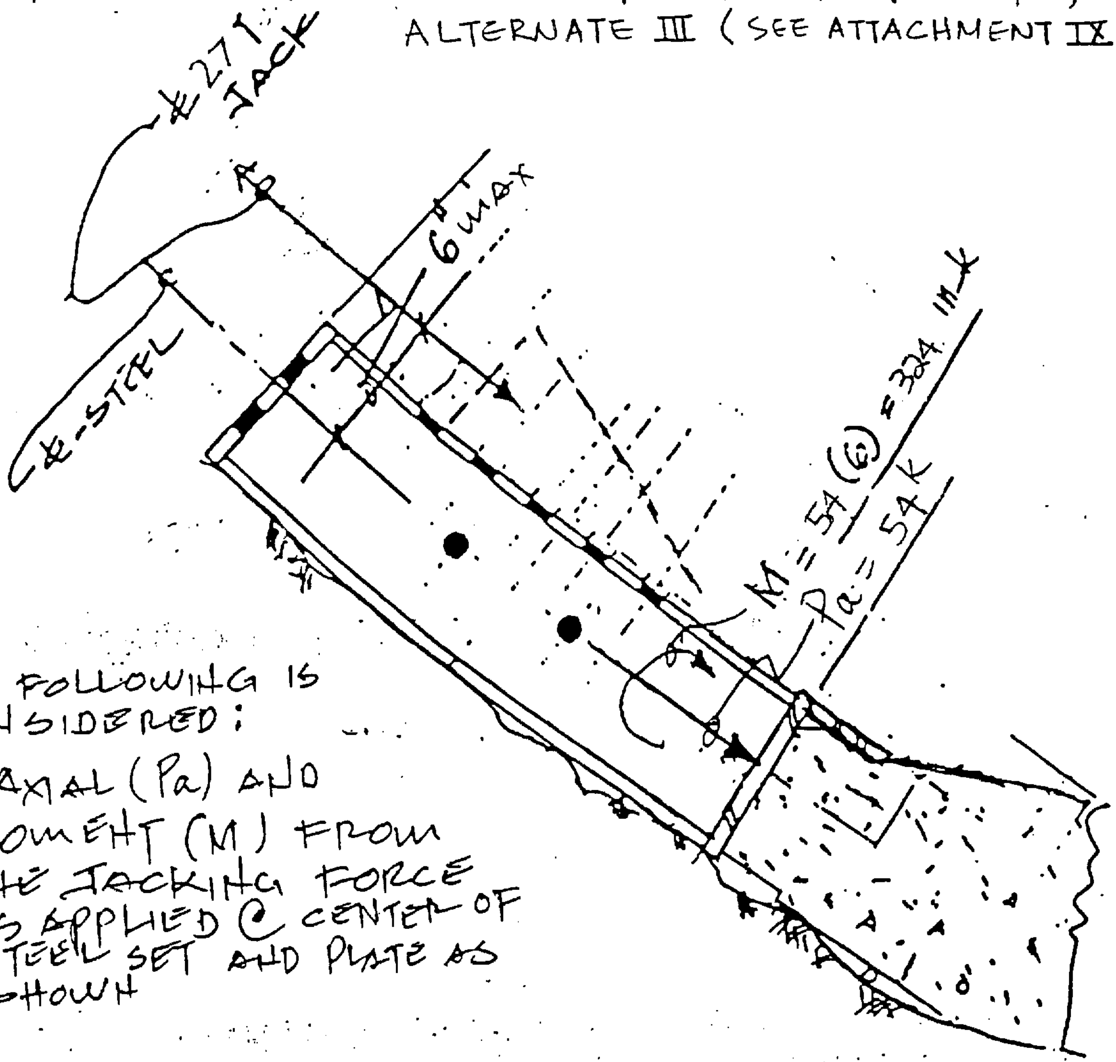
FOR WELD PLATE TO W8 USE FILLET WELDS E70XX (minimum) ELECTRODES USE 1/4" WELD AS MIN. AISC TABLE J2.4.

SUMMARY



STEEL SET FOOT PLATE
(ALTERNATE I)

PURPOSE III.E — STEEL SET FOOT PLATE DESIGN; ALTERNATE III (SEE ATTACHMENT IX)



THE FOLLOWING IS CONSIDERED:

AXIAL (Pa) AND MOMENT (M) FROM THE JACKING FORCE IS APPLIED @ CENTER OF STEEL SET AND PLATE AS SHOWN

P_a = AXIAL LOAD FROM JACKING FORCE

= 54 kips

M = MOMENT FROM JACKING FORCE WITH ECCENTRICITY OF 6"

= 324 in-k

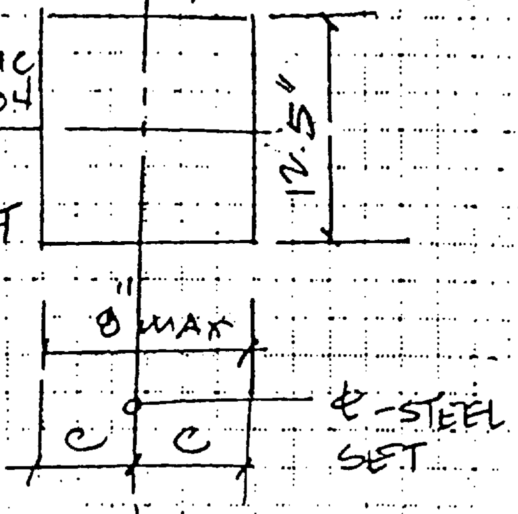
$F_p = 0.35(f'_c) = 0.35(5000) = 1750$ psi — AISC p 5-79

Fp = ALLOWABLE BEARING CAPACITY FOR f'_c=5000 PSI CONCRETE.

$$\boxed{f_p = \frac{P_{au}}{A} \pm \frac{M_c}{I}}$$ → BASIC EQUATION

A = FOOT PLATE AREA IN CONTACT WITH CONCRETE SEGMENT.

I = MOMENT OF INERTIA FOR FOOT PLATE / RESPECT TO ℄-STEEL SET.



TRIAL DIMENSION BASE

TRY 8" x 12.5" PLATE ✓

$A = 6\frac{3}{4} \times 12.5 = 84.38 \text{ in}$

$C = 4''$

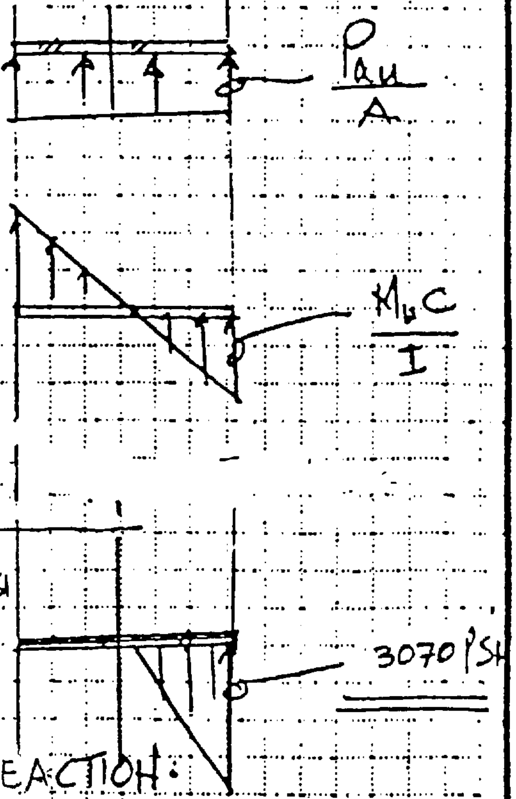
$$I = \frac{12.5(8)^3}{12} = 533.33 \text{ in}^4$$

$$f_p = \frac{54}{84.38} \pm \frac{324 \times (4)}{533.33}$$

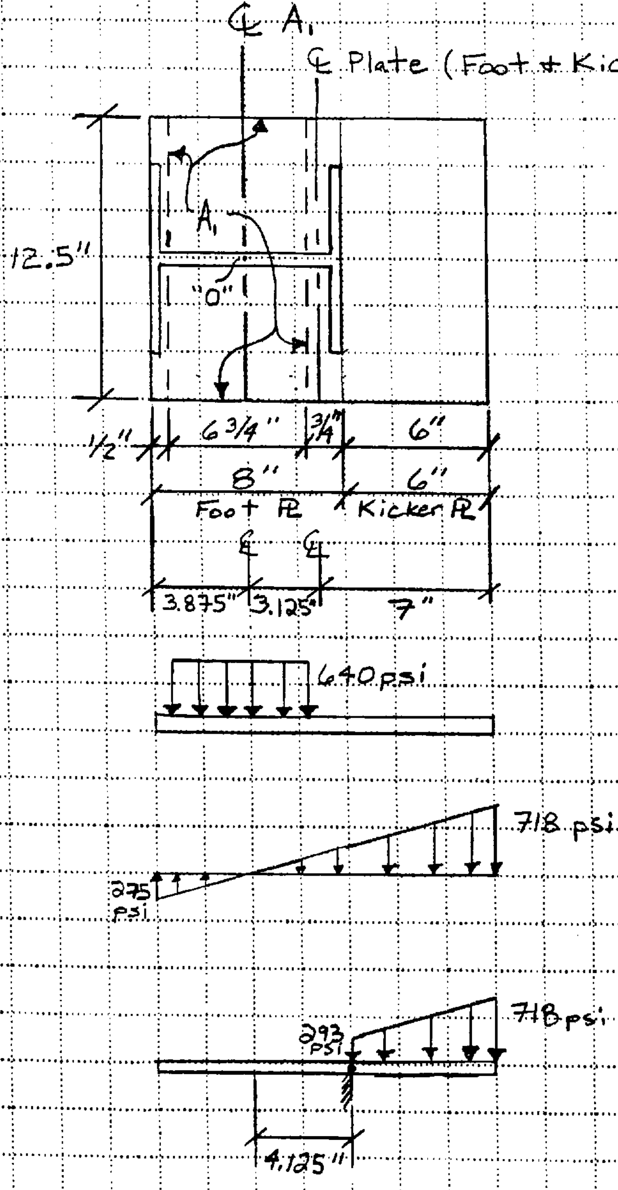
$= 0.64 \pm 2.43$

$= 3.07^{\text{ksi}} = 3070^{\text{PSI}} > F_p = 1750 \text{ psi}$

---- N.G



REVISE TRIAL DIMENSION TO INCLUDE VERTICAL PLATE REACTION:



A_1 = Bearing Area

$= (6\frac{3}{4})(12.5) = 84.38 \text{ in}^2$

$P_a = 54$ k

$\frac{P_A}{A_1} = \frac{54}{84.38} = 0.64$ ksi

I (about ℄ of A_1 @ "O")

$I = \frac{12.5(14)^3}{12} + (12.5)(14)(3.125)^2$

$= 2858.33 + 1708.98$

$= 4567.31 \text{ in}^4$

$c_1 = 3.875"$ $c_2 = 10.125"$

$M = 324$ in-k

$\frac{Mc_1}{I} = \frac{324(3.875)}{4567.31} = 0.275$ psi

$\frac{Mc_2}{I} = \frac{324(10.125)}{4567.31} = 0.718$ psi

Trap. loading for design of kicker PL: from similar Δs,

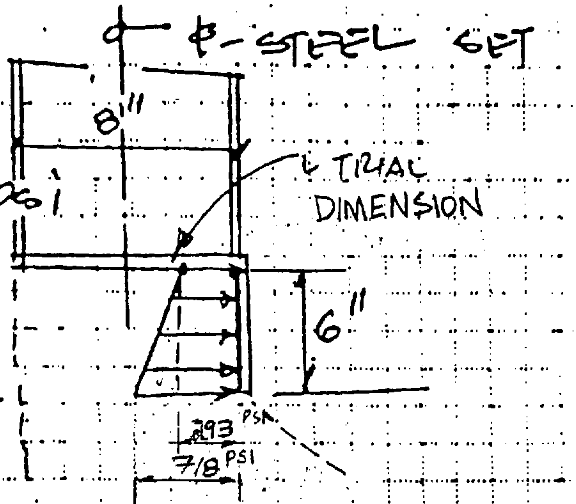
$\frac{718}{10.125} = \frac{x}{4.125} \Rightarrow x = 293$ psi

∴ MAXIMUM PRESSURE ON CONCRETE EQUAL TO

$\underline{\underline{718\ \text{PSI}}}$ MAXIMUM $< F_p = 1750\ \text{PSI}$

DESIGN VERTICAL PLATE

M_{MAX} = MOMENT @ TOP OF PLATE



PRESSURE DIAG ON VERTICAL PLATE

$$= 293(6)(3) + \frac{(718-293)}{2}(6)(4)$$

$$= 5274 + 5100$$

$$= 10374 \text{ in-lb}$$

$F_b = 27$ KSI ALLOWABLE FOR PLATE (AISC 5-48, F2-1)

$$S_x = \frac{bt^2}{6} = \frac{12.5t^2}{6} = 2.08\overline{3}\,t^2$$

$$F_b = \frac{M}{S_x} \Rightarrow S_x = \frac{M}{F_b} \Rightarrow 2.08\overline{3}\,t^2 = \frac{10374}{27000} = 0.384$$

$$\Rightarrow t = \underline{0.429''}$$

⇒ Use ½" plate to match existing design

No stiffener plates are required, however, to match existing drawings, the 2½" stiffeners shown are OK.

Check weld size:

Check $\overset{1/4}{\underset{1/4}{\longleftrightarrow}}$ Weld:

$$\text{Max Shear on Weld} = \frac{293+718}{2}(6)(12.5)\Big/1000$$

$$= 37.91\ \text{k}$$

$$\text{Weld Effective area} = (1/4 \times 0.707)(2)(12.5)$$

$$= 4.42\ \text{in}^2$$

$$\text{Weld Capacity} = (0.3)(70)(4.42) \qquad [\text{AISC } 5\text{-}70]$$

$$= 92.8\ \text{k} > 37.9\ \text{k} \Rightarrow \underline{\underline{\text{OK}}}$$

(NOT USED) Stiffners not required.

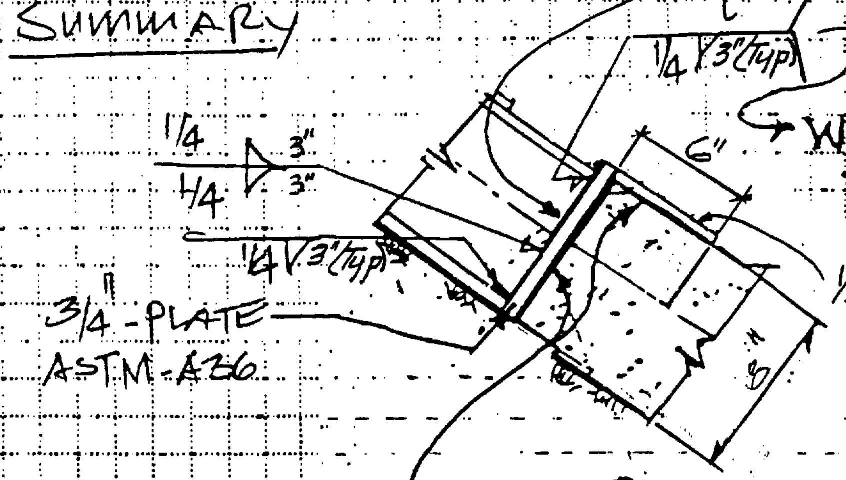
(NOT USED) Stiffners not required.

(NOT USED) Stiffners not required.

PURPOSE III. E – ALTERNATE III (SEE ATTACHMENT IX-16)

SINCE PRIMARY FORCES INDUCED TO FOOT PLATE ARE COMPRESSIVE, THE WELD REQUIREMENT IS MINIMUM. FOR WELD PLATE TO W8 USE FILLET WELDS E70XX MINIMUM ELECTRODES USE 1/4" WELD AS MIN. AISC TABLE J2.4.

SUMMARY

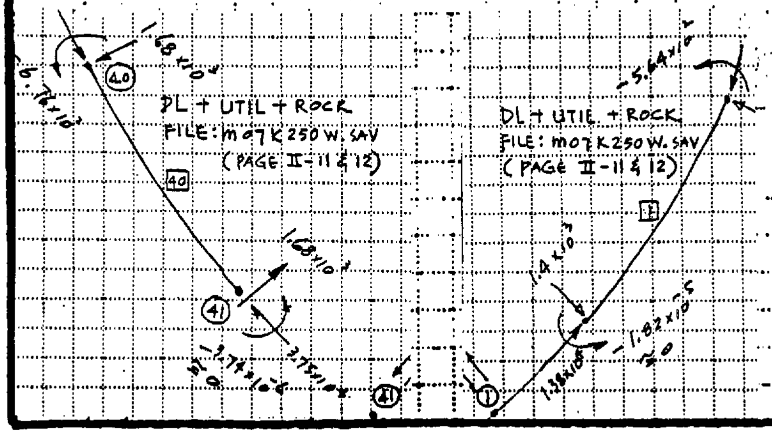


THIS PLATE IS ENLARGED FROM 3/4" x 8" x 12.5" TO 3/4"x 8.5"x 12.5" TO ACCOMODATE Vertical Plate REQD FOR JACKING LOAD.

WELD ELECTRODES SHALL BE E70XX MIN.

THESE PLATE SURFACES SHALL BE WITH POSITIVE CONTACT TO CONCRETE DURING JACKING.

SLIDING STABILITY:



REFERING TO PAGE III-113, THE CRITICAL SLIDING RESISTANCE AT SUPPORT / FOOT PLATE IS AT RUN № 11. ON PAGE III-113, THE SLIDING RESISTANCE WAS CALCULATED CONSERVATIVELY BY AVERAGING FORCES IN ELEMENT 40 AND 41. ACTUAL CRITICAL FORCES CAN BE FOUND AT NODE 41 (THE FOOT PLATE) AND ARE REPRODUCED ON THE LEFT. SLIDING STABILITY RATIO

$$= \frac{0.3(1.38\times10^4)}{1.4\times10^3} = 2.96 > 1.0 \text{ --- OK.}$$

Purpose III E (Cont.)

TABLE 1A. SEISMIC COMPUTER RUN IDENTIFIERS (ATTACHMENT II)

RUN	FILENAME	ROCK TYPE	STATION	MEMBER	SPACING	LOADING[1]
1	p10k2dy.sav	PTn	10+00	W8x31	2 ft	D+U+R+E
2	p07k2dy.sav	TCW	07+00	W8x31	4 ft	D+U+R+E
3	p18k2dy.sav	TSW_1	18+00	W8x31	4 ft	D+U+R+E
4	p34k2dyx.sav	TSW_2	34+00	W8x31	2 ft	D+U+R+E
5	m07_k2dy.sav	TCW	07+00	W6x20	4 ft	D+U+R+E
6	m18_k2dy.sav	TSW_1	18+00	W6x20	4 ft	D+U+R+E
7	m27_k2dy.sav	TSW	27+00	W6x20	4 ft	D+U+R+E
8	m34_k2dy.sav	TSW_2	34+00	W6x20	4 ft	D+U+R+E
9	m53_k2dy.sav	TSW_2	53+00	W6x20	4 ft	D+U+R+E

[1] Dead Load (D) + Utility Loads (U) + Rock Load (R) + Seismic Load (E)

TABLE 1B. STATIC COMPUTER RUN IDENTIFIERS (ATTACHMENT II)

RUN	FILENAME	ROCK TYPE	STATION	MEMBER	SPACING	LOADING[2]
10	m10k250w.sav	PTn	10+00	W8x31	2 ft	D+U +R
11	m07k250w.sav	TCW	07+00	W8x31	4 ft	D+U +R
12	m18k250w.sav	TSW_1	18+00	W8x31	4 ft	D+U +R
13	m34k250x.sav	TSW_2	34+00	W8x31	2 ft	D+U +R
14	m07_k2.sav	TCW	07+00	W6x20	4 ft	D+U +R
15	m18_k2.sav	TSW_1	18+00	W6x20	4 ft	D+U +R
16	m27_k2.sav	TSW_2	27+00	W6x20	4 ft	D+U +R
17	m34_k2.sav	TSW_2	34+00	W6x20	4 ft	D+U +R
18	m53_k2.sav	TSW_2	53+00	W6x20	4 ft	D+U +R

[2] Dead Load (D) + Utility Loads (U) + Rock Load (R) (No seismic)

Purpose III-E (Cont.)

TABLE 2A. SUMMARY OF REACTIONS AT BASE OF STEEL SETS[1] (SEISMIC LOAD CASE -W8x31)

RUN	ELEM.	NODE[5]		FORCES (SI UNITS)[2]		CONVER. FACTOR[3]	FORCES (ENGLISH UNITS)[4]	
		Nod1	Nod2	F-Shear	F-Axial		F-Shear	F-Axial
1	48	48	01	+2.946E+04	+5.693E+05	1.3704E-04	4.04	78.02
	01	01	02	-1.025E+04	+7.314E+05	"	-1.40	100.23
	40	40	41	+1.350E+04	+8.288E+05	"	1.85	113.58
	41	41	42	-2.737E+04	+6.597E+05	"	-3.75	90.41
2	48	48	01	+6.615E+03	+4.946E+04	2.7409E-04	1.81	13.56
	01	01	02	+1.695E+03	+9.691E+04	"	0.46	26.56
	40	40	41	-1.342E+03	+1.048E+05	"	-0.37	28.72
	41	41	42	+6.926E+03	+7.383E+04	"	1.89	20.24
3	48	48	01	+1.809E+04	+2.272E+05	2.7409E-04	4.96	62.27
	01	01	02	+5.482E+03	+2.344E+05	"	1.50	64.25
	40	40	41	-5.996E+03	+2.688E+05	"	-1.64	73.68
	41	41	42	-1.776E+04	+3.082E+05	"	-4.87	84.47
4	48	48	01	+4.106E+04	+2.219E+05	1.3704E-04	5.63	30.41
	01	01	02	+5.026E+03	+3.794E+05	"	0.69	52.00
	40	40	41	-3.537E+03	+4.062E+05	"	-0.48	55.67
	41	41	42	-2.736E+04	+2.459E+05	"	-3.75	33.70

FOOOTNOTES:

1. From Computer Runs 1 thru 4 identified in Table 1A (Attachment II)
2. SI Units = Newtons
3. Conversion Factor = F(newtons) x Spacing(ft)/3.28084(ft/m) x 0.22481(lbf/newton) x 0.001(kip/lbf) = F(kip)
4. English Units = Kips
5. Pinned Nodes (Moment = 0) are at Nodes 01 & 41

PURPOSE III E
(CONT.)

TABLE 2B. SUMMARY OF REACTIONS AT BASE OF STEEL SETS[1] (SEISMIC LOAD CASE -W6x20)

RUN	ELEM.	NODE[5]		FORCES (SI UNITS)[2]		CONVER. FACTOR[3]	FORCES (ENGLISH UNITS)[4]	
		Nod1	Nod2	F-Shear	F-Axial		F-Shear	F-Axial
5	48	48	01	+9.245E+03	+2.151E+04	2.7409E-04	2.53	5.90
	01	01	02	-1.525E+02	+3.071E+04	"	-0.04	8.42
	40	40	41	+1.162E+02	+3.195E+04	"	0.03	8.76
	41	41	42	-4.998E+03	+2.083E+04	"	-1.37	5.71
6	48	48	01	+2.114E+04	+1.051E+05	2.7409E-04	5.79	28.81
	01	01	02	+2.872E+02	+5.643E+04	"	0.08	15.47
	40	40	41	-2.530E+02	+7.635E+04	"	-0.07	20.93
	41	41	42	-2.202E+04	+1.531E+05	"	6.04	41.96
7	48	48	01	+2.517E+04	+1.300E+04	2.7409E-04	6.90	3.56
	01	01	02	+8.836E+02	+7.251E+04	"	0.24	19.87
	40	40	41	-1.020E+03	+8.315E+04	"	-0.28	22.79
	41	41	42	-2.845E+04	+3.529E+04	"	-7.80	9.67
8	48	48	01	+1.236E+04	+9.559E+03	2.7409E-04	3.39	2.62
	01	01	02	+9.089E+02	+7.749E+04	"	0.25	21.24
	40	40	41	-7.561E+02	+8.131E+04	"	-0.21	22.29
	41	41	42	-6.258E+03	+7.554E+04	"	-1.72	20.70
9	48	48	01	+2.456E+04	+1.328E+04	2.7409E-04	6.73	3.64
	01	01	02	+9.359E+02	+7.082E+04	"	0.26	19.41
	40	40	41	-5.696E+02	+7.827E+04	"	-0.16	21.45
	41	41	42	-2.250E+04	+4.287E+04	"	-6.17	11.75

FOOOTNOTES:

1. From Computer Runs 5 thru 9 identified in Table 1A (Attachment II)
2. SI Units = Newtons
3. Conversion Factor = F(newtons) x Spacing(ft)/3.28084(ft/m) x 0.22481(lbf/newton) x 0.001(kip/lbf) = F(kip)
4. English Units = Kips
5. Pinned Nodes (Moment = 0) are at Nodes 01 & 41

PURPOSE III-E
(CONT.)

TABLE 2C. SUMMARY OF REACTIONS AT BASE OF STEEL SETS[1] (STATIC LOAD CASE - W8x31)

RUN	ELEM.	NODE[5]		FORCES (SI UNITS)[2]		CONVER. FACTOR[3]	FORCES (ENGLISH UNITS)[4]	
		Nod1	Nod2	F-Shear	F-Axial		F-Shear	F-Axial
10	48	48	01	+1.805E+04	+3.410E+05	1.3704E-04	2.47	46.73
	01	01	02	-7.099E+03	+4.667E+05	"	-0.97	63.96
	40	40	41	+1.246E+04	+4.875E+05	"	1.71	66.81
	41	41	42	-1.513E+04	+3.543E+05	"	-2.07	48.55
11	48	48	01	-1.207E+03	-5.178E+04	2.7409E-04	-0.33	-14.19[6]
	01	01	02	-1.403E+03	+1.379E+04	"	-0.38	3.78
	40	40	41	-1.682E+03	+3.749E+04	"	-0.46	10.28
	41	41	42	-1.576E+04	-2.465E+04	"	-4.32	- 6.76[6]
12	48	48	01	+1.655E+04	+1.207E+05	2.7409E-04	4.54	33.08
	01	01	02	+2.345E+03	+1.462E+05	"	0.64	40.07
	40	40	41	-1.143E+03	+1.442E+05	"	-0.31	39.52
	41	41	42	-1.358E+04	+1.309E+05	"	-3.72	35.87
13	48	48	01	+3.282E+04	+1.111E+05	1.3704E-04	4.50	15.23
	01	01	02	+2.449E+03	+2.539E+05	"	0.34	34.80
	40	40	41	-2.068E+03	+2.647E+05	"	-0.28	36.28
	41	41	42	-1.538E+04	+1.082E+05	"	-2.11	14.82

FOOOTNOTES:

1. From Computer Runs 10 thru 13 identified in Table 1B (Attachment II)
2. SI Units = Newtons
3. Conversion Factor = F(newtons) x Spacing(ft)/3.28084(ft/m) x 0.22481(lbf/newton) x 0.001(kip/lbf) = F(kip)
4. English Units = Kips
5. Pinned Nodes (Moment = 0) are at Nodes 01 & 41
6. Negative axial forces (tension) for Run No. 11 indicate that the rock is moving away from the steel set/invert & are a result of modelling assumptions in FLAC runs to provide conservative rock loads. In reality, the steel set remains in compression at all times.

TITLE: ESF Ground Support - Structural Steel Analysis

PURPOSE III. E (CONT.)

TABLE 2D. SUMMARY OF REACTIONS AT BASE OF STEEL SETS[1] (STATIC LOAD CASE - W6x20)

RUN	ELEM.	NODE[5]		FORCES (SI UNITS)[2]		CONVER. FACTOR[3]	FORCES (ENGLISH UNITS)[4]	
		Nod1	Nod2	F-Shear	F-Axial		F-Shear	F-Axial
14	48	48	01	+4.352E+03	-1.685E+04	2.7409E-04	1.19	- 4.62[6]
	01	01	02	-2.331E+02	+1.043E+04	"	-0.06	2.86
	40	40	41	+2.307E+02	+9.822E+03	"	0.06	2.69
	41	41	42	-7.839E+02	-1.633E+04	"	-0.21	-4.48[6]
15	48	48	01	+1.645E+04	+4.356E+04	2.7409E-04	4.51	11.94
	01	01	02	+5.369E+01	+3.370E+04	"	-0.01	9.24
	40	40	41	+1.172E+02	+3.892E+04	"	-0.03	10.66
	41	41	42	-1.879E+04	+4.925E+04	"	-5.15	13.50
16	48	48	01	+2.040E+04	-2.092E+04	2.7409E-04	5.59	-5.73[6]
	01	01	02	+8.914E+02	+5.366E+04	"	0.24	14.71
	40	40	41	-8.040E+02	+5.721E+04	"	-0.22	15.68
	41	41	42	-2.483E+04	-2.027E+04	"	-6.81	-5.56[6]
17	48	48	01	+8.100E+03	-2.764E+04	2.7409E-04	2.22	-7.58[6]
	01	01	02	+8.765E+02	+5.838E+04	"	0.24	16.00
	40	40	41	-5.700E+02	+5.361E+04	"	-0.16	14.69
	41	41	42	-1.458E+03	+2.165E+04	"	-0.40	5.93
18	48	48	01	+2.058E+04	-2.727E+04	2.7409E-04	5.64	-7.47[6]
	01	01	02	+8.523E+02	+5.076E+04	"	0.23	13.91
	40	40	41	-4.445E+02	+5.212E+04	"	-0.12	14.29
	41	41	42	-1.820E+04	-1.464E+04	"	-4.99	-4.01

FOOOTNOTES:

1. From Computer Runs 14 thru 18 identified in Table 1B (Attachment II)
2. SI Units = Newtons
3. Conversion Factor = F(newtons) x Spacing(ft)/3.28084(ft/m) x 0.22481(lbf/newton) x 0.001(kip/lbf) = F(kip)
4. English Units = Kips
5. Pinned Nodes (Moment = 0) are at Nodes 01 & 41
6. Negative axial forces (tension) for Runs No. 14 & 16-18 indicate that the rock is moving away from the steel set/invert & are a result of modelling assumptions in the FLAC runs to provide conservative rock loads. In reality, the steel set remains in compression at all times.

STEEL SET FOOT PLATE OFFSET FROM FACE OF INVERT CURB.

MAX. OFFSET REQUIRED FOR BEARING (SEE SKETCH BELOW)

$P_u = P_e = 121.8^k$ (PAGE III-108). { USE UNFACTORED LOAD SINCE SEISMIC LOAD BASED ON DYNAMIC ANALYSIS & CONSERVATIVE "DBE" ZPA OF 0.37g H&V WHICH IS > UBC SEISMIC BY APPROX 2X

$P_u \leq \phi P_n =$ BEARING STRENGTH $\leq \phi\,(.85) f_c' A_1$ ACI 318, SECT. 10.15

$\phi = 0.70$ ACI 318, SECT. 9.3.2.4

$f_c' = 5000\,psi$ $A_1 = [6.75 - (X - 0.5)]\,(12.5)$

$= (7.25 - X)(12.5)$

$P_u = \phi P_n = 121.8^k \leq \underbrace{0.70\,(.85)(5000)}_{2.975\,ksi}[(7.25 - X)(12.5)]$ ----

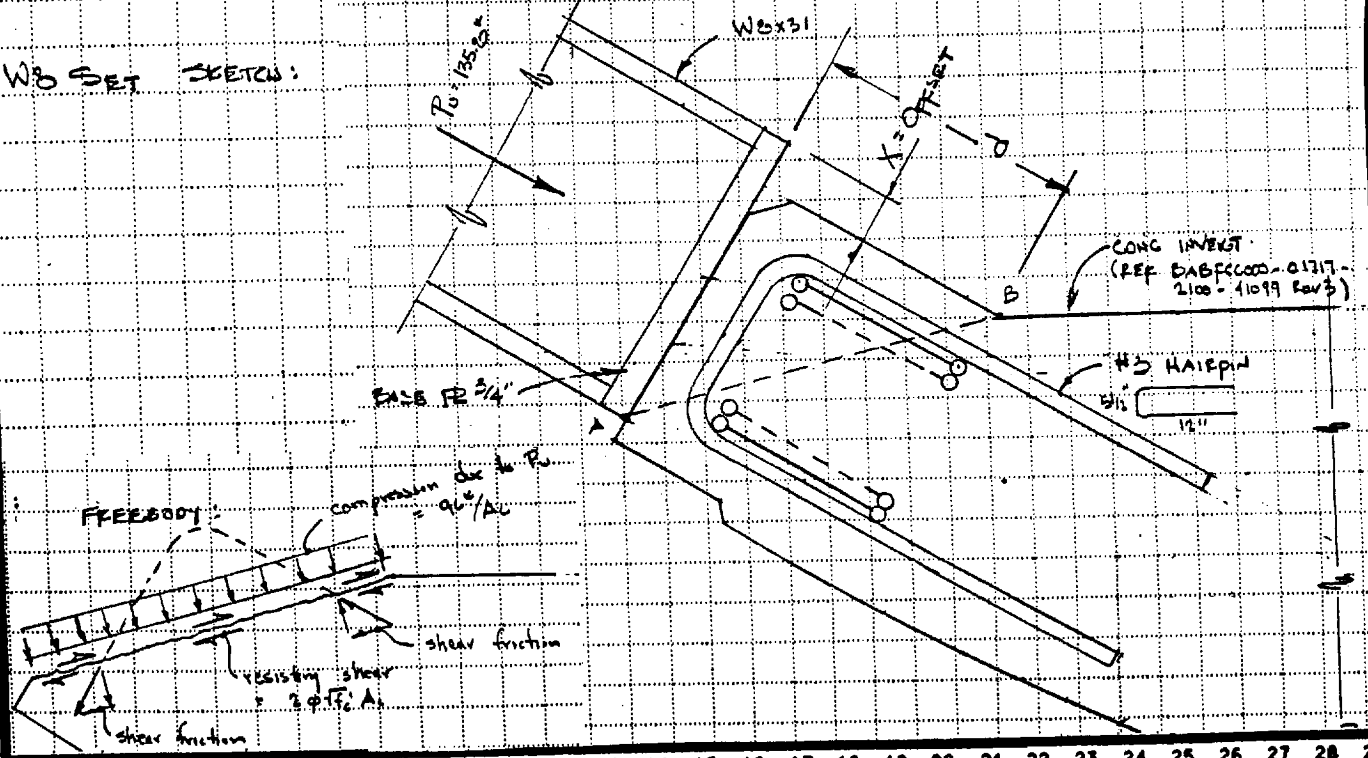
$121.8^k \leq 2.975\,(7.25 - X)\,(12.5)$

$\frac{121.8}{2.975\,(12.5)} = 3.275'' = 7.25 - X$

$X = 7.25 - 3.275 = 3.975$ SAY $\underline{\underline{4''}}$

CHECK $\frac{121.8}{(8 - 4.0 - .75)(12.5)} = 2.998\,ksi$ brng pressure $\cong 2.975$ ∴ assume ok

W8 SET SKETCH:



FOOT PLATE OFFSET (CONTINUED)

SHEAR FRICTION (REF ACI 318, SECTION 11.7):

FOR BOTH BAR, $\alpha = 45°$. ASSUMING #3 HAIRPIN ACTS AS SHEAR-FRICTION REINFORCEMENT, $A_{vf} = 0.11\ in^2 \times 2 = 0.22\ in^2$

ASSUME EFFECTIVE WIDTH OF CURB (IN SHEAR) IS $\doteq b + 2d$ SO $W_{eff} = 12.5 + 2(6.25") = 25"$ WHICH IS APPROX $\frac{1}{2}$ OF INVERT WIDTH. CONSERVATIVELY USE THIS WIDTH (DON'T FLARE @ 45°).

FOR SHEAR FRICTION REINF. ALONE (2 #3 BARS):

$V_n = A_{vf}\, f_y (\mu \sin \alpha_f + \cos \alpha_f)$ (ACI 318, SECTION 11.7.4.2)

$= (0.22)(60)(1.4(1.0) \sin 45° + \cos 45°)$

$= 13.2^k (.990 + .707) = 22.4^k << 121.8^k$ ∴ ALONE, A_{vf} CAN'T RESIST SHEAR.

FOR SHEAR ON SECTION, $V_c = 2\left(1 + \frac{N_u}{2000 A_g}\right)\sqrt{f_c'}\, A_c$ (ACI 318, SECTION 11.3.1.2)

ASSUME $1\frac{1}{4}"$ OFFSET (SELECTED TO HAVE FAILURE PLANE ABOVE PT B):

$A_c \doteq 6.5" \left(\frac{1}{\sin 45°}\right)(25") + \frac{1}{2}\underbrace{(6.5")(6.5")(2)\left(\frac{1}{\cos 45°}\right)}_{\text{AT SIDES OF SHEAR "CONE"}} = 289.6\ in^2 = A_g$

$V_c = 2\left(1 + \frac{N_u}{2000 A_g}\right)\sqrt{f_c'}$ w/ $N_u = 121.8^k$ $A_g = 289.6$

$= 2\left(1 + \frac{121.8^k}{2000\,(289.6)}\right)\sqrt{f_c'} = 0.171$ ksi

$V_{c_1} = 0.171\,(289.6) = 49.5^k$

ADD NET COMPRESSION ACROSS SECTION TO V_c

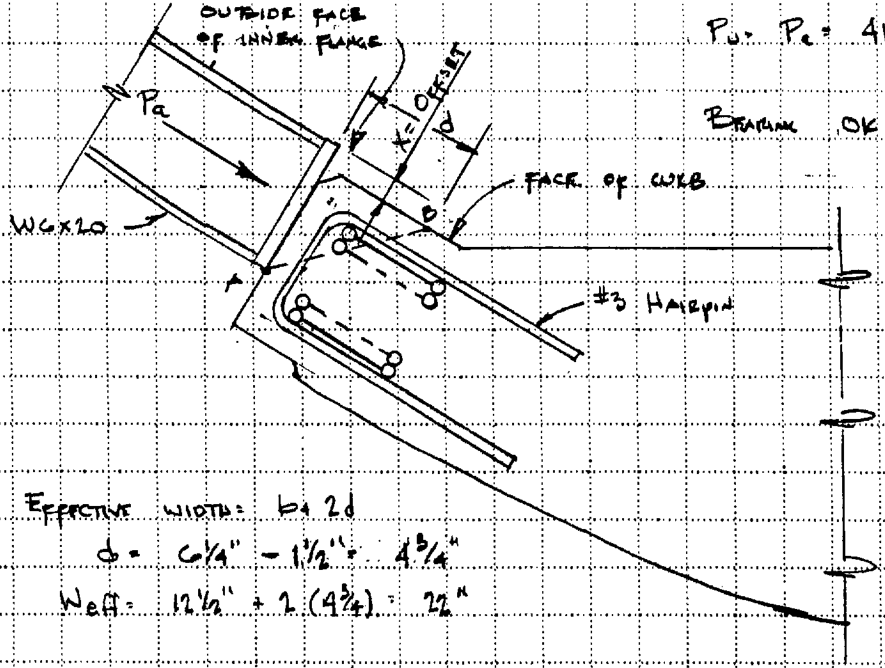
$V_{c_2} = 121.8^k \cos 45° = 86.1^k$ (ACI 318, SECT 11.7.7)

$V_n = 49.5^k + 86.1^k = 135.6^k$

$\phi V_n = 0.85(135.6) = 115.3^k \doteq V_u = 121.8$ (5% UNDER)

∴ MAX. OFFSET = $1\frac{1}{4}"$ (95%) $\cong 1\frac{1}{8}"$ ∴ USE $\underline{\underline{1"}}$ MAX. OFFSET

FOOT PLATE OFFSET (CONTINUED)



CHECK W6 STEEL SET

$P_u = P_e = 41.96^k$ (w/ SEISMIC) SAY $= 42^k$

BEARING OK BY INSPECTION

START BY ASSUMING:
OFFSET $= x = 1\frac{1}{2}''$

CHECK SHEAR ON SECTION A-B

FROM PREVIOUS PAGE, SHEAR-FRICTION REINF. IS NOT SUFFICIENT.

EFFECTIVE WIDTH = $b + 2d$

$d = 6\frac{1}{4}'' - 1\frac{1}{2}'' = 4\frac{3}{4}''$

$W_{eff} = 12\frac{1}{2}'' + 2(4\frac{3}{4}) = 22''$

$$A_c \cong (4.75'')\left(\frac{1}{\sin 45^\circ}\right)(22'') + \frac{1}{2}(4.75)(4.75)(2)(1/\cos 45^\circ) = 179.7\ \text{in}^2$$

$$V_c = 2\left(1 + \frac{N_u}{2000 A_g}\right)\sqrt{f_c'} = 2\left(1 + \frac{42{,}000}{2000\,(179.7)}\right)\sqrt{5000} = 0.158\ \text{ksi}$$

$$\left.\begin{array}{l} V_{c_1} = 0.158\,(179.7) = 28.4^k \\ V_{c_1} = 42^k \cos 45^\circ = 29.7^k \end{array}\right\} \quad V_n = V_{c_1} + V_{c_2} = 28.4 + 29.7 = 58.1^k$$

$$\phi V_n = 0.85\,(58.1) = 49.4^k > 42.0^k \quad \therefore \quad 1\frac{1}{2}''\ \text{OFFSET OK FOR W6}$$

SUMMARY:

BASED ON SHEAR FAILURE OF THE INVERT CURB, AN ALLOWANCE OF <u>1"</u> WILL BE SPECIFIED FOR THE MAX. OFFSET OF THE BASEPLATE TOWARD THE TUNNEL CENTERLINE FOR BOTH THE W6 & W8 STEEL SETS. OFFSET TO BE MEASURED FROM FACE OF INVERT CURB TO OUTSIDE FACE OF INNER FLANGE OF THE W6 OR W8.

PURPOSE III.F A) STEEL SET FOOT SEGMENT CALCULATION FOR W 8x31 FOOT SEGMENT

DESIGN STEEL SET-FOOT SEGMENT

W8x31 IS "OK" FOR ROCK LONG TERM LOADS (SEE COMPUTER OUTPUT).

CHECK THE CONSTRUCTION LOADS - USING 25 TONS JACK AND 27 TONS DESIGN LOAD.

$P_a = 27^T \times 2^{k/T}$

$P_a = 54$ k

$M = \frac{54(6)}{12}$

$= 27$ FT-k

FOR W8x31

$A_1 = 9.13$ in^2

$I_1 = 110$ in^4 , $S = 27.5$ in^3

$f_{bx} = \frac{27^{k} \times 12}{27.5} = 11.78^{ksi}$

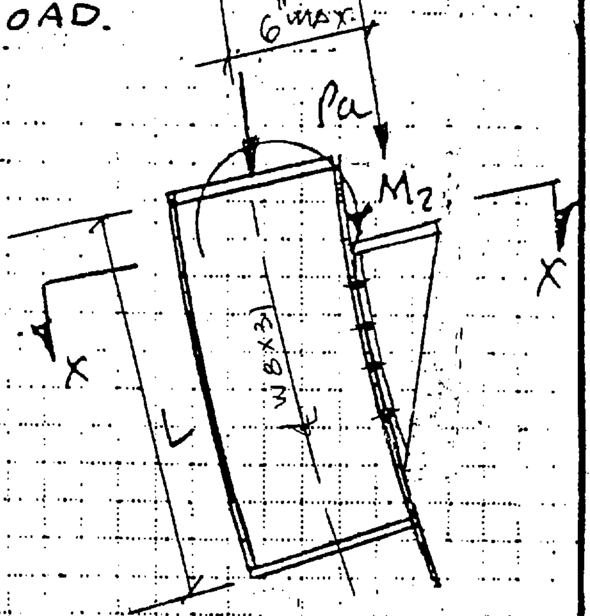
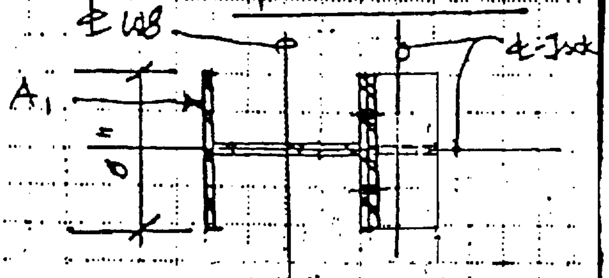


FIGURE-A



SECTION X-X

PURPOSE III. F

W8x31 FOOT SEGMENT

DESIGN PARAMETERS

$L = 12'-0"$ MAX (TYPICAL DIMENSION)

$A = 9.13 \text{ in}^2$, $I = 110.0 \text{ in}^4$,

$r_x = 3.47$

$r_y = 2.02$

$$f_a = \frac{P_a}{A} = \frac{54.00}{9.13} = 5.91 \text{ ksi}$$

$$\frac{KL}{r_y} = \frac{(1)(12 \times 12)}{2.02} = 71.3 \quad F_a = 16.3 \text{ ksi}$$

(AISC TABLE C-36)

$$f_a/F_a = \frac{5.91}{16.3} = 36.3\% > 15\%$$ CHECK AISC (H1-1&2)

$$\frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{(1 - \frac{f_a}{F'_{ex}}) F_{bx}} \leq 1.0$$ ---AISC (H1-1)

$$K l_b / r_b = \frac{1.0 \times 144}{3.47} = 41.5, \quad F'_{ex} = 86.7$$ --- AISC P5-122

$$0.336 + \frac{1.0 \times 11.78}{(1 - \frac{5.91}{86.7}) \times 21.6} \xrightarrow{} 0.585 = 0.875 < 1.0$$ ---- O.K.

PURPOSE III.F   FOR W 8X31 FOOT SEGMENT

$$fa/_{0.6F_y} + \frac{fb_x}{Fb_x}$$ ---- AISC (H1-2)

$$\frac{5.91}{21.6} + \frac{11.78}{21.6} = 0.82 < 1.0$$ ---- O.K.

∴ USE W8X31 WITH MINIMUM JACKING BRACKET AS SHOWN ON FIGURE A AND MAXIMUM LENGTH 12'-0".

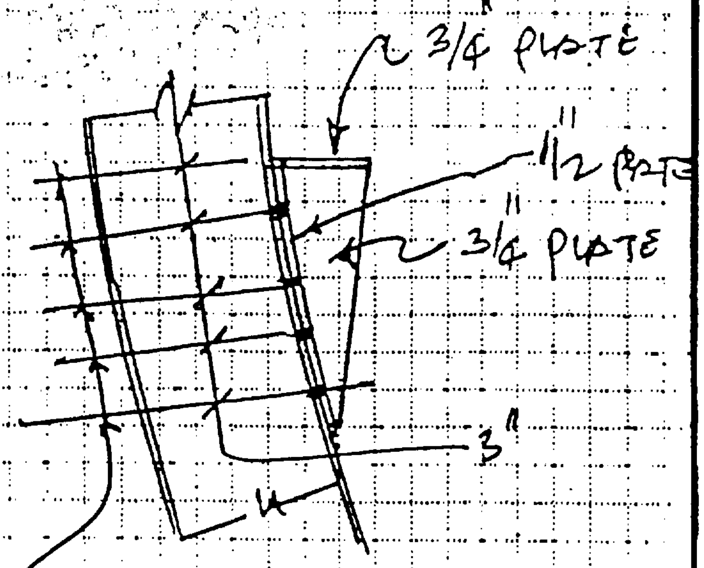
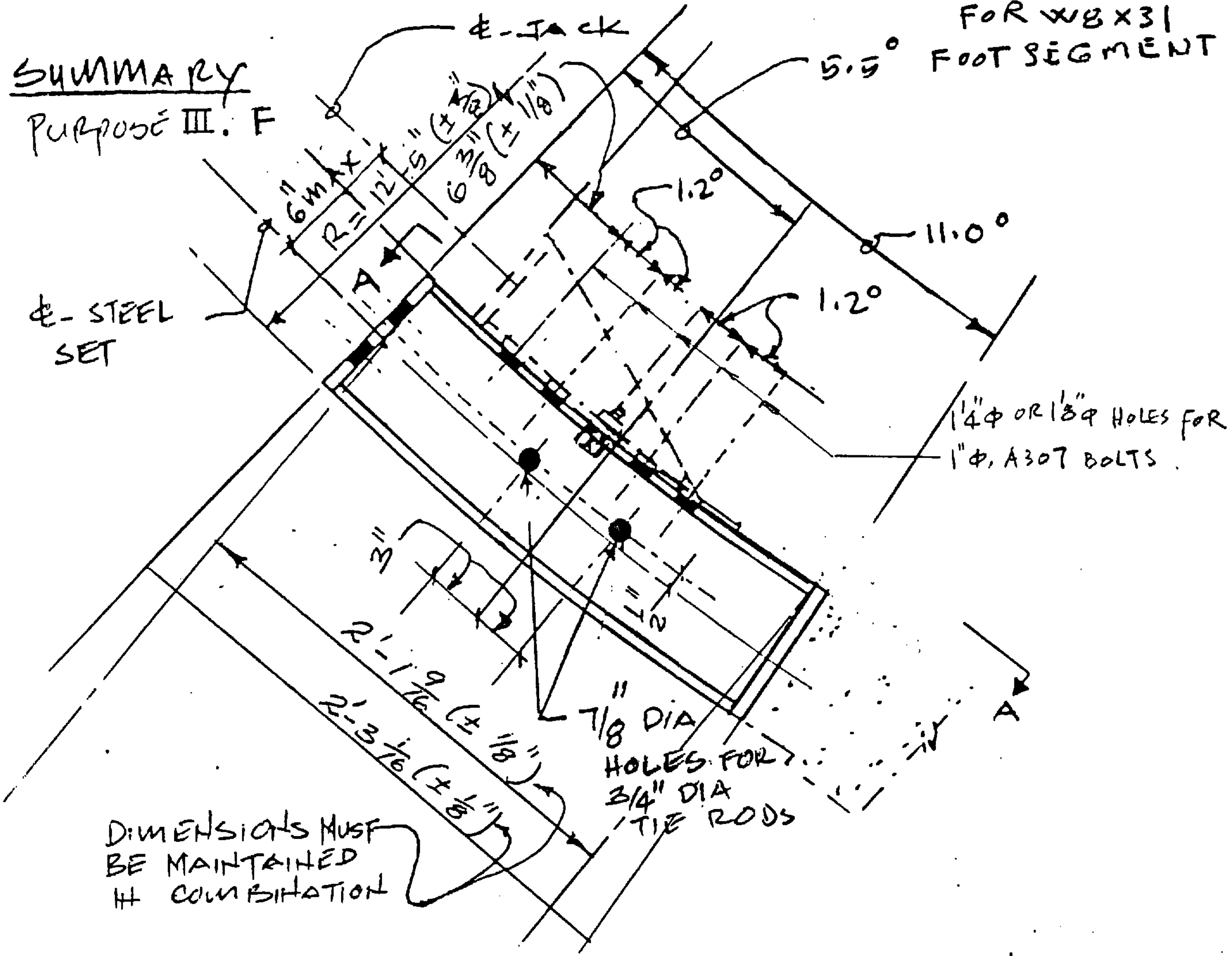


FIGURE-A

SUMMARY

PURPOSE III. F

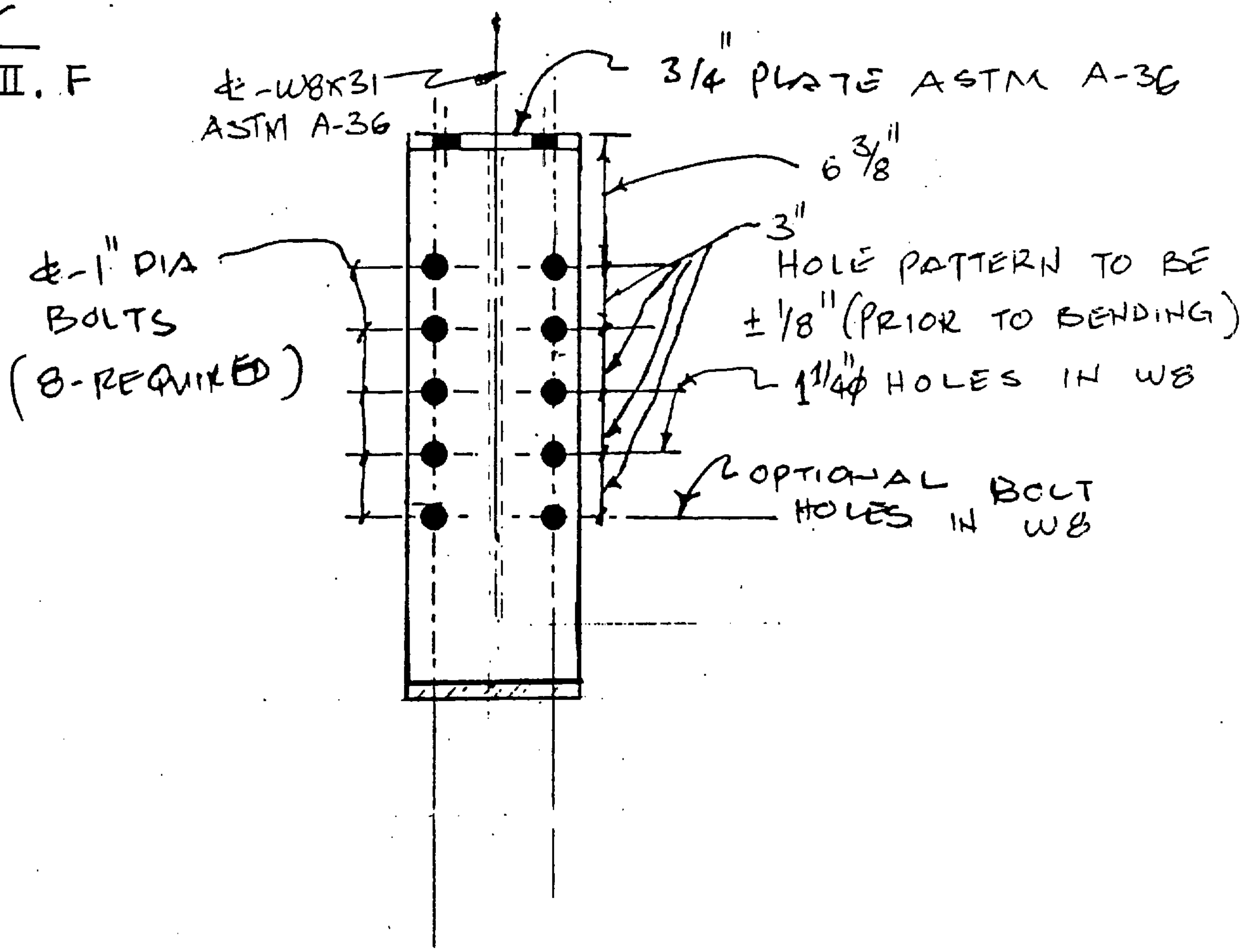


STEEL SET FOOT SEGMENT

FOR W8X31 FOOT SEGMENT

SUMMARY

PURPOSE III. F



SECTION A-A

PURPOSE III.F B) STEEL SET FOOT SEGMENT CALCULATION - FOR W6 x 20 FOOT SEGMENT

DESIGN STEEL SET - FOOT SEGMENT

W8 x 31 IS "OK" FOR LONG TERM LOADS (SEE COMPUTER OUTPUT).

CHECK THE CONSTRUCTION LOADS - USING 15 TONS JACK AND 17 TONS DESIGN LOAD.

$P_a = 17^T \times 2^{k/T}$

$P_a = 34\ k$

$M = \frac{34(5)}{12}$

$= 14.17\ FT\text{-}K$

FOR W 6 x 20

$A_1 = 5.87\ IN^2$

$I_1 = 41.4\ IN^4$, $S = 13.4\ IN^3$

$f_{bx} = \frac{14.17^{K} \times 12}{13.4} = 12.69^{KSI}$

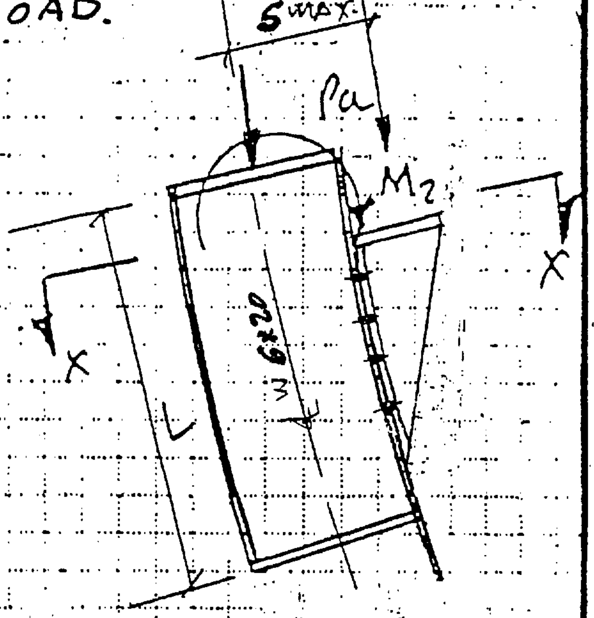
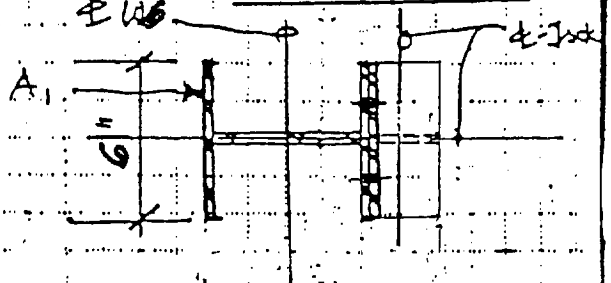


FIGURE - A



SECTION X-X

PURPOSE III. F

W6x20 FOOT SEGMENT

DESIGN PARAMETERS

$L = 12'-0"$ MAX (TRIBL DIMENSION)

$A = 5.87 \ in^2$, $I = 41.4 \ in^4$,

$r_x = 2.66$

$r_y = 1.5$

$$f_a = \frac{P_a}{A} = \frac{34.00}{5.87} = 5.79 \ ksi$$

$$\frac{KL}{r_y} = \frac{(1)(12 \times 12)}{1.5} = 96 \qquad F_a = 13.48 \ ksi$$

(AISC TABLE C-36)

$$f_a/F_a = \frac{5.79}{13.48} = 42.95\% > 15\% \quad \text{CHECK AISC (H1-1\&2)}$$

$$\frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{\left(1 - \frac{f_a}{F'_{ex}}\right) F_{bx}} \leq 1.0 \text{ ---- AISC (H1-1)}$$

$$K l_b / r_b = \frac{1.0 \times 144}{2.66} = 54.14, \quad F'_{ex} = 50.8 \text{ --- AISC P5-122}$$

$$0.287 + \frac{1.0 \times 12.69}{\left(1 - \frac{5.79}{50.8}\right) \times 21.6} = 0.95 < 1.0 \text{ --- O.K.}$$

$$\xrightarrow{} 0.663$$

PURPOSE III. F FOR W6X20 FOOT SEGMENT

$f_a/_{0.6F_y} + \frac{f_{b_x}}{F_{b_x}}$ ---- AISC (H1-2)

$\frac{5.79}{21.6} + \frac{12.69}{21.6} = 0.856 < 1.0$ ---- O.K.

- USE W6X20 WITH MINIMUM JACKING BRACKET AS SHOWN ON FIGURE A AND MAXIMUM LENGTH 12'-0".

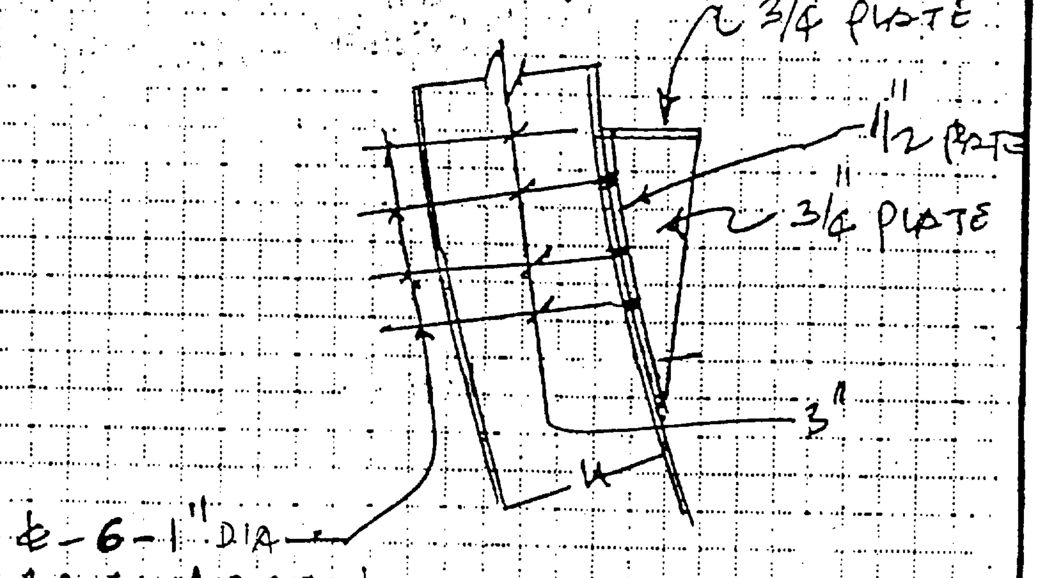
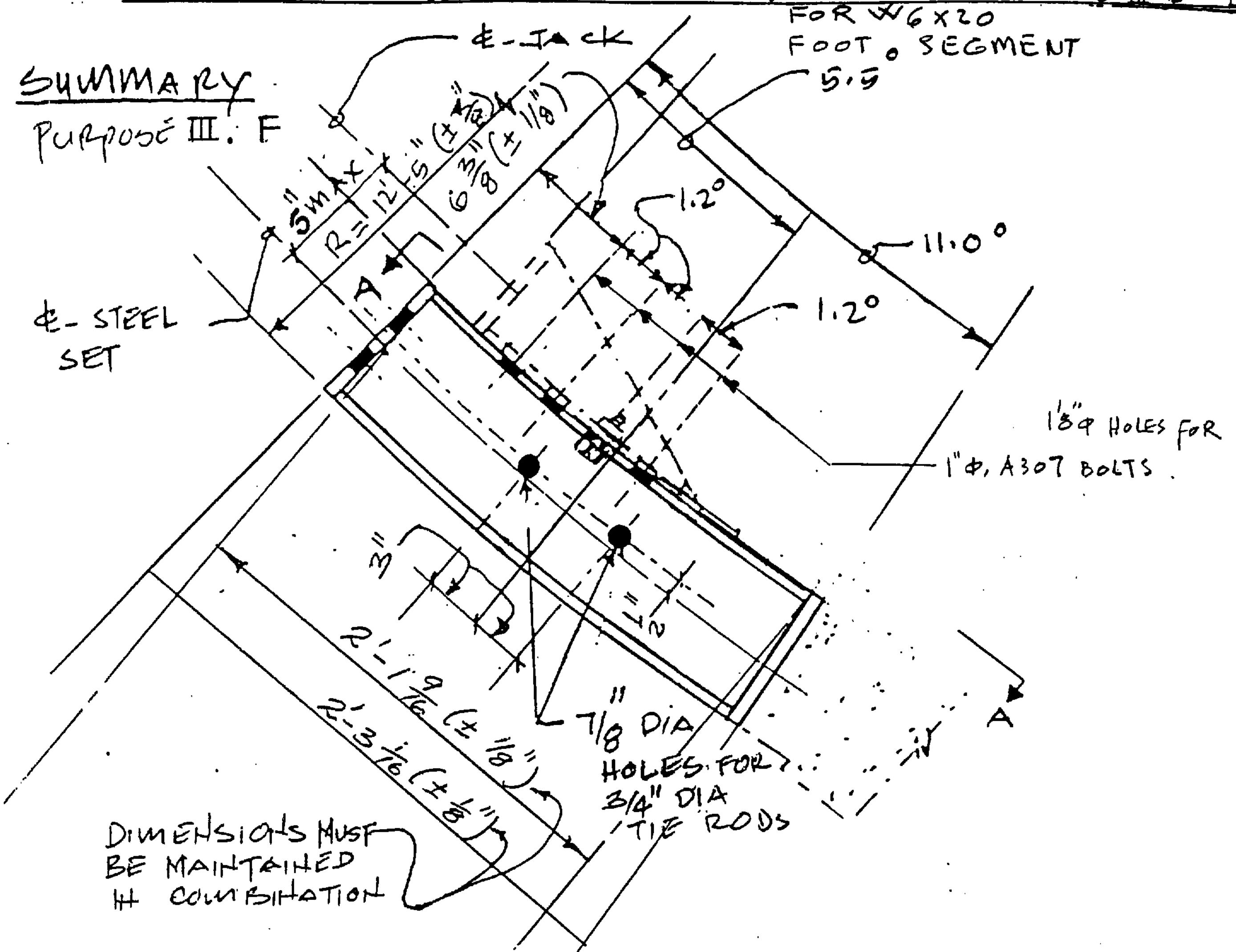


FIGURE-A

SUMMARY
PURPOSE III. F

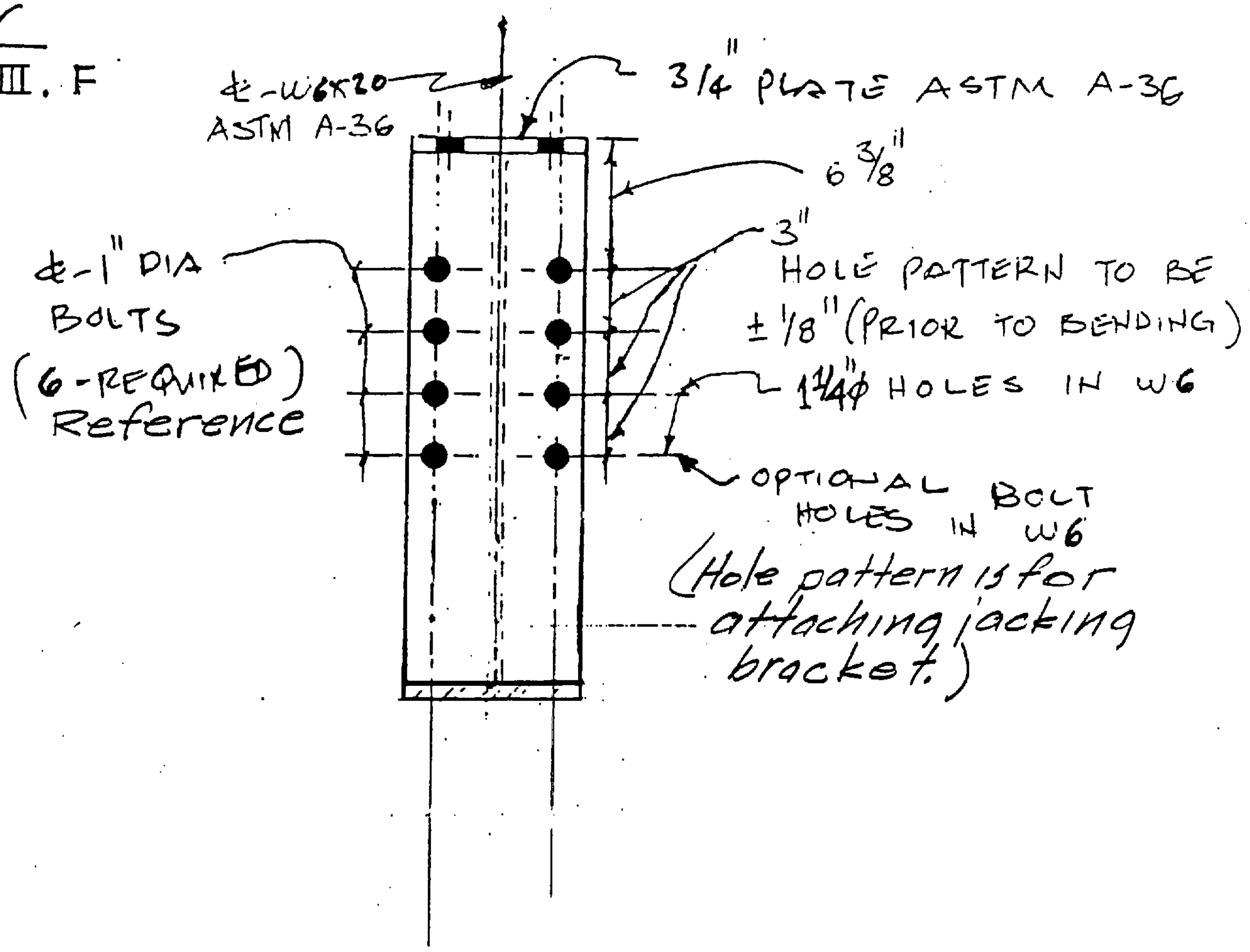


STEEL SET FOOT SEGMENT

FOR W6X20 FOOT SEGMENT

SUMMARY

PURPOSE III. F



SECTION A-A

PURPOSE III G CONNECTION BETWEEN STEEL SET SEGMEMTS CALCULATION

A) FOR W8x31 STEEL SETS

SPLICE LOCATIONS ARE AT NODES 27 AND 15.

CRITICAL LOADS AND LOCATIONS:

CASE 1) SEISMIC LOADING AT STATION 18+00, NODE 15:
SPACING 4'-0"

SHEAR = 12,970 N. FACTORED = 12.970 × 1.22 × 0.225 = 3.56^{k}

AXIAL = 252.10 N. " = 252.1 × 1.22 × 0.225 = 69.20^{k}

MOMENT = 2.14 N m " = 2.14 × 1.22 × 0.738 = 1.93k'

CASE 2) STATIC LOADING AT STATION 7+00, NODE 15:
SPACING 4'-0"

SHEAR = 1.876 N " = 1.876 × 1.22 × 0.225 = 0.51^{k}

AXIAL = 5.86 N = 5.86 × 1.22 × 0.225 = 1.61^{k}

MOMENT = 0.289 N M = .289 × 1.22 × 0.738 = 0.26^{k}

CASE 3) SEISMIC LOADING AT STATION 10+00, NODE 27
SPACING 2'-0"

SHEAR = 15.11 N " = 15.11 × 0.61 × 0.225 = 2.07^{k}

AXIAL = 1,069.00 N " = 1069.00 × 0.67 × 0.225 = 146.72

MOMENT = 4.773 N M " = 4.773 × 0.61 × 0.738 = 2.15^{k}

REVIEW OF THE ABOVE LOADING AND COMPARISON OF THE ABOVE LOADING WITH THE JACKING LOADS INDICATES THAT JACKING LOADS GOVERNS THE DESIGN OF BOLTS FOR THE SPLICE CONNECTION. (SEE THE FOLLOWING CALCULATION SHEETS.

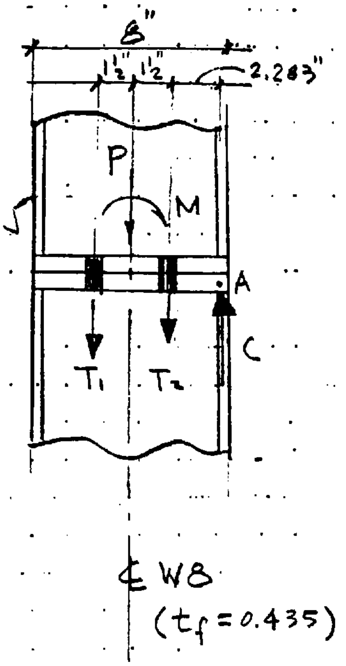
PURPOSE III.G CONNECTION BETWEEN STEEL SET SEGMENTS CALCULATION

The splice design is controlled by the jacking loading conditions. The joint at the connection point is modeled in the computer input as a fixed joint. The axial force, shear, and bending moment used for design of the connection are based on the file STLRV3A (Attachment I) which produces the maximum tensile stresses in the connection bolts.

PURPOSE III. G A) CONNECTION BETWEEN STEEL SET SEGMENTS CALCULATION FOR W 8×31

DESIGN OF STEEL SET SPLICE CONNECTION:

THE CRITICAL DESIGN LOADS AT THE CONNECTION ARE PRODUCED BY JACKING LOADS (STLRV3A) JOINT 16 MEMBER 15



$P = -41.16^k$ COMPRESSION

$V = 9.44^k$ SHEAR

$M = 9.11^{\prime k}$ MOMENT

$\Sigma M_{@A} = 0$

$9.11^{\prime k} \times 12 - (5.283 T_1 + 2.283 T_2) - 41.16^{k} \times 3.783 = 0$ $^{155.8}$

$T_1 + 0.432 T_2 + 8.78 = 0$ ---- (1)

AND,

$T_1 / T_2 = 5.283 / 2.283$

$T_1 = 2.314 T_2$

FROM EQ. (1)

$2.314 T_2 + 0.432 T_2 + 8.78 = 0$

$T_2 = -3.2^k$ (COMPRESSION)

$T_1 = -7.4^k$ (COMPRESSION)

THE COMPRESSION FORCES AT BOLTS INDICATE NO BOLT TENSION AND THE COMPRESSION FORCES ARE ACTURALY TAKEN BY BEARING BETWEEN PLATES.

PURPOUSE III G A) CONT'D.

CHECK STRESS IN BOLT ~

USING 1"Φ A307 BOLTS, AREA FOR TENSILE STRESS = 0.606 IN^2 --- P 4-147 AISC

TENSION STRESS IN BOLT = 0

SHEAR STRESS IN BOLT $= \frac{9.44^{K}}{(4)\text{ BOLTS} \times 0.7854} = 3.0^{KSI} = f_v$

ALLOWABLE SHEAR $F_v = 10^{KSI} > f_v = 3.0^{KSI}$ --- O.K.
--(AISC PAGE 4-5)

USE (4) - 1"Φ A-307 BOLTS.

CHECK END PL AT SPLICE CONNECTION ~ (END PL THICKNESS = $\frac{3}{4}$")

MAX. BENDING IN PLATE = 0

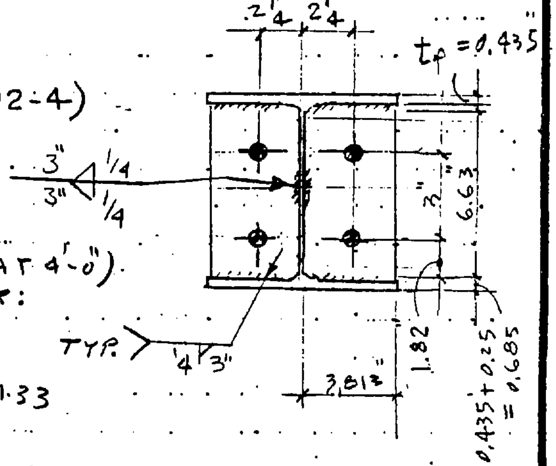
WELD OF END PL TO STEEL STEEL SET,

USE MINIMUM $\frac{1}{4}$ $\frac{1}{4}$ --- (AISC TABLE J2-4)

WELD OF WEB TO END PLATE:

MAX. SHEAR = 3.56^{K} (SEE LOAD AT STATION 18+00 - NODE 15 - STEEL SET AT 4'-0").
FOR 1/4" FILLET WELD x 3" LONG - 2 SIDES:
ALLOW WELD CAP = V_A

$V_A = (0.3 \times 70\text{ ksi})(0.25\text{ in} \times \cos 45°)(2 \times 3\text{ IN}) \times 1.33$
$= 29.6\text{ K} >> 3.56\text{ K}$ O.K.



USE 3/4" PL, A36 AT EACH END OF W8
AND 1/4" FILLET WELD AS SHOWN.

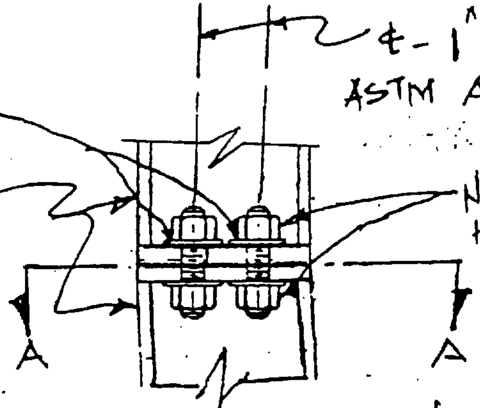
WELD OF FLANGE TO END PLATE:

THE STEEL SET IS IN FULL COMPRESSION AND REQUIRES NO STRENGTH WELD AT FLANGE
HOWEVER, FOR GOOD DESIGN PRACTICE USE 1/4 V3" AS SHOWN.

SUMMARY

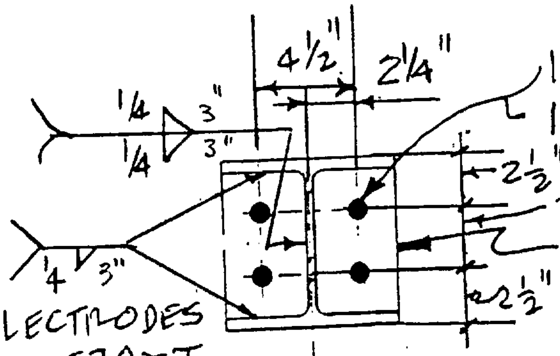
PURPOSE III.G

A) FOR W8x31 STEEL SETS



Washer & nut are selected based on compatibility with ASTM A307 Bolts.

CONNECTION BETWEEN STEEL SET SEGMENTS



NOTE: HOLE DIAMETER 1⅛" or 1¼" SHALL BE AT CONSTRUCTOR'S OPTION.

SECTION A-A

PURPOSE III G B) CONNECTION BETWEEN STEEL SET

SEGMENT CALCULATIONS FOR W6X20 STEEL SETS

MOST CRITICAL LOAD CONDITION FOR THE SPLICE:

LOCATIONS: NODES 27 AND NODE 15

CRITICAL LOADING CONDITION:

CASE 1) STATIC LOADING AT STATION 53+00, NODE 15
SPACING 4'-0"
SHEAR 2566 N. FACTORED = 2.566X1.22X0.225 = 0.709^{K}
AXIAL 52,550 " = 52.55 X 1.22X0.225 = 14.92^{K},
MOMENT 573.4 NM " = 0.573X1.22X0.738 = $0.52^{K'}$

CASE 2) STATIC LOADING AT STATION 7+00, NODE 15
SPACING 4'-0"
SHEAR 691.4 N " = 0.691 X1.22 X0.225 = 0.190 K
AXIAL 18440 N " = 18.44 X1.22 X0.225 = 5.06 K
MOMENT 246.7 NM " = 0.247 X1.22 X0.738 = 0.222 K'

CASE 3) STATIC LOADING AT STATION 53.0, NODE 15
SPACING 4'-0"
SHEAR 2041 N " = 2.04X1.22 X0.225 = 0.560 K
AXIAL 37,750 N " = 37.75X1.22X0.225 = 10.36 K,
MOMENT 654.4 NM " = 0.654X1.22X0.738 = 0.589^{K}

PURPOSE III G B) CONNECTION BETWEEN STEEL SET (CONT'D)

SEGMENT CALCULATIONS FOR W6x20 STEEL SETS

JACKING CONDITION LOADS:

REF. COMPUTER RUN FOR 15 TON JACKING ATTACHMENT VIII "PROGRAM STLRV3". JOINT 16 MEMB. 15

$P_z = -23.81^k \quad V_y = -5.54^k \quad M_z = 5.51^{k'}$

BY COMPARISON OF THE JACKING LOADS TO STATIC AND SEISMIC LOADING, JACKING LOAD WILL GOVERN THE CONNECTION DESIGN.

CONNECTION DESIGN

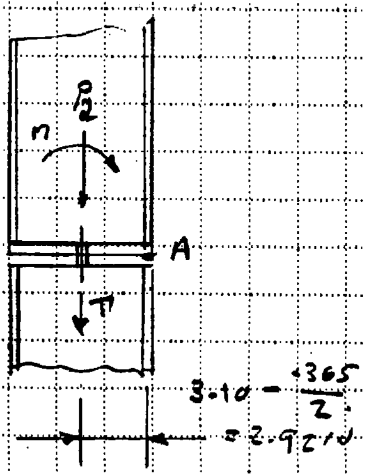
TRY 2 - 1" ϕ BOLTS AND 5/8" THK END PLATES.

$\Sigma M_A = 0$

$23.81 \times 2.92 + T \times 2.92 = 5.51 \times 12$

$2.92T = 66.12 - 69.52$

$T = -1.17^k$ ∴ BOLTS ARE IN TENSION.



CHECK BOLTS FOR SHEAR;

$V_b = \frac{5.54^k}{2 \text{ BOLTS}} = 2.77^k/\text{BOLT} < 7.9^k/\text{BOLT}$ * O.K.

* ALLOW SHEAR FOR 1" ϕ A307 BOLT PER AISC TABLE I-D

∴ 2 - 1" ϕ A307 BOLTS O.K. FOR SPLICE LOCATION

PURPOSE III.G B) SPLICE CONNECTION FOR W6x20 (CONT'D)

CHECK END PLATE FOR SPLICE CONNECTION: (5/8" THICK PL)

MAXIMUM BENDING IN PLATE = 0

∴ 5/8" THICK PLATE O.K. FOR BENDING.

WELD OF PLATE TO STEEL SET:

MAX. WELD SIZE ≤ W6x20 WEB THICKNESS

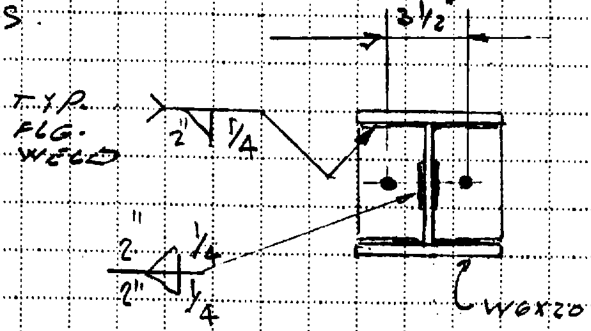
$t_w = 1/4"$ (AISC 5-67)

TRY 3/16 FILLET WELD 2" LONG EACH SIDE OF THE WEB TO RESIST SHEAR FORCES.

CAPACITY OF 2" WELD = V

$V = (0.3 \times 70\,ksi)(\frac{3}{16} \cos 45^\circ) \times 2\,SIDES \times 2\,in) = 11.14^K$

MAX. SHEAR = $5.54^K < 11.14^K$

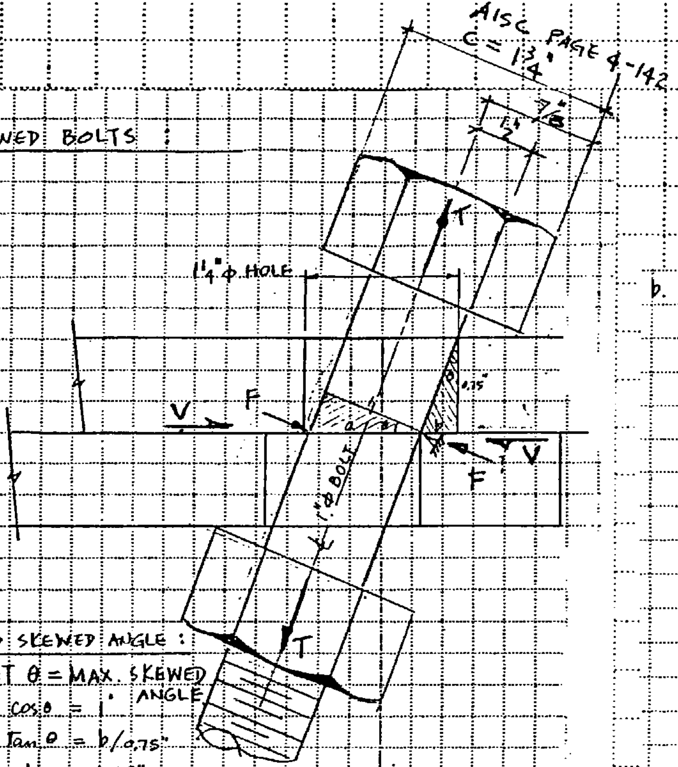


WELD OF FLG TO END PL: (SEE PAGE III-97)

∴ 3/16 WELD x 2" LONG AT EACH SIDE OF THE WEB MIN. TO RESIST MAXIMUM SHEAR FORCES

USE 5/8" THICK A36 PLATE WITH 1/4" FILLET WELD AS SHOWN ON EACH SIDE OF SPLICE CONNECTION

SKEWED BOLTS :



NOTE :

$F = V \cos\theta = 2.36 \cos 15.85° = 2.27^k$

$T = V \sin\theta = 2.36 \sin 15.85° = 0.64^k$

$M = F a \sin\theta =$ (SEE BELOW) $= 0.64''^k$

b. DENDING IN SKEWED BOLT :

USING 1"φ A307 BOLT IN $1\frac{1}{4}"$φ MAX. HOLE.
THE TENSION IN BOLT AT SNUG TIGHT CONDITION ≅ 0
(PER TELEPHONE CONVERSATION WITH AISC ENGINEER STAFF)(SEE VI-9)
THE BENDING IN THE SKEWED BOLT DUE TO BOLT TENSION IS NEGLIGIBLE.
CONSIDER BENDING IN THE SKEWED BOLT DUE TO SHEAR.
MAX. SHEAR AT CONNECTION = 9.44^k ---- PAGE III-96
(JACKING CONDITION)

MAX. SHEAR PER BOLT $= 9.44^k / 4$ BOLTS $= 2.36^k = V$

FROM THE FREE BODY OF THE UPPER HALF OF THE BOLT (SEE SKETCH) .
$F =$ MAX BOLT SHEAR $= V \cos\theta = 2.36 \cos 15.85°$
$F = 2.27^k$
MOMENT IN BOLT $= F \times (a \sin\theta)$
$= 2.27^k \times (1.04" \sin 15.85°) = 0.64''^k$
SECTION MODULUS OF THREAD BOLT
$= \frac{\pi d^3}{32} = \frac{\pi (0.847)^3}{32} = 0.06 \text{ IN}^3$

$f_t = f_b + \frac{T}{A} = 10.7 + 0.8 = 11.5 \text{ksi} < F_t = 20^{\text{KSI}}$ --- AISC PG 4-3

where $\begin{cases} f_b = \frac{M}{S} = \frac{0.64"}{0.06} = 10.7 \text{ ksi tension} \\ T/A = 0.64 / 0.7854 = 0.8 \text{ ksi} \end{cases}$ ALLOWABLE TENSILE STRESS (ALSO SEE BELOW)

CHECK COMBINED STRESS (AISC J3.5 & TABLE J3.3)

$f_v = \frac{V}{A} = \frac{2.27^k}{.7854} = 2.89 \text{ ksi} < F_v = 10 \text{ ksi}$

$F_t = 26 - 1.8 f_v \le 20$ (AISC TABLE J3.3)
$= 26 - 1.8(2.89) = 20.8$ ksi ∴ USE $F_t = 20$ ksi
AS SHOWN ABOVE

THE SKEWED BOLT IS OK AS SHOWN

a. FIND SKEWED ANGLE :

LET θ = MAX. SKEWED ANGLE

$\begin{cases} a \cos\theta = 1" \\ \tan\theta = b/0.75" \\ a + b = 1.25" \end{cases}$

$\frac{1}{\cos\theta} + 0.75 \tan\theta = 1.25"$

$\frac{1}{\cos\theta} + \frac{0.75 \sin\theta}{\cos\theta} = 1.25"$

$1 + 0.75 \sin\theta = 1.25 \cos\theta$

$(0.75)\sqrt{1 - \cos^2\theta} = 1.25 \cos\theta - 1$

$0.5625 (1 - \cos^2\theta) = 1.5625 \cos^2\theta - 2.5\cos\theta + 1$

$2.125 \cos^2\theta - 2.5 \cos\theta + 0.4375 = 0$

$\cos\theta = \frac{2.5 \pm \sqrt{6.25 - 3.719}}{4.25} = \frac{2.5 \pm 1.59}{4.25}$

$\cos\theta = 0.962$ OR 0.214

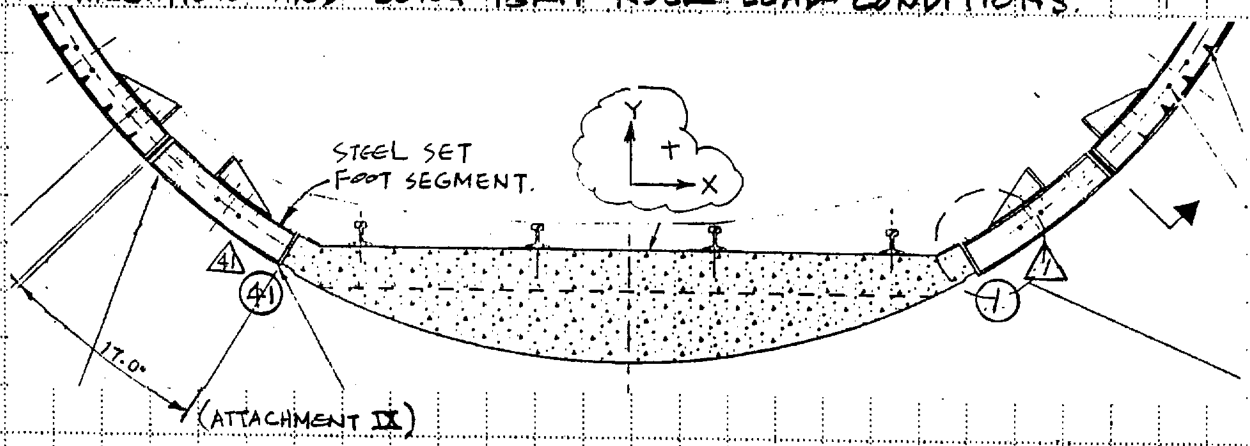
$\theta = 15.85°$
$a = 1/\cos\theta$
$= 1.04"$
$b = 1.25" - 1.04$
$= 0.21"$

MAX. SKEWED ANGLE = 15.85°

PURPOSE III.H.

STABILITY OF STEEL SET FOOT SEGMENT:

THE STEEL SET FOOT SEGMENTS ARE SUPPORTED ON CONCRETE INVERT AS SHOWN BELOW. THE FOOT SEGMENT MUST BE STABLE DURING JACKING INSTALLATION AND LONG TERM ROCK LOAD CONDITIONS.



TUNNEL SET ELEVATION

△ ≡ MEMBER
○ ≡ NODE

〈A〉 LONG TERM ROCK LOAD CONDITION :

THE STEEL SET FOOT SUPPORT POINTS ON CONCRETE INVERT ARE AT NODES 01 AND 41 IN COMPUTER MODEL (SEE ATTACHMENT II). THE STEEL SET FOOT SEGMENT STABILITY ANALYSIS AGAINST SLIDING IS PRESENTED IN THE FOLLOWING PAGES.

This analysis compares the average axial force in the steel set and concrete invert with the maximum shear force generated in the lower elements of the steel set. The average axial force is used because the steel set and invert exhibit ring compression. As modeled in FLAC, the rock squeezes the steel set into an oval shape, developing compressive forces in the sides of the set and tensile forces in the top of the set and in the invert. The average of these forces represents the axial force distributed throughout the steel set and invert. The maximum shear in the lower elements of the steel set was selected from the shear diagrams shown in Reference 5.20. As shown in the diagrams, the maximum shear forces in the steel set occur at locations above the springline where utilities are supported. These shear forces are absorbed by the surrounding rock and are not applicable to determine the sliding of the steel set on the concrete invert. To be conservative, the maximum shear in an area near the steel / concrete interface was found by looking at the FLAC data in Attachment II and determining the cutoff point where the shear begins to decrease in value. For this analysis, the lower elements of the steel set refer to the segments between elements 35 and 40 and between elements 1 and 6.

FILE: m07k250w.sav AT STATION TCW 7+00 (II-10 to II-12)
STEEL SET W8×31 @ 4'-0" O.C.
LOADING ; STATIC DL + UTIL

TOTAL AXIAL FORCE OF 48 ELEMENTS
$\Sigma F = 236.05 \times 10^4$ NEWTONS PER SPACING @ ONE METER
AVERAGE AXIAL FORCE ALONG THE STEEL SET

$$= \frac{\Sigma F}{48 \text{ ELEMENTS}}$$

$$= \frac{236.05 \times 10^4}{48} = (4.918 \times 10^4 \text{ NEWTONS}) \times (2.2481 \times 10^{-4} \text{ KIPS/NEWTONS})$$

$$= 11.06 \frac{\text{KIPS}}{\text{METER SPACING}} \times \frac{1 \text{ m}}{3.281 \text{ ft}} \times 4 \text{ ft} = 13.48^k \text{ @ } 4' \text{ SPACING}$$

MAX SHEAR IN BOTTOM ELEMENTS OF STEEL SET (BETWEEN NODES 35 TO 40 AND NODES 1 TO 6) = 4.972×10^3 N (ELEM 38)
= 1.36 kips @ 4' spacing

FRICTION FORCE AT BOTTOM OF STEEL SET FOOT SEGMENT
$= \mu N$; $\mu_k = 0.3$ BETWEEN CONCRETE & STEEL (REF. 5.17, p.275)
$= 0.3 \times 13.48 = 4.04^k \gg 1.36^k$ MAX SHEAR
---- O.K.

NO SLIDING @ STATION TCW 7+00 (W8 SET @ 4'0")

OVERALL FACTOR OF SLIDING RESISTANCE = $\frac{\text{FRICTION FORCE}}{\text{MAX SHEAR}}$

$$\text{F.S.R.} = \frac{4.04}{1.36} = 2.97$$

ALL OTHER STATIONS ALONG THE MAIN DRIFT USING W8×31 STEEL SETS ARE SUMMARIZED IN PAGE III-107. ALL FRICTION FORCES ARE LARGER THAN THE SHEAR IN THE FOOT SEGMENT. NO ANCHORAGE IS REQUIRED. THE LOWEST FACTOR OF SLIDING RESISTANCE FOR THE W8×31 STEELSETS IS 2.97 (m07k250w). THIS IS A VERY CONSERVATIVE FACTOR BASED ON STANDARD ENGINEERING PRACTICE AND IS THEREFORE REASONABLE.

FILE: M07_K2.SAV AT STATION TCW 7+00 (III-18 to III-50)
STEEL SET W6×20 @ 4'0" O.C.
LOADING: STATIC: DL+UTIL

TOTAL AXIAL FORCE OF 48 ELEMENTS
$\Sigma F = 4.991 \times 10^5$ NEWTONS PER ONE METER SPACING
AVERAGE AXIAL FORCE ALONG THE STEEL SET

$$= \frac{\Sigma F}{48 \text{ ELEMENTS}}$$

$$= \frac{4.991 \times 10^5}{48} = (9.357 \times 10^3 \, N)(2.2481 \times 10^{-4} \text{ kips}/N)$$

$$= 2.103 \frac{\text{kips}}{1\text{m Spacing}} * \frac{1\text{m}}{3.281\text{ft}} * 4\text{ ft} = 2.564 \text{ kips @ 4' SPACING}$$

MAX SHEAR IN BOTTOM ELEMENTS OF STEEL SET (BETWEEN NODES 35 TO 40 AND NODES 1 TO 6) = 1.119×10^3 N (ELEM 5)
= 0.307 kips @ 4' spacing
FRICTION FORCE AT BOTTOM OF STEEL SET FOOT SEGMENT
= μN ; $\mu = 0.3$ BETWEEN CONCRETE & STEEL (REF 5.17, p.275)
= $0.3 * 2.564$ k = 0.769 k > 0.307 (Max Shear)
$\Rightarrow$ O.K.

$\Rightarrow$ NO SLIDING @ STATION TCW 7+00 (W6 SET @ 4'0")

OVERALL FACTOR OF SLIDING RESISTANCE = $\frac{\text{FRICTION FORCE}}{\text{MAX SHEAR}}$

$$\text{F.S.R.} = \frac{0.769}{0.307} = 2.51$$

ALL OTHER STATIONS ALONG THE MAIN DRIFT USING W 6 X 20 STEEL SETS ARE SUMMARIZED IN PAGE III-108. ALL FRICTION FORCES ARE LARGER THAN THE SHEAR IN THE FOOT SEGMENT. NO ANCHORAGE IS REQUIRED. THE LOWEST FACTOR OF SLIDING RESISTANCE FOR THE W6X20 STEEL SETS IS 2.51 (M07_K2). THIS IS A VERY CONSERVATIVE FACTOR BASED ON STANDARD ENGINEERING PRACTICE AND IS THEREFORE REASONABLE.

DETERMINATION OF SLIDING					
STEEL SET / SPACING	W8x31, 4'0" o.c.	W8x31, 2'0" o.c.	W8x31, 4'0" o.c.	W8x31, 2'0" o.c.	W8x31, 4'0" o.c.
FILE	m07k250w.sav	m10k250w.sav	m18k250w.sav	m34k250x.sav	p07k2dy.sav
STATION	TCW @ 7+00	PTN @ 10+00	TSW1 @ 18+00	TSW2 @ 34+00	TCW @ 7+00
LOADING	Static	Static	Static	Static	Seismic+Static
Axial sum (N/1 m spacing)	2.360E+06	2.780E+07	1.153E+07	1.999E+07	6.355E+06
Axial ave (N/1 m spacing)	4.918E+04	5.791E+05	2.402E+05	4.165E+05	1.324E+05
Axial ave (kips/spacing)	1.348E+01	7.936E+01	6.583E+01	5.707E+01	3.629E+01
Controlling shear, N	4.972E+03	9.315E+03	1.187E+04	1.222E+04	7.011E+03
Controlling shear, kips	1.363E+00	2.553E+00	3.253E+00	3.348E+00	1.922E+00
Friction force (kips)	4.043E+00	2.381E+01	1.975E+01	1.712E+01	1.089E+01
Result (friction>shear)	O.K.	O.K.	O.K.	O.K.	O.K.
Overall F.S. R	2.97	9.33	6.07	5.11	5.67

Overall Summary: There is no sliding at any of the above stations.

Axial and shear forces at each station are from Attachment II.
Controlling shear refers to the maximum shear in the lower elements of the steel set.
Calculations for this analysis are obtained by the process outlined on pages III-105 and III-106.

DETERMINATION OF SLIDING			
STEEL SET / SPACING	W8x31, 2'0" o.c.	W8x31, 4'0" o.c.	W8x31, 2'0" o.c.
FILE	p10k2dy.sav	p18k2dy.sav	p34k2dyx.sav
STATION	PTN @ 10+00	TSW1 @ 18+00	TSW2 @ 34+00
LOADING	Seismic+Static	Seismic+Static	Seismic+Static
Axial sum (N/1 m spacing)	4.265E+07	1.776E+07	2.737E+07
Axial ave (N/1 m spacing)	8.886E+05	3.701E+05	5.702E+05
Axial ave (kips/spacing)	1.218E+02	1.014E+02	7.814E+01
Controlling shear, N	1.206E+04	1.497E+04	1.568E+04
Controlling shear, kips	3.305E+00	4.103E+00	4.296E+00
Friction force (kips)	3.653E+01	3.043E+01	2.344E+01
Result (friction>shear)	O.K.	O.K.	O.K.
Overall F.S. R.	11.05	7.42	5.46

Overall Summary: There is no sliding at any of the above stations.

Axial and shear forces at each station are from Attachment II.
Controlling shear refers to the maximum shear in the lower elements of the steel set.
Calculations for this analysis are obtained by the process outlined on pages III-105 and III-106.

DETERMINATION OF SLIDING

STEEL SET / SPACING	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.
FILE	m07_k2.sav	m18_k2.sav	m27_k2.sav	m34_k2.sav	m53_k2.sav
STATION	TCW @ 7+00	TSW1 @ 18+00	TSW2 @ 27+00	TSW2 @ 34+00	TSW2 @ 53+00
LOADING	Static	Static	Static	Static	Static
Axial sum (N/1 m spacing)	4.491E+05	3.141E+06	1.764E+06	2.286E+06	1.861E+06
Axial ave (N/1 m spacing)	9.357E+03	6.544E+04	3.675E+04	4.762E+04	3.877E+04
Axial ave (kips/spacing)	2.564E+00	1.793E+01	1.007E+01	1.305E+01	1.063E+01
Controlling shear, N	1.119E+03	4.490E+03	3.538E+03	2.929E+03	3.398E+03
Controlling shear, kips	3.067E-01	1.231E+00	9.697E-01	8.028E-01	9.313E-01
Friction force (kips)	7.693E-01	5.380E+00	3.022E+00	3.915E+00	3.188E+00
Result (friction>shear)	O.K.	O.K.	O.K.	O.K.	O.K.
Overall F.S.R.	2.51	4.37	3.12	4.88	3.42

Overall Summary: There is no sliding at any of the above stations.

Axial and shear forces at each station are from Attachment II.
Controlling shear refers to the maximum shear in the lower elements of the steel set.
Calculations for this analysis are obtained by the process outlined on pages III-105 and III-106.

DETERMINATION OF SLIDING

STEEL SET / SPACING	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.	W6x20, 4'0" o.c.
FILE	m07_k2dy.sav	m18_k2dy.sav	m27_k2dy.sav	m34c2k2d.sav	m53_k2dy.sav
STATION	TCW @ 7+00	TSW1 @ 18+00	TSW2 @ 27+00	TSW2 @ 34+00	TSW2 @ 53+00
LOADING	Seismic+Static	Seismic+Static	Seismic+Static	Seismic+Static	Seismic+Static
Axial sum (N/1 m spacing)	1.675E+06	5.270E+06	3.166E+06	5.029E+06	3.274E+06
Axial ave (N/1 m spacing)	3.489E+04	1.098E+05	6.596E+04	1.048E+05	6.821E+04
Axial ave (kips/spacing)	9.562E+00	3.009E+01	1.808E+01	2.872E+01	1.870E+01
Controlling shear, N	1.576E+03	6.242E+03	4.392E+03	1.045E+04	4.199E+03
Controlling shear, kips	4.319E-01	1.711E+00	1.204E+00	2.864E+00	1.151E+00
Friction force (kips)	2.869E+00	9.027E+00	5.423E+00	8.615E+00	5.609E+00
Result (friction>shear)	O.K.	O.K.	O.K.	O.K.	O.K.
Overall F.S.R.	6.64	5.28	4.51	3.01	4.87

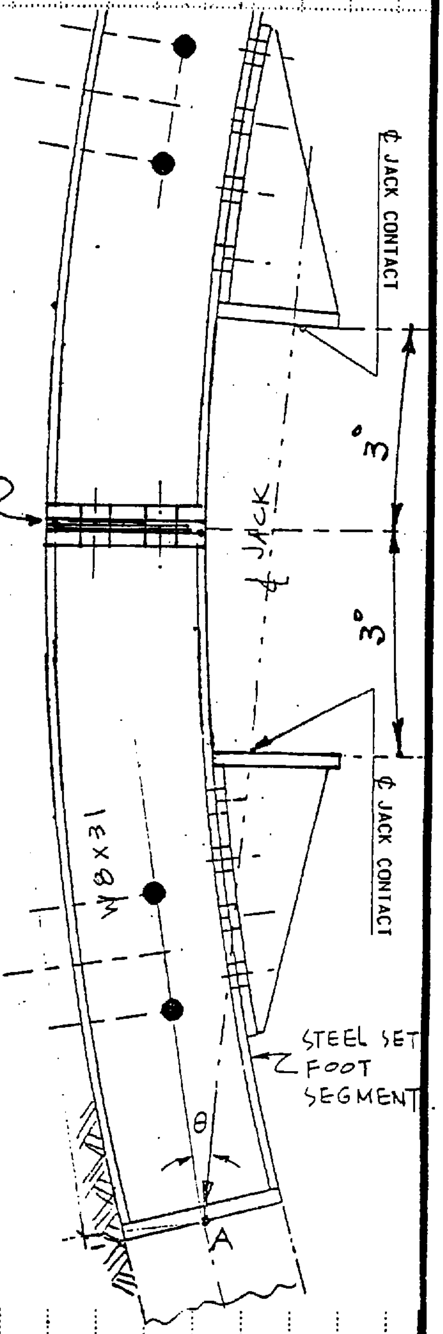
Overall Summary: There is no sliding at any of the above stations.

Axial and shear forces at each station are from Attachment II.
Controlling shear refers to the maximum shear in the lower elements of the steel set.
Calculations for this analysis are obtained by the process outlined on pages III-105 and III-106.

PURPOSE III. H

⟨B⟩ JACKING CONDITION DURING STEEL SET INSTALLATION :
(ALTERNATE I ONLY. SEE ATTACHMENT IX-5)

THE STEEL SET FOOT SEGMENT DETAIL IS SHOWN ON THE RIGHT. THE STABILITY OF THE FOOT SEGMENT DURING JACKING DEPENDS ON THE POSITION OF THE JACK. AN ANALYSIS TO DETERMINE STABILITY OF THE FOOT SEGMENT IS SHOWN ON THE FOLLOWING PAGES.



STABILITY DETERMINATION OF THE STEEL SET, FOOT SEGMANT AT JACKING LOCATION: W8×31 STEEL SET.

WITH JACKING BRACKETS LOCATED AS SHOWN ON THE "STEEL SET DIMENSIONS" SKETCH, FOLLOWING SHEET, DETERMINE THE LOCATION OF INTERSECTION OF THE LINE OF JACKING FORCE AND THE BASE PLATE. IF THIS LOCATION FALLS TO THE LEFT OF 1/3 SECTON OF THE BASE PLATE, STEEL SET AT JACK LOCATION WILL BE STABLE DURING THE JACKING OPERATION. SEE DETAIL 1 FOLLOWING PAGES.

IN DET. 1:

R = RADIUS TO ℄ STEEL SET $= 12'\text{-}5'' - 4'' = 12'\text{-}1'' = 145''$

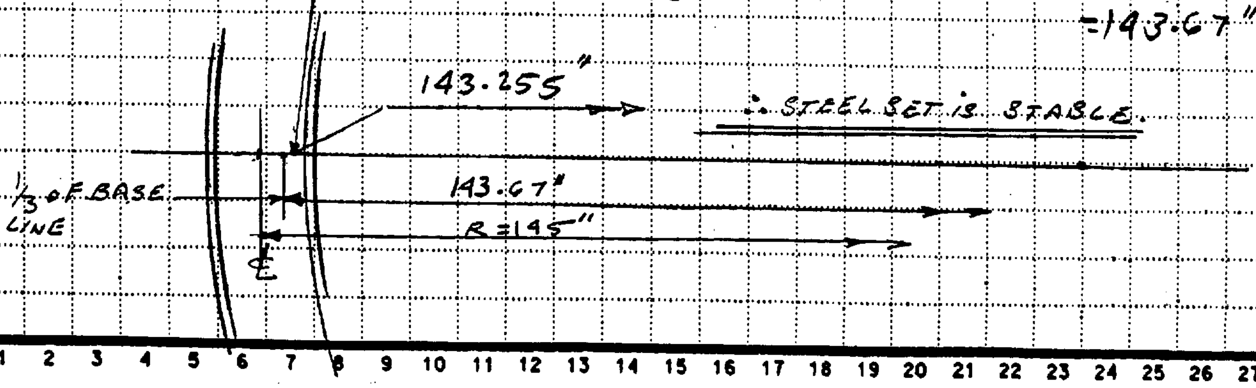
θ = ANGLE BTWN TOP OF LOWER JACK BRACKET & BASE

$\theta = 17^\circ - 3^\circ = 14^\circ \qquad \cos 14^\circ = 0.9703$

$$\cos\theta = \frac{R - (4'' + 2'')}{D} = \frac{145 - 6}{D} = 0.9703$$

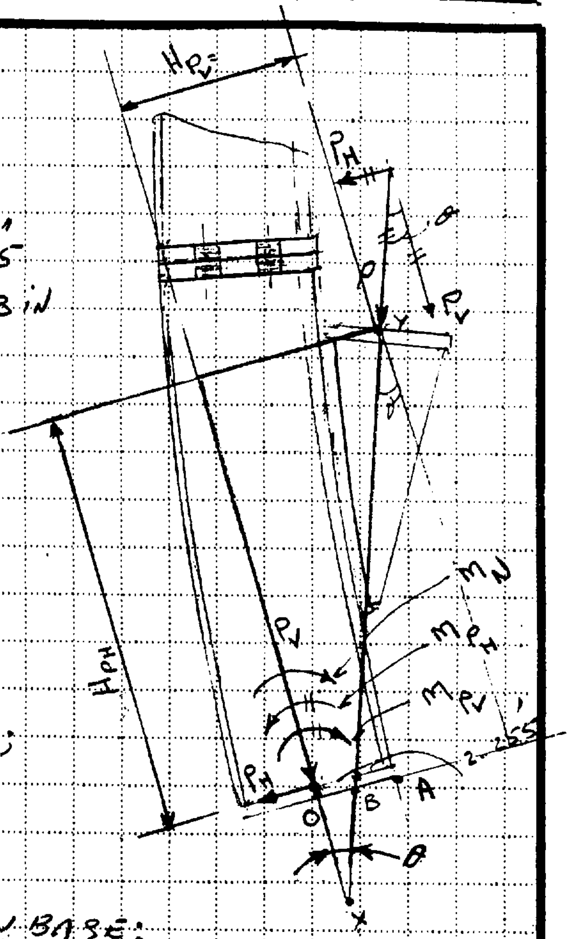
$D = 143.255''$ = DISTANCE BTWN. CENTER OF STEEL SET TO LINE OF JACKING FORCE ON THE BASE PLATE

℄ STEEL SET CIRCLE TO 1/3 OF BASE PLATE $= 145' - 1.33$
$= 143.67''$



∴ STEEL SET IS STABLE.

DETERMINE STABILITY RATIO



$\angle\theta = 17° - 3° = 14°$ (SEE DET. 1) SKETCH

$\Delta(OBX)$; $\theta = 14°$; $\overline{OB} = (145 - 143.255) = 1.745"$

$B\overline{X} = \overline{OB} \div \sin\theta = 1.745 \div 0.242 = 7.213$ in

$\overline{YB} = \tan 14(145-6) = 34.66$ in

$Y\overline{X} = 7.213 + 34.66 = 41.873$ in

$O\overline{X} = \frac{OB}{\tan\theta} = \frac{1.745}{.2493} = 7.00$

$\frac{Y\overline{X}}{B\overline{X}} = \frac{H_{PH}}{OX}$; $H_{PH} = \frac{7 \times 41.873}{7.213} = 40.636$

$H_{PV} = Y\overline{X} \sin\theta = 41.873 \times 0.2419 = 10.13$ in

RESOLVE JACKING FORCES "P" INTO P_H & P_V;

$P_H = P \sin 14° = 0.219 P$

$P_V = P \cos 14° = 0.97 P$

SUPERIMPOSE P_V & P_H TO POINT "O" ON BASE:

$M_{PV} = P_V \times H_{PV} = 10.13 P_V$; $M_{PH} = P_H \times H_{PH} = 40.636 \times P_H$

$= 10.13(0.97P) = 9.83 P$ $\quad = 40.636 \times 0.219 P = 8.90 P$

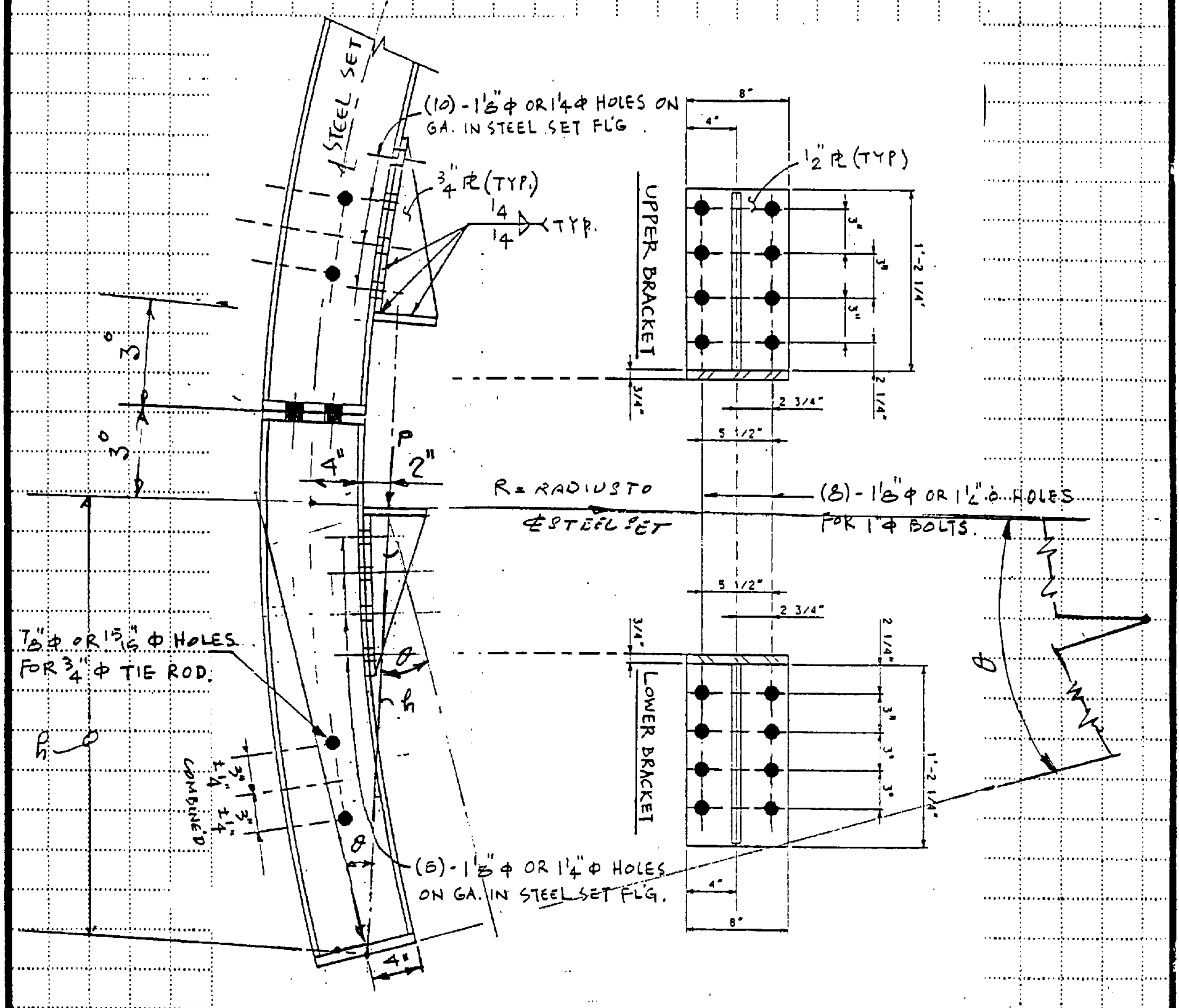
$OTM = \overset{\curvearrowright}{9.83 P} - \overset{\curvearrowleft}{8.90 P} = \overset{\curvearrowright}{0.93 P}$

STABILITY MOMENT ABOUT TOE (POINT "A") = $P_V \times 4"$ = $0.97 P \times 4" = 3.88 P$

STABILITY RATIO = $\frac{3.88 P}{0.93 P} = 4.17 > 1.0$ STABILITY RATIO O.K.

CHECK SLIDING: $P_H = 0.219 P$

FRICTION AT BASE = $\mu N = 0.3 P > 0.219 P$ ∴ SLIDING O.K.



DETAIL (1) / IX-5 & 6

STABILITY DETERMINATION OF THE STEEL SET AT JACKING

LOCATION: W6X20 STEEL SET.

FOR REFERENCE OF THIS ENGINEERING CALCULATIONS SEE STABILITY CALCULATIONS FOR W8X31 STEEL SETS;

R = RADIUS TO ℄ STEEL SET = 12'-5" - 3" = 12-2" = 146"

θ = ANGLE BTWN TOP OF LOWER JACK BRACKET & BASE PLATE.

$\theta = 17^\circ - 3^\circ = 14^\circ$; $\cos 14^\circ = 0.9703$

D = DISTANCE BTWN. CENTER OF STL. SET TO LINE OF JACKING FORCE ON THE BASE PLATE.

$$\cos\theta = \frac{R - (3'' + 2'')}{D} = \frac{146'' - 5''}{D} = 0.9703$$

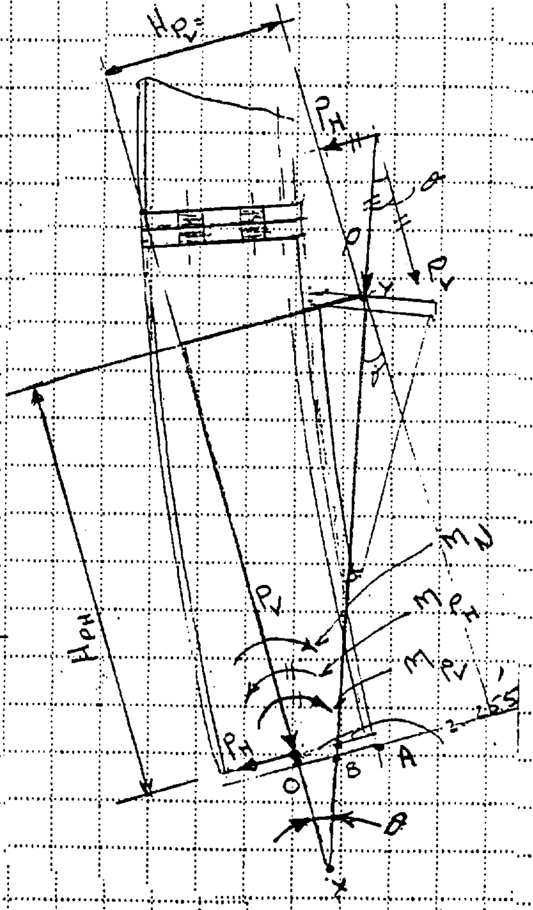
$D = 145.3''2$

℄ STEEL SET TO 1/3 OF BASE PL

$= 145 - 3'' + \frac{6}{3} = 144$ IN

∴ LINE OF JACKING IS TO THE LEFT OF 1/3 OF BASE PL LINE

∴ STEEL SET FOR W6X20 SECTION IS STABLE.



DETERMINE STABILITY RATIO FOR W6x20 STEEL SECTION

$\Delta(oBx)$ $\theta = 14^\circ$ $\overline{oB} = (146 - 145.32) = 0.68$ in

$\overline{Bx} = \frac{oB}{S\theta} = \frac{0.68}{.242} = 2.81$ in

$\overline{YB} = \tan 14(146 - 5) = 35.155$ in

$\overline{Yx} = 2.81 + 35.155 = 37.965$

$\overline{ox} = \frac{oB}{\tan\theta} = \frac{0.68}{0.2493} = 2.73$ in

$\frac{\overline{Yx}}{\overline{Bx}} = \frac{H_{PH}}{ox}$; $H_{PH} = \frac{2.73 \times 37.965}{2.81} = 36.88$ in

$H_{PV} = \overline{Yx}\ \text{Sin}\theta = 37.965 \times 0.2419 = 10.13$ in

RESOLVE JACKING FORCE "P" INTO P_H & P_V;

$P_H = P\ \text{Sin}\ 14^\circ = 0.219\,P$

$P_V = P\ \text{Cos.}\ 14^\circ = 0.97\,P$

SUPER IMPOSE P_V & P_H TO POINT "O" ON THE BASE PLATE:

$M_{PV} = P_V \times H_{PV} = 10.13 \times 0.97P = \overset{\curvearrowright}{9.83}\,P$

$M_{PH} = P_H \times H_{PH} = 36.88 \times 0.291 = \overset{\curvearrowleft}{10.73}\,P$

$OTM = \overset{\curvearrowleft}{10.73}\,P - \overset{\curvearrowright}{9.83}\,P = \overset{\curvearrowleft}{0.90}\,P$ ∴ OTM IS IN DIRECTION AGINST THE TUNNEL WALL + $P_V \times 3'' = 0.97\,P \times 3'' = \overset{\curvearrowleft}{2.91}\,P$

IN ADDITION STABILITY MOMENT = $P_V \times 3' = 0.97 \times 3 \times P = \overset{\curvearrowleft}{2.91}\,P$

∴ STEEL SET IS PUSHED AGAINST WALL DURING JACKING

(PURPOSE III.I AND III.J NOT USED)

PURPOSE K A) SHIM PLATE CALCULATION FOR W8X31 STEEL SETS

MOST CRITICAL LOADING CONDITION FROM COMPUTER OUTPUT:

STATIC LOADING - STATION 10+00 STEEL SET AT 2'-0' SPACING MEMBER #39.

SHEAR = -10.49 KN; AXIAL = 548.8 KN; MOMENT = 5.01 KNM

$\therefore V = 10.49 \text{ KN} \times 0.225 \, {}^{K}/_{KN} \times \overset{*}{0.61} = 1.44^{K}$

$P_d = 548.8 \text{ KN} \times 0.225 \, {}^{K}/_{KN} \times \overset{*}{0.61} = 75.26^{K}$

$M = 5.01 \text{ KNM} \times 0.738 \, {}^{KFT}/_{KN} \times \overset{*}{0.61} = 2.26^{K'}$

* COMPUTER RUN IS BASED ON TRIBUTARY WIDTH OF 1.0 METER, WHILE STEEL SETS ARE TO BE PLACED AT 2'-0" $\therefore$ 2.0' ÷ 3.28' = 0.61 LOAD FACTOR.

CONTACT AREA OF THE END PLATE: $A_c = 8'' \times 8'' = 64 \text{ in}^2$

I = MOMENT OF INERTIA OF THE PLATE $= \frac{8(8)^3}{12} = 341.33 \text{ in}^4$

$c = 4''$; $\frac{Mc}{I} = \frac{2.26(12)(4)}{341.33} = 0.318 \text{ ksi}$

$\frac{P_d}{A_c} = \frac{75.26}{64} = 1.18 \text{ ksi}$

P = MAXIMUM BEARING ON END PLATE $= \frac{P_d}{A_c} \pm \frac{Mc}{I}$

$P = 1.18 \pm 0.318 = \begin{cases} 1.498 \approx 1.5 \text{ ksi} \\ 0.862 \end{cases}$

PURPOSE III.K A) SHIM PLATE CALCULATION FOR W8X31 STEELSETS

LOADS:

P = MAXIMUM BEARING PRESSURE ON END PLATE = 1.5 ksi

P_S = MAX. BRG ON SHIM PLATE

$= 1.5\ ksi\ \frac{\text{AREA END PLATE}}{\text{AREA SHIM PLATE}}$

AREA OF SLOTS = A_{SL}

$A_{SL} = 2 \times \left[\left(6.25 - \frac{1.25}{2}\right) \times 1.25 + \frac{1}{2}\left(\pi \times \frac{1.25^2}{4}\right)\right] = 15.28\ in^2$

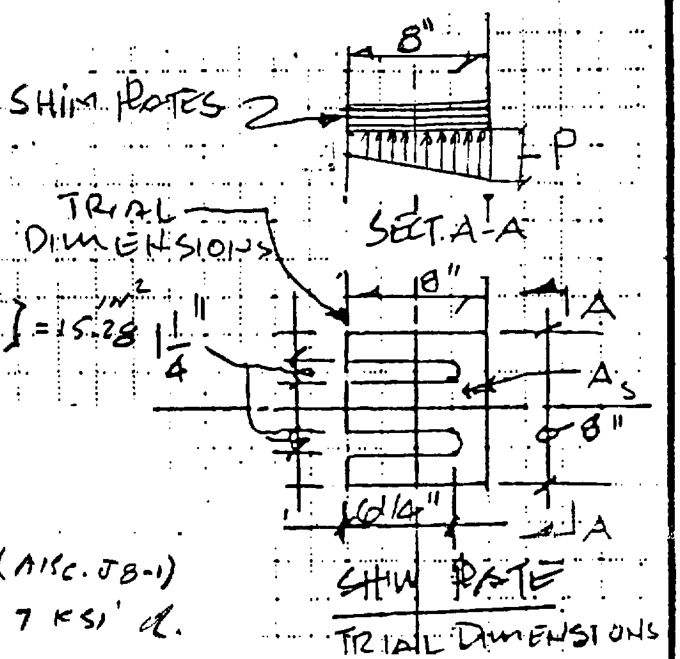
AREA OF SHIM PLATE = A_S

$A_S = 64\ in^2 - 15.28 = 48.72\ in^2$

$P_S = 1.5\ ksi \times \frac{64}{48.72} = 1.97\ ksi$

ALLOW BEARING = 0.9 × 36 ksi (AISC. J8-1)

$= 32.4\ ksi >> 1.97\ ksi$ ok.



SHIM PLATES IS OK FOR MAXIMUM PRESSURE

NOTES;

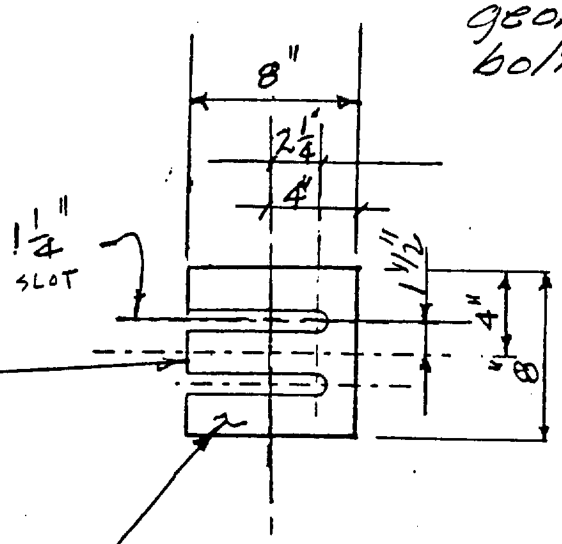
SHIM PLATES PACK RECOMMENDED
1/8" - PLATE
1/4" - "
1/2" - "
1" - "

TOTAL THICKNESS OF THE SHIM PLATES PACK WILL BE CONTRACTOR'S OPTION AND WILL BE BASED ON THE INSERT HEIGHT.

SUMMARY

PURPOSE III.K A)

Shim plate design is based on the geometry of the bolted connections.



SHIM PLATE PACK
2 EA. 1/8" PLATE
2 EA. 1/4" PLATE
2 EA 1/2" PLATE
1 1" PLATE
CONSTRUCTOR OPTION.

PLATES ASTM - A36 (minimum

SHIM PLATES

PURPOSE K B) SHIM PLATE CALCULATION FOR W6x20 STEEL SET.

MOST CRITICAL LOADING CONDITION FROM COMPUTER OUT PUT.

STATION 27+00 ; STATIC LOADING ; NODE 39 ;

SHEAR 1776 N ; AXIAL 55460 N ; MOM 425.3 N.M

COMPUTER OUTPUT IS BASED ON 1 METER SPACING WHILE STEEL SETS ARE SPACED AT 4'-0"

$\frac{4.0'}{3.28} = 1.22$ ⇒ FACTOR LOADS

1 KIP = 0.225 KN ; 1 KIP FT = 0.738 KNM

$V = 1.776 \text{ kN} \times 0.225 \times 1.22 = 0.49^{k}$

$P = 55.46 \text{ kN} \times 0.225 \times 1.22 = 15.22^{k}$,

$M = 0.425 \text{ kNm} \times 0.738 = 0.38^{k}$

p = PRESSURE ON END PLATE $= \frac{P}{A_c} \pm \frac{Mc}{I}$

$A_c = 6.25'' \times 7.0'' = 43.75 \text{ in}^2$; $c = 7'' \div 2 = 3.5''$

$I = \frac{1}{12} \times 7.5 (6.25)^3 = 152.59 \text{ in}^4$

$$p = \frac{15.22^{k}}{43.75} \pm \frac{0.38 \times 12 \times 3.5}{152.51} = 0.348 \pm 0.105 = \begin{cases} 0.243 \text{ ksi} \\ 0.453 \text{ ksi} \end{cases}$$

PURPOSE III, K (B) SHIM PLATE CALCULATION FOR W16x20 STEEL SETS.

LOADS; (FROM PREVIOUS HEET).

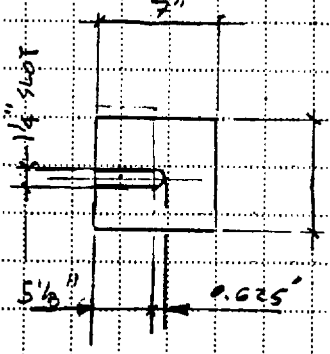
$P_2 = 0.453$ ksi = MAXIMUM BEARING PRESSURE ON 6.25" x 7.0" END PLATE = $43.75\ in^2$

AREA OF THE SHIM PLATE = $43.75\ in^2$ − AREA OF THE SLOT.

AREA OF THE SLOT = A_s

$$A_s = 2 \times \left[1.25 \times 3.125 + (.5 \times \pi \times .625^2)\right]$$

$$= 2(3.906 + 0.613) = 9.04\ in^2$$



AREA SHIM PLATE = 43.75 − 9.04
= $34.71\ in^2$

MAXIMUM BEARING PRESSURE ON THE SHIM PLATE

$$= P_2 \times \frac{\text{AREA END PLATE}}{\text{AREA OF SHIM PLATE}} = \frac{43.75}{34.71} \times 0.453 = 0.571\ \text{ksi}$$

0.571 ksi < ALLOW. BEARING PRESSURE FOR STEEL

∴ SHIM PLATES ok. FOR BEARING PRESSURE

USE 6 1/4 x 7" PLATES - ASTM A-36, MINIMUM.

Purpose III.L Steel Wedges

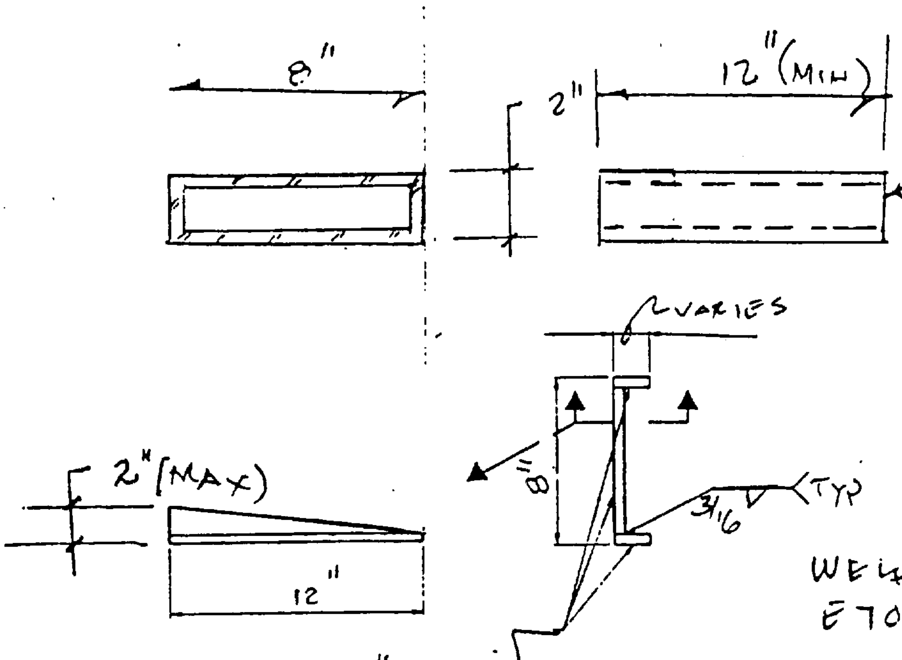
Wedges and blocking are installed behind the steel set as required to ensure that the steel set is in positive contact with the excavated surface. (See Section 2.3) Wedge and blocking material can be of wood or metal. A typical steel wedge made from plate or tubing is shown on p. III-124. Other suggested options are shown in Attachment IX, p. IX-14. Alternate designs by the Constructor are subject to A/E approval.

Crushing of the wedge material may occur during rock loading, however positive contact between the excavated surface and the steel set will remain. Numerical analysis of the wedge is not required.

Blocking, backfill or other materials placed in voids shall be selected by the Constructor and are subject to A/E approval.

(NOT USED)

SUMMARY



CUT FROM TS 8 x 2 x 3/8 (STRUCTURAL TUBING.) with minimum yield stress >36 KSI

WELDING ELECTRODES E70XX OR E70XT

3/8" PLATE ASTM A 36, MIN.

STEEL WEDGES

Structural Tubing or Plate Shown

ALTERNATE DESIGN BY CONSTRUCTOR SHALL BE REVIEWED BY A/E.

IMPACT REVIEW ACTION NOTICE

CRWMS/M&O

Impact Review Action Notice

Complete only applicable items.

QA: N
Page: 1 Of: 1

1. From JOHN PYE John H Pye

2. Date 08/02/95

3. To DANA ROGERS

Please review the document or data described below to determine the impact on design documents of the MGDS development organization. Document results of impact review below. State that there are no impacts requiring action or provide your assessment of actions required to ensure consistency between the provisions of the document or data reviewed and design products. Include document and revision numbers of documents to be revised.

4. Please Complete Impact Review by (Date)
08/04/95

5. Document/TDIF/Data to be Evaluated:

Title Letter: Sandia National Laboratories, Joe Grant to John Pye, Strain Gage Data Results, Plots of Stress versus Time

Revision No. Information Only

Effective Date 07/27/95

Document Identifier None

6. Results of Impact Review

See Attachment 1.0 (Page 1 of 1).

M. E Taylor 8-2-95
Evaluator Date

Date: 08/02/95
Page 1 of 1

Attachment 1.0

Impact Review Action Notice for Letter: Sandia National Laboratories, Joe Grant to John Pye, Strain Gage Data Results, Plots of Stress versus Time

6. Results of Impact Review

The document identified in Block 5, transmits preliminary unchecked Stress versus Time Plots based on strain gage data for 28 steel sets installed in the ESF. Review of these stress/time plots indicates that steel stresses at the gages generally range from -12,500 psi (tension) to 11,000 psi (compression) with three major stress deviations ranging from -24,000 psi to 30,000 psi.

Two of the stress deviations are in steel set #158, station 2+50, at stress values of 20,000 psi and 30,000 psi and are based on data from gages identified as defective in February 1995, and are therefore not valid. The other stress deviation is in steel set #189, station 3+48, at a stress value of -24,000 psi. This stress deviation is assumed to be from a valid gage reading for this review. A gage reading opposite this deviation is -4,000 psi for set #189, and does not reflect a similar high stress value. This stress deviation may be the result of an eccentrically loaded flange or the result of a faulty gage.

Using the stress deviation above for set #189, the following axial and bending stresses were developed:

Steel Set #189

Axial Stress = -8333 psi
Bending Stress = 11160 psi
Combined axial tension and bending stresses are proportioned to 0.91 which is less than 1.0 and is in accordance with AISC requirements.

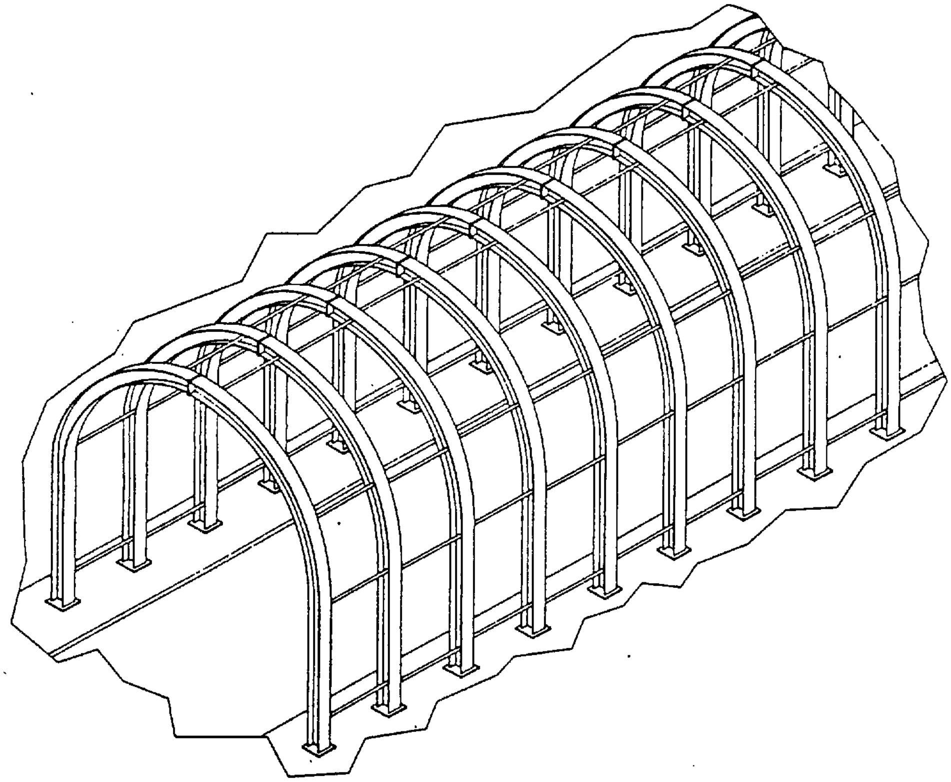
The major stress deviation analyzed is within AISC requirements. The general range of gaged steel stress, -12,500 psi to 11,000 psi, will therefore be within AISC requirements.

Strain gage data and stress/time plots are preliminary and are being checked. A final report on strain gage data and stress/time plots is expected within three weeks and an impact review will be made. No further impact reviews will be made on preliminary and unchecked strain gage data and related reports.

In conclusion, there are no impacts on design products based on data reviewed.

ATTACHMENT V

CPS STRUCTURAL STEEL SUPPORTS CATALOG



STRUCTURAL STEEL SUPPORTS

Commercial Pantex Sika, Inc.

TECHNICAL CAPABILITIES FOR STEEL RIBS

Seven K Construction, Farmers Branch, TX

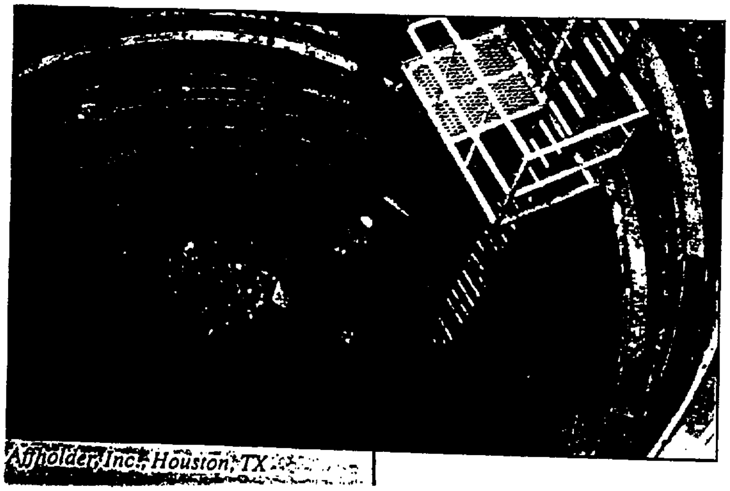
Commercial Pantex Sika has cold-rolled beams for underground supports for over 70 years. What we have learned about shaping steel for strength, performance and value in the world's tunnels and mines can be applied to the benefit of your project.

Our abilities to bend I, WF and H sections range from 4" to 27" in depth. We have bent 14" WF at 287 lbs. per foot with 2" thick flanges. Curvatures range from a minimum radius of 10 times the beam depth for 4" and 6 " sections to 14 times the depth of section for any greater radius. We are also able to bend more than one radius in a single length if compound arcs are specified. While we have worked with 30 foot sections we recommend they not exceed 22 to 25 feet. We also recommend against the use of lighter weight per foot sections when the radius of curvature is less than 25 times the depth of section.

All beams are checked to a template after bending. Both ends must conform to the true template and the maximum departure from the template is held to the following tolerances:

Under 20 ft.	+/- 3/8 inch
20 to 25 ft.	+/- 1/2 inch
25 ft. and up	+/- 3/4 inch

Variance is gradual without any abrupt change in curvature, the tolerance approaching maximum at beam center. Referenced to any 3 ft. segment of a curved beam tolerance is held to 1/8". Where necessary to hold curvature even closer, additional la-



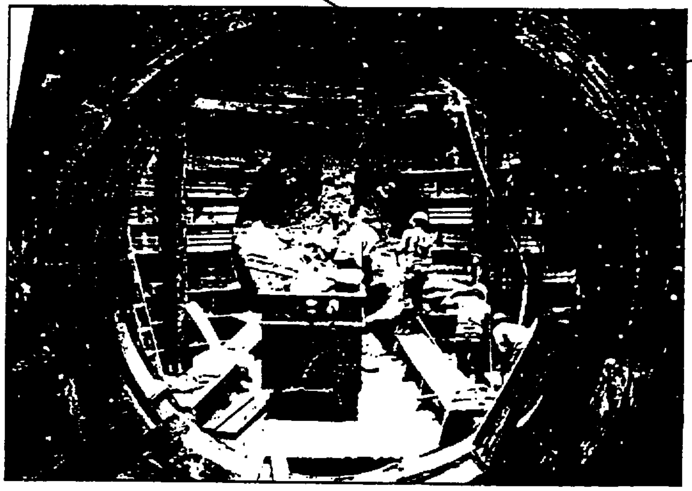
Affholder, Inc., Houston, TX

Seven K Construction, Farmers Branch, TX

bor over and above standard procedure can be performed to insure even less variation and tighter tolerances.

The uniformity of the material as-rolled is a factor that affects tolerances. The closer the profile of the as-rolled beams conforms to the cross section the closer and more uniform the tolerances of the finished product will be.

The methods we use do not distort or impair the grain flow of the metal, nor do they reduce the load carrying capacity of the finished section. In fact, certain characteristics such as camber and flange alignment are improved. It has also been our experience that cold working of steel actually increases the as-rolled yield point. Nevertheless, we do not feel that load carrying values of our cold rolled bent beams should be calculated as having greater strength than as-rolled sections. When curved to a minimum radius some droop may occur to the outer edges of the top flange.

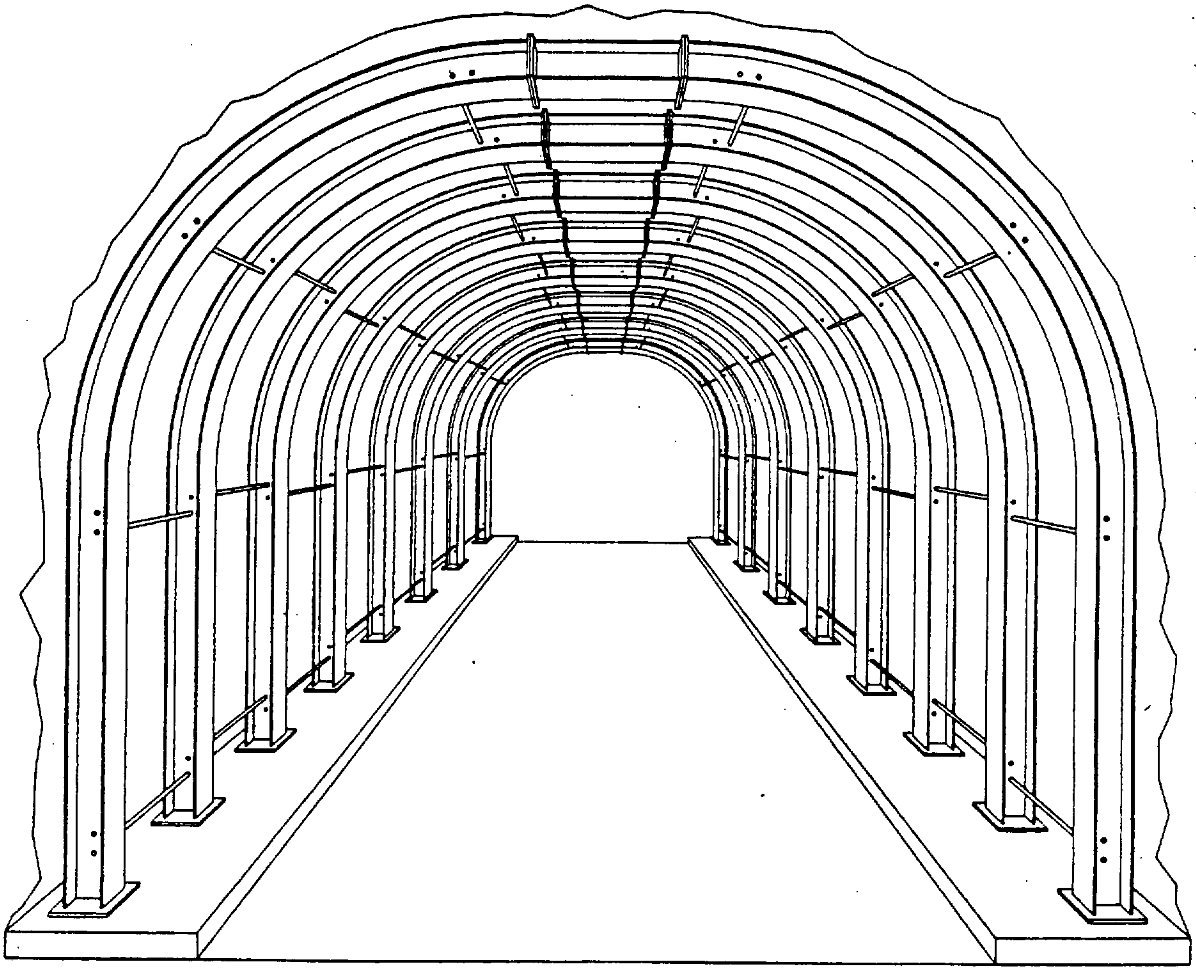


Affholder, Inc., Houston, TX

Because every beam necessarily fulfills specific requirements, prices for our work must be quoted for each inquiry. We are prepared to furnish labor and material.

Commercial Pantex Sika is the leading full service supplier of underground support systems and related specialty products in North America. It has been our pleasure to service the North American underground market since 1923. In addition to beams we manufacture liner plates and Pantex design Lattice Girders.

We also fabricate straight beams, forepoling sheets and steel lagging. Contact us for your underground support needs.



Commercial Pantex Sika, Inc.

1941 Bishop Lane, Suite 1000 • Louisville, KY 40218-1941
(502) 473-1010 • Fax: (502) 473-0707

COLD FORMED STEEL BEAMS

We appreciate your interest in our capabilities to bend structural beams cold for use in curved arch support.

Our abilities to bend I, WF and H sections range generally from 4" to 27" in depth. We have bent 14" WF at 287 lbs. per foot with 2" thick flanges. Curvatures range from a minimum radius of 14 times the depth of the section to any greater radius. We're also able to bend more than one radius in a single length of section if compound arcs are specified. While we have worked with 30 foot sections, we recommend they not exceed 22 to 25 feet which, incidentally, is convenient for shipment by truck. We also recommend against the use of lighter (wt./ft.) sections when the radius of curvature is less than 25 times the depth of the section.

All beams are checked to a template after bending. Both ends must conform to the true template and the maximum departure from the true template is held to ± 3/8" for beams not exceeding 20 feet in length. Tolerance for beams 20 to 25 feet in length are held to ± 1/2"; 25 to 30 feet in length to ± 3/4". Variance is gradual without any abrupt changes in curvature, the tolerance approaching maximum at beam center. Referenced to any 3' segment of a curved beam, tolerance are held to within 1/8". Where necessary to hold curvature even closer, additional labor over and above standard procedure can be performed to insure even less variation.

It becomes obvious that the uniformity of the material as-rolled is a factor that affects tolerances. The closer the profile of the as-rolled beam conforms to the cross section, the closer and more uniform the tolerances of the finished product will be.

The methods we use do not distort or impair the grain flow of the metal, nor do they reduce the load-carrying capacity of the finished section. In fact, certain characteristics such an camber and flange alignment are improved. Also, it has been our experience that cold working of steel actually increases the as-rolled yield point. Nevertheless, we do not feel that load-carrying values of our cold bent beams should be calculated as having greater strength than as-rolled sections. When curved to minimum radius, some droop may occur to the outer edges of the top flange.

Because every beam necessarily fulfills specific requirements, prices for our work must be quoted for each inquiry. We are prepared to furnish labor and material; consequently we carry structurals with heaviest demand in stock. If the customer prefers to supply material, we will quote labor only. Care should be exercised, however, to insure that all structurals furnished are clean and free from excessive rust and scaling surface.

Although we are the recognized leader in the underground support industry, we are not structural fabricators. Therefore we offer no engineering or technical service for the design, specification or other technical aspects of any above-ground structure.

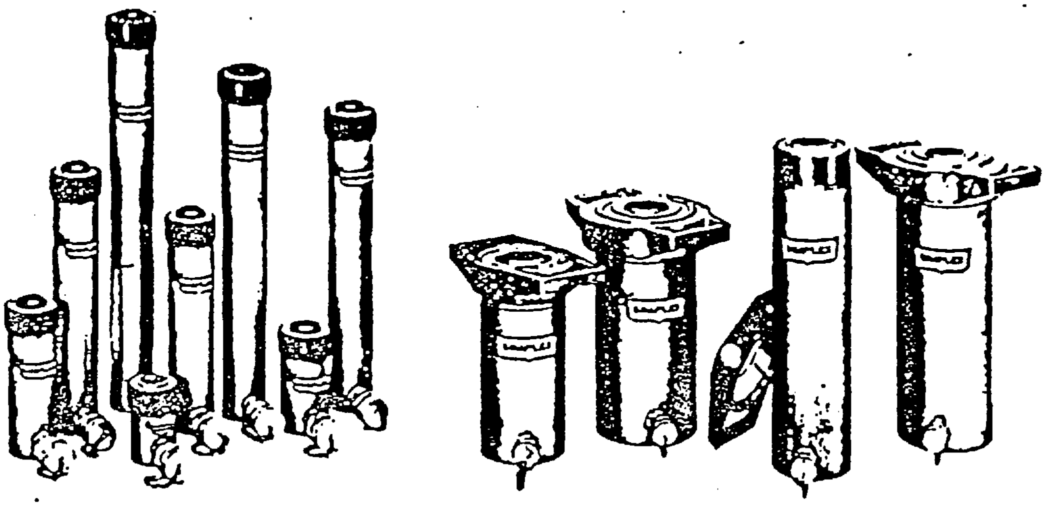
ATTACHMENT VI
MISCELLANEOUS REFERENCE DATA

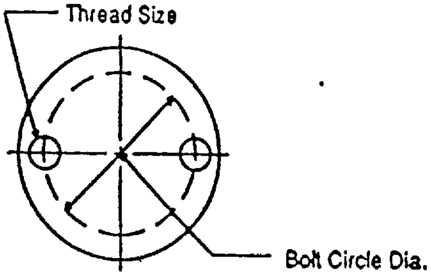
1. JACKING PERFORMANCE INFORMATION, ORIGINAL SOURCE: TK SIMPLEX CATALOG, HYDRAULIC AND MECHANICAL JACKS FOR INDUSTRY, 1990, SEE PAGES VI-2 THRU VI-6 (FOR INFORMATION ONLY: TYPE HSR-258T & HSR-2510T DIMENSIONAL INFORMATION AS USED IN ATTACHMENTS I & IX, WHICH APPROXIMATES THE 25 TON JACK USED IN CONSTRUCTION OF INITIAL W8x31 STEEL SETS)

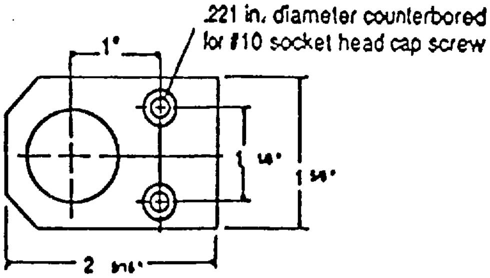
2. JACKING PERFORMANCE INFORMATION, NEW SOURCE: SIMPLEX CATALOG NO. SC101, HYDRAULIC AND MECHANICAL POWER, 1995, SEE PAGES VI-7 & VI-8 (FOR INFORMATION ONLY: DIMENSIONAL INFORMATION FOR TYPES R-258 & R-2510 WHICH ARE SAME AS 25 TON JACKS IN ITEM 1, ABOVE. ALSO, AS NOTED IN ATTACHMENT VIII, PAGE VIII-1, ANALYSIS FOR 15 TON JACKING LOAD REQUIRED FOR PROPOSED W6x20 STEEL SETS USED SAME JACKING CONFIGURATION AS USED IN ATTACHMENT I)

3. TELECON RECORD, M. CHEN/M&O WITH AISC ENGINEERING & RESEARCH STAFF, SUBJECT: DEFINITION OF SNUG TIGHT ON BOLTS, 10/03/95.

SIMPLEX® Spring Return Tooling Cylinders







HSR 50 Dimensions

Mounting Hole Dimensions

Cylinder	Thread Size	Bolt Circle Diameter (in)
*5 ton	1/4 - 20 x 1/2	1.00
10 ton	5/16 - 18 x 1/2	1.56
15 ton	3/8 - 16 x 7/8	1.87
25 ton	1/2 - 16 x 7/8	2.31
**50 ton	1/2 - 13 x 3/4	3.75

* All 5 ton models except HSR50
** HSR506T & HSR5013T only

Collar & Plunger Threads

Cylinder	Collar Thread Size	Plunger Thread Size
*5 ton	1 1/2 - 16 x 1 1/4	3/4 - 16 x 3/4
10 ton	2 1/4 - 14 x 1 1/4	**1 - 8 x 3/4
15 ton	2 3/4 - 16 x 1 15/16	1 - 8 x 1
25 ton	3 5/16 - 12 x 1 15/16	3 5/16 - 12 x 1 15/16
30 ton	3 5/16 - 12 x 1 15/16	1 1/4 - 16 x 1 1/16
50 ton	5 - 12 x 2 1/4	----
75 ton	5 3/4 - 12 x 1 3/4	----
100 ton	6 1/4 - 12 x 2 1/4	----

* None on HSR50
** None on HSR101T

Suggested Tonnage Gauges for HSR Series

Cylinder	Gauge	Gauge Face Diameter (in)
5 ton	1917201	2 1/2
10 ton	1917301	2 1/2
15 ton	1917401	2 1/2
25 ton	1917701	2 1/2
30 ton	1915801	3 1/2
50 ton	1916301	3 1/2
100 ton	1916701	3 1/2

For further information on gauges see page 32.

SIMPLEX®

Spring Return Tooling Cylinders

5 to 100 ton HSR-series

These single-acting, spring return cylinders are an excellent choice for maintenance lifting, machinery positioning, or any of a wide variety of high pressure, heavy duty pressing or tooling operations.

All models except the HSR-50 and HSR-101T have plunger, base and collar threads to ensure application flexibility and are equipped with snap-in removable grooved load caps. The HSR-series cylinders include high-flow, quick disconnect ram half-couplers.

Plated pistons not only resist corrosion, they also provide exceptional bearing surfaces. All collar threads are designed to hold the full rated capacity of the cylinders. Simplex HSR-series cylinders have a 2:1 factor of safety on material yield and are in full compliance with ASME/ANSI B30.1 safety standards.

The Simplex HSR-series cylinders are dimensionally interchangeable with most competitive models.

The HSR506T, HSR5013T, HSR756T, HSR1006T and HSR10010T include removable thread-on handles.

AS USED IN ATTACHMENT I & IX For W6

AS USED IN ATTACHS. I & IX For W8

Solid Ram - Spring Return Cylinders

Model Number	Order Number	Capacity (tons)	Stroke (in)	Closed Height (in)	Pressure @ Capacity (psi)	Reservoir Capacity Required (cu in)	Body Dia. (in)	Effective Area (sq in)	Piston Dia. (in)	Weight (lbs)	Smallest Suggested Hand Pump
HSR-50	13171	5	⅝	1 ⅝	10,060	.8	¾	.99	1	2 ½	34145
HSR-51T	13172		1	4 11/32		1.0	1 ½			2 ½	
HSR-53T	13173		3	6 ½		3.0				3 ¼	
HSR-55T	13174		5	8 ½		5.0				4	
HSR-57T	13175		7	10 ⅝		7.0				5	
HSR-59T	13176		9 ⅛	12 ¾		9.1				5 ½	
HSR-101T	13177	10	1	3 17/32	8,945	2.2	2 ¼	2.24	1 ½	3 ½	
HSR-102T	13178		2 ⅛	4 25/32		4.8				4 ¾	
HSR-104T	13179		4 ⅛	6 ¾		9.2				6 ¼	
HSR-106T	13180		6 ⅛	9 ¾		13.7				8 ¾	
HSR-108T	13181		8	11 ¾		18.0				10 ½	
HSR-1010T	13182		10 ⅛	13 ¾		22.7				12	
HSR-1012T	13183		12	15 ¾		27.0				13 ½	
HSR-1014T	13184		14	17 ¾		31.5				15 ¼	34003
HSR-152T	13152	15	2	5 ⅞	9,554	6.3	2 ¾	3.14	1 ¾	8 ¼	34145
HSR-154T	13153		4	7 ⅞		12.6				10 ¾	
HSR-156T	13154		6	10 11/16		19.0				14 ½	
HSR-1510T	13156		10	14 11/16		31.4				19 ¼	34003
HSR-1512T	13157		12	16 11/16		37.7				22	
HSR-1514T	13158		14	18 11/16		44.0				24 ½	
HSR-251T	13160	25	1	5 ½	9,700	5.2	3 ⅜	5.15	2 ¼	12	34145
HSR-252T	13161		2	6 ½		10.3				15	
HSR-254T	13162		4	8 ½		20.6				18	
HSR-256T	13163		6 ¼	10 ¾		32.2				23	34003
HSR-258T	13164		8 ¼	12 ¾		42.5				27	
HSR-2510T	13165		10 ¼	14 ¾		52.8				31	
HSR-2512T	13166		12 ¼	16 ¾		63.1				35	
HSR-2514T	13167		14 ¼	18 ¾		73.4				39	35102
HSR-308T	13270	30	8 ¼	15 ¼	9,245	53.8	4	6.49	2 ½	40	
HSR-502T	13271	50	2	6 15/16	9,054	22.1	5	11.05	3 ¼	32	34145
HSR-506T	13273		6 ¼	11 ½		69.0				50	35102
HSR-5013T	13275		13 ¼	18 ½		146.3				78	*
HSR-756T	13276	75	6 ⅛	11 ¼	9,430	97.4	5 ¾	15.90	3 ¾	63	
HSR-1006T	13277	100	6 ¼	13 ¼	9,695	137.0	6 ¼	20.63	4 ¼	90	
HSR-10010T	13278		10 ¼	16 ¾		212.0				110	

* [illegible] are suggested for these units (see pages 19-25).

SIMPLEX® | VL Jacking Cylinder Tables

VL Plain Piston Cylinders

Model Number	Order Number	Capacity (tons)	Stroke (in)	Closed Ht. (in)	Reservoir Cap. req. (cu in)	Effective Area (sq in)	Pressure @ Cap. (psi)	Body Diam. (in)	Rod Diam. (in)	Weight (lbs)
CC306	15002	30	6	8.87	38.9	6.49	9,240	4.00	2.88	32
CC3012	15003		12	14.87	77.9					53
CC506	15021	50	6	8.97	66.3	11.05	9,054	5.25	3.75	55
CC5012	15022		12	14.97	133.0					92
CC1006	15041	100	6	10.02	124.0	20.63	9,695	7.19	5.13	115
CC10012	15042		12	16.02	248.0					184
CC1502	15060	150	2	6.50	66.4	33.18	9,041	9.00	6.50	117
CC1506	15061		6	10.50	199.0					189
CC15012	15062		12	16.50	398.0					297
CC2002	15080	200	2	7.50	88.4	44.18	9,054	10.50	7.50	184
CC2006	15081		6	11.50	265.0					282
CC20012	15082		12	17.50	530.0					429
CC3002	15201	300	2	9.00	120.3	60.13	9,978	12.00	8.75	288
CC3006	15202		6	13.00	361.0					405
CC30012	15203		12	19.00	722.0					597
CC5002	15220	500	2	11.50	207.7	103.87	9,628	16.00	11.5	655
CC5006	15221		6	15.50	623.0					855
CC50012	15222		12	21.50	1246.0					1197

VL Lock Nut Cylinders

Model Number	Order Number	Cap. (tons)	Stroke (in)	Closed Ht. (in)	Reservoir Cap. Req. (cu in)	Effective Area (sq in)	Pressure @ Cap. (psi)	Body Diam. (in)	Rod Diam. (in)	Lock Nut (in)	Weight (lbs)
CCLN302	15101	30	2	5.87	13.0	6.49	9,240	4.00	2.88	1.00	21
CCLN306	15102		6	9.87	38.9						35
CCLN3012	15103		12	15.87	77.9						57
CCLN502	15120	50	2	6.22	22.1	11.05	9,054	5.25	3.75	1.25	38
CCLN506	15121		6	10.22	66.2						63
CCLN5012	15122		12	10.22	133.0						100
CCLN1002	15140	100	2	7.52	41.3	20.63	9,695	7.19	5.13	1.50	87
CCLN1006	15141		6	11.52	124.0						132
CCLN10012	15142		12	17.52	248.0						202
CCLN1502	15160	150	2	8.25	66.4	33.18	9,041	9.00	6.50	1.75	149
CCLN1506	15161		6	12.25	199.0						221
CCLN15012	15162		12	17.25	398.0						311
CCLN2002	15180	200	2	9.50	88.4	44.18	9,054	10.50	7.50	2.00	233
CCLN2006	15181		6	13.50	265.0						332
CCLN20012	15182		12	19.50	530.0						479
CCLN3002	15401	300	2	11.50	120.3	60.13	9,978	12.00	8.75	2.50	357
CCLN3006	15402		6	15.50	361.0						485
CCLN30012	15403		12	21.50	722.0						677
CCLN5002	15420	500	2	14.75	207.7	103.87	9,628	16.00	11.5	3.25	813
CCLN5006	15421		6	18.75	623.0						1041

1

SIMPLEX®

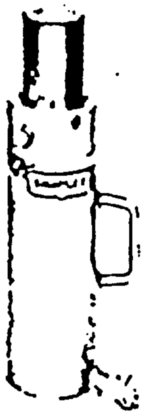
VL Jacking Cylinders

Unparalleled Jacking Performance

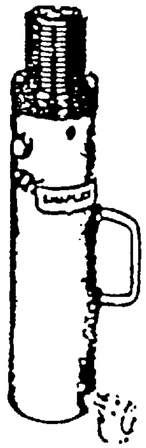
These economical, single-acting, load-return cylinders are the perfect choice for use in tight working conditions such as bridge lifting as well as other construction or jacking applications. Simplex VL jacking cylinders offer up to 2" more stroke than conventionally designed single-acting cylinders of equal closed height.

Only Simplex jacking cylinders employ the exclusive Smart Stop™ 3-Way Over-travel Prevention System. First, a red warning ring appears when the piston has reached the limit of its rated stroke. If this warning goes unnoticed when the cylinder is under load, a bleed valve safely vents oil to the atmosphere. Finally, an internal stop ring prevents over-extension of the piston when operating under no load conditions.

VL jacking cylinders are available in a plain piston version, or with threaded pistons and lock nuts. The lock nut version eliminates the need for cribbing loads in applications requiring sustained load holding.



VL plain piston



VL threaded jacking cylinder with lock nut

Other unique Simplex features

- VL jacking cylinders comply with ASME/ANSI B30.1 safety standards.
- Domed piston rods minimize the effect of eccentric and side loading.
- Grease fittings protect against moisture, dirt and corrosion.
- Plated pistons resist corrosion.
- Built-in carrying handles on 30 and 50 ton models.
- Eye bolts for lifting and positioning on 100-500 ton models.
- Specially designed seals avoid damage when the piston is extended beyond its rated stroke under load.
- Black-oxided lock nuts resist corrosion.

Economic Hydraulic System Design

Templeton, Kenly & Co.'s patented Retractor Valve allows the practical application of our VL jacking cylinders into systems less costly than traditional high-tonnage jacking systems.

The following price percentage comparison demonstrates this cost savings. Each system includes four (4) 200 ton X 6 inch stroke cylinders. One of the systems utilizes traditional double-acting cylinders with double runs of hose to each cylinder. The other uses the new Simplex single-acting VL Jacking Cylinders and a Retractor Valve equipped pump.

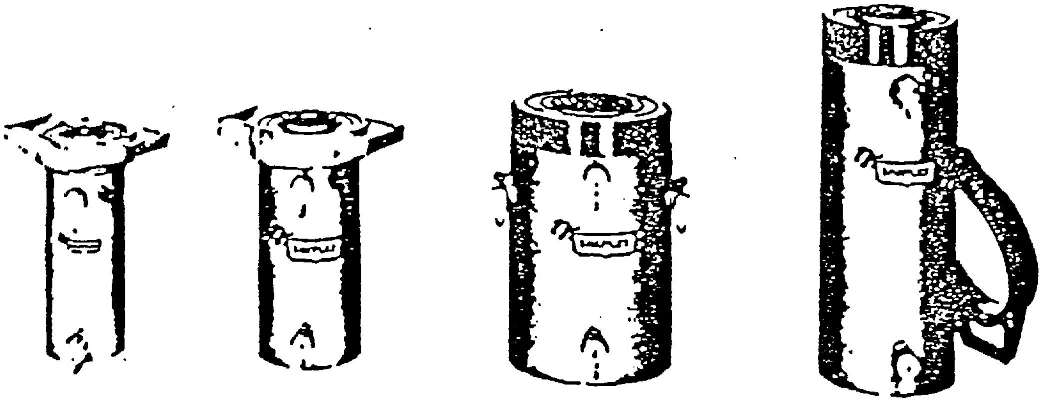
System Component	Traditional Double-Acting System		Simplex System w/VL Jacking Cylinders and Retractor Valve	
	Order #	% of Sys. Cost	Order #	% of Trad. Sys. Cost
Pump: 1.5 HP Perm. Mag. 5 Gallon Reservoir, Manual 3 Pos. Valve.	7100504	12.5	7100513	12.7
Control Manifold:	18086	1.8	18086	1.8
Return Manifold:	1814201	.5	Not Required	0.0
Hoses: Assumes • 2 cylinders @ 10' distance • 2 cylinders @ 30' distance • 1/4" I.D. hose on double-acting • 3/8" I.D. on single-acting. All hoses are 10 foot multiples.	 (8) 18204 (8) 18202 (1) 18164 (16) 18113	 4.4 3.7 .3 .6	 (4) 18098 (4) 18097 (8) 18113	 4.0 3.6 .3
Check Release Valve:	(4) 18074	4.7	(4) 18074	4.7
Cylinders:	(4) 13233	71.5	(4) 15081	49.9
Total System Cost =		100.0		77.0

Savings with new Simplex VL Jacking Cylinders = 23%

SIMPLEX® Double-Acting Solid Ram Cylinders

Simplex Double-Acting Cylinders should be considered when the application requires fast cylinder retraction and/or frequent duty cycles. They are also necessary for applications requiring both push and pull force. These cylinders not only retract faster, they also allow for better retraction control than single acting cylinders. More rigorous duty cycles are possible because the inherent design keeps the cylinder rod lubricated. All double-acting cylinders are equipped with safety relief valves to protect against over-pressurizing the rod end of the cylinder.

- Most models have threaded plungers to accommodate pulling attachments.
- All cylinders have a 2:1 factor of safety on material yield and comply fully with ASME/ANSI B30.1 safety standards.
- Tonnage gauges and swivel load caps are also available for many of these cylinders.
- The Pine cylinder line is available on a build-to-order basis for solid ram applications up to 664 ton capacity. (See page 29.)
- All models include high flow couplings.

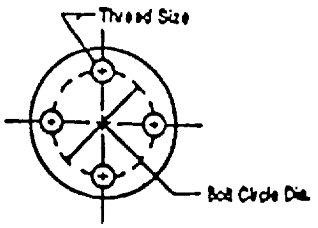


Double-Acting Solid Ram Cylinders

Model Number	Order Number	Push Cap. (tons)	Stroke (in)	Pull Cap. (tons)	Closed Height (in)	Pressure at Cap. (psi)	Effective Area (sq in)	Pump Reservoir Cap. Req. (cu in)	Body Dia. (in)	Plunger Internal Thread Size X Length	Collar Thread Size X Length	Piston Rod Dia. (in)	Weight (lbs)
H506T	1332201	50	6 1/4	16.8	13 1/4	9,054	11.05	46	5	1 - 12 x 1 1/2	5 - 12 x 1 3/4	3 1/4	85
H5012T	1332501		12		19 1/4			92					130
H5024T	1332601		24		31 1/4			184					223
H100-6DAT	13356	100	6 3/32	40	13 3/4	9,239	21.65	77	7	3 1/4 - 12 x 2 1/2	7 - 12 x 2 1/2	4	152
H100-12DAT	13951		12		19 3/4			151					187
H150-6DAT	13363	150	6 3/32	61	15 7/16	9,041	33.18	120	8.5	3 1/2 - 12 x 2 3/4	8 1/2 - 12 x 2 7/16	5	218
H150-12DAT	13953		12		21 1/4			236					295
RC-2006	13233	200	6	72	15 7/16	9,054	44.18	170	10	———	9 3/4 x 1 7/8	6	315
RC-20013	13234		13		22 7/16			368					440

Mounting Holes and Assessories

Cylinder Series	Thread Size	Bolt Circle Dia. (in)	Tonnage Gauge	Swivel Cap Number	Additional Height of Cap (in)
50 ton	3/4 - 11 x 3/4	3.75	1916301	———	———
100 ton	3/4 - 11 x 1	4.25	1916801	18325	3/4
150 ton	1 - 8 x 1 3/4	5.00	1917101	18328	1 3/4
200 ton	1 - 8 x 1 1/4	5.00	1900501	———	———



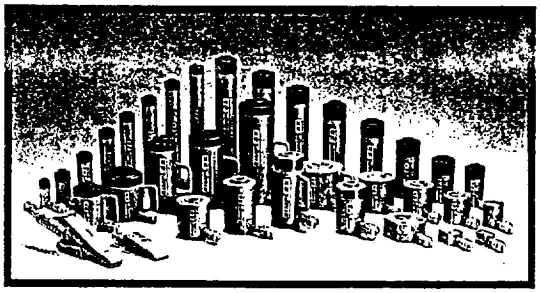
SIMPLEX®
A Division Of Templeton, Kenly & Co., Inc.

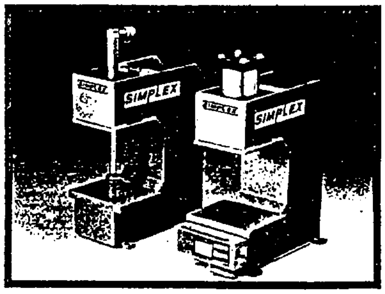
HYDRAULIC

AND

MECHANICAL

POWER

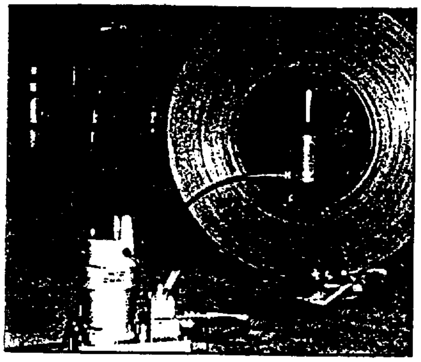




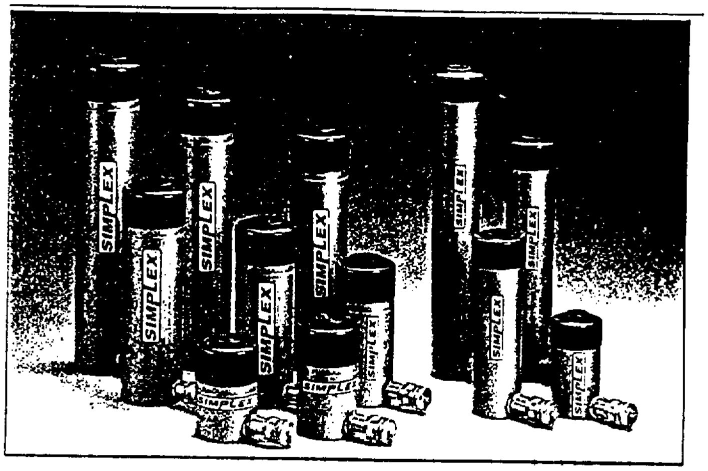
SC101

SPRING RETURN - 15-25 TON CYLINDERS

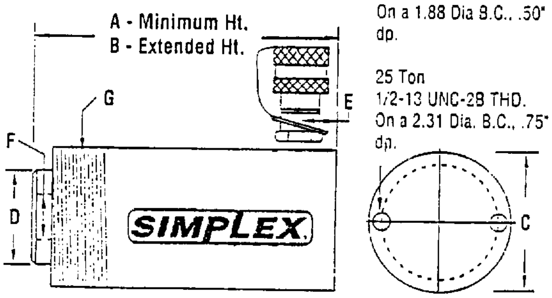
Simplex Cylinders Quickly & Safely Reshape Steel Coils.



Large steel coils that were damaged in handling would not fit the arbor of a large steel slitting machine. Using a Simplex R256 cylinder and P70 Series pump, maintenance crews were able to reshape the coil I.D. saving time and expense in the process. "Simplex hydraulics were much faster and safer than the methods we used previously."



DIAGRAM



Base Mounting Holes
15 Ton
3/8-16 UNC-2B THD
On a 1.88 Dia B.C., .50" dp.

25 Ton
1/2-13 UNC-2B THD.
On a 2.31 Dia. B.C., .75" dp.

BENEFITS/FEATURES

Simplex 15 & 25 ton R Series rams are the choice when reliability & durability are key. Heavy duty steel construction, plated piston rods & large bronze bearings add up to tough, long lasting cylinders. Ideal for a wide range of applications at construction sites, mills, power plants, rail car shops & industrial maintenance.

- 13 Models
- High Flow, quality couplers with metal caps.
- Collar threads designed for full load.
- Base & piston mountings for easy fixturing.
- Removable load caps for flexibility & safety.
- Steel stop ring for piston blow-out protection.
- Plated piston to resist scoring & corrosion.
- Large bearings resist side load.
- Rod wiper protects inner cylinder from dirt.

Spring Return Cylinders 15 & 25 Ton Capacities

Model Number	Cap. (tons)	Stroke (in)	A Min. Ht. (in)	B Ext. Ht. (in)	Ram Bore Dia. (in)	Effect Area (sq in)	Pres. @ Cap. (psi)	Oil Cap. Req'd (cu in)	C Body O.D. (in)	D Piston O.D. (in)	E Base To Port C/L (in)	F		G		Wgt. (lbs)	Sugstd. Hand Pump
												Piston I.D. Thrds. (in)	Piston Thrd. Depth (in)	Collar Thrds. (in)	Collar Thrd. Lgth. (in)		
R152	15	2	5 7/8	7 7/8	2	3.14	9,554	6.3	2 3/4	15/8	3/4	1 x 8	1	21/2 x 16	1 3/16	8.3	P42
R154		4	7 7/8	11 7/8				12.6								10.8	
R156		6	10 11/16	16 11/16				19.0			1					14.5	
R1510		10	14 11/16	24 11/16				31.4								19.5	P140
R1514		14	18 11/16	32 11/16				44.0								24.5	
R251	25	1	5 1/2	6 1/2	2 9/16	5.15	9,700	5.2	3 3/8	2 1/4		1 1/2 x 16	1 1/8	35/16x12	1 15/16	12.0	P42
R252		2	6 1/2	8 1/2				10.3								15.0	
R254		4	8 1/2	12 1/2				20.6								18.0	
R256		6 1/4	10 3/4	17				32.2								23.0	
R258		8 1/4	12 3/4	21				42.5								27.0	P140
R2510		10 1/4	14 3/4	25				52.8								31.0	
R2512		12 1/4	16 3/4	29				63.1								35.0	
R2514		14 1/4	18 3/4	33				73.4								39.0	

COMPARES TO PAGE VI-3 For W8
COMPARES TO PAGE VI-3 For W6

M&O

RECORD OF TELEPHONE CONVERSATION

FROM: MORRIE CHEN

DATE: OCT. 3, 1995 TIME: 9:00 A.M.

LOCATION: 5TH FLR, 101 CONVENTION CENTER DR.
LAS VEGAS, NV. 89109

SUBJECT: SNUG TIGHT OF BOLT.

TO: AISC ENGINEERING & RESEARCH

P.O. NO. 04580826

LOCATION: CHICAGO

OTHER REF.

PER TELEPHONE CONVERSATION WITH AISC ENGINEERING AND RESEARCH STAFF, THE TENSION IN BOLT IS NEGLIGIBLE WHEN THE BOLT IS BROUGHT TO A SNUG-TIGHT CONDITION. SNUG TIGHT IS DEFINED AS THE TIGHTNESS THAT EXIST WHEN THE PLIES OF THE JOINT ARE IN FIRM CONTACT.

Morrie S. Chen

CC: M.E. TAYLOR
M.D. STINE
D. J. ROGERS

ATTACHMENT VII

MISCELLANEOUS SHOP FABRICATION TOLERANCES AND STEEL SET INSTALLATION TOLERANCES*

*Not Addressed Elsewhere within this Analysis

SHOP FABRICATION TOLERANCES:

A. Source of Fabrication & Installation Tolerances.

Tolerances are established generally based on AISC recommendations. In some instances, Constructor's comments and suggestions were incorporated. Tolerances for structural steel items will be shown on the fabricator's shop drawings that are reviewed and approved by the A/E. The tolerances in Section B, below are representative of good workmanship and industry practice and the values shown are to be used in developing the fabrication drawings (also refer to the Commercial Pantex Sika Catalog information in Attachment V for tolerances common to the steel set fabrication industry). Any deviations from the tolerances indicated must be shown on the shop drawings and will be subject to A/E review and approval. Tolerances which relate to the critical design attributes of Section 8.5 in the Body of the Analysis are described in Section C, below.

B. Mill and Fabrication Tolerances.

1. Mill tolerances shall be in accordance with AISC M016, pages 1-145 to 1-158, and ASTM A6/A6M.

2. The following fabrication tolerances are non-critical and are in accordance with standard industry practice for fabricating steel sets and miscellaneous associated structural steel. In addition, judgement, based on observed field conditions, and experience gained from previously installed steel sets, result in upper bound tolerances for bending and fabrication as follows:

   a. Bending Tolerances: After bending, all steel shapes shall conform to mill tolerances except as allowed below for bounding the upper limits of the tolerances for bending:

      - Departure from true template between rib ends - 1/2" max. (based on Attachment V).
      - Departure from true template for any one point - 1/4" max. in any gage length of 4'-0" max.
      - Flange droop - 1/4" max.
      - Deviation from flat for web buckling - 3/16" max. within 1/2 beam depth from each end.

- Deviation from nominal beam depth - 1/4" (minus) max.
- Sweep in beams between end plates will be allowed to vary from established mill rolling tolerances, but shall not exceed 5 inches.

b. Fabrication Tolerances - Tolerances shall not exceed the following upper bounding limits:

- Departure from theoretical plane of face of butt plate - 1/4" max.
- Gap between butt plate and beam end - 1/16" max. for 75% of bearing prior to welding contact. Excess gap filled with weld.
- Tie rod hole spacing in a group - 3/8" max. tolerance on dimension between holes as shown on shop drawings.
- Tie rod hole group spacing - (±)3/8" on dimension from W-shape centerline, and (±) 1" on dimension along the length of the beam (all dimensions as shown on shop drawings).
- Deviation of sheared plate dimensions from dimension shown - (±) 1/8".
- Deviation of holes within butt plate group - 3/16" max.
- Deviation of butt plate holes after assembly - 3/16" max.
- Camber and sweep permitted in straight structural members not to exceed mill rolling tolerances.

C. Installation Tolerances.

Some of the following installation features and their respective tolerances relate to selected critical design attributes of Section 8.5 in the Body of the Analysis. Where a tolerance on an installation feature is not critical, and not specifying a tolerance will have no effect on the capability of the steel set to perform its safety related function, it is so noted as a non-critical feature. Similarly, critical features important to performance are also noted and will require QA Controls:

1. Location on Inverts (Critical):
   Steel sets shall be located away from the joints in the concrete invert segments a sufficient distance to prevent damage or overstress in the invert segment. The clear distance from the edge of the steel set foot plate to edge of invert segment at joints shall be 4" minimum (Page VII-6). In addition, the inside edge of the W8x31 steel set flange shall not be offset inward from the inside edge of the invert segment curb by more than 5/8-inch (Attachment III.E, Page III-83). Similarly, the W6x20 shall not be offset beyond the inside edge of the invert segment curb by more than 1-1/2 inches (Attachment III.E, Page III-84).

2. Spacing Tolerance Parallel to Longitudinal Tunnel Centerline (Critical):
   Steel set spacing (2 ft, 4 ft or 6 ft, see Table 14, Ref. 5.20) is controlled by the length of the pipe spacers, which are snugged into position when the tie rods are tightened. It may occasionally be necessary to add shims between the end of the pipe spacers and the web of the ring beam, or to cut a short section off the end of the pipe spacers, to adjust set spacing due to a buildup of tolerances when a series of sets have been erected through a given reach of tunnel. There is no tolerance for decreasing the set spacing to less than the nominal value represented by Table 14 in Ref. 5.20. By inspection of the steel set interaction equations of Attachments I & III.A and the lagging analysis of Attachment III.B, it is judged that an increase of up to 2 inches beyond the nominal set spacing will not adversely affect the load carrying capacity of the steel set or lagging.

3. Tie Rod Spacing (Critical):

   The spacing of the tie rods along the centerline of the steel set W-shape shall not exceed 35°. Tie rods shall be located within the foot segment, no more than 7° from the foot segment base plate. In addition, the tie rods shall be located 1/2" inside of centerline of the W-shape (±) 3/8".

4. Expansion/Blocking of the Steel Set (Critical):

   The critical attribute relating to this tolerance is that the set, via the lagging,be forced to make positive contact with the as-excavated tunnel crown and walls to the extent practical, i.e. consistent with standard industry practice (see Section 8.5F). This is accomplished by either expanding the set using jacks, or blocking the set where voids occur, or a combination of both as appropriate. Because the set is often pre-assembled and lagged under cover of the tail shield on the TBM (for obvious safety reasons), there is no way to verify/quantify the number or location of points the set or lagging actually makes contact with the rock. This sort of verification is not considered necessary as long as experienced supervision is available to oversee the steel set erection process. Therefore, there is not an appropriate tolerance to control this feature.

5. Vertical Alignment (Non-Critical):

The vertical plane of the steel sets shall be nominally perpendicular to the horizontal axis of the tunnel. The maximum offset of 16-1/4" at the crown measured relative to the base calculated on Page VII-8 is an upper bound limit on the worst offset possible due to tunnel grade, fabrication tolerance on steel set bearing plates, and invert segment bearing surface slope. As shown on Page VII-10, vertical misalignment of the steel set will not overstress the steel set even at this worst case offset. It is judged that normal installation of the foot plate flat on the invert segment curb will adequately control the installation. Therefore, no tolerance is necessary to control this feature.

6. Skew Parallel to Longitudinal Tunnel Centerline (Non-Critical):

Skew is not considered important, as the erection process will only tolerate a minor amount of skewing before it is impossible to insert the bolts used to make up the joints. Therefore, no tolerance is necessary to control this feature.

7. Diametrical Tolerance Transverse to Longit. Tunnel Centerline (Non-Critical):

There is no tolerance associated with the vertical and horizontal placement of the steel set transverse to the longitudinal tunnel centerline. The overriding concern is that the set be expanded/blocked as stated under Section C.4, above.

8. Bolted Connections (Critical):

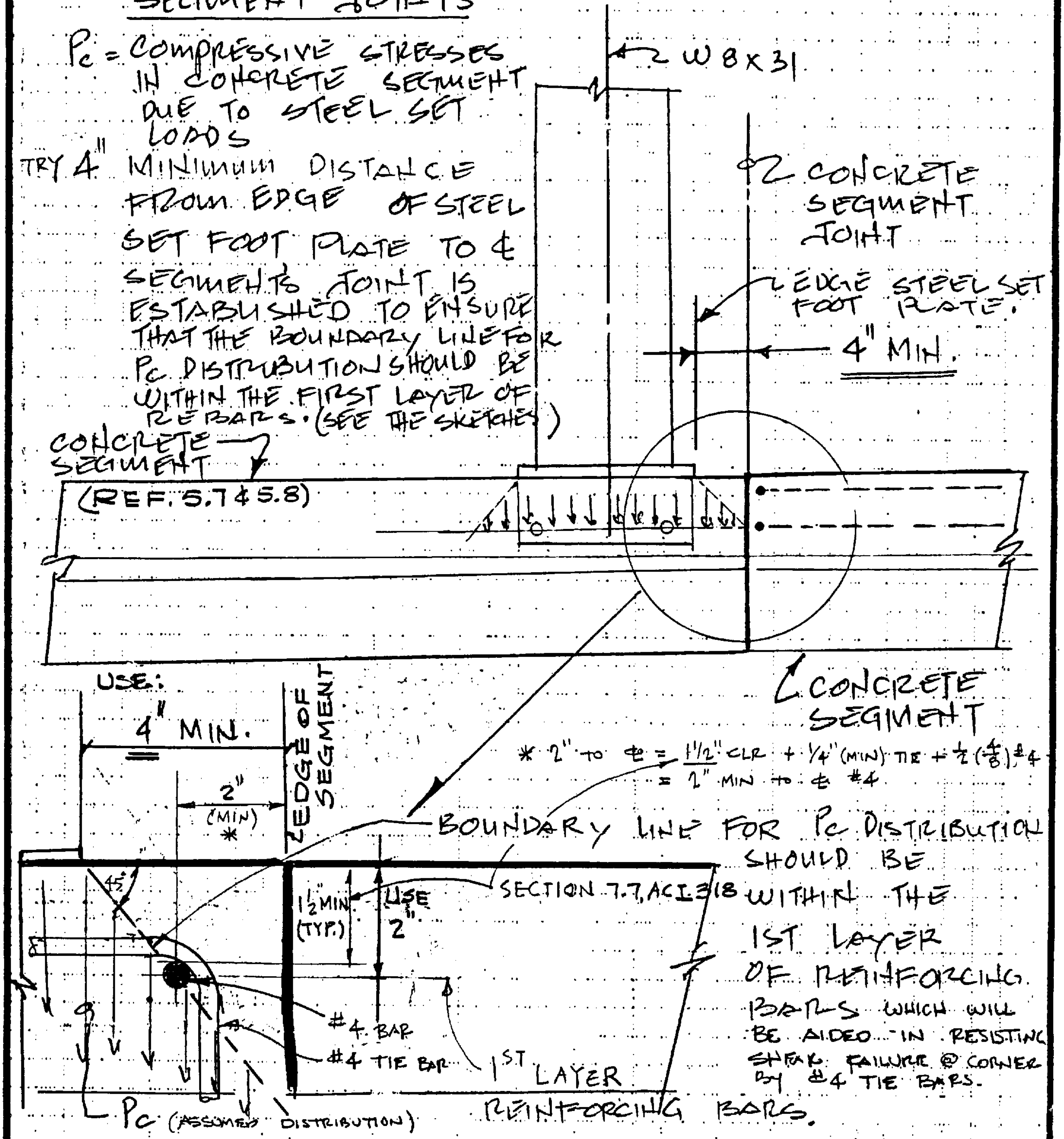
All bolted connections using ASTM A307 (or higher strength) bolts shall be installed to a snug tight condition. Bolt head and nut or washer(s) shall make contact with the joint plates. Snug tightness shall be in accordance with AISC M016, except that gaps between joint plates and shims may exceed 1/16 inch if plates or plates and shims contact at any point in the connection plane. As a result of vibrations due to the passage of rail traffic over the invert segment rails and seating of the connection plates as the sets take load, it is anticipated that the nuts on the steel set connection bolts might loosen over time. This condition will be mitigated by the requirement in the construction specifications (Section 01501, Paragraph 3.01J - Reference 5.4) that the Constructor provide "routine inspection, maintenance, monitoring and repair (as required) of the permanent function ground support system" in order to meet the maintainable life of 100 years required for incorporation into a potential repository. This inspection and repair program will ensure that the steel set connections are maintained during the life of the ESF, but will have to be carried forward (along with other ground support maintenance tasks) through the ESF operations phase into repository construction and operations, when the ground support begins to perform its nuclear safety-related function.

STEEL SET INSTALLATION TOLERANCES:

MINIMUM EDGE DISTANCE FROM STEEL FOOT PLATE TO SEGMENT JOINTS

P_c = COMPRESSIVE STRESSES IN CONCRETE SEGMENT DUE TO STEEL SET LOADS

TRY 4" MINIMUM DISTANCE FROM EDGE OF STEEL SET FOOT PLATE TO ℄ SEGMENTS JOINT IS ESTABLISHED TO ENSURE THAT THE BOUNDARY LINE FOR P_c DISTRIBUTION SHOULD BE WITHIN THE FIRST LAYER OF REBARS. (SEE THE SKETCHES)



* 2" to ℄ = 1½" CLR + ¼" (MIN) TIE + ½ (4/8) #4
= 2" MIN to ℄ #4

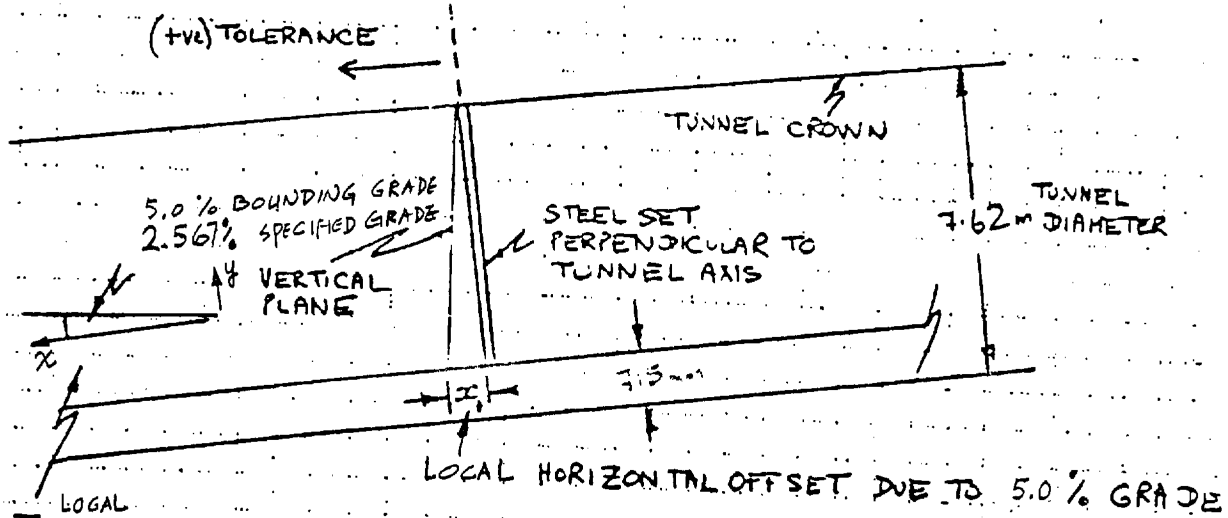
BOUNDARY LINE FOR P_c DISTRIBUTION SHOULD BE WITHIN THE 1ST LAYER OF REINFORCING BARS WHICH WILL BE AIDED IN RESISTING SHEAR FAILURE @ CORNER BY #4 TIE BARS.

TUNNEL GRADE :

REQUIRED MAX. TUNNEL GRADE = 2.567 % (REF. 5.12). TO INCLUDE TOLERANCE, A 5.0 % BOUNDING GRADE IS USED IN THE FOLLOWING CALCULATIONS FOR INVESTIGATING THE IMPACT ON STEEL SET DESIGN DUE TO TUNNEL GRADE.

STEEL SETS TO BE POSITIONED ON PRECAST SEGMENTS SUCH THAT THE STEEL END PLATE BEARING SURFACES ARE REASONABLY IN CONTACT. TO TRANSFER ROCK LOADS THRU STEEL SET BASE PLATE INTO PRECAST CONCRETE CURBS LOCATED ON THE INVERT OF THE TUNNEL.

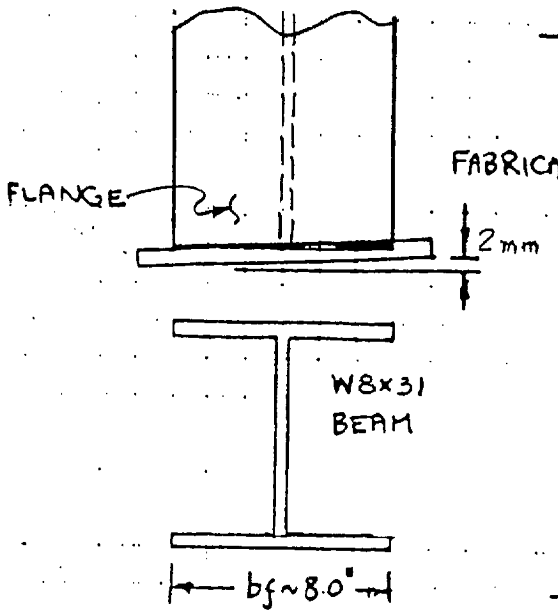
DIAMETER OF TUNNEL = 7.62 m (REF. 5.12)
BASE THICKNESS OF CONCRETE SEGMENT = 715 mm (REF. 5.8)



THE LOCAL HORIZONTAL OFF-SET "x_1" FOR A STEEL SET NORMAL TO TUNNEL AT 5.0 % GRADE

$$x_1 = \frac{5.0}{100}(7.62 - 0.715) \times 1000 \text{ mm}$$

$x_1 = \underline{345}$ mm (≈ ~~5.8~~ 13.6") WMDS 9/11/95



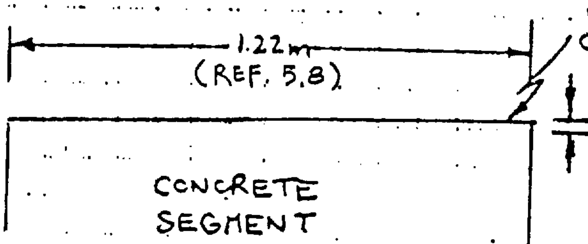
STEEL SET/BEARING PLATE

FABRICATION TOLERANCE = $1/16''$ ---(See Para. II.2.B, pg VII-2)
= 1.588^{mm} USE 2^{mm}

VERTICAL OFF-SET INDUCED BY 1mm FABRICATION OFF-SET FROM PERPENDICULAR

$$\frac{1}{203}(7.62-0.715)(1000) = \underline{34.00\,mm}=(x_2)$$

CONCRETE SEGMENT



BEARING SURFACE ON EDGE OF SEGMENT

$1/4'' = 6.35^{mm}$ say ~~5~~ 6^{mm} **

5mm FABRICATION TOLERANCE (Code Ref. 4.4.1, ACI 301) *

VERTICAL OFF-SET INDUCED BY 6mm CASTING TOLERANCE

$$\frac{6\,mm}{1.22\,(1000)}(7.62-0.715)(1000)$$

$$= \underline{34.0\,mm}=(x_3)$$

*NOTE: FABRICATION TOLERANCE OF 1/4" FROM ACI 301, TABLE 4.3.1 IS 1/4" IN 10 FT FOR CAST-IN-PLACE FORMS. THIS VALUE IS CONSERVATIVELY APPLIED HERE AS THE MAXIMUM TOLERANCE ON THE FLATNESS OF THE PRECAST STEEL FORMED INVERT CURBS ACROSS ONLY 4 FT.

CUMMULATIVE TOLERANCE

$$\Sigma x = x_1 + x_2 + x_3$$

1.	LINE & GRADE @ 5.0%	345.0 mm	(x_1)
2.	STEEL SET/BEARING PLATE.	34.0 mm	(x_2)
3.	CONCRETE INVERT SEGMENT.	34.0 mm	(x_3)
		413.0 mm	≈ (16¼")

INSTALLATION TOLERANCE = 16¼"
(413mm)

** THESE VALUES ROUNDED DOWN DUE TO CONSERVATISM IN INITIAL VALUE SELECTED (1/4") & UNLIKELYHOOD OF ALL WORST TOLERANCES OCCURRING SIMULTANEOUSLY

IMPACT OF CUMMULATIVE OFFSET ON STEEL SET DESIGN:

THE OFFSET OF 16¼" FROM PLUMB AS SHOWN ON PAGE VII-8 OF THIS ATTACHMENT FOR THE STEEL SETS IS BASED ON STEEL FABRICATION TOLERANCE, CONCRETE SEGMENT TOLERANCE AND THE TUNNEL GRADE. THE OFFSET FROM PLUMB COULD CREATE ECCENTRIC LOAD FROM UTILITY WEIGHTS TO STEEL SET AND INDUCE A LOCAL BENDING IN STEEL SET WEB. REFERRING TO FIG. 1 ON THE RIGHT, THE ROCK LOAD IS RESOLVED INTO TWO COMPONENTS. THE PERPENDICULAR TO STEEL SET FLANGE SURFACE COMPONENT IS THE TRUE ROCK PRESSURE ON STEEL SET AND SHOULD INDUCE NO ECCENTRIC LOAD. THE PARALLEL TO STEEL SET FLANGE SURFACE COMPONENT IS SUPPORTED BY THE ROCK ITSELF. THE DESIGN OF STEEL SET USES FULL ROCK, NOT THE COMPONENT, WHICH IS CONSERVATIVE.

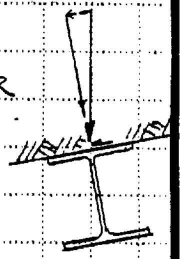
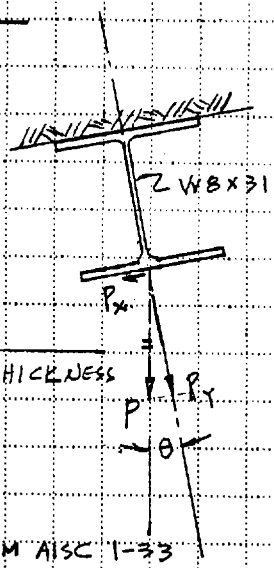


FIG. 1

TO EVALUATE THE IMPACT OF THE CUMULATIVE OFFSET ON STEEL SET DESIGN, A CALCULATION TO OBTAIN THE MAXIMUM STRESS IN W8 X 31 WEB IS SHOWN ON NEXT PAGE. THE MIDDLE SUPPORT OF VENTILATION DUCTS REPRESENTS THE HEAVIEST UTILITY LOAD ON STEEL SET & IS CHOSEN TO DEMONSTRATE THE WORST CONDITION. THE RESULT SHOWS THE MAXIMUM STRESS INDUCED BY CUMULATIVE TOLERANCE IS MUCH LESS THAN ALLOWABLE.

STRESS AT CROWN OF STEEL SET INDUCED BY ECCENTRIC LOAD FROM INSTALLATION CUMMULATIVE OFFSET :



MAXIMUM UTILITY LOAD AT THE CROWN OF STEEL SET SUPPORTING VENTILATION DUCTS

$P = 3.88^k$ ---- PAGE II-11, ATTACHMENT II

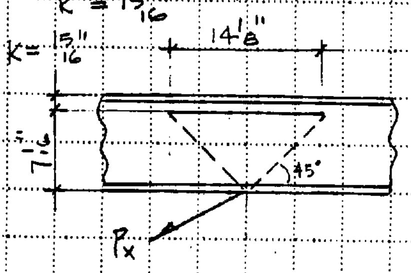
FOR 413 ^{mm} (OR $16\frac{1}{4}"$) CUMMULATIVE OFFSET,

$$\text{ANGLE } \theta \cong \tan^{-1} \frac{\text{CUMMULATIVE OFFSET}}{\text{TUNNEL DIAMETER} - \text{CONCRETE SEGMENT THICKNESS}}$$

$$= \tan^{-1} \frac{413^{mm}/1000 = 0.05981}{7.62 - 0.715}$$

$$= 3.423°$$

FROM AISC 1-33
$d = 8"$
$t_w = .285"$
$k = \frac{15}{16}"$



FORCES ACTING AT SUPPORT

$P_Y = P \cos\theta = 3.873^k \cong P = 3.88^k$

$P_x = P \sin\theta = 0.23^k$

P_x WILL INDUCE A LOCAL BENDING IN W8 WEB.

SECTION MODULUS OF THE PORTION OF WEB IN BENDING DUE TO P_X

$$= \frac{bt^2}{6} = 14.125" \times (0.285)^2/6 = 0.1912 \text{ IN}^3$$

$$M = 0.23^k \times 7.0625" = 1.624"^k$$

$$f_b = \frac{1.624}{0.1912} = 8.49^{ksi} << F_b = 0.75 F_y = 27^{ksi} \text{ --- O.K.}$$

(AISC F2-1)

THE INDUCED STRESS IS WITHIN THE ALLOWABLE STRESS, AND THE ABOVE STRESS IS NOT ADDITIVE TO STEEL SET DESIGN UNITY CHECK. THEREFORE, THE IMPACT OF STEEL SET INSTALLATION TOLERANCES ON STEEL SET DESIGN IS NOT SIGNIFICANT.

ATTACHMENT VIII STRUCTURAL STEEL SET USING W6X20

PURPOSE AND DESCRIPTION

The purpose of the attachment VIII is to confirm the capacity of the W6X20 steel shape to WITHSTAND THE LONG TERM ROCK LOAD AND TO DETERMINE THE MAXIMUM ALLOWABLE JACKING LOAD BASED ON A JACKING PROCESS SIMILAR TO THAT USED FOR THE W8X31 STEEL SETS.

For jacking loads two computer analysis were performed, one with 20 Ton jacking load and another with 17 ton jacking load. The results are that the W6X20 shape is adequate for 17 Ton jacking, but not for 20 Ton jacking. (See "Summary of computer analyses for W6X20 steel shape" at the end of this attachment).

For all inputs used in the computer analyses performed in this attachment, see Attachment I, the 51 degrees runs. The jacking bracket for jacking without insert is situated at 51 degrees with the vertical axis. (See page IX-3).

The configuration from Attachment I can be used in this analysis because the difference in radius is 1" which represents a difference of less than 1% in configuration. From the resulting interaction coefficient for the 17 Ton jack (see page VIII-26), we can conclude that the results are adequate.

W6 × 20. 17 TON JACKING.

BOTH SIDES @ 51°.

CRITICAL MEMBERS: 3, 4, 41 & 42.

$P = 32.2^{K}$ $M = 15.41^{1K}$ — (FROM STZRV3D-17 TON)

UNBRACED LENGTHS.

$LY = 7.43' = 89.16'' \doteq 35°$ TIE ROD SPACING

LX = distance between blocking = $4 \times 18.79'$ $\cong 75''$

Since $r_x > r_y$, LX DOES NOT GOVERN FOR COLUMN BUCKLING

ARCH LENGTH FROM SPRING LINE TO CONCRETE INVERT $= \dfrac{\pi r A}{180} = \dfrac{\pi(146)(90°-31°)}{180}$

ARCH LENGTH $= \dfrac{\pi * 146 * 59}{180} = 150.34266$

MEMBER LENGTH COMPRESSIVE FLANGE UNBRACED LENGTH. — $= \dfrac{150.34266}{8 (= \text{No. OF MEMBERS})} = 18.79$ in

So $LX \cong 3.0 * 18.79'' \cong 56.37''$

SEE MOMENT DIAGRAM - FOR DISTANCE BTWEEN INFLEXION POINTS ≅ 3 MEMBER LENGTHS = UNBRACED COMPRESSIVE FLANGE LENGTH

$\dfrac{K l_x}{r_x} = \dfrac{56.37}{2.66} = 21.19$ $F'_e = 332.9$

AISC 5-122

DETERMINE ALLOWABLE STRESSES

Fa . USE $K = 1$ - CONSERVATIVELY

$\frac{K L_y}{r_y} = \frac{89.16}{1.50} = 59.44$ - CRITICAL BY INSPECTION

$\underline{F_a = 17.49}$ ksi AISC TABLE C-36

Fb $L_c = \frac{76\, b_f}{\sqrt{F_y}} = \frac{76 \times 6.02}{6} = 76''$ (F1-2)

AISC 5-45 $F_b = .66 F_y = 36 \times .66 = \underline{24}$ ksi (F1-1) -

DETERMINE INTERACTION COEFFICIENT

AISC 5-54 $C_m = 1.0$ AISC pg 5-55

H 1-1 : $\frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \frac{f_a}{F'_{ex}}\right) F_b} = \frac{5.486}{17.49} + \frac{13.8}{\underbrace{\left(1 - \frac{5.486}{332.9}\right)}_{.983} 24}$

$= .3137 + .585$

$= \underline{.898 < 1.0}$

OK

$f_a = \frac{32.2}{5.87} = \underline{5.486}$ ksi

$f_b = \frac{15.41 \times 12}{13.4} = \underline{13.8}$ ksi

H 1-2 : $\frac{fa}{21.6} + \frac{fb}{24} = \frac{5.486}{21.6} + \frac{13.8}{24} = .829 < 1$

NOT CRITICAL

CHECK 20 TON JACKS

CRITICAL MEMBERS 3, 4, 41, 42 ↓ FROM STLR3D - 20 TON JACK

$P_{axial} = 37.81^{K}$ $M = 17.6^{1K}$

$fa = \frac{37.81}{5.87} = 6.44^{ksi}$

$fb = \frac{17.6 \times 12}{13.4} = 15.76^{ksi}$

$Fa = 17.49^{ksi}$

$Fb = 24^{ksi}$

$Fe' = 332.9^{ksi}$

see SHT VIII.2

AISC 5-54 - H1-1.

$$\frac{6.44}{17.49} + \frac{15.76}{\underbrace{\left(1 - \frac{6.44}{332.9}\right)}_{.98} 24} = .368 + .67 = 1.038$$

$> 1.$ NG.

HENCE 20^{T} JACK IS TOO HIGH. –

```
**************************************************
*                                                *
*             S T A A D - III                    *
*             Revision 16.0b                     *
*             Proprietary Program of             *
*             RESEARCH ENGINEERS, Inc.           *
*             Date=    SEP 11, 1995              *
*             Time=    13:42:18                  *
*                                                *
**************************************************


  1. STAAD PLANE BABEE0000-01717-0200-00003 ATTACHMENT VIII
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. * FILE STLRV3D
  4. * 20 TON JACKS APPLIED BOTH SIDES @ 51 DEGREES
  5. * W6X20
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 2.71 2.77 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.62 2.77
 19. MEMBER INCIDENCE
 20. 3 3 4 42
 21. UNIT KIP INCH
 22. MEMBER PROPERTIES
 23. 3 TO 42 TA STA W6X20
 24. CONSTANTS
 25. E 29000.0 ALL
 26. DENSITY 0.00028 ALL
 27. BETA 0 ALL
 28. UNIT FT
 29. SUPPORT
 30. 3 7 11 35 39 43 FIXED BUT FY MZ
 31. 22 24 FIXED BUT FX MZ
 32. 16 30 PINNED
 33. UNIT KIP
 34. LOAD 1
 35. SELF WEIGHT Y -1.0
 36. LOADING 2
 37. * 20 TON JACKS @ BOTH SIDES
 38. * TO OBTAIN LOADS FOR 20 TON JACKS: MULTIPLY
 39. * THE LOADS FOR 25 TON JACKS BY 0.80
 40. * THEN, MULTIPLY MOMENTS BY 5/12 BECAUSE
 41. * EXCENTRICITY IS 5" FOR  W6X20
 42. * 31.47 X .8 = 25.176 K
 43. * 38.86 X .8 = 31.088 K
 44. * 40K X 5"/12 = 16.667 FT K
 45. JOINT LOADING
 46. 3 FX -25.176
 47. 43 FX 25.176
```

```
48. 3 43 FY 31.088
49. 43 MZ -16.667
50. 3 MZ 16.667
51. LOADING COMBINATION 3
52. 1 2.5 2 1.0
53. PERFORM ANALYSIS


       P R O B L E M   S T A T I S T I C S
       -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    41/   40/   10
  ORIGINAL/FINAL BAND-WIDTH =     1/     1
  TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =    111
  SIZE OF STIFFNESS MATRIX =      666 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                  13:42:21
++ PROCESSING GLOBAL STIFFNESS MATRIX.                   13:42:21
++ PROCESSING TRIANGULAR FACTORIZATION.                  13:42:22
++ CALCULATING JOINT DISPLACEMENTS.                      13:42:22
++ CALCULATING MEMBER  FORCES.                           13:42:22

 54. LOAD LIST 3
 55. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

    3     3    0.00000    0.08192    0.00000    0.00000    0.00000    0.00474
    4     3   -0.01809    0.06631    0.00000    0.00000    0.00000    0.00380
    5     3   -0.04977    0.04079    0.00000    0.00000    0.00000    0.00068
    6     3   -0.03522    0.04325    0.00000    0.00000    0.00000   -0.00138
    7     3    0.00000    0.05094    0.00000    0.00000    0.00000   -0.00102
    8     3    0.00240    0.04800    0.00000    0.00000    0.00000    0.00006
    9     3   -0.00041    0.04444    0.00000    0.00000    0.00000    0.00002
   10     3    0.00129    0.04139    0.00000    0.00000    0.00000   -0.00001
   11     3    0.00000    0.03866    0.00000    0.00000    0.00000    0.00077
   12     3   -0.02438    0.04216    0.00000    0.00000    0.00000    0.00125
   13     3   -0.04181    0.04588    0.00000    0.00000    0.00000    0.00042
   14     3   -0.04065    0.04146    0.00000    0.00000    0.00000   -0.00084
   15     3   -0.02225    0.02440    0.00000    0.00000    0.00000   -0.00173
   16     3    0.00000    0.00000    0.00000    0.00000    0.00000   -0.00135
   17     3    0.00747   -0.00918    0.00000    0.00000    0.00000   -0.00038
   18     3    0.00726   -0.00984    0.00000    0.00000    0.00000    0.00011
   19     3    0.00470   -0.00638    0.00000    0.00000    0.00000    0.00026
   20     3    0.00246   -0.00246    0.00000    0.00000    0.00000    0.00021
   21     3    0.00122   -0.00026    0.00000    0.00000    0.00000    0.00009
   22     3    0.00060    0.00000    0.00000    0.00000    0.00000    0.00003
   23     3    0.00001    0.00050    0.00000    0.00000    0.00000    0.00000
   24     3   -0.00057    0.00000    0.00000    0.00000    0.00000   -0.00003
   25     3   -0.00119   -0.00024    0.00000    0.00000    0.00000   -0.00009
   26     3   -0.00242   -0.00242    0.00000    0.00000    0.00000   -0.00021
   27     3   -0.00465   -0.00633    0.00000    0.00000    0.00000   -0.00026
   28     3   -0.00722   -0.00979    0.00000    0.00000    0.00000   -0.00011
   29     3   -0.00745   -0.00916    0.00000    0.00000    0.00000    0.00038
   30     3    0.00000    0.00000    0.00000    0.00000    0.00000    0.00135
   31     3    0.02221    0.02437    0.00000    0.00000    0.00000    0.00173
   32     3    0.04065    0.04146    0.00000    0.00000    0.00000    0.00085
   33     3    0.04197    0.04601    0.00000    0.00000    0.00000   -0.00043
   34     3    0.02425    0.04229    0.00000    0.00000    0.00000   -0.00125
   35     3    0.00000    0.03866    0.00000    0.00000    0.00000   -0.00076
   36     3   -0.00141    0.04137    0.00000    0.00000    0.00000    0.00000
   37     3   -0.00015    0.04438    0.00000    0.00000    0.00000   -0.00004
   38     3   -0.00292    0.04794    0.00000    0.00000    0.00000   -0.00004
   39     3    0.00000    0.05078    0.00000    0.00000    0.00000    0.00106
   40     3    0.03606    0.04302    0.00000    0.00000    0.00000    0.00141
   41     3    0.05073    0.04051    0.00000    0.00000    0.00000   -0.00070
   42     3    0.01832    0.06678    0.00000    0.00000    0.00000   -0.00385
   43     3    0.00000    0.08257    0.00000    0.00000    0.00000   -0.00479
```

```
SUPPORT REACTIONS -UNIT KIP  FEET     STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

    3     3      3.59      0.00      0.00      0.00      0.00      0.00
    7     3     21.42      0.00      0.00      0.00      0.00      0.00
   11     3     17.06      0.00      0.00      0.00      0.00      0.00
   35     3    -17.11      0.00      0.00      0.00      0.00      0.00
   39     3    -21.43      0.00      0.00      0.00      0.00      0.00
   43     3     -3.56      0.00      0.00      0.00      0.00      0.00
   22     3      0.00     -1.48      0.00      0.00      0.00      0.00
   24     3      0.00     -1.49      0.00      0.00      0.00      0.00
   16     3    -11.12    -28.26      0.00      0.00      0.00      0.00
   30     3     11.15    -28.25      0.00      0.00      0.00      0.00
```

```
MEMBER END FORCES     STRUCTURE TYPE = PLANE
-----------------
 ALL UNITS ARE -- KIP   FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z    TORSION      MOM-Y      MOM-Z


   3     3   3     37.79      2.05     0.00       0.00       0.00     -16.67
             4    -37.77     -2.03     0.00       0.00       0.00      17.60

   4     3   4     37.81     -1.20     0.00       0.00       0.00     -17.60
             5    -37.75      1.24     0.00       0.00       0.00      15.69

   5     3   5     37.29     -5.98     0.00       0.00       0.00     -15.69
             6    -37.22      6.02     0.00       0.00       0.00       6.30

   6     3   6     36.19    -10.56     0.00       0.00       0.00      -6.30
             7    -36.12     10.58     0.00       0.00       0.00     -10.21

   7     3   7     30.30      5.73     0.00       0.00       0.00      10.21
             8    -30.22     -5.71     0.00       0.00       0.00      -1.23

   8     3   8     30.70      1.80     0.00       0.00       0.00       1.23
             9    -30.63     -1.79     0.00       0.00       0.00       1.58

   9     3   9     30.62      1.97     0.00       0.00       0.00       1.58
            10    -30.55     -1.97     0.00       0.00       0.00       1.11

  10     3  10     30.15      5.31     0.00       0.00       0.00      -1.11
            11    -30.08     -5.30     0.00       0.00       0.00       8.37

  11     3  11     33.98     -7.95     0.00       0.00       0.00      -8.37
            12    -33.92      7.97     0.00       0.00       0.00      -2.46

  12     3  12     34.64     -3.75     0.00       0.00       0.00       2.46
            13    -34.58      3.77     0.00       0.00       0.00      -7.60

  13     3  13     34.78     -0.24     0.00       0.00       0.00       7.60
            14    -34.72      0.27     0.00       0.00       0.00      -7.95

  14     3  14     34.53      3.69     0.00       0.00       0.00       7.95
            15    -34.47     -3.65     0.00       0.00       0.00      -2.92

  15     3  15     33.80      7.72     0.00       0.00       0.00       2.92
            16    -33.75     -7.68     0.00       0.00       0.00       7.55

  16     3  16      5.61     -2.38     0.00       0.00       0.00      -7.55
            17     -5.56      2.43     0.00       0.00       0.00       4.26

  17     3  17      5.79     -1.81     0.00       0.00       0.00      -4.26
            18     -5.76      1.86     0.00       0.00       0.00       1.76

  18     3  18      5.93     -1.19     0.00       0.00       0.00      -1.76
            19     -5.90      1.25     0.00       0.00       0.00       0.09
```

```
 MEMBER END FORCES     STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT      AXIAL    SHEAR-Y  SHEAR-Z    TORSION      MOM-Y       MOM-Z


  19     3  19       6.00      -0.58     0.00       0.00       0.00       -0.09
            20      -5.98       0.64     0.00       0.00       0.00       -0.74

  20     3  20       6.01       0.01     0.00       0.00       0.00        0.74
            21      -5.99       0.05     0.00       0.00       0.00       -0.77

  21     3  21       5.96       0.62     0.00       0.00       0.00        0.77
            22      -5.95      -0.55     0.00       0.00       0.00        0.03

  22     3  22       5.76      -0.27     0.00       0.00       0.00       -0.03
            23      -5.76       0.33     0.00       0.00       0.00       -0.39

  23     3  23       5.76       0.34     0.00       0.00       0.00        0.39
            24      -5.76      -0.27     0.00       0.00       0.00        0.03

  24     3  24       5.95      -0.55     0.00       0.00       0.00       -0.03
            25      -5.96       0.62     0.00       0.00       0.00       -0.77

  25     3  25       5.99       0.05     0.00       0.00       0.00        0.77
            26      -6.01       0.01     0.00       0.00       0.00       -0.74

  26     3  26       5.98       0.63     0.00       0.00       0.00        0.74
            27      -6.00      -0.56     0.00       0.00       0.00        0.08

  27     3  27       5.90       1.26     0.00       0.00       0.00       -0.08
            28      -5.93      -1.21     0.00       0.00       0.00        1.76

  28     3  28       5.76       1.86     0.00       0.00       0.00       -1.76
            29      -5.80      -1.81     0.00       0.00       0.00        4.26

  29     3  29       5.56       2.43     0.00       0.00       0.00       -4.26
            30      -5.61      -2.38     0.00       0.00       0.00        7.55

  30     3  30      33.77      -7.65     0.00       0.00       0.00       -7.55
            31     -33.82       7.69     0.00       0.00       0.00       -2.88

  31     3  31      34.49      -3.62     0.00       0.00       0.00        2.88
            32     -34.55       3.66     0.00       0.00       0.00       -7.88

  32     3  32      34.74       0.08     0.00       0.00       0.00        7.88
            33     -34.80      -0.05     0.00       0.00       0.00       -7.79

  33     3  33      34.57       4.04     0.00       0.00       0.00        7.79
            34     -34.63      -4.01     0.00       0.00       0.00       -2.30

  34     3  34      33.99       7.76     0.00       0.00       0.00        2,30
            35     -34.05      -7.74     0.00       0.00       0.00        8.27

  35     3  35      30.08      -5.31     0.00       0.00       0.00       -8.27
            36     -30.15       5.32     0.00       0.00       0.00        0.99
```

```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3  36     30.56     -1.76     0.00      0.00      0.00      -0.99
            37    -30.63      1.76     0.00      0.00      0.00      -1.41

  37     3  37     30.63     -1.78     0.00      0.00      0.00      -1.41
            38    -30.71      1.78     0.00      0.00      0.00      -1.37

  38     3  38     30.22     -5.70     0.00      0.00      0.00       1.37
            39    -30.30      5.71     0.00      0.00      0.00     -10.32

  39     3  39     36.06     10.83     0.00      0.00      0.00      10.32
            40    -36.14    -10.80     0.00      0.00      0.00       6.53

  40     3  40     37.23      6.04     0.00      0.00      0.00      -6.53
            41    -37.30     -6.01     0.00      0.00      0.00      15.96

  41     3  41     37.77      1.06     0.00      0.00      0.00     -15.96
            42    -37.83     -1.02     0.00      0.00      0.00      17.59

  42     3  42     37.79     -2.01     0.00      0.00      0.00     -17.59
            43    -37.81      2.03     0.00      0.00      0.00      16.67

 ************** END OF LATEST ANALYSIS RESULT **************

  56. CHECK CODE ALL
```

```
                        STAAD-III CODE CHECKING - (AISC)
                        ***********************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX            MY             MZ       LOCATION
=======================================================================

     3  ST   W6X 20         PASS      AISC- H1-2       0.963         3
                        37.77 C         0.00         17.60          0.46
     4  ST   W6X 20         PASS      AISC- H1-2       0.964         3
                        37.81 C         0.00        -17.60          0.00
     5  ST   W6X 20         PASS      AISC- H1-2       0.888         3
                        37.29 C         0.00        -15.69          0.00
     6  ST   W6X 20         PASS      AISC- H1-2       0.671         3
                        36.12 C         0.00        -10.21          1.56
     7  ST   W6X 20         PASS      AISC- H1-2       0.625         3
                        30.30 C         0.00         10.21          0.00
     8  ST   W6X 20         PASS      AISC- H1-2       0.301         3
                        30.63 C         0.00          1.58          1.56
     9  ST   W6X 20         PASS      AISC- H1-2       0.301         3
                        30.62 C         0.00          1.58          0.00
    10  ST   W6X 20         PASS      AISC- H1-2       0.554         3
                        30.08 C         0.00          8.37          1.37
    11  ST   W6X 20         PASS      AISC- H1-2       0.585         3
                        33.98 C         0.00         -8.37          0.00
    12  ST   W6X 20         PASS      AISC- H1-2       0.560         3
                        34.58 C         0.00         -7.60          1.37
    13  ST   W6X 20         PASS      AISC- H1-2       0.574         3
                        34.72 C         0.00         -7.95          1.36
    14  ST   W6X 20         PASS      AISC- H1-2       0.573         3
                        34.53 C         0.00          7.95          0.00
    15  ST   W6X 20         PASS      AISC- H1-2       0.552         3
                        33.75 C         0.00          7.55          1.36
    16  ST   W6X 20         PASS      AISC- H1-3       0.331         3
                         5.61 C         0.00         -7.55          0.00
    17  ST   W6X 20         PASS      AISC- H1-3       0.208         3
                         5.79 C         0.00         -4.26          0.00
    18  ST   W6X 20         PASS      AISC- H1-3       0.114         3
                         5.93 C         0.00         -1.76          0.00
    19  ST   W6X 20         PASS      AISC- H1-3       0.076         3
                         5.98 C         0.00         -0.74          1.36
    20  ST   W6X 20         PASS      AISC- H1-3       0.077         3
                         5.99 C         0.00         -0.77          1.36
    21  ST   W6X 20         PASS      AISC- H1-3       0.077         3
                         5.96 C         0.00          0.77          0.00
    22  ST   W6X 20         PASS      AISC- H1-3       0.061         3
                         5.76 C         0.00         -0.39          1.37
    23  ST   W6X 20         PASS      AISC- H1-3       0.061         3
                         5.76 C         0.00          0.39          0.00
    24  ST   W6X 20         PASS      AISC- H1-3       0.077         3
                         5.96 C         0.00         -0.77          1.36
    25  ST   W6X 20         PASS      AISC- H1-3       0.077         3
                         5.99 C         0.00          0.77          0.00
    26  ST   W6X 20         PASS      AISC- H1-3       0.076         3
                         5.98 C         0.00          0.74          0.00
```

```
L UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER      TABLE          RESULT/   CRITICAL COND/     RATIO/     LOADING/
                             FX            MY             MZ       LOCATION
=======================================================================

    27   ST   W6X 20          PASS     AISC- H1-3        0.114         3
                           5.93 C         0.00           1.76        1.36
    28   ST   W6X 20          PASS     AISC- H1-3        0.208         3
                           5.80 C         0.00           4.26        1.36
    29   ST   W6X 20          PASS     AISC- H1-3        0.331         3
                           5.61 C         0.00           7.55        1.37
    30   ST   W6X 20          PASS     AISC- H1-2        0.552         3
                          33.77 C         0.00          -7.55        0.00
    31   ST   W6X 20          PASS     AISC- H1-2        0.570         3
                          34.55 C         0.00          -7.88        1.37
    32   ST   W6X 20          PASS     AISC- H1-2        0.572         3
                          34.74 C         0.00           7.88        0.00
    33   ST   W6X 20          PASS     AISC- H1-2        0.567         3
                          34.57 C         0.00           7.79        0.00
    34   ST   W6X 20          PASS     AISC- H1-2        0.581         3
                          34.05 C         0.00           8.27        1.36
    35   ST   W6X 20          PASS     AISC- H1-2        0.550         3
                          30.08 C         0.00          -8.27        0.00
    36   ST   W6X 20          PASS     AISC- H1-2        0.295         3
                          30.63 C         0.00          -1.41        1.36
    37   ST   W6X 20          PASS     AISC- H1-2        0.295         3
                          30.63 C         0.00          -1.41        0.00
    38   ST   W6X 20          PASS     AISC- H1-2        0.629         3
                          30.30 C         0.00         -10.32        1.57
    39   ST   W6X 20          PASS     AISC- H1-2        0.675         3
                          36.06 C         0.00          10.32        0.00
    40   ST   W6X 20          PASS     AISC- H1-2        0.898         3
                          37.30 C         0.00          15.96        1.57
    41   ST   W6X 20          PASS     AISC- H1-2        0.964         3
                          37.83 C         0.00          17.59        1.57
    42   ST   W6X 20          PASS     AISC- H1-2        0.963         3
                          37.79 C         0.00         -17.59        0.00

  ************** END OF TABULATED RESULT OF DESIGN **************


   57. PLOT DISPLACEMENT FILE
   58. PLOT BENDING FILE
   59. FINISH

      *************** END OF STAAD-III ***************

  DATE= SEP 11,1995   TIME= 13:42:26 ******

      ************************************************************
      *       For questions on STAAD-III/ISDS, contact:          *
      *       RESEARCH ENGINEERS, Inc at (714) 974-2500          *
```

```
**************************************************
*                                                *
*                S T A A D - III                 *
*                Revision 16.0b                  *
*                Proprietary Program of          *
*                RESEARCH ENGINEERS, Inc.        *
*                Date=    SEP 11, 1995           *
*                Time=    13:57:37               *
*                                                *
**************************************************


  1. STAAD PLANE BABEE0000-01717-0200-00003 ATTACHMENT VIII
  2. * ESF GROUND SUPPORT-STRUCTURAL STEEL ANALYSIS REV 00
  3. * FILE STLRV3D
  4. * 17 TON JACKS APPLIED BOTH SIDES @ 51 DEGREES
  5. * W6X20
  6. UNIT FT KIP
  7. JOINT COORDINATES
  8. 3 2.71 2.77 ; 4 2.43 3.13
  9. 5 1.58 4.44 ; 6 0.90 5.85 ; 7 0.40 7.33 ; 8 0.10 8.87
 10. 9 0.0 10.43 ; 10 0.08 11.79 ; 11 0.31 13.14 ; 12 0.68 14.45
 11. 13 1.21 15.71 ; 14 1.86 16.90 ; 15 2.65 18.02 ; 16 3.56 19.03
 12. 17 4.58 19.94 ; 18 5.69 20.73 ; 19 6.89 21.39 ; 20 8.15 21.91
 13. 21 9.46 22.29 ; 22 10.80 22.52 ; 23 12.17 22.60 ; 24 13.53 22.52
 14. 25 14.87 22.29 ; 26 16.18 21.91 ; 27 17.45 21.39 ; 28 18.64 20.73
 15. 29 19.75 19.94 ; 30 20.77 19.03 ; 31 21.68 18.02 ; 32 22.47 16.90
 16. 33 23.13 15.71 ; 34 23.65 14.45 ; 35 24.03 13.14 ; 36 24.26 11.79
 17. 37 24.33 10.43 ; 38 24.23 8.87 ; 39 23.93 7.33 ; 40 23.44 5.85
 18. 41 22.76 4.44 ; 42 21.90 3.13 ; 43 21.62 2.77
 19. MEMBER INCIDENCE
 20. 3 3 4 42
 21. UNIT KIP INCH
 22. MEMBER PROPERTIES
 23. 3 TO 42 TA STA W6X20
 24. CONSTANTS
 25. E 29000.0 ALL
 26. DENSITY 0.00028 ALL
 27. BETA 0 ALL
 28. UNIT FT
 29. SUPPORT
 30. 3 7 11 35 39 43 FIXED BUT FY MZ
 31. 22 24 FIXED BUT FX MZ
 32. 16 30 PINNED
 33. UNIT KIP
 34. LOAD 1
 35. SELF WEIGHT Y -1.0
 36. LOADING 2
 37. * 17 TON JACKS @ BOTH SIDES
 38. * TO OBTAIN LOADS FOR 17 TON JACKS: MULTIPLY
 39. * THE LOADS FOR 20 TON JACKS BY 0.85
 40. * THEN, MULTIPLY MOMENTS BY 5/12 BECAUSE
 41. * EXCENTRICITY IS 5" FOR  W6X20
 42. * 25.176 K X .85 = 21.4 K
 43. * 31.088 K X .85 = 26.425 K
 44. * 34K X 5"/12 = 14.667 FT K
 45. JOINT LOADING
 46. 3 FX -21.4
 47. 43 FX 21.4
```

```
  48. 3 43 FY 26.425
  49. 43 MZ -14.667
  50. 3 MZ 14.667
  51. LOADING COMBINATION 3
  52. 1 2.5 2 1.0
  53. PERFORM ANALYSIS


          P R O B L E M   S T A T I S T I C S
          -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     41/   40/   10
   ORIGINAL/FINAL BAND-WIDTH =     1/     1
   TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =    111
   SIZE OF STIFFNESS MATRIX =      666 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =     0.07 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                    13:57:40
++ PROCESSING GLOBAL STIFFNESS MATRIX.                     13:57:41
++ PROCESSING TRIANGULAR FACTORIZATION.                    13:57:41
++ CALCULATING JOINT DISPLACEMENTS.                        13:57:41
++ CALCULATING MEMBER  FORCES.                             13:57:42

  54. LOAD LIST 3
  55. PRINT ANALYSIS RESULTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = PLANE
------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN

    3     3   0.00000   0.06971   0.00000   0.00000   0.00000   0.00413
    4     3  -0.01575   0.05615   0.00000   0.00000   0.00000   0.00331
    5     3  -0.04322   0.03410   0.00000   0.00000   0.00000   0.00059
    6     3  -0.03055   0.03632   0.00000   0.00000   0.00000  -0.00120
    7     3   0.00000   0.04307   0.00000   0.00000   0.00000  -0.00089
    8     3   0.00230   0.04063   0.00000   0.00000   0.00000   0.00004
    9     3  -0.00010   0.03760   0.00000   0.00000   0.00000   0.00003
   10     3   0.00122   0.03503   0.00000   0.00000   0.00000   0.00000
   11     3   0.00000   0.03274   0.00000   0.00000   0.00000   0.00065
   12     3  -0.02067   0.03571   0.00000   0.00000   0.00000   0.00106
   13     3  -0.03541   0.03885   0.00000   0.00000   0.00000   0.00036
   14     3  -0.03442   0.03510   0.00000   0.00000   0.00000  -0.00071
   15     3  -0.01884   0.02066   0.00000   0.00000   0.00000  -0.00147
   16     3   0.00000   0.00000   0.00000   0.00000   0.00000  -0.00115
   17     3   0.00634  -0.00780   0.00000   0.00000   0.00000  -0.00033
   18     3   0.00618  -0.00839   0.00000   0.00000   0.00000   0.00009
   19     3   0.00402  -0.00548   0.00000   0.00000   0.00000   0.00022
   20     3   0.00212  -0.00216   0.00000   0.00000   0.00000   0.00018
   21     3   0.00105  -0.00026   0.00000   0.00000   0.00000   0.00008
   22     3   0.00051   0.00000   0.00000   0.00000   0.00000   0.00003
   23     3   0.00001   0.00044   0.00000   0.00000   0.00000   0.00000
   24     3  -0.00049   0.00000   0.00000   0.00000   0.00000  -0.00003
   25     3  -0.00103  -0.00025   0.00000   0.00000   0.00000  -0.00008
   26     3  -0.00208  -0.00212   0.00000   0.00000   0.00000  -0.00018
   27     3  -0.00398  -0.00544   0.00000   0.00000   0.00000  -0.00022
   28     3  -0.00614  -0.00835   0.00000   0.00000   0.00000  -0.00009
   29     3  -0.00632  -0.00778   0.00000   0.00000   0.00000   0.00033
   30     3   0.00000   0.00000   0.00000   0.00000   0.00000   0.00114
   31     3   0.01881   0.02063   0.00000   0.00000   0.00000   0.00147
   32     3   0.03442   0.03510   0.00000   0.00000   0.00000   0.00072
   33     3   0.03556   0.03896   0.00000   0.00000   0.00000  -0.00036
   34     3   0.02056   0.03581   0.00000   0.00000   0.00000  -0.00106
   35     3   0.00000   0.03273   0.00000   0.00000   0.00000  -0.00065
   36     3  -0.00132   0.03501   0.00000   0.00000   0.00000  -0.00001
   37     3  -0.00038   0.03755   0.00000   0.00000   0.00000  -0.00004
   38     3  -0.00275   0.04058   0.00000   0.00000   0.00000  -0.00003
   39     3   0.00000   0.04293   0.00000   0.00000   0.00000   0.00092
   40     3   0.03127   0.03613   0.00000   0.00000   0.00000   0.00123
   41     3   0.04403   0.03386   0.00000   0.00000   0.00000  -0.00060
   42     3   0.01594   0.05656   0.00000   0.00000   0.00000  -0.00335
   43     3   0.00000   0.07027   0.00000   0.00000   0.00000  -0.00418
```

```
SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = PLANE
-----------------

JOINT  LOAD     FORCE-X     FORCE-Y    FORCE-Z       MOM-X       MOM-Y       MOM Z

    3     3        2.93        0.00       0.00        0.00        0.00        0.00
    7     3       18.36        0.00       0.00        0.00        0.00        0.00
   11     3       14.40        0.00       0.00        0.00        0.00        0.00
   35     3      -14.45        0.00       0.00        0.00        0.00        0.00
   39     3      -18.37        0.00       0.00        0.00        0.00        0.00
   43     3       -2.90        0.00       0.00        0.00        0.00        0.00
   22     3        0.00       -1.24       0.00        0.00        0.00        0.00
   24     3        0.00       -1.24       0.00        0.00        0.00        0.00
   16     3       -9.36      -23.84       0.00        0.00        0.00        0.00
   30     3        9.39      -23.84       0.00        0.00        0.00        0.00
```

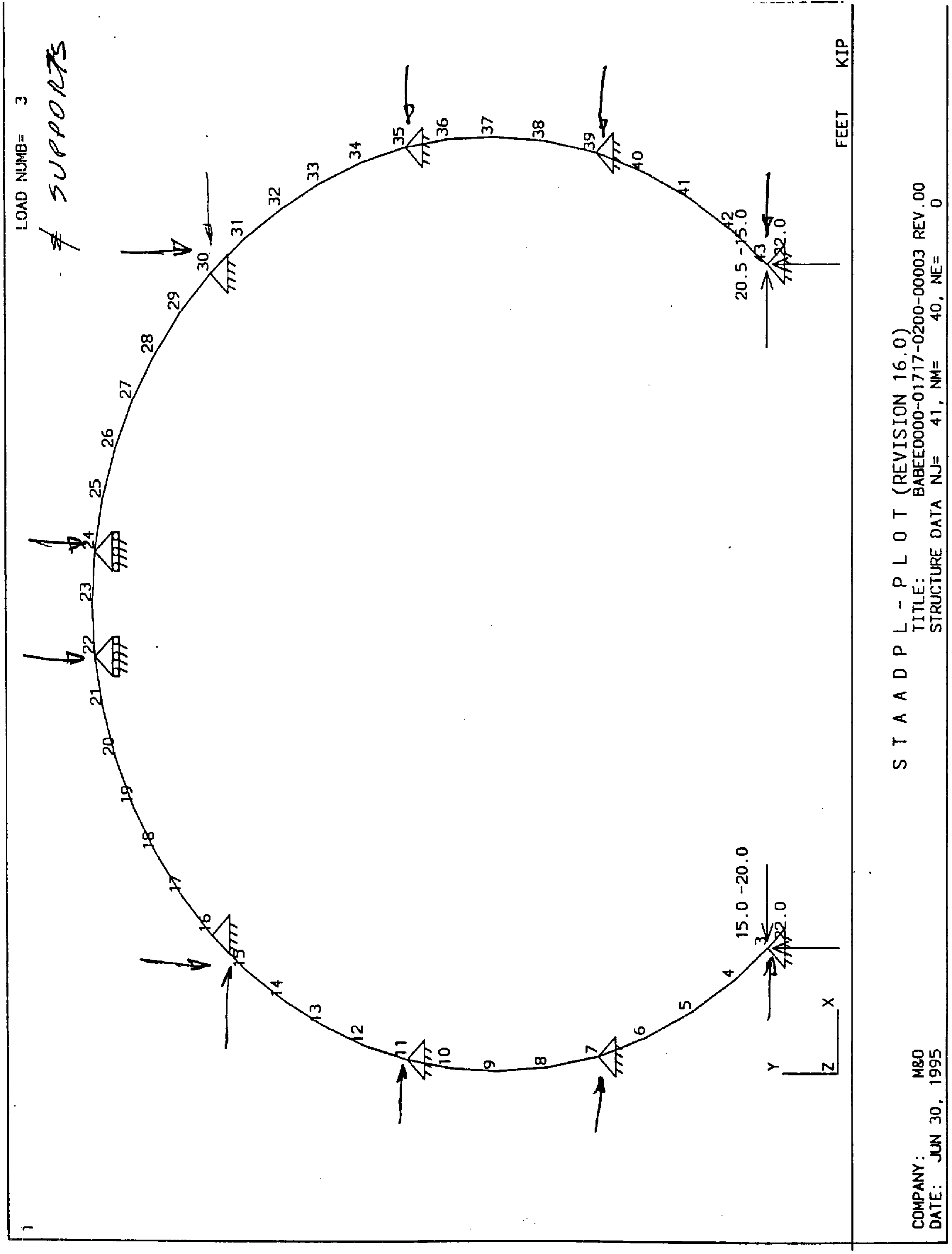
```
 MEMBER END FORCES     STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL    SHEAR-Y   SHEAR-Z    TORSION      MOM-Y       MOM-Z


   3     3    3     32.20      1.64      0.00       0.00       0.00      -14.67
              4    -32.18     -1.63      0.00       0.00       0.00       15.41

   4     3    4     32.20     -1.13      0.00       0.00       0.00      -15.41
              5    -32.14      1.17      0.00       0.00       0.00       13.62

   5     3    5     31.74     -5.20      0.00       0.00       0.00      -13.62
              6    -31.67      5.24      0.00       0.00       0.00        5.45

   6     3    6     30.78     -9.10      0.00       0.00       0.00       -5.45
              7    -30.71      9.13      0.00       0.00       0.00       -8.79

   7     3    7     25.71      4.89      0.00       0.00       0.00        8.79
              8    -25.63     -4.88      0.00       0.00       0.00       -1.13

   8     3    8     26.05      1.55      0.00       0.00       0.00        1.13
              9    -25.97     -1.55      0.00       0.00       0.00        1.30

   9     3    9     25.97      1.64      0.00       0.00       0.00        1.30
             10    -25.90     -1.64      0.00       0.00       0.00        0.94

  10     3   10     25.56      4.47      0.00       0.00       0.00       -0.94
             11    -25.50     -4.46      0.00       0.00       0.00        7.05

  11     3   11     28.79     -6.71      0.00       0.00       0.00       -7.05
             12    -28.73      6.73      0.00       0.00       0.00       -2.10

  12     3   12     29.34     -3.16      0.00       0.00       0.00        2.10
             13    -29.27      3.19      0.00       0.00       0.00       -6.44

  13     3   13     29.45     -0.20      0.00       0.00       0.00        6.44
             14    -29.39      0.23      0.00       0.00       0.00       -6.73

  14     3   14     29.22      3.13      0.00       0.00       0.00        6.73
             15    -29.17     -3.09      0.00       0.00       0.00       -2.47

  15     3   15     28.59      6.53      0.00       0.00       0.00        2.47
             16    -28.54     -6.49      0.00       0.00       0.00        6.38

  16     3   16      4.81     -2.01      0.00       0.00       0.00       -6.38
             17     -4.77      2.06      0.00       0.00       0.00        3.60

  17     3   17      4.97     -1.52      0.00       0.00       0.00       -3.60
             18     -4.93      1.58      0.00       0.00       0.00        1.49

  18     3   18      5.08     -1.00      0.00       0.00       0.00       -1.49
             19     -5.04      1.06      0.00       0.00       0.00        0.09
```

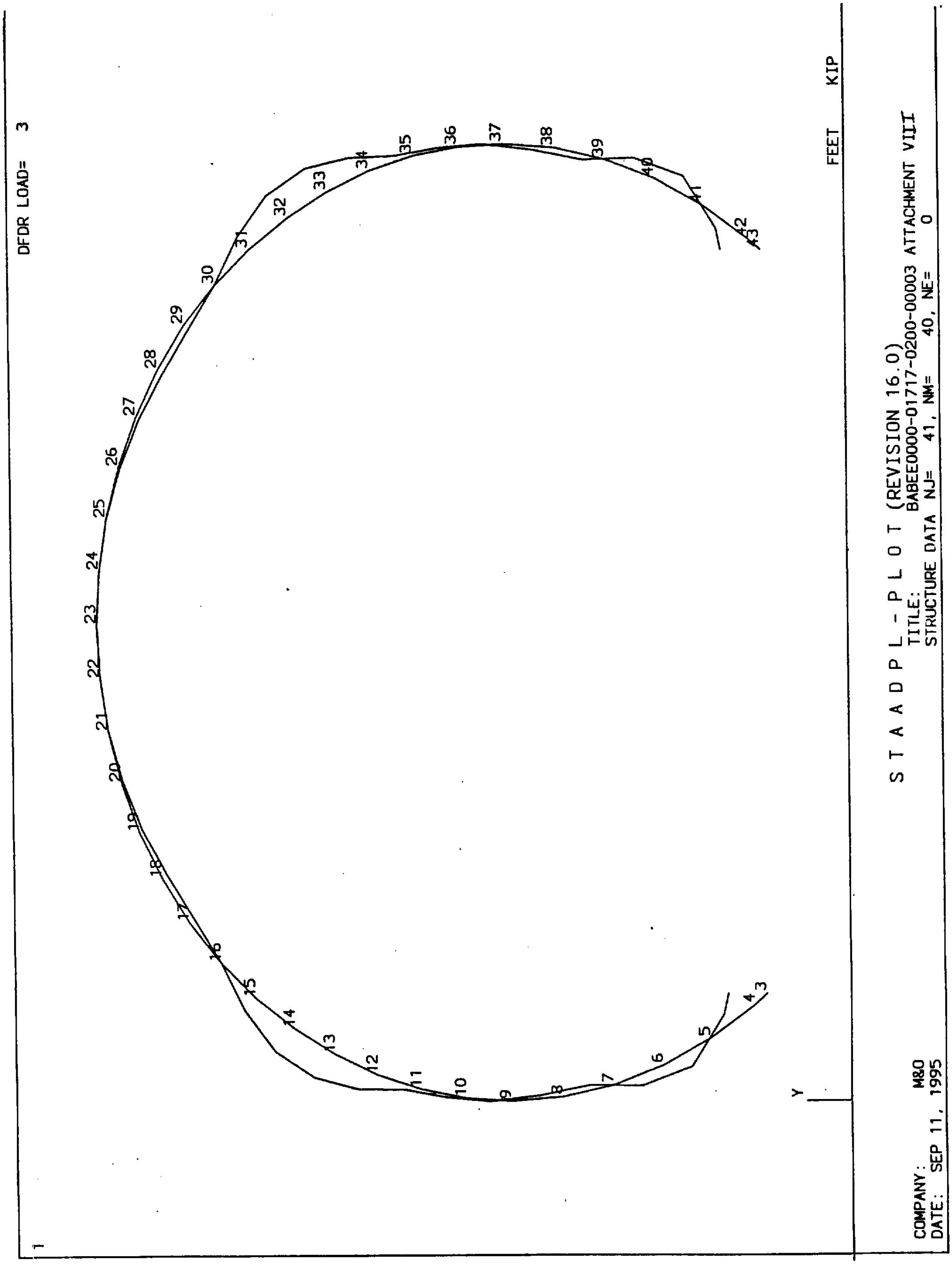
```
MEMBER END FORCES      STRUCTURE TYPE = PLANE
-----------------
 ALL UNITS ARE -- KIP   FEET

MEMB   LOAD   JT      AXIAL     SHEAR-Y   SHEAR-Z    TORSION      MOM-Y       MOM-Z


  19     3    19       5.13      -0.49      0.00       0.00        0.00       -0.09
              20      -5.10       0.55      0.00       0.00        0.00       -0.62

  20     3    20       5.13       0.01      0.00       0.00        0.00        0.62
              21      -5.12       0.06      0.00       0.00        0.00       -0.65

  21     3    21       5.09       0.52      0.00       0.00        0.00        0.65
              22      -5.08      -0.45      0.00       0.00        0.00        0.01

  22     3    22       4.92      -0.22      0.00       0.00        0.00       -0.01
              23      -4.92       0.29      0.00       0.00        0.00       -0.34

  23     3    23       4.92       0.29      0.00       0.00        0.00        0.34
              24      -4.92      -0.22      0.00       0.00        0.00        0.01

  24     3    24       5.08      -0.45      0.00       0.00        0.00       -0.01
              25      -5.09       0.52      0.00       0.00        0.00       -0.65

  25     3    25       5.12       0.05      0.00       0.00        0.00        0.65
              26      -5.13       0.01      0.00       0.00        0.00       -0.62

  26     3    26       5.11       0.53      0.00       0.00        0.00        0.62
              27      -5.13      -0.47      0.00       0.00        0.00        0.08

  27     3    27       5.04       1.07      0.00       0.00        0.00       -0.08
              28      -5.07      -1.01      0.00       0.00        0.00        1.49

  28     3    28       4.93       1.57      0.00       0.00        0.00       -1.49
              29      -4.97      -1.52      0.00       0.00        0.00        3.60

  29     3    29       4.77       2.06      0.00       0.00        0.00       -3.60
              30      -4.82      -2.01      0.00       0.00        0.00        6.38

  30     3    30      28.56      -6.46      0.00       0.00        0.00       -6.38
              31     -28.61       6.51      0.00       0.00        0.00       -2.44

  31     3    31      29.18      -3.06      0.00       0.00        0.00        2.44
              32     -29.24       3.10      0.00       0.00        0.00       -6.66

  32     3    32      29.40       0.07      0.00       0.00        0.00        6.66
              33     -29.46      -0.03      0.00       0.00        0.00       -6.60

  33     3    33      29.26       3.41      0.00       0.00        0.00        6.60
              34     -29.32      -3.39      0.00       0.00        0.00       -1.96

  34     3    34      28.78       6.56      0.00       0.00        0.00        1.96
              35     -28.85      -6.54      0.00       0.00        0.00        6.97

  35     3    35      25.49      -4.47      0.00       0.00        0.00       -6.97
              36     -25.56       4.48      0.00       0.00        0.00        0.84
```

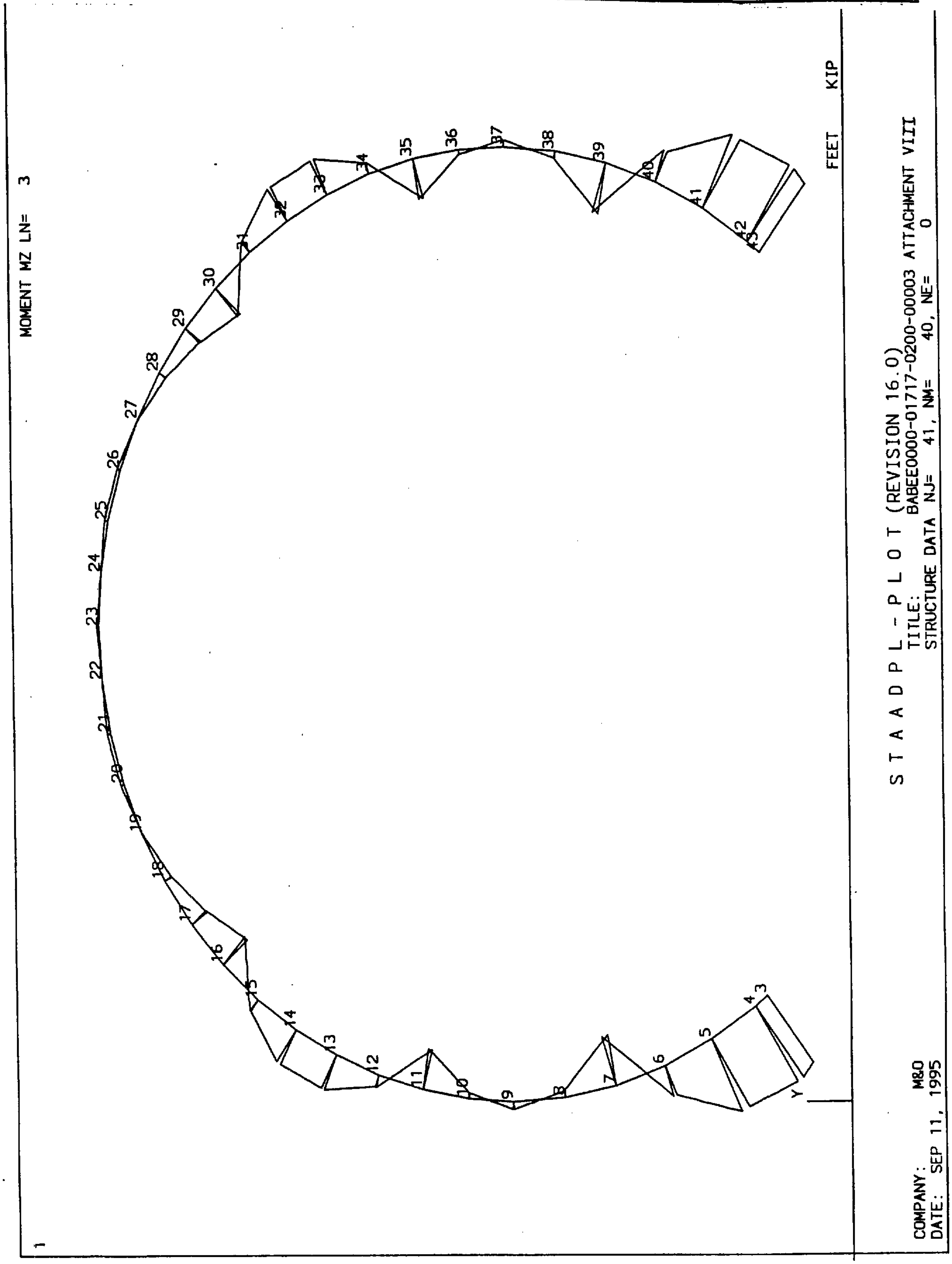
```
MEMBER END FORCES    STRUCTURE TYPE = PLANE
-----------------
 ALL UNITS ARE -- KIP  FEET

MEMB  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


  36     3  36     25.91    -1.46     0.00      0.00      0.00      -0.84
            37    -25.98     1.47     0.00      0.00      0.00      -1.16

  37     3  37     25.97    -1.54     0.00      0.00      0.00      -1.16
            38    -26.05     1.54     0.00      0.00      0.00      -1.25

  38     3  38     25.64    -4.86     0.00      0.00      0.00       1.25
            39    -25.71     4.88     0.00      0.00      0.00      -8.89

  39     3  39     30.66     9.33     0.00      0.00      0.00       8.89
            40    -30.73    -9.31     0.00      0.00      0.00       5.64

  40     3  40     31.68     5.26     0.00      0.00      0.00      -5.64
            41    -31.75    -5.22     0.00      0.00      0.00      13.85

  41     3  41     32.16     1.01     0.00      0.00      0.00     -13.85
            42    -32.22    -0.97     0.00      0.00      0.00      15.40

  42     3  42     32.20    -1.61     0.00      0.00      0.00     -15.40
            43    -32.21     1.62     0.00      0.00      0.00      14.67

 ************** END OF LATEST ANALYSIS RESULT **************

  56. CHECK CODE ALL
```

```
                         STAAD-III CODE CHECKING - (AISC)
                         ************************

ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER     TABLE         RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY             MZ       LOCATION
=======================================================================

     3  ST   W6X 20        PASS      AISC- H1-2        0.837         3
                       32.18 C          0.00         15.41         0.46
     4  ST   W6X 20        PASS      AISC- H1-2        0.837         3
                       32.20 C          0.00        -15.41         0.00
     5  ST   W6X 20        PASS      AISC- H1-2        0.765         3
                       31.74 C          0.00        -13.62         0.00
     6  ST   W6X 20        PASS      AISC- H1-2        0.575         3
                       30.71 C          0.00         -8.79         1.56
     7  ST   W6X 20        PASS      AISC- H1-2        0.535         3
                       25.71 C          0.00          8.79         0.00
     8  ST   W6X 20        PASS      AISC- H1-2        0.254         3
                       25.97 C          0.00          1.30         1.56
     9  ST   W6X 20        PASS      AISC- H1-2        0.254         3
                       25.97 C          0.00          1.30         0.00
    10  ST   W6X 20        PASS      AISC- H1-2        0.468         3
                       25.50 C          0.00          7.05         1.37
    11  ST   W6X 20        PASS      AISC- H1-2        0.494         3
                       28.79 C          0.00         -7.05         0.00
    12  ST   W6X 20        PASS      AISC- H1-2        0.474         3
                       29.27 C          0.00         -6.44         1.37
    13  ST   W6X 20        PASS      AISC- H1-2        0.486         3
                       29.39 C          0.00         -6.73         1.36
    14  ST   W6X 20        PASS      AISC- H1-2        0.485         3
                       29.22 C          0.00          6.73         0.00
    15  ST   W6X 20        PASS      AISC- H1-2        0.466         3
                       28.54 C          0.00          6.38         1.36
    16  ST   W6X 20        PASS      AISC- H1-3        0.280         3
                        4.81 C          0.00         -6.38         0.00
    17  ST   W6X 20        PASS      AISC- H1-3        0.176         3
                        4.97 C          0.00         -3.60         0.00
    18  ST   W6X 20        PASS      AISC- H1-3        0.097         3
                        5.08 C          0.00         -1.49         0.00
    19  ST   W6X 20        PASS      AISC- H1-3        0.065         3
                        5.10 C          0.00         -0.62         1.36
    20  ST   W6X 20        PASS      AISC- H1-3        0.066         3
                        5.12 C          0.00         -0.65         1.36
    21  ST   W6X 20        PASS      AISC- H1-3        0.066         3
                        5.09 C          0.00          0.65         0.00
    22  ST   W6X 20        PASS      AISC- H1-3        0.052         3
                        4.92 C          0.00         -0.34         1.37
    23  ST   W6X 20        PASS      AISC- H1-3        0.052         3
                        4.92 C          0.00          0.34         0.00
    24  ST   W6X 20        PASS      AISC- H1-3        0.066         3
                        5.09 C          0.00         -0.65         1.36
    25  ST   W6X 20        PASS      AISC- H1-3        0.066         3
                        5.12 C          0.00          0.65         0.00
    26  ST   W6X 20        PASS      AISC- H1-3        0.065         3
                        5.11 C          0.00          0.62         0.00
```

```
ALL UNITS ARE - KIP  FEET (UNLESS OTHERWISE NOTED)

MEMBER       TABLE         RESULT/   CRITICAL COND/      RATIO/     LOADING/
                             FX            MY              MZ       LOCATION
=======================================================================

     27   ST   W6X 20        PASS      AISC- H1-3         0.097         3
                           5.07 C          0.00           1.49        1.36
     28   ST   W6X 20        PASS      AISC- H1-3         0.176         3
                           4.97 C          0.00           3.60        1.36
     29   ST   W6X 20        PASS      AISC- H1-3         0.280         3
                           4.82 C          0.00           6.38        1.37
     30   ST   W6X 20        PASS      AISC- H1-2         0.466         3
                          28.56            0.00          -6.38       0.00
     31   ST   W6X 20        PASS      AISC- H1-2         0.483         3
                          29.24 C          0.00          -6.66        1.37
     32   ST   W6X 20        PASS      AISC- H1-2         0.484         3
                          29.40 C          0.00           6.66        0.00
     33   ST   W6X 20        PASS      AISC- H1-2         0.480         3
                          29.26 C          0.00           6.60        0.00
     34   ST   W6X 20        PASS      AISC- H1-2         0.491         3
                          28.85 C          0.00           6.97        1.36
     35   ST   W6X 20        PASS      AISC- H1-2         0.465         3
                          25.49 C          0.00          -6.97        0.00
     36   ST   W6X 20        PASS      AISC- H1-2         0.249         3
                          25.98 C          0.00          -1.16        1.36
     37   ST   W6X 20        PASS      AISC- H1-2         0.253         3
                          26.05 C          0.00          -1.25        1.56
     38   ST   W6X 20        PASS      AISC- H1-2         0.539         3
                          25.71 C          0.00          -8.89        1.57
     39   ST   W6X 20        PASS      AISC- H1-2         0.578         3
                          30.66 C          0.00           8.89        0.00
     40   ST   W6X 20        PASS      AISC- H1-2         0.774         3
                          31.75 C          0.00          13.85        1.57
     41   ST   W6X 20        PASS      AISC- H1-2         0.837         3
                          32.22 C          0.00          15.40        1.57
     42   ST   W6X 20        PASS      AISC- H1-2         0.836         3
                          32.20 C          0.00         -15.40        0.00

  ************** END OF TABULATED RESULT OF DESIGN **************

   57. PLOT DISPLACEMENT FILE
   58. PLOT BENDING FILE
   59. FINISH

      *************** END OF STAAD-III ***************

  DATE= SEP 11,1995   TIME= 13:57:46 ******

     ************************************************************
     *        For questions on STAAD-III/ISDS, contact:         *
     *        RESEARCH ENGINEERS, Inc at (714) 974-2500         *
```


LOAD NUMB= 3
SUPPORTS
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
20.5 -15.0
32.0
15.0 -20.0
32.0
FEET
KIP
X
Y
Z
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 REV.00
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: JUN 30, 1995
1


DFDR LOAD= 3
FEET KIP
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
Y
1
S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT VIII
STRUCTURE DATA NJ= 41, NM= 40, NE= 0
COMPANY: M&O
DATE: SEP 11, 1995



S T A A D P L - P L O T (REVISION 16.0)
TITLE: BABEE0000-01717-0200-00003 ATTACHMENT VIII
STRUCTURE DATA NJ= 41, NM= 40, NE= 0

COMPANY: M&O
DATE: SEP 11, 1995

SUMMARY OF COMPUTER ANALYSES FOR W6X20 STEEL SHAPE

Analysis No.	LOAD	SCOPE	INTERACTION COEFFICIENT		MEMBER	CONCLUSIONS
			Computer	Hand calc's		
1. STLRV3 20 TONS	20 TON JACK	))Determine)W6X20)Jack)capacity)	0.964	1.038	3,4,41,42	W6X20 is not adequate for 20 T jack
2. STLRV3 17 TONS	17 TON JACK		0.837	0.898	3,4,41,42	W6X20 is adequate for 17 T jack

ATTACHMENT VIII

CONCLUSIONS

The conclusions of the analyses performed in attachment VIII are:

1. The W6X20 steel shape is adequate for a 17 Ton jacking force, but not for a 20 Ton jacking force.

ATTACHMENT IX — SUMMARY OF DESIGN SKETCHES

GENERAL NOTES :

<1> ALL MATERIALS USED IN ENGINEERING CALCULATIONS FOR ESF GROUND SUPPORT — STRUCTURAL STEEL ANALYSIS AND DESIGN ARE BASED ON THE FOLLOWING UNLESS NOTED OTHERWISE :

ITEM	DESIGNATION	CRITICAL MATERIAL CHARACTERISTIC (MINIMUM)
a. STRUCTURAL STEEL SHAPE AND PLATE	ASTM A36	58^{KSI} MINIMUM TENSILE STRENGTH
b. BOLTS, STUDS AND TIE RODS	ASTM A307	58^{KSI} MINIMUM TENSILE STRENGTH
NUTS	ASTM A563	175^{KSI} MINIMUM PROOF LOAD STRESS
WASHERS	ASTM F436	HARDNESS 38 TO 45 HRC MINIMUM
c. STRUCTURAL PIPE	ASTM A53 GRADE B	60^{KSI} MINIMUM TENSILE STRENGTH
d. WELDING	AWS A5.1 E70XX	70^{KSI} MINIMUM TENSILE STRENGTH
e SHIM PLATE	ASTM A36	58^{KSI} MINIMUM TENSILE STRENGTH.
f CONCRETE		$f'_c = 5000^{PSI}$

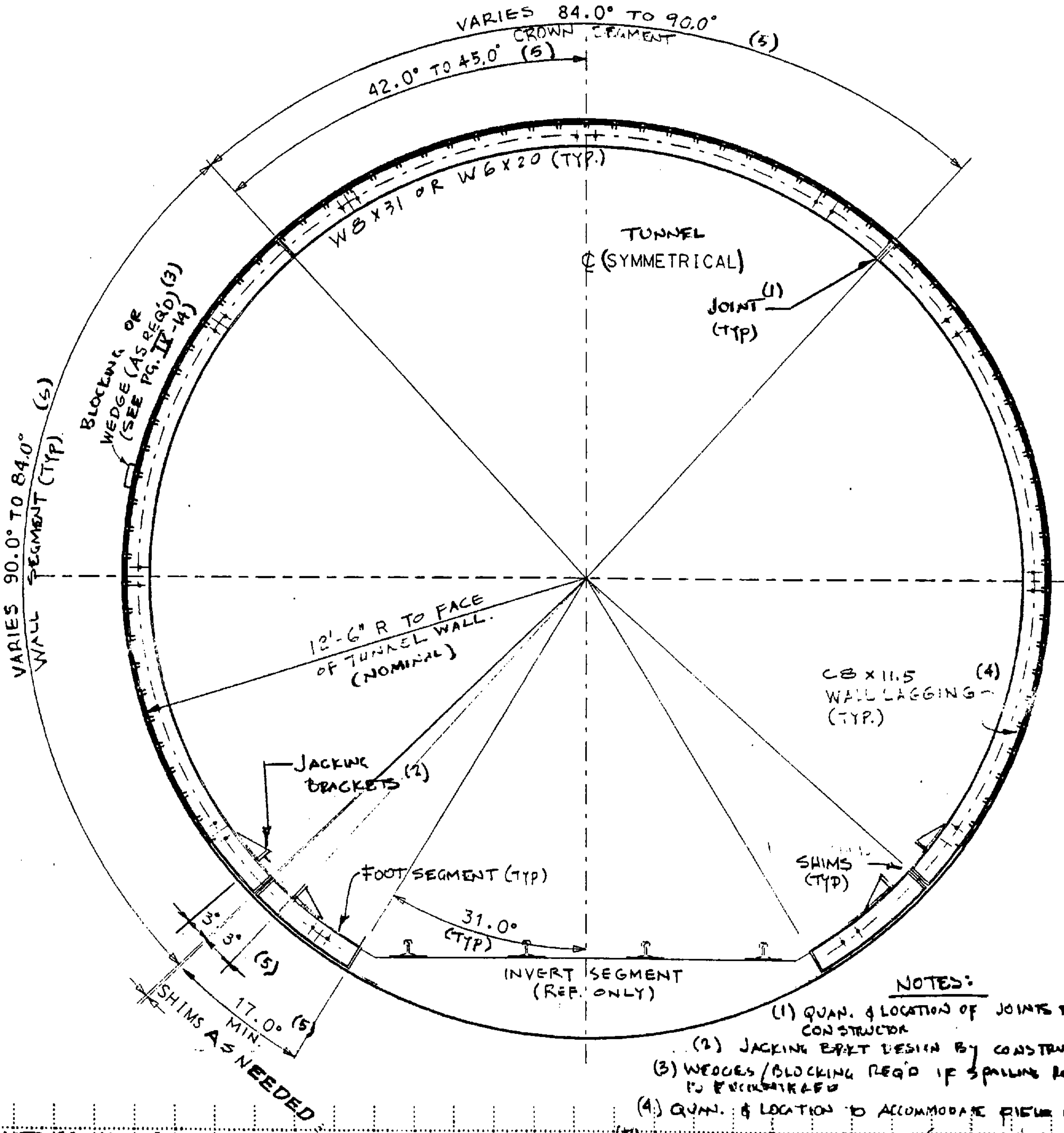
(2) THE DESIGN SKETCHES CONTAINED IN THIS ATTACHMENT ARE THE ESF GROUND SUPPORT STRUCTURAL STEEL SET SUMMARY INCLUDING SUPPORT COMPONENTS AND CONNECTION DETAILS.

THE CONFIGURATION OF THE STEEL SET, THE LENGTH OF THE SUBTENDED ARC, THE JACKING LOCATION, AND DETAILS MAY BE MODIFIED BY THE CONSTRUCTOR TO FACILITATE THE STEEL SET FABRICATION, ASSEMBLY AND ERECTION.

THE CONSTRUCTOR SHALL SUBMIT ALL MODIFICATIONS, IF ANY, FOR A/E REVIEW AND APPROVAL. HOWEVER, THE FOLLOWING ITEMS ARE NOT SUBJECT TO MODIFICATION:

a. STRUCTURAL STEEL SHAPES FOR STEEL SETS AND LAGGING.
b. NOMINAL TUNNEL DIAMETER.
c. STEEL SET SPACING.
d. INVERT SEGMENT FOUNDATION CURB CONFIGURATION.

(3) CONNECTIONS FOR UTILITY SUPPORT BRACKET TO STEEL SET SHALL BE BOLTED AND THE BOLT HOLES IN STEEL SET SHALL BE FIELD DRILLED.



NOTES:

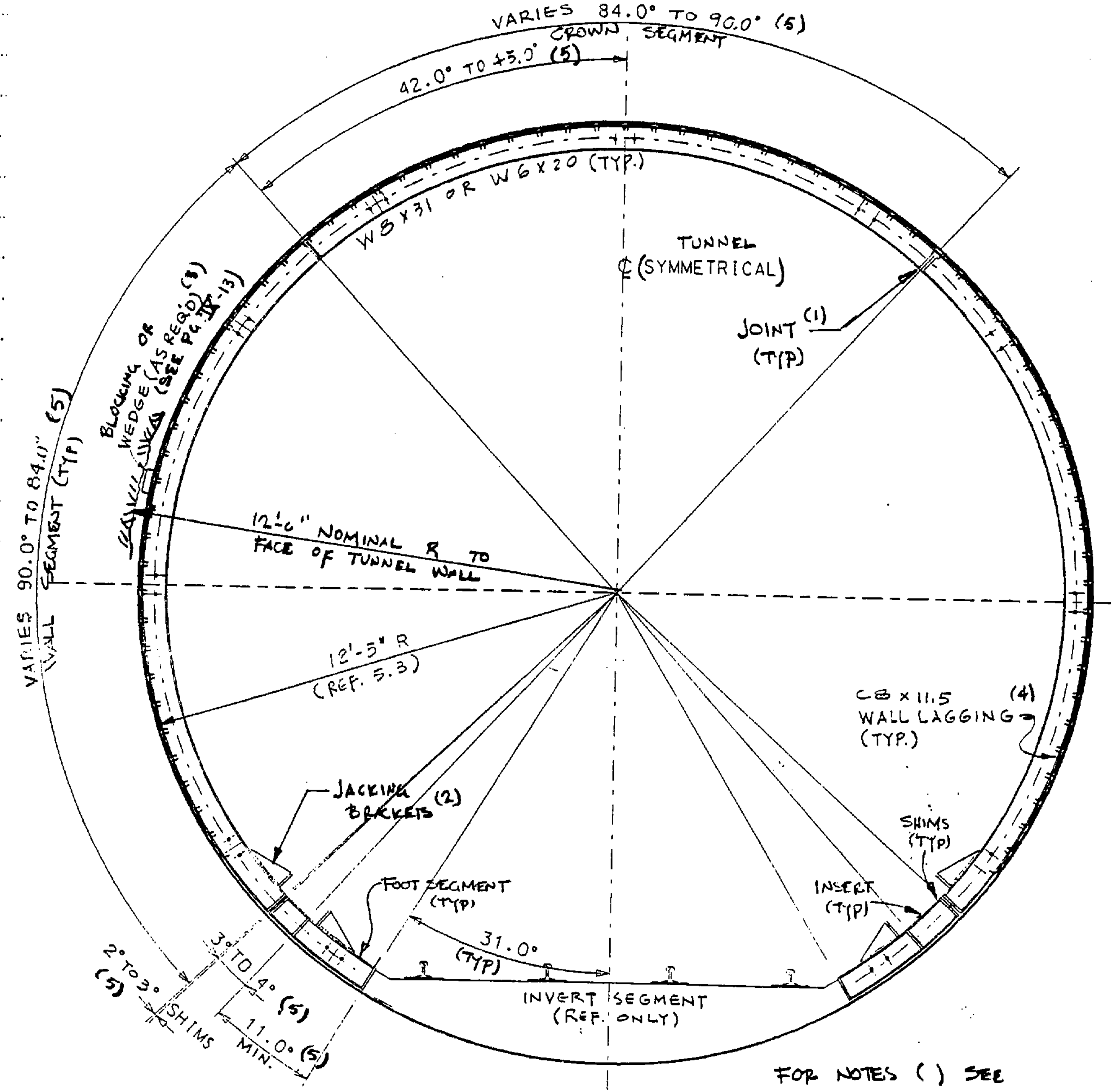
(1) QUAN. & LOCATION OF JOINTS BY CONSTRUCTOR
(2) JACKING BRKT DESIGN BY CONSTRUCTOR
(3) WEDGES/BLOCKING REQ'D IF SPALLING ROCK IS ENCOUNTERED
(4) QUAN. & LOCATION TO ACCOMMODATE FIELD COND.
(5) AS USED IN THIS ANALYSIS (INFO ONLY)

NOTE 2: FOR SOURCE OF DIMENSIONS, ANGLES & STEEL SET CONFIGURATION SEE SECTION 4.1.4, THIS ANALYSIS.

STEEL SET DIMENSIONS

ALTERNATE I *

* (LONGER FOOT SEGMENT & NO INSERT; SHIMS ONLY)

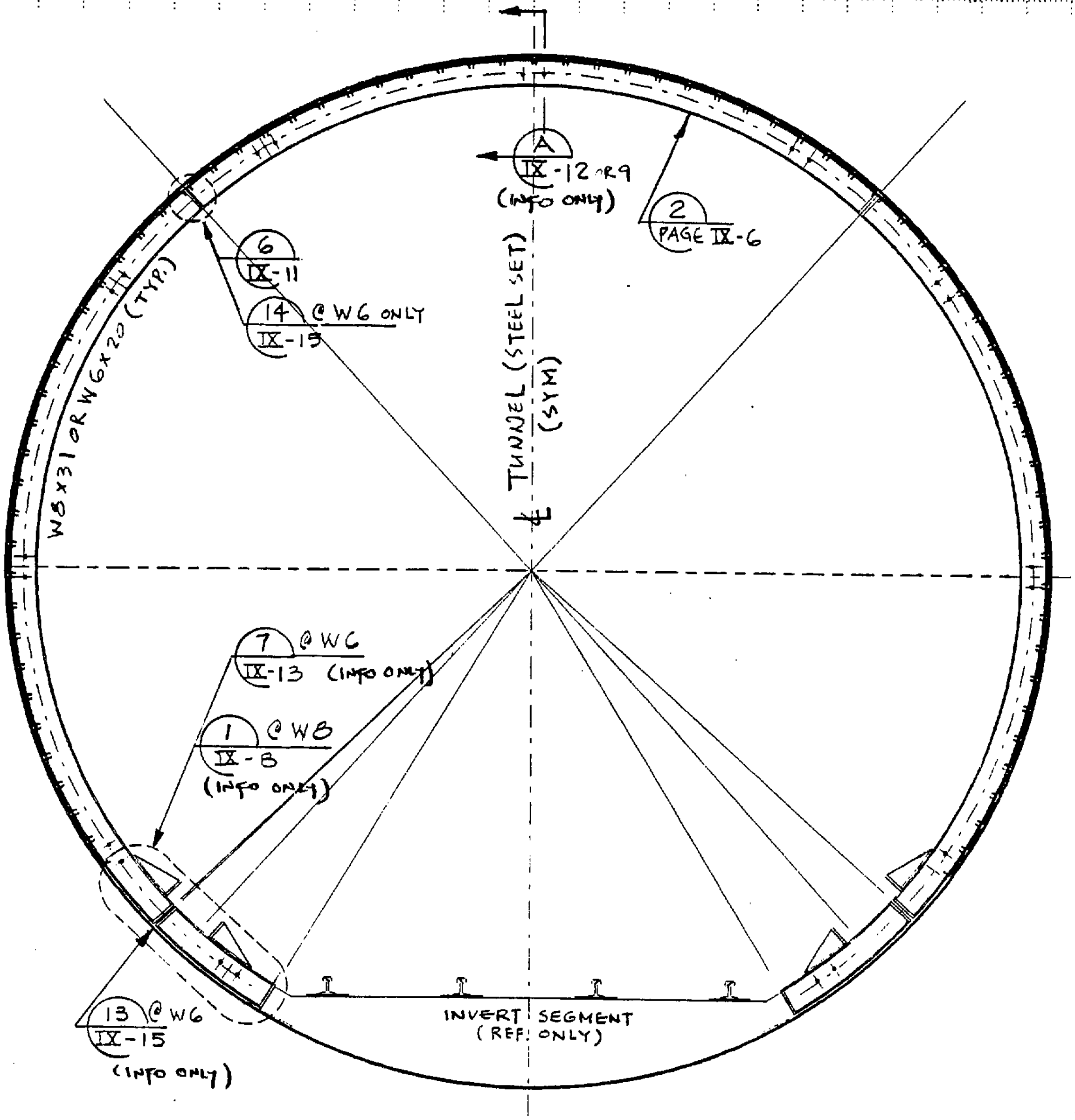


FOR NOTES ( ) SEE PAGE IX-3, ALT- I.

STEEL SET DIMENSIONS

ALTERNATE III *

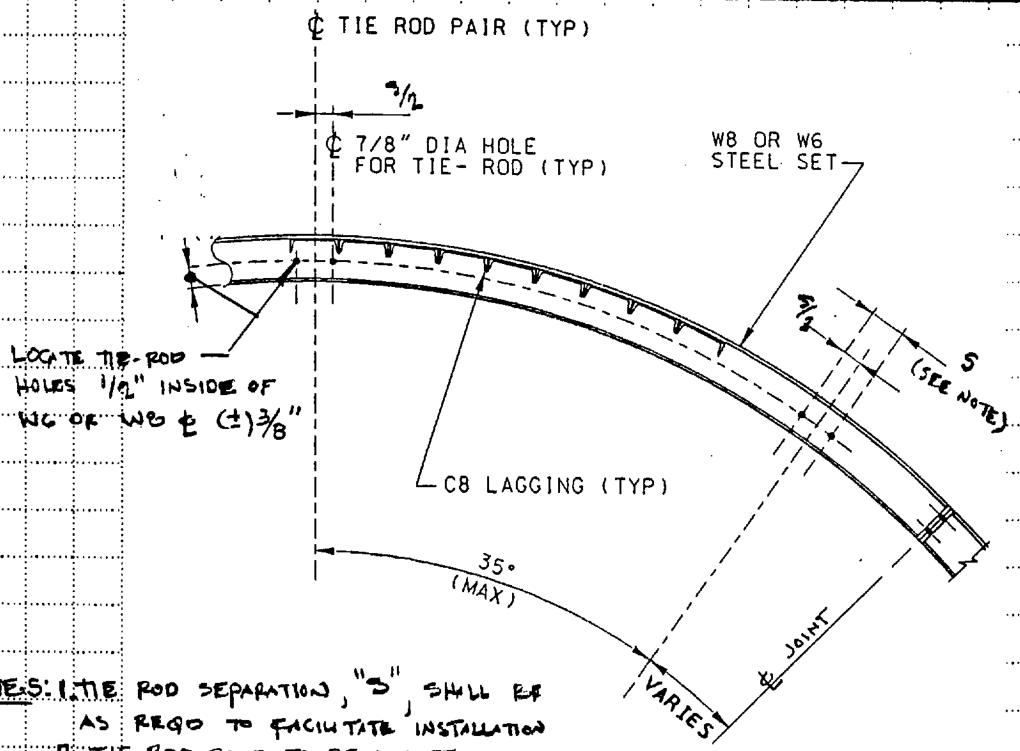
* (SHORTER FOOT SEGMENT, INSERT & SHIMS).



NOTE: "(INFO ONLY)" ITEMS ARE AS USED IN THIS ANALYSIS - MAY BE SUBJECT TO MODIFICATION BY CONSTRUCTOR WITH A/E APPROVAL (NON-CRITICAL ATTRIBUTES).

STEEL SET DETAIL

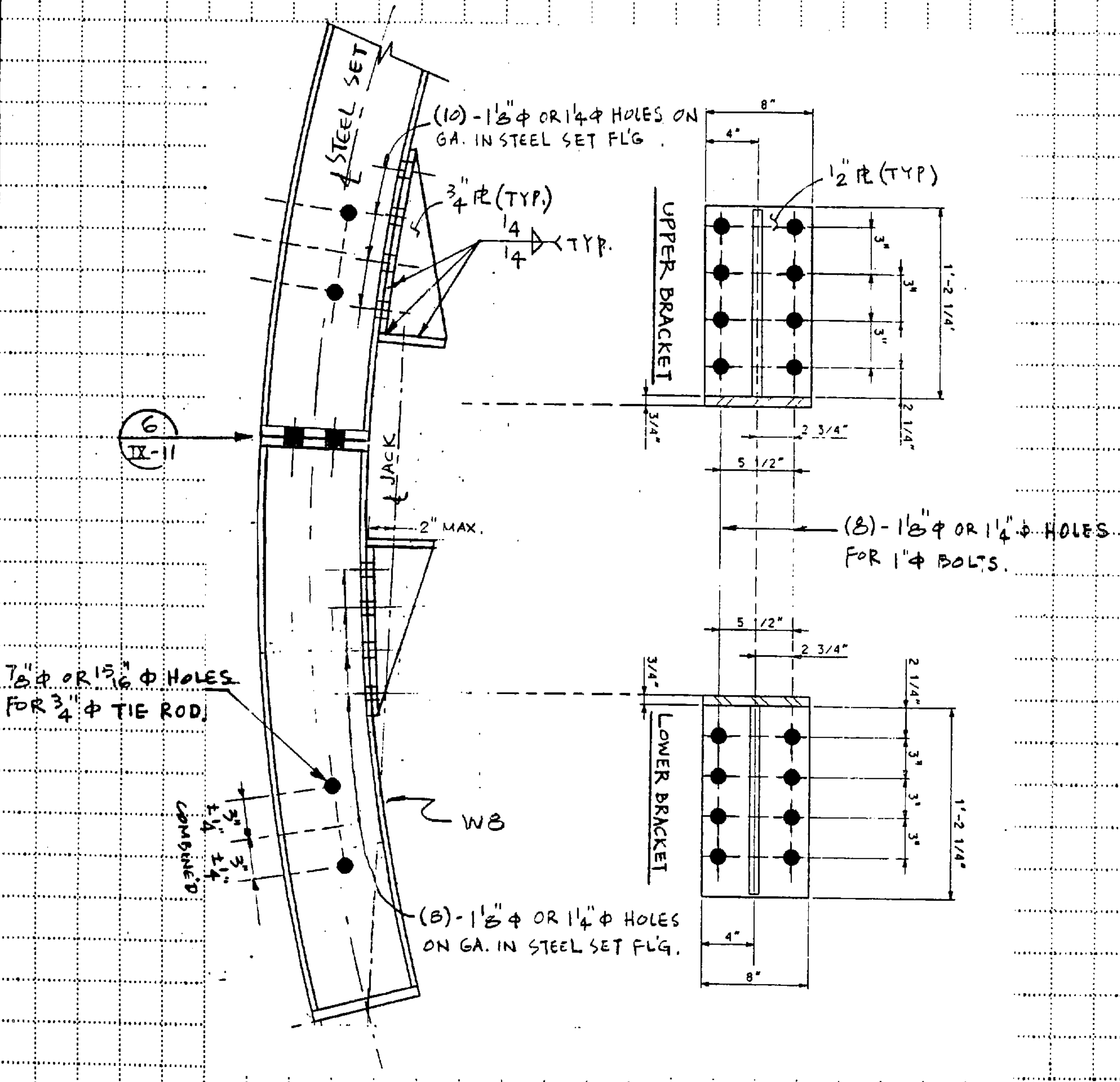
ALTERNATE I



NOTES: 1. TIE ROD SEPARATION, "S", SHALL BE AS REQD TO FACILITATE INSTALLATION
2. TIE ROD PAIR TO BE LOCATED NO MORE THAN 7° FROM FOOT SEGMENT BASE PLATES.

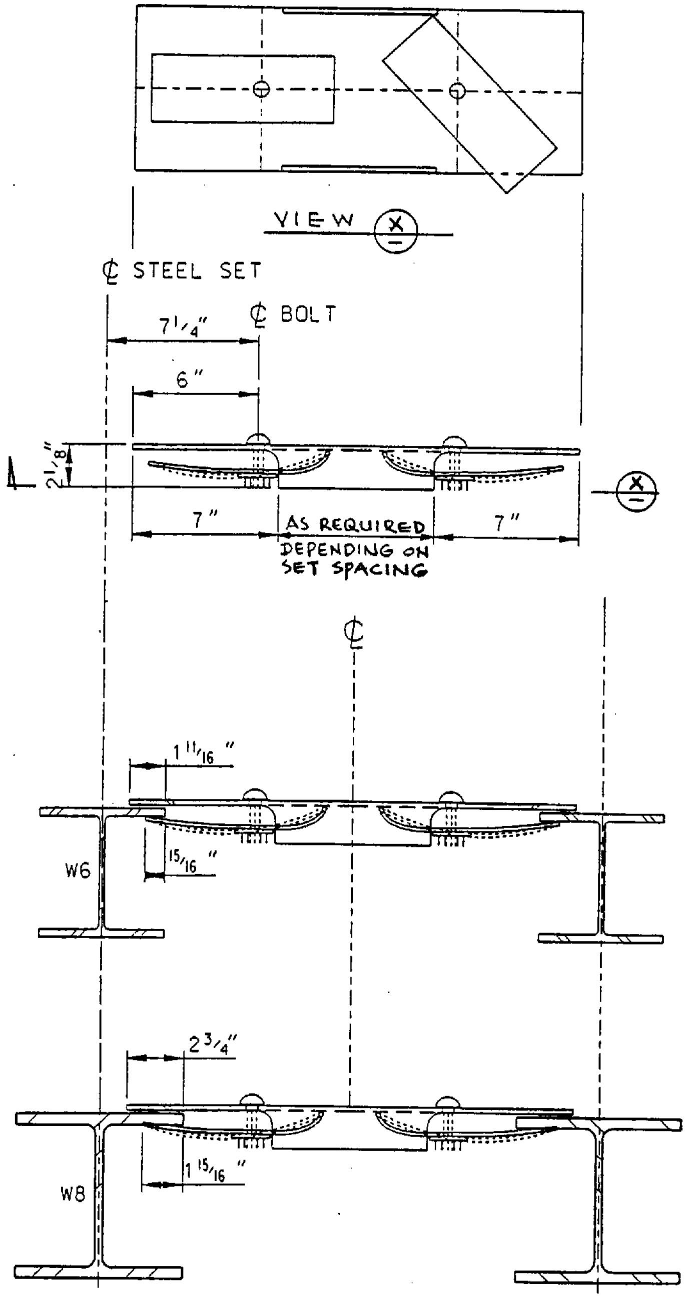
DETAIL 2
SCALE: NONE
PAGE IX-5 & IX-16

(NOT USED)



DETAIL (1 / IX-5)
(INFO ONLY)*

* AS USED IN THIS ANALYSIS

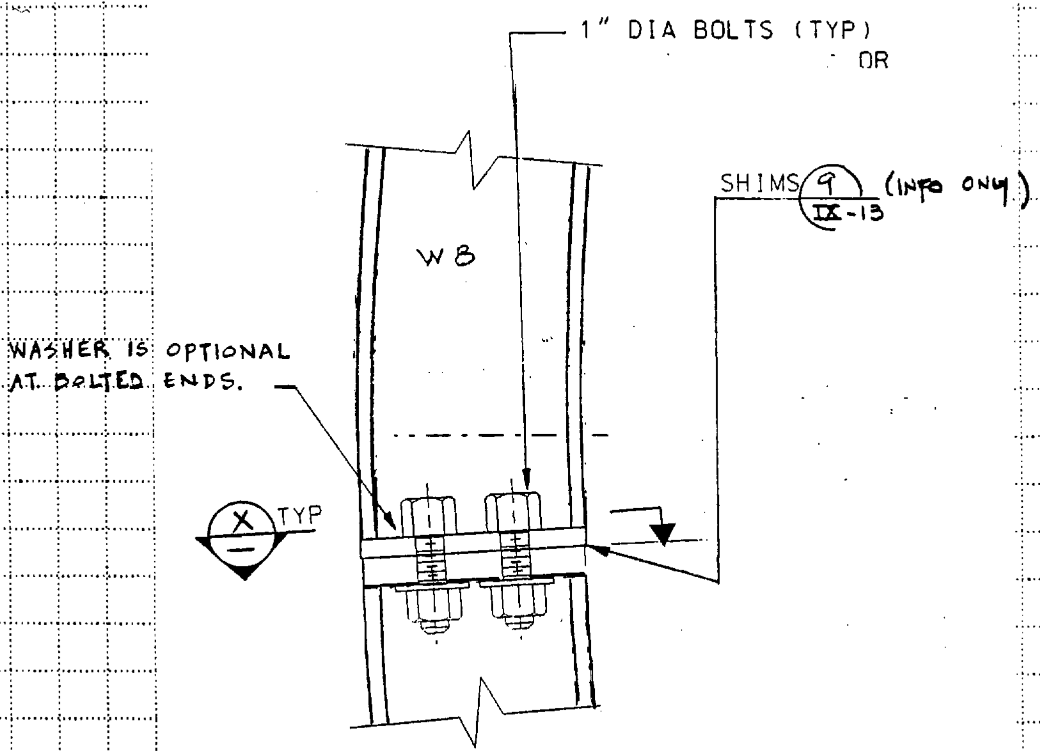


LAGGING CONFIGURATION USED IN THIS ANALYSIS.

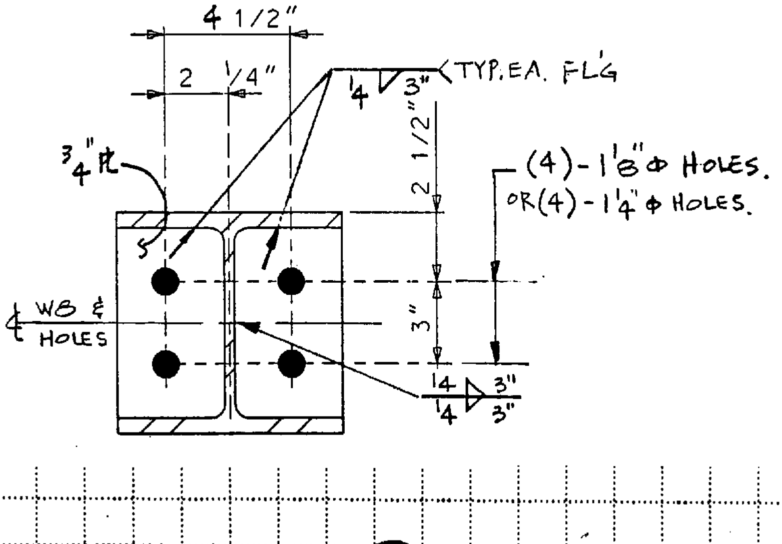
SECTION (A / IX-5)
(INFO ONLY)*

*AS USED IN THIS ANALYSIS

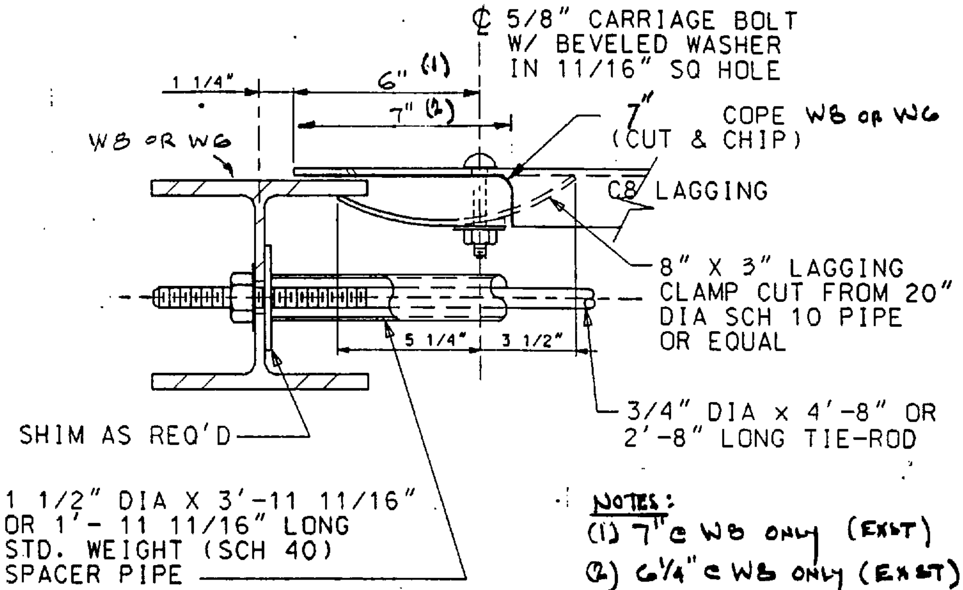
(NOT USED)



DETAIL 6 / IX-5 & 8



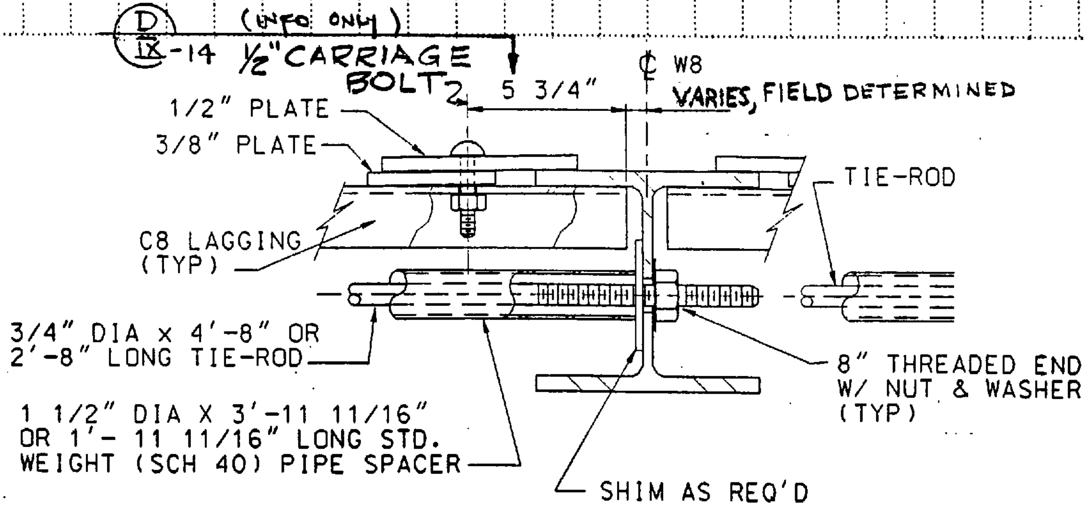
SECTION X



NOTES:
(1) 7" ℄ W8 ONLY (EXIST)
(2) 6 1/4" ℄ W8 ONLY (EXIST)

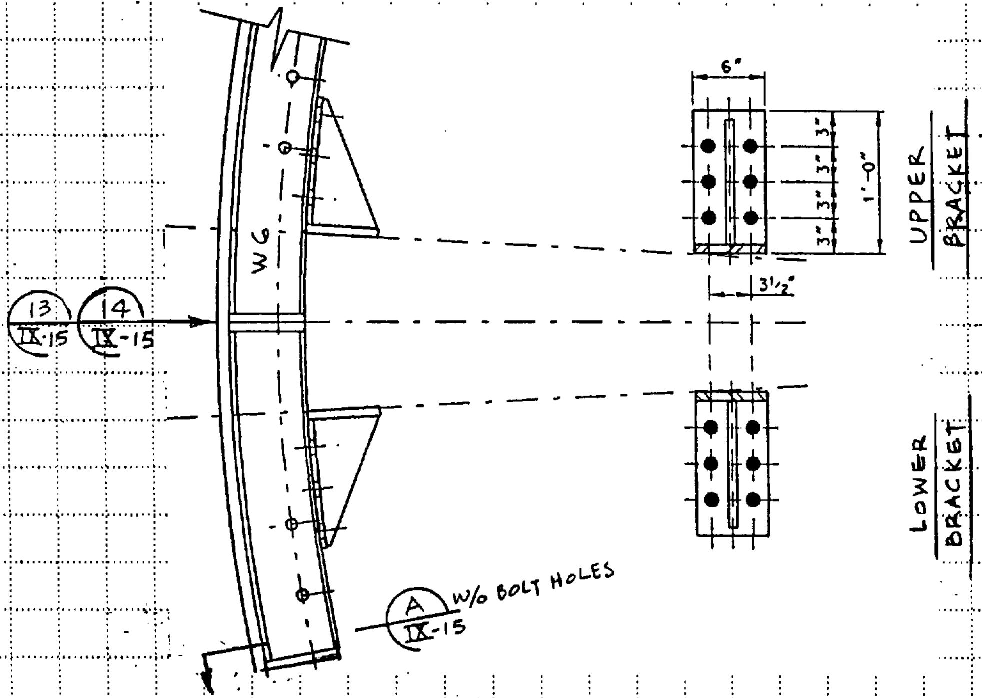
SECTION $\frac{A}{IX-5}$ (INFO ONLY)* OPTION III

LAGGING CLAMP, CARRIAGE BOLT, NUT AND WASHER ARE NON-Q ITEMS.



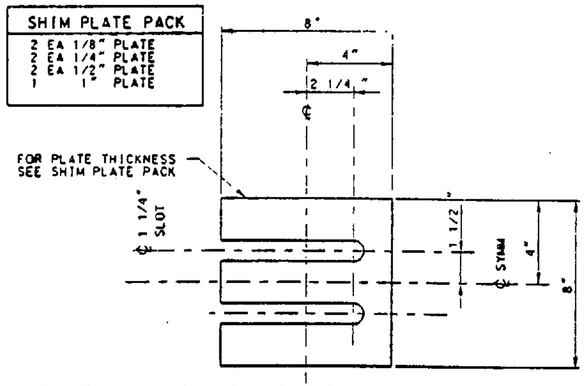
DETAIL $\frac{8}{-}$ (FOR W8 ONLY) (INFO ONLY)* OPTION I

* DETAILS AS USED IN THIS ANALYSIS.



NOTE: 1. SAME DIMENSIONS FOR UPPER & LOWER BRACKETS.
2. FOR INFORMATION NOT SHOWN SEE DETAIL 1, PAGE IX-8

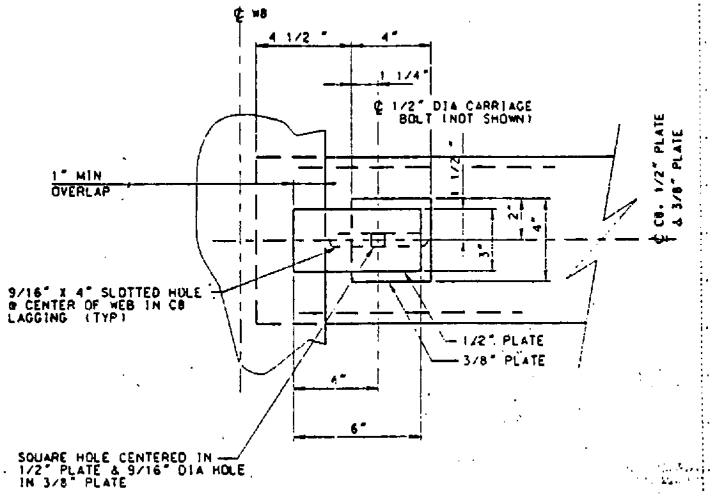
DETAIL 7 (INFO ONLY)* PAGE IX-5 & IX-17



SHIM PLATE PACK
2 EA 1/8" PLATE
2 EA 1/4" PLATE
2 EA 1/2" PLATE
1 1" PLATE

DETAIL 9 (INFO ONLY)* IX-11

* DETAILS AS USED IN THIS ANALYSIS ONLY



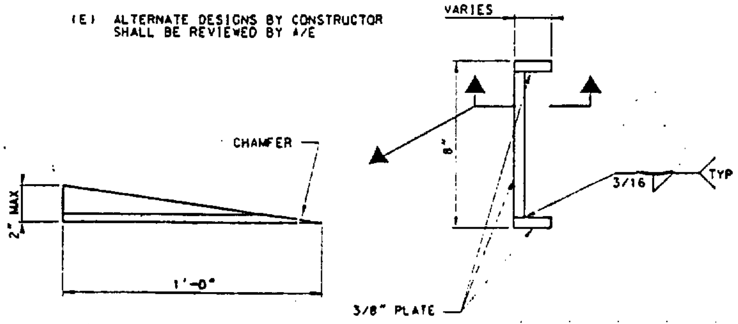
VIEW D
IX-12

SCALE: 3" = 1'-0"

(INFO ONLY)*

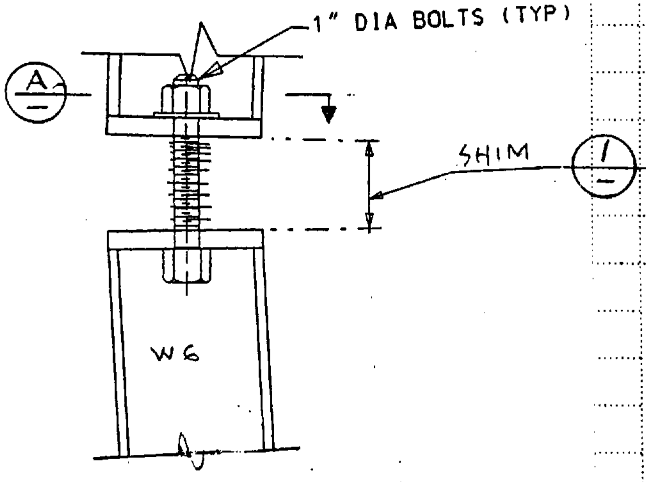
FABRICATION OF STEEL WEDGES SHALL BE CONSTRUCTORS OPTION OF THE FOLLOWING:

(A) FABRICATE AS SHOWN ON THIS DETAIL.
(B) CUT FROM TS 8x2x3/8 STRUCTURAL TUBING.
(C) CUT & BEND 3/8" PLATE.
(D) CUT FROM C8x11.5
(E) ALTERNATE DESIGNS BY CONSTRUCTOR SHALL BE REVIEWED BY A/E

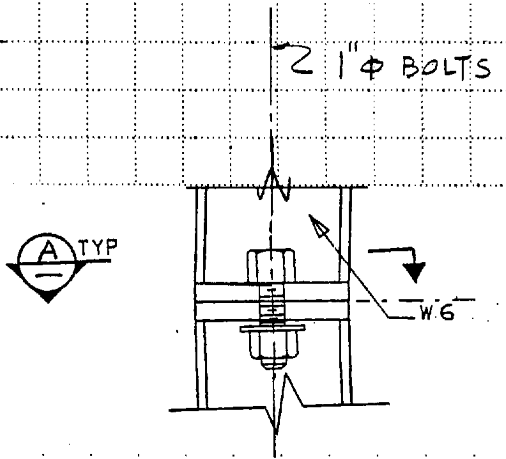


WEDGE DETAIL
(INFO ONLY)*

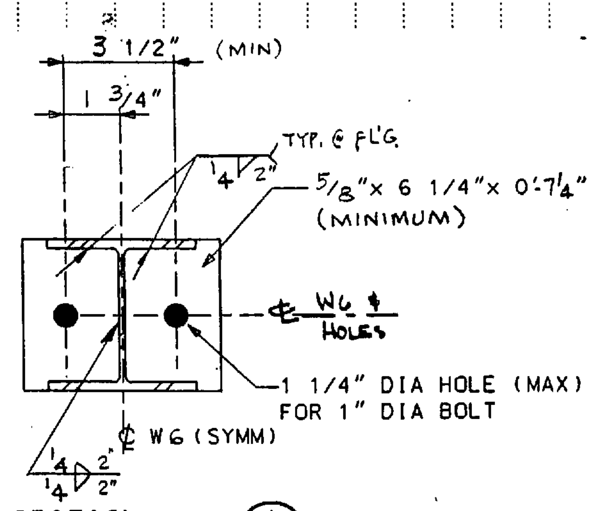
* DETAILS AS USED IN THIS ANALYSIS ONLY.



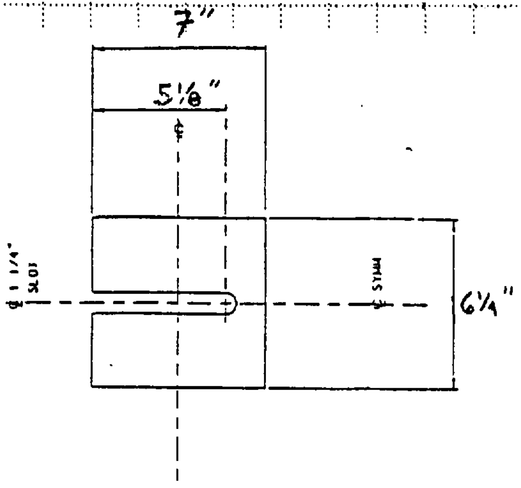
DETAIL 13 (INFO ONLY)* IX-5, IX-13



DETAIL 14 IX-5, IX-13



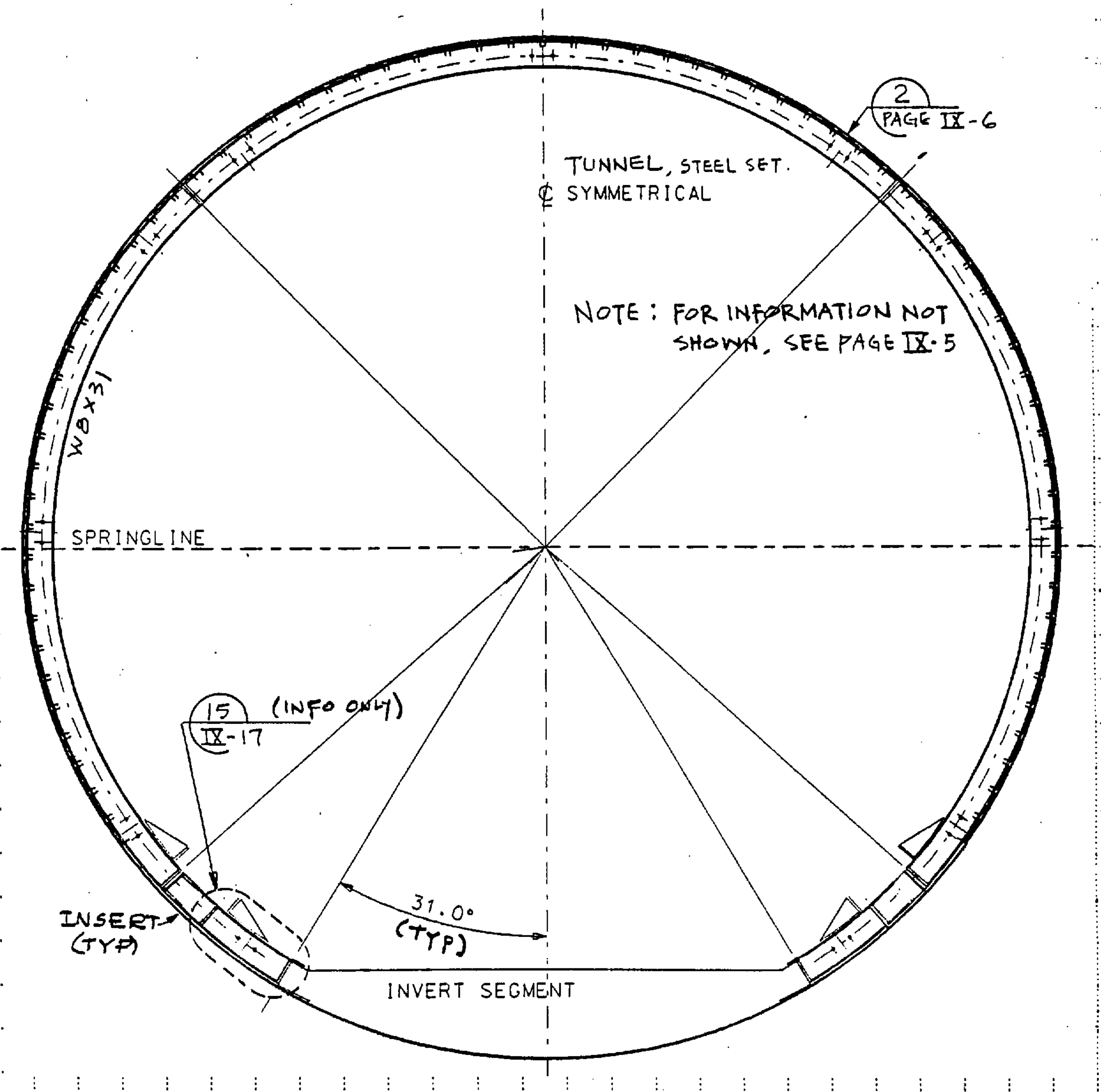
SECTION A IX-13 (w/o Holes)



DETAIL 1 SCALE: NONE (INFO ONLY)*

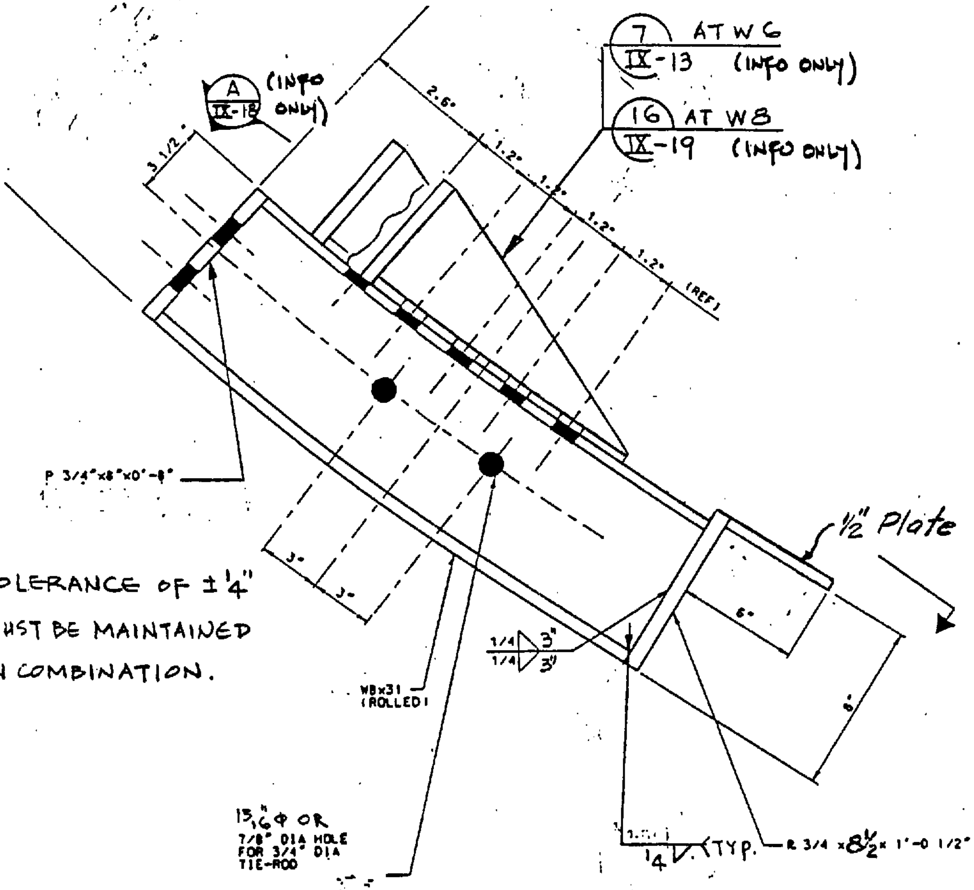
QUANTITY OF SHIM PACK AND PLATE THICKNESS IS CONSTRUCTORS OPTION

* DETAILS 1 & 13 AS USED IN THIS ANALYSIS ONLY



STEEL SET DETAIL

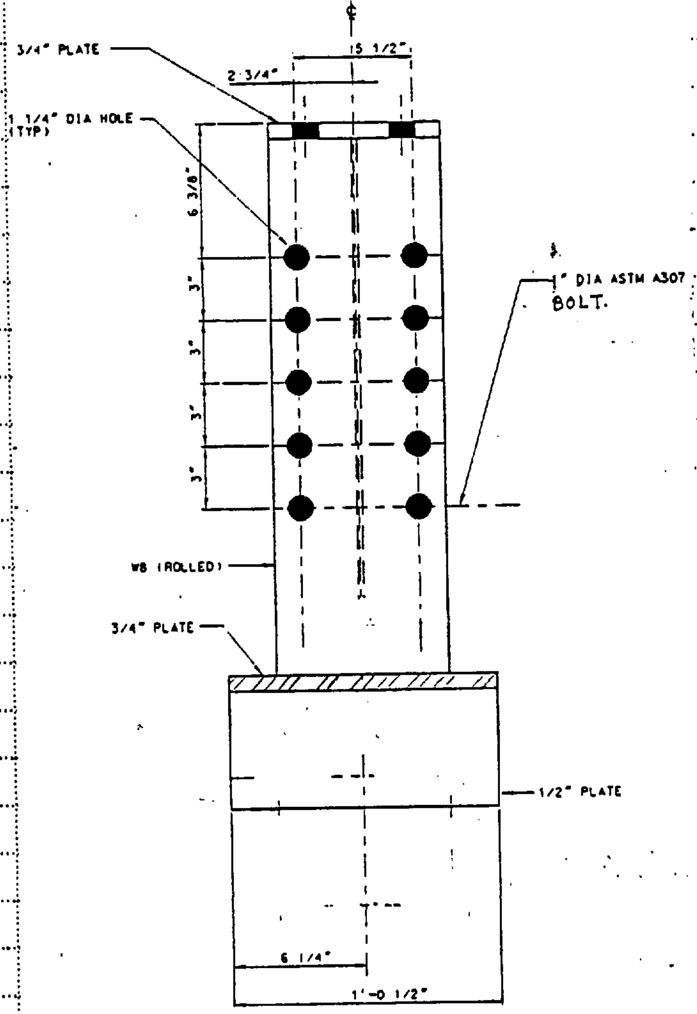
ALTERNATE III



NOTE: TOLERANCE OF ±¼" MUST BE MAINTAINED IN COMBINATION.

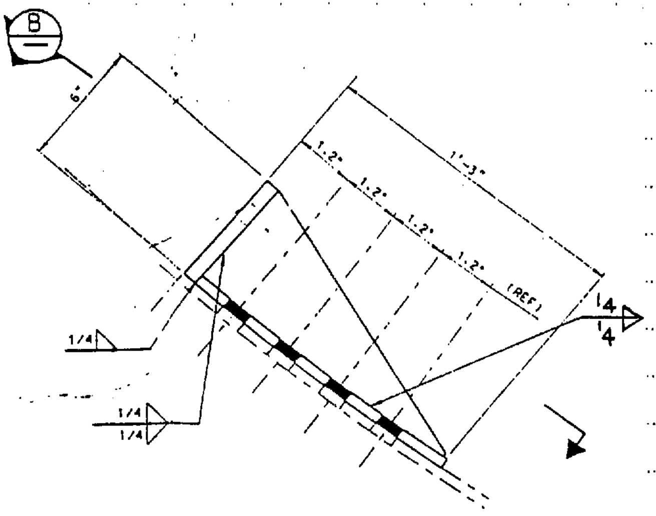
DETAIL 15 / IX-16
(INFO ONLY)*

*DETAILS AS USED IN THIS ANALYSIS ONLY

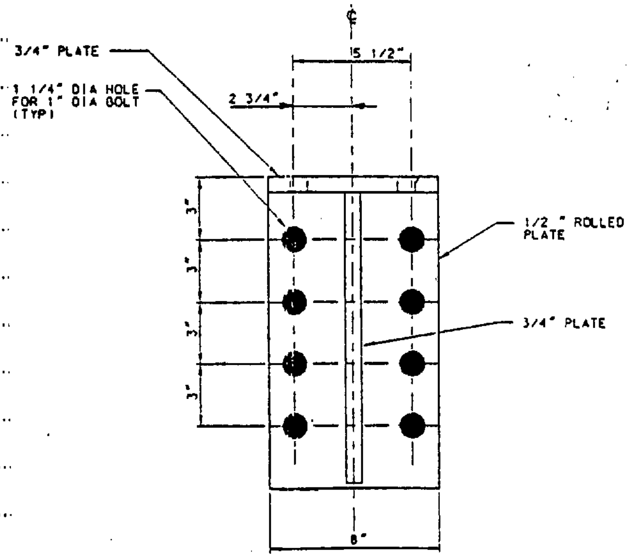


VIEW (A) / IX-17
(INFO ONLY)*

*DETAIL AS USED IN THIS ANALYSIS ONLY



DETAIL 16 / IX-17 2 BRACKETS EA RIB (4 TOTAL) REQD
SCALE: 3" = 1'-0" (INFO ONLY)*



VIEW B
SCALE: 3" = 1'-0" (INFO ONLY)*

* DETAILS AS USED IN THIS ANALYSIS ONLY

ATTACHMENT X

FINITE ELEMENT ANALYSIS FOR W8x31 BASE PLATE

Contents

Purpose

The purpose of this finite element analysis of the W8x31 base plate is to determine if the stress developed in the plate under the following loading is less than the AISC allowable stress:

Dead + Utility + Rock + Seismic Load (D+U+R+S) = P_a = 121.8 kips (see Design Data).

The AISC Allowable Bending Stress = $F_b = 0.75F_y$ = 0.75(36) (AISC pg 5-48, Eqn F2-1)
= 27 ksi x 1.333 (1/3 increase for seismic)
= 36 ksi.

The static load case of (D +U + R) is addressed in Attachment III, page III-65 of this analysis.

Design Data

Base plate dimensions: 12-1/2" x 3/4" x 0'-8" (Attachment III, pg III - 65)
W8x31 Properties (AISC M016, pg I - 32):
t_f = 0.435" b_f = 7.995" d = 8.00"
t_w = 0.285" A = 9.13"

Design Axial Load on W8x31:
P_a = 121.8 kips (D+U+R+S, Attachment III, pg III - 108)

Description

The 12-1/2" x 3/4" x 0'-8" base plate is supported by the invert segment curb which is 6-3/4" wide at the location of bearing contact with the base plate. The invert segment curb is 8" wide with a blockout for a seal on the side nearest the rock wall of ½" and a 3/4" chamfer on the interior side (see Figure X.1 on page X-5). The W8x31 steel set ring beam is welded to the base plate with 3" long fillet welds on the inside of the flanges and on both sides of the web (Attachment IX, page IX-11) .

Analysis Methodology (Spring Approach)

Since the base plate is not fully supported by the invert curb, it cannot be analyzed by the conventional AISC methods (AISC M016, pg 3-106). The base plate is welded to the W8 at the flanges and at the web (see above); therefore, the plate is analyzed with only the welded portions of the flanges and web fixed to the plate at corresponding nodes (see Loading/Fixed Node Configuration, page X-8), with those same nodes free to deflect vertically (or with vertical springs depending on location). The base plate area in contact with the invert curb is modeled with vertical springs to represent the concrete support as described in the following paragraph.

To model the concrete support under the base plate, a spring element is placed at each node that is in contact with the concrete. A value of 4000 kip/in was chosen as a best estimate spring stiffness (constant) to represent the concrete based on the following, assuming the curb acts as a short column in compression:

Average invert depth = (6-3/4" @ curb & 24" @ center) so assume ≈ 14"

Assume 12" wide x 14" deep column; Area = A = (12")(14") =168 in^2

$E = 57000\,(f_c')^{1/2} = 57000\,(5000\text{psi})^{1/2} = 4030$ ksi (From ACI 318, Section 8.5)

L = Length of column = arc length of invert ≈ [(2)(31.01°)/360°](25')(π) = 13.53 ft

K = stiffness ≈ AE/L = (168 in^2)(4030 ksi)/(13.53ft)(12in/ft)
= 4170 kip/in say = 4000 kip/in

Axial load from the W8 is applied as a pressure loading through the web and flanges of the W8 (see Loading/Fixed Joint Configuration, page X-8). The pressure loading is determined by dividing the total load (P_a) by the area the W8 member:

121.8 kip / 9.13 in^2 = 13.341 ksi.

However, since all the nodes do not have the same tributary area, it was necessary to factor the spring constant for the remaining nodes by multiplying the ratio of tributary areas by 4000 as shown in the following example for node number 73:

Approx. tributary area of greatest number of elements = 1.0185*0.938 = 0.9554
Tributary area of node 73 = (1.126+0.80)/2 * 0.938 = 0.9033
Spring constant for node 73 = 4000*0.9033/0.9554 = 3782 ≈ 3800 (rounded)

As shown above, the results were rounded for simplicity. In addition, nodes that occur at the corners and along the edges are further reduced by 1/4 and 1/2 respectively, as only 1/4 (corner) or 1/2 (edge) of the tributary area contributes at these nodes. Each node is also released in the x and y directions.

The resulting stress plot for the 4000 kip/in case shows a maximum stress contour of 29.54 ksi (pg X-9), with a maximum stress value of 33.23 ksi (elements 122 and 126, page X-27). The stress in the plate is below the allowable stress of 36 ksi; therefore, the plate is adequate for the governing (D+R+U+S) design load of 121.8 kips.

Deviations from Normal Installation

The base plate is designed for the normal condition of relatively uniform bearing on the invert segment curb as shown on Figure X.1. However, due to installation conditions, uneven bearing may occur, in which case the allowable stresses of the AISC and ACI codes might be exceeded as described below.

Prior to expanding the steel set, the foot segment is installed nominally perpendicular to the tunnel alignment and as close to the tunnel wall as practical with the base plate bearing flat on the invert segment curb. As jacking and expansion of the steel set occurs, the foot segment may rotate and move, creating uneven bearing on the invert curb. Rotation and movement of the foot segment during the jacking process may occur because of construction and/or erection conditions such as excavated tunnel shape (out-of-round), accumulation of tolerances, irregularities or voids in the tunnel walls, or other conditions that may affect the relative alignment of the steel set and concrete invert. When the foot segment base plate bears unevenly on the concrete invert curb or when the foot segment base plate is offset toward the tunnel centerline, the plate bearing area will decrease, increasing the bearing pressure on the concrete and the bending stress in the steel base plate. Bending of the steel base plate or localized spalling of the concrete curb might occur. However, excessive offset of the foot segment base plate towards the tunnel centerline is limited during the jacking/expansion process because if the base plate is offset excessively, the jacking force cannot be applied, i.e. there will be inadequate support for the base plate and the foot segment will rotate toward the centerline of the tunnel. The offset of the base plate should not exceed 1 inch at any location measured from the face of the curb to the inside face of the W8. This value was determined on page III-84 in Attachment III of this analysis.

Base plate and curb contact in the extreme case may occur initially through a single plate edge bearing on the concrete curb. To distribute the design load, this bearing condition might spall the contacted concrete in the localized bearing area until support is achieved through development of a satisfactory bearing area. In addition, the steel base plate might also deform and assist in developing a satisfactory bearing area. Provided the foot segment is properly positioned prior to jacking, localized spalling of the concrete invert curb or distortion of the base plate will not prohibit the steel set from performing its intended function of providing ground support in the ESF (invert arrangement will be modified and upgraded prior to incorporation into the repository).

Localized spalling of the concrete invert curb, obvious distortion of the base plate, or offset of the base plate exceeding 1 inch (page III-84) should be reported as nonconforming in accordance with Yucca Mountain Site Characterization Project Procedures so that the supports can be tracked for further manifestation of loading through ongoing monitoring programs. Reported nonconforming items will be evaluated according to specific conditions and dispositioned accordingly.

Conclusions

The 12-1/2" x 3/4" x 0'-8" plate is adequate for the design axial load applied.

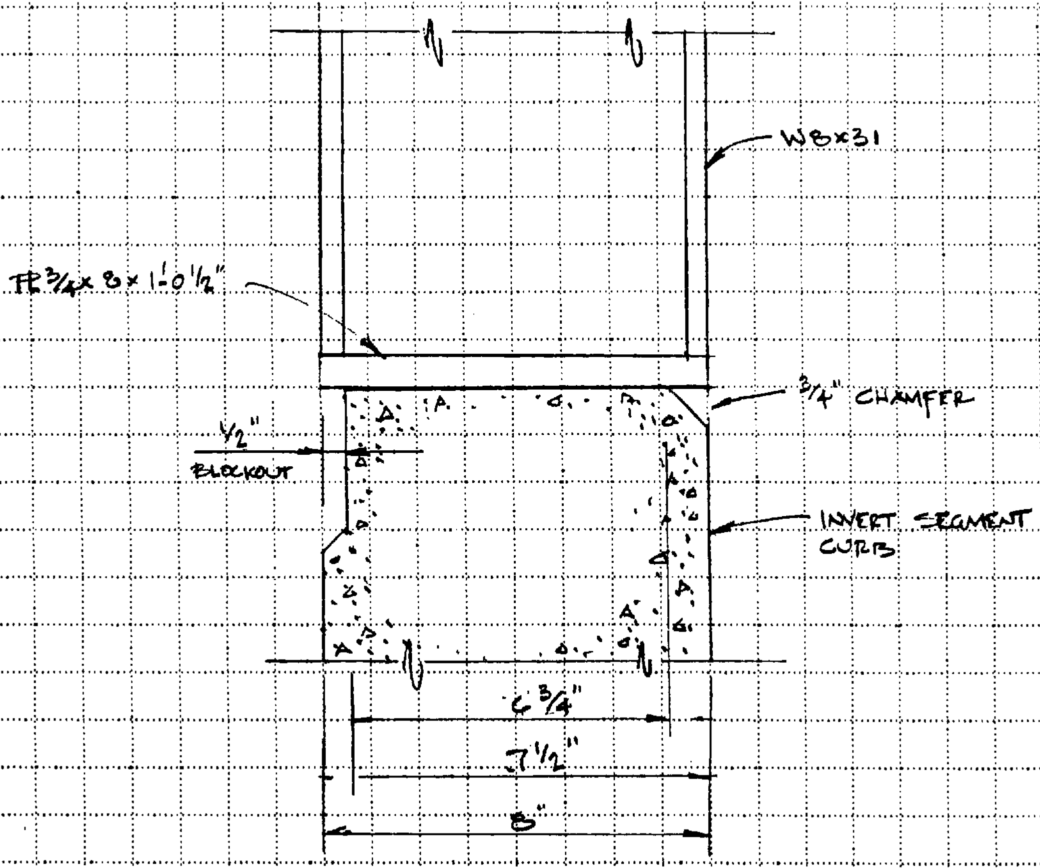
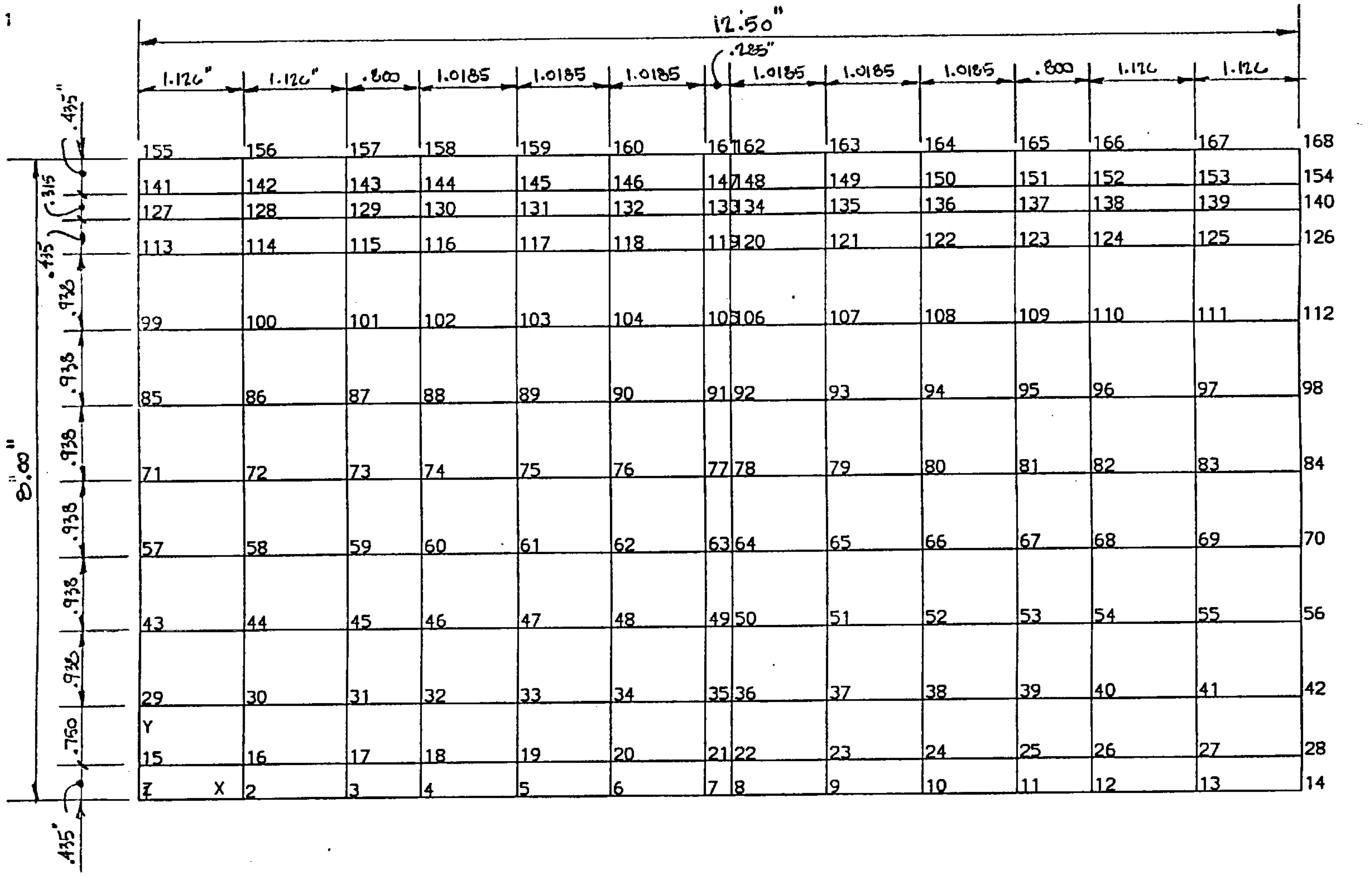


FIGURE X.1 W8 & CURB INTERFACE

NODE, NUMBERING & DIMENSIONS - SPRING MODEL



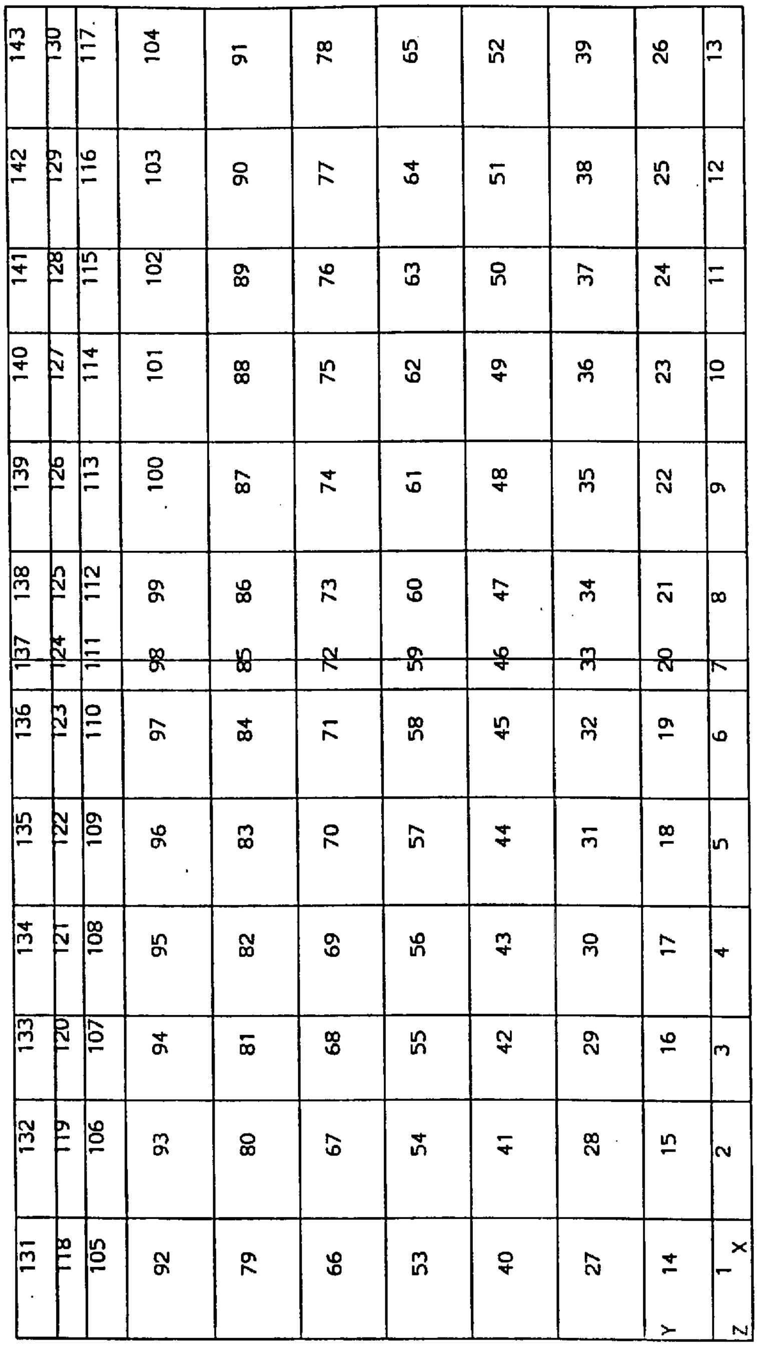
IN KIP

STAADPL-PLOT (REVISION 16.0)

COMPANY: M&O
DATE: MAY 2, 1996

TITLE: FINITE ELEMENT ANALYSIS FOR W8X31 BASEPL
STRUCTURE DATA NJ= 168, NM= 0, NE= 143

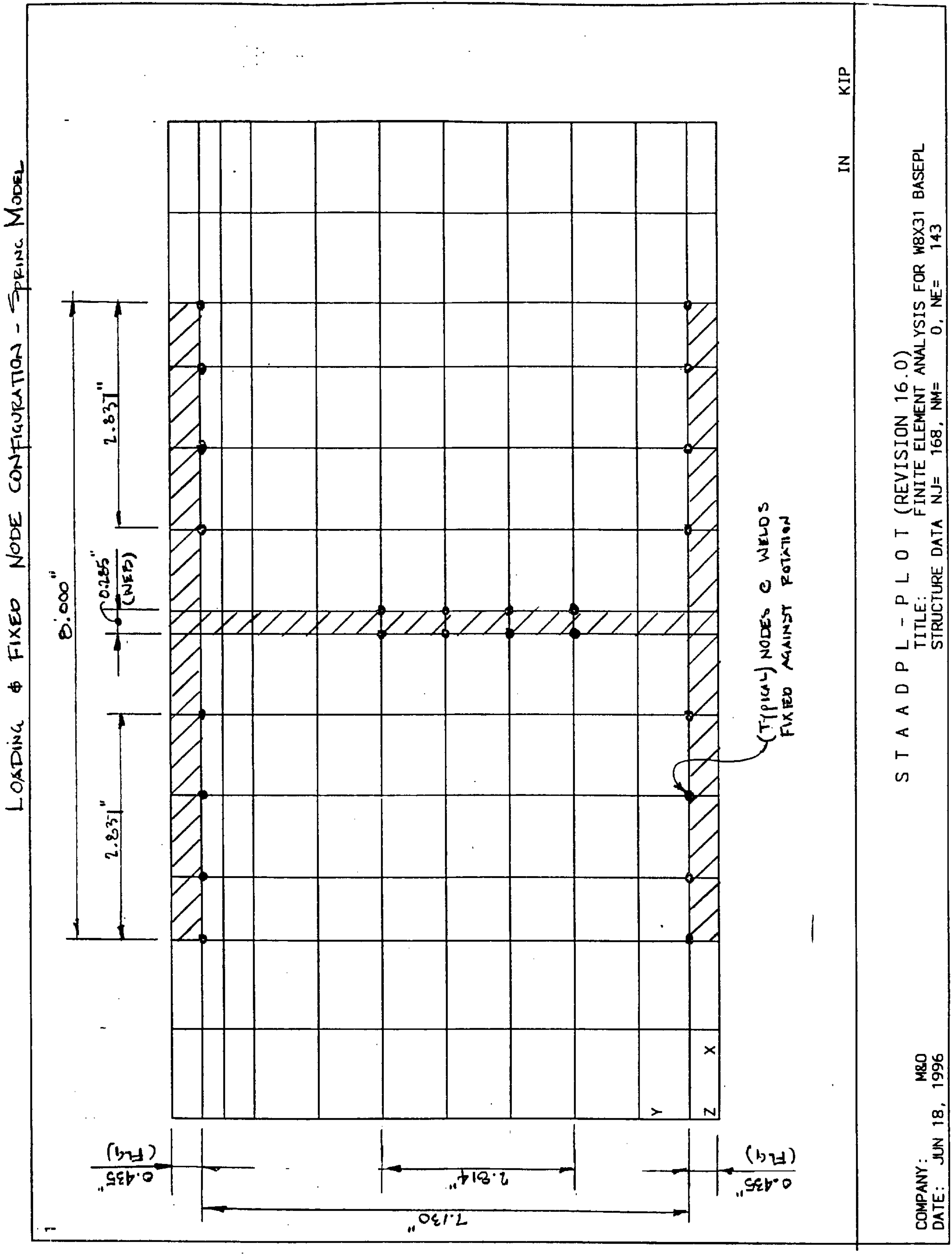
ELEMENT NUMBERING - SPRING MODEL



IN KIP

S T A A D P L - P L O T (REVISION 16.0)
TITLE: FINITE ELEMENT ANALYSIS FOR W8X31 BASEPL
STRUCTURE DATA NJ= 168, NM= 0, NE= 143

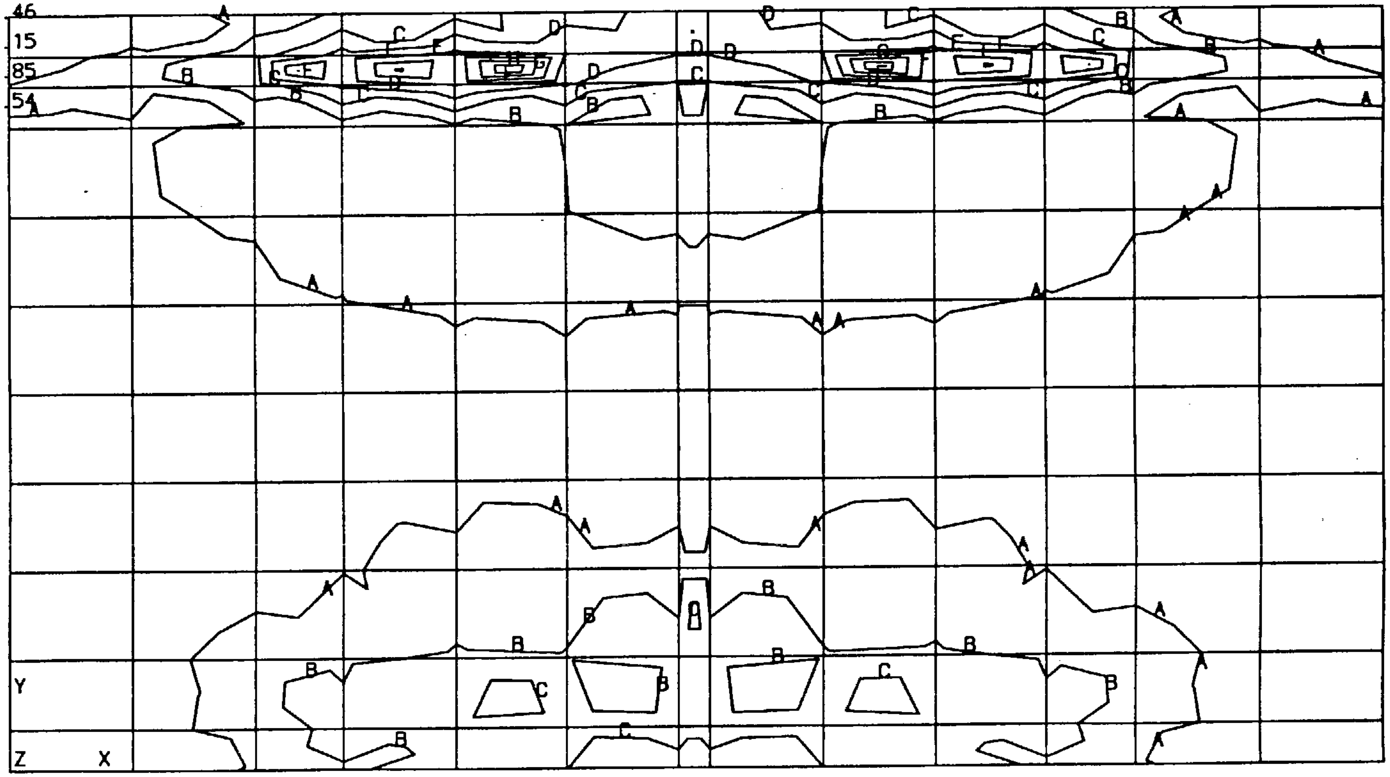
COMPANY: M&O
DATE: MAY 2, 1996


LOADING & FIXED NODE CONFIGURATION - SPRING MODEL
8.000"
2.837"
0.285" (WEB)
2.837"
(TYPICAL) NODES @ WELDS FIXED AGAINST ROTATION
0.435" (FLG)
2.814"
0.435" (FLG)
7.130"
X
Y
Z
IN
KIP
S T A A D P L - P L O T (REVISION 16.0)
TITLE: FINITE ELEMENT ANALYSIS FOR W8X31 BASEPL
STRUCTURE DATA NJ= 168, NM= 0, NE= 143
COMPANY: M&O
DATE: JUN 18, 1996

STDR LOAD= 1

1 STRESS CONTOUR

A	3.69
B	7.38
C	11.08
D	14.77
E	18.46
F	22.15
G	25.85
H	29.54



MAX. STRESS = 33.23 KSI @ NODES 122 & 126

IN KIP

S T A A D P L - P L O T (REVISION 16.0)
TITLE: FINITE ELEMENT ANALYSIS FOR W8X31 BASEPL
STRUCTURE DATA NJ= 168, NM= 0, NE= 143

COMPANY: M&O
DATE: JUN 21, 1996

```
     ****************************************************
     *                                                  *
     *            S T A A D - III                       *
     *            Revision 16.0b                        *
     *            Proprietary Program of                *
     *            RESEARCH ENGINEERS, Inc.              *
     *            Date=    JUN 21, 1996                 *
     *            Time=    15: 3:44                     *
     *                                                  *
     ****************************************************

  1. STAAD SPACE FINITE ELEMENT ANALYSIS FOR W8X31 BASEPLATE
  2. * THIS ANALYSIS DETERMINES STRESS IN 3/4" BASE PLATE
  3. * SPRING CONSTANTS ARE BASED ON K = 4000 K/IN
  4. * LOADING IS ON WEB AND FLANGES
  5. * PLATE IS FIXED AT WELD LOCATIONS WITH FZ FREE OR KFZ SPRINGS
  6. * FILENAME = "PLATEZ"
  7. UNIT KIP IN
  8. INPUT WIDTH 79
  9. JOINT COORDINATES
 10. 1 0.0 0.0 0.0 3 2.252 0.0 0.0
 11. 4 3.052 0.0 0.0
 12. 5 4.0705 0.0 0.0 7 6.1075 0.0 0.0
 13. 8 6.3925 0.0 0.0 11 9.448 0.0 0.0
 14. 12 10.248 0.0 0.0
 15. 13 11.374 0.0 0.0 14 12.5 0 0
 16. REPEAT ALL 11 0 .435 0 0 .75 0 0 .9383 0 15*0 0 .435 0 0 .315 0 0 .435 0
 17. ELEMENT INCIDENCE
 18. 1 1 2 16 15
 19. REPEAT 12 1 1
 20. REPEAT ALL 10 13 14
 21. UNIT KIP INCH
 22. ELEMENT PROPERTIES
 23. 1 TO 143 TH 0.75
 24. CONSTANTS
 25. E 29000.0 ALL
 26. DENSITY 0.000283 ALL
 27. BETA 0 ALL
 28. SUPPORTS
 29. 72 83 86 97 FIXED BUT FX FY MX MY KFZ 4400
 30. 71 84 85 98 FIXED BUT FX FY MX MY KFZ 2200
 31. 73 82 87 96 FIXED BUT FX FY MX MY KFZ 3800
 32. 75 76 79 80 89 90 93 94 FIXED BUT FX FY MX MY KFZ 4000
 33. 49 63 77 91 FIXED BUT KFZ 2600
 34. 105 FIXED BUT FX FY MX MY KFZ 2600
 35. 50 64 78 92 FIXED BUT KFZ 2600
 36. 106 FIXED BUT FX FY MX MY KFZ 2600
 37. 133 134 FIXED BUT FX FY MX MY KFZ 600
 38. 35 36 FIXED BUT FX FY MX MY KFZ 2300
 39. 15 28 FIXED BUT FX FY MX MY KFZ 900
 40. 43 56 57 70 99 112 FIXED BUT FX FY MX MY KFZ 2200
 41. 127 140 FIXED BUT FX FY MX MY KFZ 500
 42. 16 27 FIXED BUT FX FY MX MY KFZ 1800
 43. 31 40 FIXED BUT FX FY MX MY KFZ 3400
 44. 44 55 58 69 100 111 FIXED BUT FX FY MX MY KFZ 4400
 45. 128 139 FIXED BUT FX FY MX MY KFZ 1000
 46. 45 54 59 68 101 110 FIXED BUT FX FY MX MY KFZ 3800
 47. 129 138 FIXED BUT FX FY MX MY KFZ 900
```

```
48. 47 48 51 52 61 62 65 66 FIXED BUT FX FY MX MY KFZ 4000
49. 103 104 107 108 FIXED BUT FX FY MX MY KFZ 4000
50. 46 53 60 67 74 81 88 95 102 109 FIXED BUT FX FY MX MY KFZ 3600
51. 29 42 FIXED BUT FX FY MX MY KFZ 2000
52. 30 41 FIXED BUT FX FY MX MY KFZ 4000
53. 33 34 37 38 FIXED BUT FX FY MX MY KFZ 3600
54. 32 39 FIXED BUT FX FY MX MY KFZ 3200
55. 113 126 FIXED BUT FX FY MX MY KFZ 1600
56. 114 125 FIXED BUT FX FY MX MY KFZ 3200
57. 115 124 FIXED BUT FX FY MX MY KFZ 2800
58. 116 123 FIXED BUT FX FY MX MY KFZ 2600
59. 117 118 121 122 FIXED BUT FX FY MX MY KFZ 2900
60. 119 120 FIXED BUT FX FY MX MY KFZ 1900
61. 130 137 FIXED BUT FX FY MX MY KFZ 800
62. 131 132 135 136 FIXED BUT FX FY MX MY KFZ 900
63. 17 26 FIXED BUT KFZ 1500
64. 18 25 FIXED BUT KFZ 1400
65. 19 20 23 24 FIXED BUT KFZ 1600
66. 21 22 FIXED BUT FX FY MX MY KFZ 1000
67. 143 TO 146 FIXED BUT FZ
68. 149 TO 152 FIXED BUT FZ
69. UNIT KIP IN
70. LOAD 1 PRESSURE ON WEB & FLANGES ONLY FROM 121.8 K AXIAL LOAD
71. ELEMENT LOAD
72. 3 TO 11 PRESSURE 13.341
73. 133 TO 141 PRESSURE 13.341
74. 20 33 46 59 72 85 98 111 124 PRESSURE 13.341
75. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =   168/  143/  134
  ORIGINAL/FINAL BAND-WIDTH =   15/   15
  TOTAL PRIMARY LOAD CASES  =    1, TOTAL DEGREES OF FREEDOM =  1008
  SIZE OF STIFFNESS MATRIX =   96768 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =    2.55 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                  15: 3:48
++ PROCESSING GLOBAL STIFFNESS MATRIX.                   15: 4: 6
++ PROCESSING TRIANGULAR FACTORIZATION.                  15: 4:38
++ CALCULATING JOINT DISPLACEMENTS.                      15: 5:18
++ CALCULATING MEMBER  FORCES.                           15: 5:22

  76. PRINT SUPPORT REACTIONS
```

```
SUPPORT REACTIONS -UNIT KIP  IN      STRUCTURE TYPE = SPACE
-----------------

JOINT  LOAD   FORCE-X    FORCE-Y    FORCE-Z     MOM-X      MOM-Y      MOM Z

  72    1       0.00       0.00       0.20       0.00       0.00       0.00
  83    1       0.00       0.00       0.20       0.00       0.00       0.00
  86    1       0.00       0.00       0.20       0.00       0.00       0.00
  97    1       0.00       0.00       0.20       0.00       0.00       0.00
  71    1       0.00       0.00       0.09       0.00       0.00       0.00
  84    1       0.00       0.00       0.09       0.00       0.00       0.00
  85    1       0.00       0.00       0.15       0.00       0.00       0.00
  98    1       0.00       0.00       0.15       0.00       0.00       0.00
  73    1       0.00       0.00       0.24       0.00       0.00       0.00
  82    1       0.00       0.00       0.24       0.00       0.00       0.00
  87    1       0.00       0.00       0.15       0.00       0.00       0.00
  96    1       0.00       0.00       0.15       0.00       0.00       0.00
  75    1       0.00       0.00       0.24       0.00       0.00       0.00
  76    1       0.00       0.00      -0.42       0.00       0.00       0.00
  79    1       0.00       0.00      -0.42       0.00       0.00       0.00
  80    1       0.00       0.00       0.24       0.00       0.00       0.00
  89    1       0.00       0.00       0.09       0.00       0.00       0.00
  90    1       0.00       0.00      -0.45       0.00       0.00       0.00
  93    1       0.00       0.00      -0.45       0.00       0.00       0.00
  94    1       0.00       0.00       0.09       0.00       0.00       0.00
  49    1       0.00       0.00      -1.29       0.97       0.42       0.00
  63    1       0.00       0.00      -1.03       0.24       0.59       0.00
  77    1       0.00       0.00      -0.94       0.08       0.62       0.00
  91    1       0.00       0.00      -0.90      -0.28       0.50       0.00
 105    1       0.00       0.00      -1.53       0.00       0.00       0.00
  50    1       0.00       0.00      -1.29       0.97      -0.42       0.00
  64    1       0.00       0.00      -1.03       0.24      -0.59       0.00
  78    1       0.00       0.00      -0.94       0.08      -0.62       0.00
  92    1       0.00       0.00      -0.90      -0.28      -0.50       0.00
 106    1       0.00       0.00      -1.53       0.00       0.00       0.00
 133    1       0.00       0.00      -1.42       0.00       0.00       0.00
 134    1       0.00       0.00      -1.42       0.00       0.00       0.00
  35    1       0.00       0.00      -2.39       0.00       0.00       0.00
  36    1       0.00       0.00      -2.39       0.00       0.00       0.00
  15    1       0.00       0.00      -0.03       0.00       0.00       0.00
  28    1       0.00       0.00      -0.03       0.00       0.00       0.00
  43    1       0.00       0.00       0.14       0.00       0.00       0.00
  56    1       0.00       0.00       0.14       0.00       0.00       0.00
  57    1       0.00       0.00       0.10       0.00       0.00       0.00
  70    1       0.00       0.00       0.10       0.00       0.00       0.00
  99    1       0.00       0.00       0.20       0.00       0.00       0.00
 112    1       0.00       0.00       0.20       0.00       0.00       0.00
 127    1       0.00       0.00      -0.05       0.00       0.00       0.00
 140    1       0.00       0.00      -0.05       0.00       0.00       0.00
  16    1       0.00       0.00      -0.68       0.00       0.00       0.00
  27    1       0.00       0.00      -0.68       0.00       0.00       0.00
  31    1       0.00       0.00      -1.64       0.00       0.00       0.00
  40    1       0.00       0.00      -1.64       0.00       0.00       0.00
  44    1       0.00       0.00      -0.08       0.00       0.00       0.00
  55    1       0.00       0.00      -0.08       0.00       0.00       0.00
```

```
SUPPORT REACTIONS -UNIT KIP  IN       STRUCTURE TYPE = SPACE
-----------------

JOINT  LOAD    FORCE-X     FORCE-Y     FORCE-Z       MOM-X       MOM-Y       MOM Z

   58     1        0.00        0.00        0.15        0.00        0.00        0.00
   69     1        0.00        0.00        0.15        0.00        0.00        0.00
  100     1        0.00        0.00       -0.17        0.00        0.00        0.00
  111     1        0.00        0.00       -0.17        0.00        0.00        0.00
  128     1        0.00        0.00       -0.55        0.00        0.00        0.00
  139     1        0.00        0.00       -0.55        0.00        0.00        0.00
   45     1        0.00        0.00       -0.36        0.00        0.00        0.00
   54     1        0.00        0.00       -0.36        0.00        0.00        0.00
   59     1        0.00        0.00        0.14        0.00        0.00        0.00
   68     1        0.00        0.00        0.14        0.00        0.00        0.00
  101     1        0.00        0.00       -0.57        0.00        0.00        0.00
  110     1        0.00        0.00       -0.57        0.00        0.00        0.00
  129     1        0.00        0.00       -1.02        0.00        0.00        0.00
  138     1        0.00        0.00       -1.02        0.00        0.00        0.00
   47     1        0.00        0.00       -0.79        0.00        0.00        0.00
   48     1        0.00        0.00       -1.21        0.00        0.00        0.00
   51     1        0.00        0.00       -1.21        0.00        0.00        0.00
   52     1        0.00        0.00       -0.79        0.00        0.00        0.00
   61     1        0.00        0.00        0.07        0.00        0.00        0.00
   62     1        0.00        0.00       -0.57        0.00        0.00        0.00
   65     1        0.00        0.00       -0.57        0.00        0.00        0.00
   66     1        0.00        0.00        0.07        0.00        0.00        0.00
  103     1        0.00        0.00       -1.18        0.00        0.00        0.00
  104     1        0.00        0.00       -1.58        0.00        0.00        0.00
  107     1        0.00        0.00       -1.58        0.00        0.00        0.00
  108     1        0.00        0.00       -1.18        0.00        0.00        0.00
   46     1        0.00        0.00       -0.52        0.00        0.00        0.00
   53     1        0.00        0.00       -0.52        0.00        0.00        0.00
   60     1        0.00        0.00        0.15        0.00        0.00        0.00
   67     1        0.00        0.00        0.15        0.00        0.00        0.00
   74     1        0.00        0.00        0.29        0.00        0.00        0.00
   81     1        0.00        0.00        0.29        0.00        0.00        0.00
   88     1        0.00        0.00        0.16        0.00        0.00        0.00
   95     1        0.00        0.00        0.16        0.00        0.00        0.00
  102     1        0.00        0.00       -0.80        0.00        0.00        0.00
  109     1        0.00        0.00       -0.80        0.00        0.00        0.00
   29     1        0.00        0.00        0.10        0.00        0.00        0.00
   42     1        0.00        0.00        0.10        0.00        0.00        0.00
   30     1        0.00        0.00       -0.75        0.00        0.00        0.00
   41     1        0.00        0.00       -0.75        0.00        0.00        0.00
   33     1        0.00        0.00       -3.02        0.00        0.00        0.00
   34     1        0.00        0.00       -3.34        0.00        0.00        0.00
   37     1        0.00        0.00       -3.34        0.00        0.00        0.00
   38     1        0.00        0.00       -3.02        0.00        0.00        0.00
   32     1        0.00        0.00       -2.12        0.00        0.00        0.00
   39     1        0.00        0.00       -2.12        0.00        0.00        0.00
  113     1        0.00        0.00        0.03        0.00        0.00        0.00
  126     1        0.00        0.00        0.03        0.00        0.00        0.00
  114     1        0.00        0.00       -1.04        0.00        0.00        0.00
  125     1        0.00        0.00       -1.04        0.00        0.00        0.00
```

```
SUPPORT REACTIONS -UNIT KIP  IN      STRUCTURE TYPE = SPACE
-----------------

JOINT  LOAD   FORCE-X    FORCE-Y    FORCE-Z     MOM-X      MOM-Y      MOM Z

  115    1      0.00       0.00      -2.02       0.00       0.00       0.00
  124    1      0.00       0.00      -2.02       0.00       0.00       0.00
  116    1      0.00       0.00      -2.55       0.00       0.00       0.00
  123    1      0.00       0.00      -2.55       0.00       0.00       0.00
  117    1      0.00       0.00      -3.57       0.00       0.00       0.00
  118    1      0.00       0.00      -4.05       0.00       0.00       0.00
  121    1      0.00       0.00      -4.05       0.00       0.00       0.00
  122    1      0.00       0.00      -3.57       0.00       0.00       0.00
  119    1      0.00       0.00      -2.88       0.00       0.00       0.00
  120    1      0.00       0.00      -2.88       0.00       0.00       0.00
  130    1      0.00       0.00      -1.20       0.00       0.00       0.00
  137    1      0.00       0.00      -1.20       0.00       0.00       0.00
  131    1      0.00       0.00      -1.69       0.00       0.00       0.00
  132    1      0.00       0.00      -1.97       0.00       0.00       0.00
  135    1      0.00       0.00      -1.97       0.00       0.00       0.00
  136    1      0.00       0.00      -1.69       0.00       0.00       0.00
   17    1      0.00       0.00      -1.32       1.92       1.40       0.00
   26    1      0.00       0.00      -1.32       1.92      -1.40       0.00
   18    1      0.00       0.00      -1.74       2.89       1.10       0.00
   25    1      0.00       0.00      -1.74       2.89      -1.10       0.00
   19    1      0.00       0.00      -2.42       3.82       0.96       0.00
   20    1      0.00       0.00      -2.85       4.18       1.36       0.00
   23    1      0.00       0.00      -2.85       4.18      -1.36       0.00
   24    1      0.00       0.00      -2.42       3.82      -0.96       0.00
   21    1      0.00       0.00      -2.14       0.00       0.00       0.00
   22    1      0.00       0.00      -2.14       0.00       0.00       0.00
  143    1      0.00       0.00       0.00      -2.70       1.59       0.00
  144    1      0.00       0.00       0.00      -3.79       1.36       0.00
  145    1      0.00       0.00       0.00      -5.12       1.41       0.00
  146    1      0.00       0.00       0.00      -5.64       1.92       0.00
  149    1      0.00       0.00       0.00      -5.64      -1.92       0.00
  150    1      0.00       0.00       0.00      -5.12      -1.41       0.00
  151    1      0.00       0.00       0.00      -3.79      -1.36       0.00
  152    1      0.00       0.00       0.00      -2.70      -1.59       0.00


 ************** END OF LATEST ANALYSIS RESULT **************

  77. PRINT ELEMENT STRESSES
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD          QX          QY           MX           MY          MXY
                                   FX           FY          FXY


     1       1       0.12       -0.12        -0.09         0.00         0.05
                                 0.00         0.00         0.00
      TOP :   SMAX=      0.26  SMIN=     -1.19  TMAX=      0.73  ANGLE= -26.1
      BOTT:   SMAX=      1.19  SMIN=     -0.26  TMAX=      0.73  ANGLE= -26.1

     2       1       1.34       -0.61         0.14        -0.13         0.08
                                 0.00         0.00         0.00
      TOP :   SMAX=      1.77  SMIN=     -1.60  TMAX=      1.68  ANGLE=  15.0
      BOTT:   SMAX=      1.60  SMIN=     -1.77  TMAX=      1.68  ANGLE=  15.0

     3       1       3.10       -3.38        -0.04        -0.53         0.30
                                 0.00         0.00         0.00
      TOP :   SMAX=      1.15  SMIN=     -7.15  TMAX=      4.15  ANGLE=  25.5
      BOTT:   SMAX=      7.15  SMIN=     -1.15  TMAX=      4.15  ANGLE=  25.5

     4       1       1.55       -3.65        -0.13        -0.59         0.19
                                 0.00         0.00         0.00
      TOP :   SMAX=     -0.66  SMIN=     -7.04  TMAX=      3.19  ANGLE=  19.7
      BOTT:   SMAX=      7.04  SMIN=      0.66  TMAX=      3.19  ANGLE=  19.7

     5       1       1.77       -4.43        -0.25        -0.80         0.26
                                 0.00         0.00         0.00
      TOP :   SMAX=     -1.52  SMIN=     -9.64  TMAX=      4.06  ANGLE=  21.9
      BOTT:   SMAX=      9.64  SMIN=      1.52  TMAX=      4.06  ANGLE=  21.9

     6       1       4.48       -3.59        -0.15        -0.56         0.79
                                 0.00         0.00         0.00
      TOP :   SMAX=      4.90  SMIN=    -12.45  TMAX=      8.67  ANGLE=  37.7
      BOTT:   SMAX=     12.45  SMIN=     -4.90  TMAX=      8.67  ANGLE=  37.7

     7       1       0.00       -0.41         1.16         0.20         0.00
                                 0.00         0.00         0.00
      TOP :   SMAX=     12.36  SMIN=      2.17  TMAX=      5.10  ANGLE=   0.0
      BOTT:   SMAX=     -2.17  SMIN=    -12.36  TMAX=      5.10  ANGLE=   0.0

     8       1      -4.48       -3.59        -0.15        -0.56        -0.79
                                 0.00         0.00         0.00
      TOP :   SMAX=      4.90  SMIN=    -12.45  TMAX=      8.67  ANGLE= -37.7
      BOTT:   SMAX=     12.45  SMIN=     -4.90  TMAX=      8.67  ANGLE= -37.7

     9       1      -1.77       -4.43        -0.25        -0.80        -0.26
                                 0.00         0.00         0.00
      TOP :   SMAX=     -1.52  SMIN=     -9.64  TMAX=      4.06  ANGLE= -21.9
      BOTT:   SMAX=      9.64  SMIN=      1.52  TMAX=      4.06  ANGLE= -21.9

    10       1      -1.55       -3.65        -0.13        -0.59        -0.19
                                 0.00         0.00         0.00
      TOP :   SMAX=     -0.66  SMIN=     -7.04  TMAX=      3.19  ANGLE= -19.7
      BOTT:   SMAX=      7.04  SMIN=      0.66  TMAX=      3.19  ANGLE= -19.7
```

```
ELEMENT FORCES    FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX          QY          MX          MY          MXY
                                  FX          FY          FXY


  11       1       -3.10       -3.38       -0.04       -0.53       -0.30
                                0.00        0.00        0.00
    TOP :  SMAX=        1.15  SMIN=       -7.15  TMAX=        4.15  ANGLE= -25.5
    BOTT:  SMAX=        7.15  SMIN=       -1.15  TMAX=        4.15  ANGLE= -25.5

  12       1       -1.34       -0.61        0.14       -0.13       -0.08
                                0.00        0.00        0.00
    TOP :  SMAX=        1.77  SMIN=       -1.60  TMAX=        1.68  ANGLE= -15.0
    BOTT:  SMAX=        1.60  SMIN=       -1.77  TMAX=        1.68  ANGLE= -15.0

  13       1       -0.12       -0.12       -0.09        0.00       -0.05
                                0.00        0.00        0.00
    TOP :  SMAX=        0.26  SMIN=       -1.19  TMAX=        0.73  ANGLE=  26.1
    BOTT:  SMAX=        1.19  SMIN=       -0.26  TMAX=        0.73  ANGLE=  26.1

  14       1       -0.33        0.29       -0.10       -0.15        0.13
                                0.00        0.00        0.00
    TOP :  SMAX=        0.03  SMIN=       -2.72  TMAX=        1.37  ANGLE=  39.8
    BOTT:  SMAX=        2.72  SMIN=       -0.03  TMAX=        1.37  ANGLE=  39.8

  15       1        1.44       -1.61        0.24        0.29       -0.07
                                0.00        0.00        0.00
    TOP :  SMAX=        3.61  SMIN=        2.07  TMAX=        0.77  ANGLE=  34.4
    BOTT:  SMAX=       -2.07  SMIN=       -3.61  TMAX=        0.77  ANGLE=  34.4

  16       1        1.97       -3.39        0.22        0.81       -0.11
                                0.00        0.00        0.00
    TOP :  SMAX=        8.82  SMIN=        2.09  TMAX=        3.37  ANGLE=  10.3
    BOTT:  SMAX=       -2.09  SMIN=       -8.82  TMAX=        3.37  ANGLE=  10.3

  17       1        1.00       -4.19        0.30        1.02       -0.09
                                0.00        0.00        0.00
    TOP :  SMAX=       11.02  SMIN=        3.05  TMAX=        3.98  ANGLE=   7.1
    BOTT:  SMAX=       -3.05  SMIN=      -11.02  TMAX=        3.98  ANGLE=   7.1

  18       1        0.90       -5.30        0.32        1.20       -0.06
                                0.00        0.00        0.00
    TOP :  SMAX=       12.89  SMIN=        3.36  TMAX=        4.77  ANGLE=   4.0
    BOTT:  SMAX=       -3.36  SMIN=      -12.89  TMAX=        4.77  ANGLE=   4.0

  19       1       -0.16       -2.95        0.00        0.06        0.39
                                0.00        0.00        0.00
    TOP :  SMAX=        4.52  SMIN=       -3.83  TMAX=        4.17  ANGLE= -42.8
    BOTT:  SMAX=        3.83  SMIN=       -4.52  TMAX=        4.17  ANGLE= -42.8

  20       1        0.00       -0.78        0.34       -1.00        0.00
                                0.00        0.00        0.00
    TOP :  SMAX=        3.67  SMIN=      -10.64  TMAX=        7.16  ANGLE=   0.0
    BOTT:  SMAX=       10.64  SMIN=       -3.67  TMAX=        7.16  ANGLE=   0.0
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT   LOAD         QX           QY            MX            MY            MXY
                                    FX            FY            FXY


    21        1        0.16        -2.95          0.00          0.06         -0.39
                                    0.00          0.00          0.00
     TOP :   SMAX=        4.52  SMIN=     -3.83  TMAX=      4.17  ANGLE=   42.8
     BOTT:   SMAX=        3.83  SMIN=     -4.52  TMAX=      4.17  ANGLE=   42.8

    22        1       -0.90        -5.30          0.32          1.20          0.06
                                    0.00          0.00          0.00
     TOP :   SMAX=       12.89  SMIN=      3.36  TMAX=      4.77  ANGLE=   -4.0
     BOTT:   SMAX=       -3.36  SMIN=    -12.89  TMAX=      4.77  ANGLE=   -4.0

    23        1       -1.00        -4.19          0.30          1.02          0.09
                                    0.00          0.00          0.00
     TOP :   SMAX=       11.02  SMIN=      3.05  TMAX=      3.98  ANGLE=   -7.1
     BOTT:   SMAX=       -3.05  SMIN=    -11.02  TMAX=      3.98  ANGLE=   -7.1

    24        1       -1.97        -3.39          0.22          0.81          0.11
                                    0.00          0.00          0.00
     TOP :   SMAX=        8.82  SMIN=      2.09  TMAX=      3.37  ANGLE= -10.3
     BOTT:   SMAX=       -2.09  SMIN=     -8.82  TMAX=      3.37  ANGLE= -10.3

    25        1       -1.44        -1.61          0.24          0.29          0.07
                                    0.00          0.00          0.00
     TOP :   SMAX=        3.61  SMIN=      2.07  TMAX=      0.77  ANGLE= -34.4
     BOTT:   SMAX=       -2.07  SMIN=     -3.61  TMAX=      0.77  ANGLE= -34.4

    26        1        0.33         0.29         -0.10         -0.15         -0.13
                                    0.00          0.00          0.00
     TOP :   SMAX=        0.03  SMIN=     -2.72  TMAX=      1.37  ANGLE= -39.8
     BOTT:   SMAX=        2.72  SMIN=     -0.03  TMAX=      1.37  ANGLE= -39.8

    27        1       -0.16         0.25         -0.06         -0.12          0.11
                                    0.00          0.00          0.00
     TOP :   SMAX=        0.20  SMIN=     -2.14  TMAX=      1.17  ANGLE=   36.7
     BOTT:   SMAX=        2.14  SMIN=     -0.20  TMAX=      1.17  ANGLE=   36.7

    28        1       -0.17        -0.12         -0.05         -0.19          0.16
                                    0.00          0.00          0.00
     TOP :   SMAX=        0.56  SMIN=     -3.13  TMAX=      1.85  ANGLE=   32.8
     BOTT:   SMAX=        3.13  SMIN=     -0.56  TMAX=      1.85  ANGLE=   32.8

    29        1       -0.27        -0.39         -0.05         -0.26          0.15
                                    0.00          0.00          0.00
     TOP :   SMAX=        0.32  SMIN=     -3.64  TMAX=      1.98  ANGLE=   27.5
     BOTT:   SMAX=        3.64  SMIN=     -0.32  TMAX=      1.98  ANGLE=   27.5

    30        1       -0.33        -0.62         -0.04         -0.33          0.11
                                    0.00          0.00          0.00
     TOP :   SMAX=       -0.09  SMIN=     -3.85  TMAX=      1.88  ANGLE=   18.3
     BOTT:   SMAX=        3.85  SMIN=      0.09  TMAX=      1.88  ANGLE=   18.3
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
---------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX            QY            MX            MY            MXY
                                    FX            FY            FXY


   31       1       -0.41         -0.42         -0.13         -0.45          0.05
                                   0.00          0.00          0.00
     TOP :  SMAX=       -1.31  SMIN=     -4.85  TMAX=       1.77  ANGLE=    8.3
     BOTT:  SMAX=        4.85  SMIN=      1.31  TMAX=       1.77  ANGLE=    8.3

   32       1        0.07         -0.25         -0.06         -0.80         -0.06
                                   0.00          0.00          0.00
     TOP :  SMAX=       -0.61  SMIN=     -8.64  TMAX=       4.02  ANGLE=   -4.8
     BOTT:  SMAX=        8.64  SMIN=      0.61  TMAX=       4.02  ANGLE=   -4.8

   33       1        0.00         -0.74         -0.25         -1.17          0.00
                                   0.00          0.00          0.00
     TOP :  SMAX=       -2.71  SMIN=    -12.46  TMAX=       4.87  ANGLE=    0.0
     BOTT:  SMAX=       12.46  SMIN=      2.71  TMAX=       4.87  ANGLE=    0.0

   34       1       -0.07         -0.25         -0.06         -0.80          0.06
                                   0.00          0.00          0.00
     TOP :  SMAX=       -0.61  SMIN=     -8.64  TMAX=       4.02  ANGLE=    4.8
     BOTT:  SMAX=        8.64  SMIN=      0.61  TMAX=       4.02  ANGLE=    4.8

   35       1        0.41         -0.42         -0.13         -0.45         -0.05
                                   0.00          0.00          0.00
     TOP :  SMAX=       -1.31  SMIN=     -4.85  TMAX=       1.77  ANGLE=   -8.3
     BOTT:  SMAX=        4.85  SMIN=      1.31  TMAX=       1.77  ANGLE=   -8.3

   36       1        0.33         -0.62         -0.04         -0.33         -0.11
                                   0.00          0.00          0.00
     TOP :  SMAX=       -0.09  SMIN=     -3.85  TMAX=       1.88  ANGLE=  -18.3
     BOTT:  SMAX=        3.85  SMIN=      0.09  TMAX=       1.88  ANGLE=  -18.3

   37       1        0.27         -0.39         -0.05         -0.26         -0.15
                                   0.00          0.00          0.00
     TOP :  SMAX=        0.32  SMIN=     -3.64  TMAX=       1.98  ANGLE=  -27.5
     BOTT:  SMAX=        3.64  SMIN=     -0.32  TMAX=       1.98  ANGLE=  -27.5

   38       1        0.17         -0.12         -0.05         -0.19         -0.16
                                   0.00          0.00          0.00
     TOP :  SMAX=        0.56  SMIN=     -3.13  TMAX=       1.85  ANGLE=  -32.8
     BOTT:  SMAX=        3.13  SMIN=     -0.56  TMAX=       1.85  ANGLE=  -32.8

   39       1        0.16          0.25         -0.06         -0.12         -0.11
                                   0.00          0.00          0.00
     TOP :  SMAX=        0.20  SMIN=     -2.14  TMAX=       1.17  ANGLE=  -36.7
     BOTT:  SMAX=        2.14  SMIN=     -0.20  TMAX=       1.17  ANGLE=  -36.7

   40       1       -0.09          0.19         -0.02         -0.06          0.06
                                   0.00          0.00          0.00
     TOP :  SMAX=        0.21  SMIN=     -1.07  TMAX=       0.64  ANGLE=   33.6
     BOTT:  SMAX=        1.07  SMIN=     -0.21  TMAX=       0.64  ANGLE=   33.6
```

```
 ELEMENT FORCES     FORCE,LENGTH UNITS= KIP  IN
 --------------
 FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD        QX          QY          MX          MY          MXY
                                 FX          FY          FXY


   41       1      -0.16        0.20       -0.03       -0.16         0.07
                                0.00        0.00        0.00
     TOP :  SMAX=       0.03  SMIN=     -2.00  TMAX=     1.02  ANGLE=   23.6
     BOTT:  SMAX=       2.00  SMIN=     -0.03  TMAX=     1.02  ANGLE=   23.6

   42       1      -0.16        0.33       -0.07       -0.27         0.06
                                0.00        0.00        0.00
     TOP :  SMAX=      -0.53  SMIN=     -3.04  TMAX=     1.25  ANGLE=   16.3
     BOTT:  SMAX=       3.04  SMIN=      0.53  TMAX=     1.25  ANGLE=   16.3

   43       1      -0.19        0.31       -0.13       -0.35         0.03
                                0.00        0.00        0.00
     TOP :  SMAX=      -1.33  SMIN=     -3.75  TMAX=     1.21  ANGLE=    7.0
     BOTT:  SMAX=       3.75  SMIN=      1.33  TMAX=     1.21  ANGLE=    7.0

   44       1      -0.06        0.55       -0.22       -0.41        -0.02
                                0.00        0.00        0.00
     TOP :  SMAX=      -2.29  SMIN=     -4.44  TMAX=     1.08  ANGLE=   -6.0
     BOTT:  SMAX=       4.44  SMIN=      2.29  TMAX=     1.08  ANGLE=   -6.0

   45       1       1.30        0.09        0.15       -0.15        -0.13
                                0.00        0.00        0.00
     TOP :  SMAX=       2.14  SMIN=     -2.12  TMAX=     2.13  ANGLE= -20.3
     BOTT:  SMAX=       2.12  SMIN=     -2.14  TMAX=     2.13  ANGLE= -20.3

   46       1       0.00       -1.11        0.00        0.00         0.00
                                0.00        0.00        0.00
     TOP :  SMAX=       0.00  SMIN=      0.00  TMAX=     0.00  ANGLE=   90.0
     BOTT:  SMAX=       0.00  SMIN=      0.00  TMAX=     0.00  ANGLE=   90.0

   47       1      -1.30        0.09        0.15       -0.15         0.13
                                0.00        0.00        0.00
     TOP :  SMAX=       2.14  SMIN=     -2.12  TMAX=     2.13  ANGLE=   20.3
     BOTT:  SMAX=       2.12  SMIN=     -2.14  TMAX=     2.13  ANGLE=   20.3

   48       1       0.06        0.55       -0.22       -0.41         0.02
                                0.00        0.00        0.00
     TOP :  SMAX=      -2.29  SMIN=     -4.44  TMAX=     1.08  ANGLE=    6.0
     BOTT:  SMAX=       4.44  SMIN=      2.29  TMAX=     1.08  ANGLE=    6.0

   49       1       0.19        0.31       -0.13       -0.35        -0.03
                                0.00        0.00        0.00
     TOP :  SMAX=      -1.33  SMIN=     -3.75  TMAX=     1.21  ANGLE=   -7.0
     BOTT:  SMAX=       3.75  SMIN=      1.33  TMAX=     1.21  ANGLE=   -7.0

   50       1       0.16        0.33       -0.07       -0.27        -0.06
                                0.00        0.00        0.00
     TOP :  SMAX=      -0.53  SMIN=     -3.04  TMAX=     1.25  ANGLE= -16.3
     BOTT:  SMAX=       3.04  SMIN=      0.53  TMAX=     1.25  ANGLE= -16.3
```

```
ELEMENT FORCES    FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD        QX          QY          MX          MY          MXY
                                 FX          FY          FXY


  51       1        0.16        0.20       -0.03       -0.16       -0.07
                                0.00        0.00        0.00
   TOP :  SMAX=       0.03  SMIN=     -2.00  TMAX=       1.02  ANGLE= -23.6
   BOTT:  SMAX=       2.00  SMIN=     -0.03  TMAX=       1.02  ANGLE= -23.6

  52       1        0.09        0.19       -0.02       -0.06       -0.06
                                0.00        0.00        0.00
   TOP :  SMAX=       0.21  SMIN=     -1.07  TMAX=       0.64  ANGLE= -33.6
   BOTT:  SMAX=       1.07  SMIN=     -0.21  TMAX=       0.64  ANGLE= -33.6

  53       1       -0.01        0.06        0.00       -0.01        0.01
                                0.00        0.00        0.00
   TOP :  SMAX=       0.08  SMIN=     -0.19  TMAX=       0.13  ANGLE=  90.0
   BOTT:  SMAX=       0.19  SMIN=     -0.08  TMAX=       0.13  ANGLE=  90.0

  54       1       -0.08        0.07       -0.01       -0.06        0.01
                                0.00        0.00        0.00
   TOP :  SMAX=      -0.02  SMIN=     -0.64  TMAX=       0.31  ANGLE=  15.5
   BOTT:  SMAX=       0.64  SMIN=      0.02  TMAX=       0.31  ANGLE=  15.5

  55       1       -0.12        0.12       -0.04       -0.11        0.01
                                0.00        0.00        0.00
   TOP :  SMAX=      -0.35  SMIN=     -1.18  TMAX=       0.41  ANGLE=  10.4
   BOTT:  SMAX=       1.18  SMIN=      0.35  TMAX=       0.41  ANGLE=  10.4

  56       1       -0.15        0.13       -0.12       -0.15        0.01
                                0.00        0.00        0.00
   TOP :  SMAX=      -1.28  SMIN=     -1.63  TMAX=       0.17  ANGLE=   9.5
   BOTT:  SMAX=       1.63  SMIN=      1.28  TMAX=       0.17  ANGLE=   9.5

  57       1        0.04        0.18       -0.19       -0.16        0.00
                                0.00        0.00        0.00
   TOP :  SMAX=      -1.66  SMIN=     -2.06  TMAX=       0.20  ANGLE=   2.3
   BOTT:  SMAX=       2.06  SMIN=      1.66  TMAX=       0.20  ANGLE=   2.3

  58       1        1.12       -0.05        0.24        0.02       -0.03
                                0.00        0.00        0.00
   TOP :  SMAX=       2.58  SMIN=      0.13  TMAX=       1.22  ANGLE=  -6.6
   BOTT:  SMAX=      -0.13  SMIN=     -2.58  TMAX=       1.22  ANGLE=  -6.6

  59       1        0.00       -0.39        0.00        0.00        0.00
                                0.00        0.00        0.00
   TOP :  SMAX=       0.00  SMIN=      0.00  TMAX=       0.00  ANGLE=  90.0
   BOTT:  SMAX=       0.00  SMIN=      0.00  TMAX=       0.00  ANGLE=  90.0

  60       1       -1.12       -0.05        0.24        0.02        0.03
                                0.00        0.00        0.00
   TOP :  SMAX=       2.58  SMIN=      0.13  TMAX=       1.22  ANGLE=   6.6
   BOTT:  SMAX=      -0.13  SMIN=     -2.58  TMAX=       1.22  ANGLE=   6.6
```

```
ELEMENT FORCES    FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT   LOAD         QX           QY           MX           MY           MXY
                                    FX           FY           FXY


   61       1       -0.04         0.18        -0.19        -0.16          0.00
                                  0.00         0.00         0.00
    TOP :   SMAX=       -1.66   SMIN=      -2.06   TMAX=       0.20   ANGLE=   -2.3
    BOTT:   SMAX=        2.06   SMIN=       1.66   TMAX=       0.20   ANGLE=   -2.3

   62       1        0.15         0.13        -0.12        -0.15         -0.01
                                  0.00         0.00         0.00
    TOP :   SMAX=       -1.28   SMIN=      -1.63   TMAX=       0.17   ANGLE=   -9.5
    BOTT:   SMAX=        1.63   SMIN=       1.28   TMAX=       0.17   ANGLE=   -9.5

   63       1        0.12         0.12        -0.04        -0.11         -0.01
                                  0.00         0.00         0.00
    TOP :   SMAX=       -0.35   SMIN=      -1.18   TMAX=       0.41   ANGLE= -10.4
    BOTT:   SMAX=        1.18   SMIN=       0.35   TMAX=       0.41   ANGLE= -10.4

   64       1        0.08         0.07        -0.01        -0.06         -0.01
                                  0.00         0.00         0.00
    TOP :   SMAX=       -0.02   SMIN=      -0.64   TMAX=       0.31   ANGLE= -15.5
    BOTT:   SMAX=        0.64   SMIN=       0.02   TMAX=       0.31   ANGLE= -15.5

   65       1        0.01         0.06         0.00        -0.01         -0.01
                                  0.00         0.00         0.00
    TOP :   SMAX=        0.08   SMIN=      -0.19   TMAX=       0.13   ANGLE=   90.0
    BOTT:   SMAX=        0.19   SMIN=      -0.08   TMAX=       0.13   ANGLE=   90.0

   66       1       -0.02        -0.12        -0.01        -0.03         -0.02
                                  0.00         0.00         0.00
    TOP :   SMAX=        0.08   SMIN=      -0.43   TMAX=       0.25   ANGLE= -32.8
    BOTT:   SMAX=        0.43   SMIN=      -0.08   TMAX=       0.25   ANGLE= -32.8

   67       1       -0.10        -0.15        -0.01        -0.09         -0.02
                                  0.00         0.00         0.00
    TOP :   SMAX=       -0.04   SMIN=      -0.99   TMAX=       0.47   ANGLE= -16.0
    BOTT:   SMAX=        0.99   SMIN=       0.04   TMAX=       0.47   ANGLE= -16.0

   68       1       -0.13        -0.25        -0.04        -0.15         -0.02
                                  0.00         0.00         0.00
    TOP :   SMAX=       -0.44   SMIN=      -1.66   TMAX=       0.61   ANGLE=   -9.6
    BOTT:   SMAX=        1.66   SMIN=       0.44   TMAX=       0.61   ANGLE=   -9.6

   69       1       -0.16        -0.27        -0.13        -0.21          0.00
                                  0.00         0.00         0.00
    TOP :   SMAX=       -1.38   SMIN=      -2.23   TMAX=       0.42   ANGLE=   -3.2
    BOTT:   SMAX=        2.23   SMIN=       1.38   TMAX=       0.42   ANGLE=   -3.2

   70       1       -0.02        -0.37        -0.20        -0.24          0.02
                                  0.00         0.00         0.00
    TOP :   SMAX=       -2.10   SMIN=      -2.63   TMAX=       0.26   ANGLE=   21.2
    BOTT:   SMAX=        2.63   SMIN=       2.10   TMAX=       0.26   ANGLE=   21.2
```

```
 ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
 --------------
 FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT   LOAD        QX          QY          MX          MY          MXY
                                  FX          FY          FXY

    71       1       1.18       -0.33        0.21       -0.04        0.03
                                 0.00        0.00        0.00
     TOP :   SMAX=       2.28  SMIN=     -0.49  TMAX=      1.39  ANGLE=   7.3
     BOTT:   SMAX=       0.49  SMIN=     -2.28  TMAX=      1.39  ANGLE=   7.3

    72       1       0.00       -0.18        0.00        0.00        0.00
                                 0.00        0.00        0.00
     TOP :   SMAX=       0.00  SMIN=      0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:   SMAX=       0.00  SMIN=      0.00  TMAX=      0.00  ANGLE=  90.0

    73       1      -1.18       -0.33        0.21       -0.04       -0.03
                                 0.00        0.00        0.00
     TOP :   SMAX=       2.28  SMIN=     -0.49  TMAX=      1.39  ANGLE=  -7.3
     BOTT:   SMAX=       0.49  SMIN=     -2.28  TMAX=      1.39  ANGLE=  -7.3

    74       1       0.02       -0.37       -0.20       -0.24       -0.02
                                 0.00        0.00        0.00
     TOP :   SMAX=      -2.10  SMIN=     -2.63  TMAX=      0.26  ANGLE= -21.2
     BOTT:   SMAX=       2.63  SMIN=      2.10  TMAX=      0.26  ANGLE= -21.2

    75       1       0.16       -0.27       -0.13       -0.21        0.00
                                 0.00        0.00        0.00
     TOP :   SMAX=      -1.38  SMIN=     -2.23  TMAX=      0.42  ANGLE=   3.2
     BOTT:   SMAX=       2.23  SMIN=      1.38  TMAX=      0.42  ANGLE=   3.2

    76       1       0.13       -0.25       -0.04       -0.15        0.02
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.44  SMIN=     -1.66  TMAX=      0.61  ANGLE=   9.6
     BOTT:   SMAX=       1.66  SMIN=      0.44  TMAX=      0.61  ANGLE=   9.6

    77       1       0.10       -0.15       -0.01       -0.09        0.02
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.04  SMIN=     -0.99  TMAX=      0.47  ANGLE=  16.0
     BOTT:   SMAX=       0.99  SMIN=      0.04  TMAX=      0.47  ANGLE=  16.0

    78       1       0.02       -0.12       -0.01       -0.03        0.02
                                 0.00        0.00        0.00
     TOP :   SMAX=       0.08  SMIN=     -0.43  TMAX=      0.25  ANGLE=  32.8
     BOTT:   SMAX=       0.43  SMIN=     -0.08  TMAX=      0.25  ANGLE=  32.8

    79       1      -0.13       -0.32       -0.03       -0.13       -0.08
                                 0.00        0.00        0.00
     TOP :   SMAX=       0.12  SMIN=     -1.89  TMAX=      1.01  ANGLE= -28.6
     BOTT:   SMAX=       1.89  SMIN=     -0.12  TMAX=      1.01  ANGLE= -28.6

    80       1      -0.23       -0.31       -0.05       -0.26       -0.10
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.12  SMIN=     -3.19  TMAX=      1.54  ANGLE= -21.7
     BOTT:   SMAX=       3.19  SMIN=      0.12  TMAX=      1.54  ANGLE= -21.7
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD          QX          QY          MX          MY          MXY
                                   FX          FY          FXY


   81       1       -0.23       -0.47       -0.10       -0.40        -0.09
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.76  SMIN=     -4.54  TMAX=      1.89  ANGLE= -15.3
     BOTT:   SMAX=       4.54  SMIN=      0.76  TMAX=      1.89  ANGLE= -15.3

   82       1       -0.26       -0.48       -0.16       -0.52        -0.05
                                 0.00        0.00        0.00
     TOP :   SMAX=      -1.59  SMIN=     -5.65  TMAX=      2.03  ANGLE=  -8.2
     BOTT:   SMAX=       5.65  SMIN=      1.59  TMAX=      2.03  ANGLE=  -8.2

   83       1       -0.11       -0.65       -0.24       -0.61         0.01
                                 0.00        0.00        0.00
     TOP :   SMAX=      -2.56  SMIN=     -6.51  TMAX=      1.97  ANGLE=   2.0
     BOTT:   SMAX=       6.51  SMIN=      2.56  TMAX=      1.97  ANGLE=   2.0

   84       1        0.77       -0.77       -0.02       -0.62         0.04
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.16  SMIN=     -6.69  TMAX=      3.26  ANGLE=   3.8
     BOTT:   SMAX=       6.69  SMIN=      0.16  TMAX=      3.26  ANGLE=   3.8

   85       1        0.00       -0.45        0.06       -0.66         0.00
                                 0.00        0.00        0.00
     TOP :   SMAX=       0.62  SMIN=     -7.08  TMAX=      3.85  ANGLE=   0.0
     BOTT:   SMAX=       7.08  SMIN=     -0.62  TMAX=      3.85  ANGLE=   0.0

   86       1       -0.77       -0.77       -0.02       -0.62        -0.04
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.16  SMIN=     -6.69  TMAX=      3.26  ANGLE=  -3.8
     BOTT:   SMAX=       6.69  SMIN=      0.16  TMAX=      3.26  ANGLE=  -3.8

   87       1        0.11       -0.65       -0.24       -0.61        -0.01
                                 0.00        0.00        0.00
     TOP :   SMAX=      -2.56  SMIN=     -6.51  TMAX=      1.97  ANGLE=  -2.0
     BOTT:   SMAX=       6.51  SMIN=      2.56  TMAX=      1.97  ANGLE=  -2.0

   88       1        0.26       -0.48       -0.16       -0.52         0.05
                                 0.00        0.00        0.00
     TOP :   SMAX=      -1.59  SMIN=     -5.65  TMAX=      2.03  ANGLE=   8.2
     BOTT:   SMAX=       5.65  SMIN=      1.59  TMAX=      2.03  ANGLE=   8.2

   89       1        0.23       -0.47       -0.10       -0.40         0.09
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.76  SMIN=     -4.54  TMAX=      1.89  ANGLE=  15.3
     BOTT:   SMAX=       4.54  SMIN=      0.76  TMAX=      1.89  ANGLE=  15.3

   90       1        0.23       -0.31       -0.05       -0.26         0.10
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.12  SMIN=     -3.19  TMAX=      1.54  ANGLE=  21.7
     BOTT:   SMAX=       3.19  SMIN=      0.12  TMAX=      1.54  ANGLE=  21.7
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD          QX          QY            MX            MY            MXY
                                   FX            FY            FXY


   91       1        0.13       -0.32         -0.03         -0.13          0.08
                                 0.00          0.00          0.00
    TOP :  SMAX=        0.12  SMIN=      -1.89  TMAX=        1.01  ANGLE=  28.6
    BOTT:  SMAX=        1.89  SMIN=      -0.12  TMAX=        1.01  ANGLE=  28.6

   92       1       -0.26       -0.41         -0.07         -0.26         -0.15
                                 0.00          0.00          0.00
    TOP :  SMAX=        0.06  SMIN=      -3.61  TMAX=        1.84  ANGLE= -28.9
    BOTT:  SMAX=        3.61  SMIN=      -0.06  TMAX=        1.84  ANGLE= -28.9

   93       1       -0.07        0.21         -0.05         -0.30         -0.18
                                 0.00          0.00          0.00
    TOP :  SMAX=        0.47  SMIN=      -4.22  TMAX=        2.34  ANGLE= -27.5
    BOTT:  SMAX=        4.22  SMIN=      -0.47  TMAX=        2.34  ANGLE= -27.5

   94       1       -0.11        0.62         -0.09         -0.37         -0.17
                                 0.00          0.00          0.00
    TOP :  SMAX=       -0.05  SMIN=      -4.80  TMAX=        2.37  ANGLE= -25.6
    BOTT:  SMAX=        4.80  SMIN=       0.05  TMAX=        2.37  ANGLE= -25.6

   95       1       -0.29        0.94         -0.06         -0.43         -0.14
                                 0.00          0.00          0.00
    TOP :  SMAX=       -0.09  SMIN=      -5.08  TMAX=        2.50  ANGLE= -18.5
    BOTT:  SMAX=        5.08  SMIN=       0.09  TMAX=        2.50  ANGLE= -18.5

   96       1       -0.41        0.93         -0.15         -0.61         -0.08
                                 0.00          0.00          0.00
    TOP :  SMAX=       -1.45  SMIN=      -6.64  TMAX=        2.59  ANGLE=  -9.9
    BOTT:  SMAX=        6.64  SMIN=       1.45  TMAX=        2.59  ANGLE=  -9.9

   97       1        0.20        0.04         -0.08         -0.87         -0.04
                                 0.00          0.00          0.00
    TOP :  SMAX=       -0.88  SMIN=      -9.29  TMAX=        4.20  ANGLE=  -2.8
    BOTT:  SMAX=        9.29  SMIN=       0.88  TMAX=        4.20  ANGLE=  -2.8

   98       1        0.00       -1.21         -0.08         -1.03          0.00
                                 0.00          0.00          0.00
    TOP :  SMAX=       -0.81  SMIN=     -11.03  TMAX=        5.11  ANGLE=   0.0
    BOTT:  SMAX=       11.03  SMIN=       0.81  TMAX=        5.11  ANGLE=   0.0

   99       1       -0.20        0.04         -0.08         -0.87          0.04
                                 0.00          0.00          0.00
    TOP :  SMAX=       -0.88  SMIN=      -9.29  TMAX=        4.20  ANGLE=   2.8
    BOTT:  SMAX=        9.29  SMIN=       0.88  TMAX=        4.20  ANGLE=   2.8

  100       1        0.41        0.93         -0.15         -0.61          0.08
                                 0.00          0.00          0.00
    TOP :  SMAX=       -1.45  SMIN=      -6.64  TMAX=        2.59  ANGLE=   9.9
    BOTT:  SMAX=        6.64  SMIN=       1.45  TMAX=        2.59  ANGLE=   9.9
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX           QY           MX           MY           MXY
                                   FX           FY           FXY


  101       1        0.29         0.94        -0.06        -0.43          0.14
                                  0.00         0.00         0.00
     TOP :   SMAX=      -0.09   SMIN=     -5.08   TMAX=      2.50   ANGLE=   18.5
     BOTT:   SMAX=       5.08   SMIN=      0.09   TMAX=      2.50   ANGLE=   18.5

  102       1        0.11         0.62        -0.09        -0.37          0.17
                                  0.00         0.00         0.00
     TOP :   SMAX=      -0.05   SMIN=     -4.80   TMAX=      2.37   ANGLE=   25.6
     BOTT:   SMAX=       4.80   SMIN=      0.05   TMAX=      2.37   ANGLE=   25.6

  103       1        0.07         0.21        -0.05        -0.30          0.18
                                  0.00         0.00         0.00
     TOP :   SMAX=       0.47   SMIN=     -4.22   TMAX=      2.34   ANGLE=   27.5
     BOTT:   SMAX=       4.22   SMIN=     -0.47   TMAX=      2.34   ANGLE=   27.5

  104       1        0.26        -0.41        -0.07        -0.26          0.15
                                  0.00         0.00         0.00
     TOP :   SMAX=       0.06   SMIN=     -3.61   TMAX=      1.84   ANGLE=   28.9
     BOTT:   SMAX=       3.61   SMIN=     -0.06   TMAX=      1.84   ANGLE=   28.9

  105       1       -0.31        -0.09        -0.10        -0.28         -0.13
                                  0.00         0.00         0.00
     TOP :   SMAX=      -0.30   SMIN=     -3.71   TMAX=      1.70   ANGLE=  -27.9
     BOTT:   SMAX=       3.71   SMIN=      0.30   TMAX=      1.70   ANGLE=  -27.9

  106       1        0.93         2.16         0.09         0.09         -0.08
                                  0.00         0.00         0.00
     TOP :   SMAX=       1.84   SMIN=      0.11   TMAX=      0.87   ANGLE=   90.0
     BOTT:   SMAX=      -0.11   SMIN=     -1.84   TMAX=      0.87   ANGLE=   90.0

  107       1        0.77         4.21         0.14         0.54         -0.08
                                  0.00         0.00         0.00
     TOP :   SMAX=       5.94   SMIN=      1.36   TMAX=      2.29   ANGLE=   10.9
     BOTT:   SMAX=      -1.36   SMIN=     -5.94   TMAX=      2.29   ANGLE=   10.9

  108       1        0.35         5.25         0.26         0.74         -0.07
                                  0.00         0.00         0.00
     TOP :   SMAX=       8.01   SMIN=      2.71   TMAX=      2.65   ANGLE=    8.1
     BOTT:   SMAX=      -2.71   SMIN=     -8.01   TMAX=      2.65   ANGLE=    8.1

  109       1       -0.02         6.27         0.20         0.74         -0.15
                                  0.00         0.00         0.00
     TOP :   SMAX=       8.33   SMIN=      1.73   TMAX=      3.30   ANGLE=   14.0
     BOTT:   SMAX=      -1.73   SMIN=     -8.33   TMAX=      3.30   ANGLE=   14.0

  110       1       -0.51         4.02         0.11        -0.30         -0.36
                                  0.00         0.00         0.00
     TOP :   SMAX=       3.39   SMIN=     -5.39   TMAX=      4.39   ANGLE=  -30.2
     BOTT:   SMAX=       5.39   SMIN=     -3.39   TMAX=      4.39   ANGLE=  -30.2
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX          QY          MX          MY          MXY
                                  FX          FY          FXY


  111        1       0.00        1.50       -0.02       -1.27        0.00
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.21  SMIN=    -13.57  TMAX=      6.68  ANGLE=    0.0
     BOTT:   SMAX=      13.57  SMIN=      0.21  TMAX=      6.68  ANGLE=    0.0

  112        1       0.51        4.02        0.11       -0.30        0.36
                                 0.00        0.00        0.00
     TOP :   SMAX=       3.39  SMIN=     -5.39  TMAX=      4.39  ANGLE=   30.2
     BOTT:   SMAX=       5.39  SMIN=     -3.39  TMAX=      4.39  ANGLE=   30.2

  113        1       0.02        6.27        0.20        0.74        0.15
                                 0.00        0.00        0.00
     TOP :   SMAX=       8.33  SMIN=      1.73  TMAX=      3.30  ANGLE=  -14.0
     BOTT:   SMAX=      -1.73  SMIN=     -8.33  TMAX=      3.30  ANGLE=  -14.0

  114        1      -0.35        5.25        0.26        0.74        0.07
                                 0.00        0.00        0.00
     TOP :   SMAX=       8.01  SMIN=      2.71  TMAX=      2.65  ANGLE=   -8.1
     BOTT:   SMAX=      -2.71  SMIN=     -8.01  TMAX=      2.65  ANGLE=   -8.1

  115        1      -0.77        4.21        0.14        0.54        0.08
                                 0.00        0.00        0.00
     TOP :   SMAX=       5.94  SMIN=      1.36  TMAX=      2.29  ANGLE=  -10.9
     BOTT:   SMAX=      -1.36  SMIN=     -5.94  TMAX=      2.29  ANGLE=  -10.9

  116        1      -0.93        2.16        0.09        0.09        0.08
                                 0.00        0.00        0.00
     TOP :   SMAX=       1.84  SMIN=      0.11  TMAX=      0.87  ANGLE=   90.0
     BOTT:   SMAX=      -0.11  SMIN=     -1.84  TMAX=      0.87  ANGLE=   90.0

  117        1       0.31       -0.09       -0.10       -0.28        0.13
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.30  SMIN=     -3.71  TMAX=      1.70  ANGLE=   27.9
     BOTT:   SMAX=       3.71  SMIN=      0.30  TMAX=      1.70  ANGLE=   27.9

  118        1      -0.35       -0.18       -0.11       -0.26       -0.16
                                 0.00        0.00        0.00
     TOP :   SMAX=      -0.06  SMIN=     -3.85  TMAX=      1.89  ANGLE=  -31.9
     BOTT:   SMAX=       3.85  SMIN=      0.06  TMAX=      1.89  ANGLE=  -31.9

  119        1       2.69        3.05        0.45        0.71        0.31
                                 0.00        0.00        0.00
     TOP :   SMAX=       9.79  SMIN=      2.56  TMAX=      3.61  ANGLE=  -33.6
     BOTT:   SMAX=      -2.56  SMIN=     -9.79  TMAX=      3.61  ANGLE=  -33.6

  120        1       3.80        5.90        0.51        1.99        0.38
                                 0.00        0.00        0.00
     TOP :   SMAX=      22.18  SMIN=      4.41  TMAX=      8.89  ANGLE=  -13.6
     BOTT:   SMAX=      -4.41  SMIN=    -22.18  TMAX=      8.89  ANGLE=  -13.6
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX          QY          MX          MY          MXY
                                  FX          FY          FXY


  121      1        2.54        7.18        0.64        2.42        0.34
                                0.00        0.00        0.00
     TOP :   SMAX=     26.42  SMIN=      6.14  TMAX=     10.14  ANGLE= -10.4
     BOTT:   SMAX=     -6.14  SMIN=    -26.42  TMAX=     10.14  ANGLE= -10.4

  122      1        2.76        9.63        0.76        3.08        0.28
                                0.00        0.00        0.00
     TOP :   SMAX=     33.23  SMIN=      7.75  TMAX=     12.74  ANGLE=  -6.7
     BOTT:   SMAX=     -7.75  SMIN=    -33.23  TMAX=     12.74  ANGLE=  -6.7

  123      1        0.63        5.67        0.17        0.96       -0.70
                                0.00        0.00        0.00
     TOP :   SMAX=     14.56  SMIN=     -2.51  TMAX=      8.53  ANGLE=  30.2
     BOTT:   SMAX=      2.51  SMIN=    -14.56  TMAX=      8.53  ANGLE=  30.2

  124      1        0.00        3.38        1.17       -1.20        0.00
                                0.00        0.00        0.00
     TOP :   SMAX=     12.45  SMIN=    -12.85  TMAX=     12.65  ANGLE=   0.0
     BOTT:   SMAX=     12.85  SMIN=    -12.45  TMAX=     12.65  ANGLE=   0.0

  125      1       -0.63        5.67        0.17        0.96        0.70
                                0.00        0.00        0.00
     TOP :   SMAX=     14.56  SMIN=     -2.51  TMAX=      8.53  ANGLE= -30.2
     BOTT:   SMAX=      2.51  SMIN=    -14.56  TMAX=      8.53  ANGLE= -30.2

  126      1       -2.76        9.63        0.76        3.08       -0.28
                                0.00        0.00        0.00
     TOP :   SMAX=     33.23  SMIN=      7.75  TMAX=     12.74  ANGLE=   6.7
     BOTT:   SMAX=     -7.75  SMIN=    -33.23  TMAX=     12.74  ANGLE=   6.7

  127      1       -2.54        7.18        0.64        2.42       -0.34
                                0.00        0.00        0.00
     TOP :   SMAX=     26.42  SMIN=      6.14  TMAX=     10.14  ANGLE=  10.4
     BOTT:   SMAX=     -6.14  SMIN=    -26.42  TMAX=     10.14  ANGLE=  10.4

  128      1       -3.80        5.90        0.51        1.99       -0.38
                                0.00        0.00        0.00
     TOP :   SMAX=     22.18  SMIN=      4.41  TMAX=      8.89  ANGLE=  13.6
     BOTT:   SMAX=     -4.41  SMIN=    -22.18  TMAX=      8.89  ANGLE=  13.6

  129      1       -2.69        3.05        0.45        0.71       -0.31
                                0.00        0.00        0.00
     TOP :   SMAX=      9.79  SMIN=      2.56  TMAX=      3.61  ANGLE=  33.6
     BOTT:   SMAX=     -2.56  SMIN=     -9.79  TMAX=      3.61  ANGLE=  33.6

  130      1        0.35       -0.18       -0.11       -0.26        0.16
                                0.00        0.00        0.00
     TOP :   SMAX=     -0.06  SMIN=     -3.85  TMAX=      1.89  ANGLE=  31.9
     BOTT:   SMAX=      3.85  SMIN=      0.06  TMAX=      1.89  ANGLE=  31.9
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD         QX           QY           MX           MY           MXY
                                   FX           FY           FXY


  131       1        0.28         0.12        -0.07         0.00        -0.09
                                  0.00         0.00         0.00
     TOP :   SMAX=       0.63  SMIN=     -1.34  TMAX=       0.98  ANGLE=  33.6
     BOTT:   SMAX=       1.34  SMIN=     -0.63  TMAX=       0.98  ANGLE=  33.6

  132       1        1.20         0.60         0.20        -0.13        -0.02
                                  0.00         0.00         0.00
     TOP :   SMAX=       2.17  SMIN=     -1.39  TMAX=       1.78  ANGLE=  -4.1
     BOTT:   SMAX=       1.39  SMIN=     -2.17  TMAX=       1.78  ANGLE=  -4.1

  133       1        3.72         3.58        -0.06        -0.57        -0.38
                                  0.00         0.00         0.00
     TOP :   SMAX=       1.60  SMIN=     -8.27  TMAX=       4.93  ANGLE= -28.1
     BOTT:   SMAX=       8.27  SMIN=     -1.60  TMAX=       4.93  ANGLE= -28.1

  134       1        2.29         3.67        -0.14        -0.58        -0.30
                                  0.00         0.00         0.00
     TOP :   SMAX=       0.09  SMIN=     -7.86  TMAX=       3.98  ANGLE= -26.9
     BOTT:   SMAX=       7.86  SMIN=     -0.09  TMAX=       3.98  ANGLE= -26.9

  135       1        2.96         4.54        -0.27        -0.85        -0.41
                                  0.00         0.00         0.00
     TOP :   SMAX=      -0.63  SMIN=    -11.31  TMAX=       5.34  ANGLE= -27.2
     BOTT:   SMAX=      11.31  SMIN=      0.63  TMAX=       5.34  ANGLE= -27.2

  136       1        6.11         3.60        -0.14        -0.53        -1.05
                                  0.00         0.00         0.00
     TOP :   SMAX=       7.84  SMIN=    -14.93  TMAX=      11.39  ANGLE= -39.7
     BOTT:   SMAX=      14.93  SMIN=     -7.84  TMAX=      11.39  ANGLE= -39.7

  137       1        0.00        -1.60         1.74         0.51         0.00
                                  0.00         0.00         0.00
     TOP :   SMAX=      18.55  SMIN=      5.47  TMAX=       6.54  ANGLE=   0.0
     BOTT:   SMAX=      -5.47  SMIN=    -18.55  TMAX=       6.54  ANGLE=   0.0

  138       1       -6.11         3.60        -0.14        -0.53         1.05
                                  0.00         0.00         0.00
     TOP :   SMAX=       7.84  SMIN=    -14.93  TMAX=      11.39  ANGLE=  39.7
     BOTT:   SMAX=      14.93  SMIN=     -7.84  TMAX=      11.39  ANGLE=  39.7

  139       1       -2.96         4.54        -0.27        -0.85         0.41
                                  0.00         0.00         0.00
     TOP :   SMAX=      -0.63  SMIN=    -11.31  TMAX=       5.34  ANGLE=  27.2
     BOTT:   SMAX=      11.31  SMIN=      0.63  TMAX=       5.34  ANGLE=  27.2

  140       1       -2.29         3.67        -0.14        -0.58         0.30
                                  0.00         0.00         0.00
     TOP :   SMAX=       0.09  SMIN=     -7.86  TMAX=       3.98  ANGLE=  26.9
     BOTT:   SMAX=       7.86  SMIN=     -0.09  TMAX=       3.98  ANGLE=  26.9
```

```
ELEMENT FORCES     FORCE,LENGTH UNITS= KIP   IN
--------------
FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT   LOAD          QX          QY           MX           MY            MXY
                                    FX           FY           FXY


  141       1         -3.72        3.58        -0.06        -0.57          0.38
                                   0.00         0.00         0.00
     TOP :   SMAX=       1.60  SMIN=     -8.27  TMAX=       4.93  ANGLE=  28.1
     BOTT:   SMAX=       8.27  SMIN=     -1.60  TMAX=       4.93  ANGLE=  28.1

  142       1         -1.20        0.60         0.20        -0.13          0.02
                                   0.00         0.00         0.00
     TOP :   SMAX=       2.17  SMIN=     -1.39  TMAX=       1.78  ANGLE=   4.1
     BOTT:   SMAX=       1.39  SMIN=     -2.17  TMAX=       1.78  ANGLE=   4.1

  143       1         -0.28        0.12        -0.07         0.00          0.09
                                   0.00         0.00         0.00
     TOP :   SMAX=       0.63  SMIN=     -1.34  TMAX=       0.98  ANGLE= -33.6
     BOTT:   SMAX=       1.34  SMIN=     -0.63  TMAX=       0.98  ANGLE= -33.6

 ********************END OF ELEMENT FORCES********************

  78. PRINT DISPLACEMENTS
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = SPACE
-----------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

   1    1    0.00000    0.00000    0.00011   -0.00017   -0.00028    0.00000
   2    1    0.00000    0.00000    0.00054   -0.00033   -0.00038    0.00000
   3    1    0.00000    0.00000    0.00104   -0.00018   -0.00038    0.00000
   4    1    0.00000    0.00000    0.00144   -0.00026   -0.00023    0.00000
   5    1    0.00000    0.00000    0.00172   -0.00022   -0.00019    0.00000
   6    1    0.00000    0.00000    0.00210   -0.00041   -0.00029    0.00000
   7    1    0.00000    0.00000    0.00295   -0.00185   -0.00015    0.00000
   8    1    0.00000    0.00000    0.00295   -0.00185    0.00015    0.00000
   9    1    0.00000    0.00000    0.00210   -0.00041    0.00029    0.00000
  10    1    0.00000    0.00000    0.00172   -0.00022    0.00019    0.00000
  11    1    0.00000    0.00000    0.00144   -0.00026    0.00023    0.00000
  12    1    0.00000    0.00000    0.00104   -0.00018    0.00038    0.00000
  13    1    0.00000    0.00000    0.00054   -0.00033    0.00038    0.00000
  14    1    0.00000    0.00000    0.00011   -0.00017    0.00028    0.00000
  15    1    0.00000    0.00000    0.00004   -0.00014   -0.00030    0.00000
  16    1    0.00000    0.00000    0.00038   -0.00037   -0.00039    0.00000
  17    1    0.00000    0.00000    0.00088    0.00000    0.00000    0.00000
  18    1    0.00000    0.00000    0.00124    0.00000    0.00000    0.00000
  19    1    0.00000    0.00000    0.00151    0.00000    0.00000    0.00000
  20    1    0.00000    0.00000    0.00178    0.00000    0.00000    0.00000
  21    1    0.00000    0.00000    0.00214   -0.00181   -0.00016    0.00000
  22    1    0.00000    0.00000    0.00214   -0.00181    0.00016    0.00000
  23    1    0.00000    0.00000    0.00178    0.00000    0.00000    0.00000
  24    1    0.00000    0.00000    0.00151    0.00000    0.00000    0.00000
  25    1    0.00000    0.00000    0.00124    0.00000    0.00000    0.00000
  26    1    0.00000    0.00000    0.00088    0.00000    0.00000    0.00000
  27    1    0.00000    0.00000    0.00038   -0.00037    0.00039    0.00000
  28    1    0.00000    0.00000    0.00004   -0.00014    0.00030    0.00000
  29    1    0.00000    0.00000   -0.00005   -0.00010   -0.00020    0.00000
  30    1    0.00000    0.00000    0.00019   -0.00024   -0.00026    0.00000
  31    1    0.00000    0.00000    0.00048   -0.00048   -0.00028    0.00000
  32    1    0.00000    0.00000    0.00066   -0.00063   -0.00026    0.00000
  33    1    0.00000    0.00000    0.00084   -0.00077   -0.00018    0.00000
  34    1    0.00000    0.00000    0.00093   -0.00089   -0.00014    0.00000
  35    1    0.00000    0.00000    0.00104   -0.00102   -0.00001    0.00000
  36    1    0.00000    0.00000    0.00104   -0.00102    0.00001    0.00000
  37    1    0.00000    0.00000    0.00093   -0.00089    0.00014    0.00000
  38    1    0.00000    0.00000    0.00084   -0.00077    0.00018    0.00000
  39    1    0.00000    0.00000    0.00066   -0.00063    0.00026    0.00000
  40    1    0.00000    0.00000    0.00048   -0.00048    0.00028    0.00000
  41    1    0.00000    0.00000    0.00019   -0.00024    0.00026    0.00000
  42    1    0.00000    0.00000   -0.00005   -0.00010    0.00020    0.00000
  43    1    0.00000    0.00000   -0.00006   -0.00002   -0.00008    0.00000
  44    1    0.00000    0.00000    0.00002   -0.00011   -0.00009    0.00000
  45    1    0.00000    0.00000    0.00009   -0.00027   -0.00007    0.00000
  46    1    0.00000    0.00000    0.00014   -0.00038   -0.00007    0.00000
  47    1    0.00000    0.00000    0.00020   -0.00044   -0.00007    0.00000
  48    1    0.00000    0.00000    0.00030   -0.00045   -0.00015    0.00000
```

```
JOINT DISPLACEMENT (INCH RADIANS)     STRUCTURE TYPE = SPACE
------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

  49     1    0.00000    0.00000    0.00050    0.00000    0.00000    0.00000
  50     1    0.00000    0.00000    0.00050    0.00000    0.00000    0.00000
  51     1    0.00000    0.00000    0.00030   -0.00045    0.00015    0.00000
  52     1    0.00000    0.00000    0.00020   -0.00044    0.00007    0.00000
  53     1    0.00000    0.00000    0.00014   -0.00038    0.00007    0.00000
  54     1    0.00000    0.00000    0.00009   -0.00027    0.00007    0.00000
  55     1    0.00000    0.00000    0.00002   -0.00011    0.00009    0.00000
  56     1    0.00000    0.00000   -0.00006   -0.00002    0.00008    0.00000
  57     1    0.00000    0.00000   -0.00004    0.00000   -0.00001    0.00000
  58     1    0.00000    0.00000   -0.00003   -0.00003   -0.00001    0.00000
  59     1    0.00000    0.00000   -0.00004   -0.00008    0.00000    0.00000
  60     1    0.00000    0.00000   -0.00004   -0.00011    0.00000    0.00000
  61     1    0.00000    0.00000   -0.00002   -0.00012   -0.00008    0.00000
  62     1    0.00000    0.00000    0.00014   -0.00010   -0.00023    0.00000
  63     1    0.00000    0.00000    0.00040    0.00000    0.00000    0.00000
  64     1    0.00000    0.00000    0.00040    0.00000    0.00000    0.00000
  65     1    0.00000    0.00000    0.00014   -0.00010    0.00023    0.00000
  66     1    0.00000    0.00000   -0.00002   -0.00012    0.00008    0.00000
  67     1    0.00000    0.00000   -0.00004   -0.00011    0.00000    0.00000
  68     1    0.00000    0.00000   -0.00004   -0.00008    0.00000    0.00000
  69     1    0.00000    0.00000   -0.00003   -0.00003    0.00001    0.00000
  70     1    0.00000    0.00000   -0.00004    0.00000    0.00001    0.00000
  71     1    0.00000    0.00000   -0.00004   -0.00001    0.00001    0.00000
  72     1    0.00000    0.00000   -0.00005   -0.00001    0.00001    0.00000
  73     1    0.00000    0.00000   -0.00006    0.00000    0.00002    0.00000
  74     1    0.00000    0.00000   -0.00008    0.00000    0.00001    0.00000
  75     1    0.00000    0.00000   -0.00006   -0.00001   -0.00008    0.00000
  76     1    0.00000    0.00000    0.00010   -0.00002   -0.00024    0.00000
  77     1    0.00000    0.00000    0.00036    0.00000    0.00000    0.00000
  78     1    0.00000    0.00000    0.00036    0.00000    0.00000    0.00000
  79     1    0.00000    0.00000    0.00010   -0.00002    0.00024    0.00000
  80     1    0.00000    0.00000   -0.00006   -0.00001    0.00008    0.00000
  81     1    0.00000    0.00000   -0.00008    0.00000   -0.00001    0.00000
  82     1    0.00000    0.00000   -0.00006    0.00000   -0.00002    0.00000
  83     1    0.00000    0.00000   -0.00005   -0.00001   -0.00001    0.00000
  84     1    0.00000    0.00000   -0.00004   -0.00001   -0.00001    0.00000
  85     1    0.00000    0.00000   -0.00007   -0.00001   -0.00002    0.00000
  86     1    0.00000    0.00000   -0.00004    0.00004   -0.00002    0.00000
  87     1    0.00000    0.00000   -0.00004    0.00011    0.00000    0.00000
  88     1    0.00000    0.00000   -0.00004    0.00015   -0.00001    0.00000
  89     1    0.00000    0.00000   -0.00002    0.00017   -0.00007    0.00000
  90     1    0.00000    0.00000    0.00011    0.00015   -0.00020    0.00000
  91     1    0.00000    0.00000    0.00034    0.00000    0.00000    0.00000
  92     1    0.00000    0.00000    0.00034    0.00000    0.00000    0.00000
  93     1    0.00000    0.00000    0.00011    0.00015    0.00020    0.00000
  94     1    0.00000    0.00000   -0.00002    0.00017    0.00007    0.00000
  95     1    0.00000    0.00000   -0.00004    0.00015    0.00001    0.00000
  96     1    0.00000    0.00000   -0.00004    0.00011    0.00000    0.00000
```

JOINT DISPLACEMENT (INCH RADIANS)   STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
97	1	0.00000	0.00000	-0.00004	0.00004	0.00002	0.00000
98	1	0.00000	0.00000	-0.00007	-0.00001	0.00002	0.00000
99	1	0.00000	0.00000	-0.00009	0.00007	-0.00013	0.00000
100	1	0.00000	0.00000	0.00004	0.00019	-0.00013	0.00000
101	1	0.00000	0.00000	0.00015	0.00040	-0.00011	0.00000
102	1	0.00000	0.00000	0.00022	0.00054	-0.00010	0.00000
103	1	0.00000	0.00000	0.00030	0.00066	-0.00009	0.00000
104	1	0.00000	0.00000	0.00039	0.00067	-0.00014	0.00000
105	1	0.00000	0.00000	0.00059	0.00062	-0.00006	0.00000
106	1	0.00000	0.00000	0.00059	0.00062	0.00006	0.00000
107	1	0.00000	0.00000	0.00039	0.00067	0.00014	0.00000
108	1	0.00000	0.00000	0.00030	0.00066	0.00009	0.00000
109	1	0.00000	0.00000	0.00022	0.00054	0.00010	0.00000
110	1	0.00000	0.00000	0.00015	0.00040	0.00011	0.00000
111	1	0.00000	0.00000	0.00004	0.00019	0.00013	0.00000
112	1	0.00000	0.00000	-0.00009	0.00007	0.00013	0.00000
113	1	0.00000	0.00000	-0.00002	0.00027	-0.00033	0.00000
114	1	0.00000	0.00000	0.00032	0.00043	-0.00036	0.00000
115	1	0.00000	0.00000	0.00072	0.00070	-0.00032	0.00000
116	1	0.00000	0.00000	0.00098	0.00088	-0.00032	0.00000
117	1	0.00000	0.00000	0.00123	0.00109	-0.00023	0.00000
118	1	0.00000	0.00000	0.00140	0.00129	-0.00018	0.00000
119	1	0.00000	0.00000	0.00151	0.00156	0.00001	0.00000
120	1	0.00000	0.00000	0.00151	0.00156	-0.00001	0.00000
121	1	0.00000	0.00000	0.00140	0.00129	0.00018	0.00000
122	1	0.00000	0.00000	0.00123	0.00109	0.00023	0.00000
123	1	0.00000	0.00000	0.00098	0.00088	0.00032	0.00000
124	1	0.00000	0.00000	0.00072	0.00070	0.00032	0.00000
125	1	0.00000	0.00000	0.00032	0.00043	0.00036	0.00000
126	1	0.00000	0.00000	-0.00002	0.00027	0.00033	0.00000
127	1	0.00000	0.00000	0.00010	0.00036	-0.00040	0.00000
128	1	0.00000	0.00000	0.00055	0.00056	-0.00044	0.00000
129	1	0.00000	0.00000	0.00114	0.00051	-0.00033	0.00000
130	1	0.00000	0.00000	0.00151	0.00064	-0.00031	0.00000
131	1	0.00000	0.00000	0.00188	0.00076	-0.00025	0.00000
132	1	0.00000	0.00000	0.00219	0.00103	-0.00027	0.00000
133	1	0.00000	0.00000	0.00236	0.00210	-0.00010	0.00000
134	1	0.00000	0.00000	0.00236	0.00210	0.00010	0.00000
135	1	0.00000	0.00000	0.00219	0.00103	0.00027	0.00000
136	1	0.00000	0.00000	0.00188	0.00076	0.00025	0.00000
137	1	0.00000	0.00000	0.00151	0.00064	0.00031	0.00000
138	1	0.00000	0.00000	0.00114	0.00051	0.00033	0.00000
139	1	0.00000	0.00000	0.00055	0.00056	0.00044	0.00000
140	1	0.00000	0.00000	0.00010	0.00036	0.00040	0.00000
141	1	0.00000	0.00000	0.00024	0.00036	-0.00044	0.00000
142	1	0.00000	0.00000	0.00072	0.00070	-0.00049	0.00000
143	1	0.00000	0.00000	0.00135	0.00000	0.00000	0.00000
144	1	0.00000	0.00000	0.00182	0.00000	0.00000	0.00000

```
JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN

  145    1    0.00000    0.00000    0.00222    0.00000    0.00000    0.00000
  146    1    0.00000    0.00000    0.00269    0.00000    0.00000    0.00000
  147    1    0.00000    0.00000    0.00317    0.00256   -0.00032    0.00000
  148    1    0.00000    0.00000    0.00317    0.00256    0.00032    0.00000
  149    1    0.00000    0.00000    0.00269    0.00000    0.00000    0.00000
  150    1    0.00000    0.00000    0.00222    0.00000    0.00000    0.00000
  151    1    0.00000    0.00000    0.00182    0.00000    0.00000    0.00000
  152    1    0.00000    0.00000    0.00135    0.00000    0.00000    0.00000
  153    1    0.00000    0.00000    0.00072    0.00070    0.00049    0.00000
  154    1    0.00000    0.00000    0.00024    0.00036    0.00044    0.00000
  155    1    0.00000    0.00000    0.00042    0.00041   -0.00039    0.00000
  156    1    0.00000    0.00000    0.00102    0.00063   -0.00050    0.00000
  157    1    0.00000    0.00000    0.00154    0.00022   -0.00047    0.00000
  158    1    0.00000    0.00000    0.00201    0.00025   -0.00033    0.00000
  159    1    0.00000    0.00000    0.00243    0.00021   -0.00033    0.00000
  160    1    0.00000    0.00000    0.00302    0.00045   -0.00044    0.00000
  161    1    0.00000    0.00000    0.00423    0.00253   -0.00014    0.00000
  162    1    0.00000    0.00000    0.00423    0.00253    0.00014    0.00000
  163    1    0.00000    0.00000    0.00302    0.00045    0.00044    0.00000
  164    1    0.00000    0.00000    0.00243    0.00021    0.00033    0.00000
  165    1    0.00000    0.00000    0.00201    0.00025    0.00033    0.00000
  166    1    0.00000    0.00000    0.00154    0.00022    0.00047    0.00000
  167    1    0.00000    0.00000    0.00102    0.00063    0.00050    0.00000
  168    1    0.00000    0.00000    0.00042    0.00041    0.00039    0.00000

 ************** END OF LATEST ANALYSIS RESULT **************

  79. PLOT STRESS FILE
  80. PLOT DISPLACEMENT FILE
  81. PLOT SECTION FILE
  82. FINISH

    *************** END OF STAAD-III ***************

 DATE= JUN 21,1996   TIME= 15: 5:33 ******

    ********************************************************
    *       For questions on STAAD-III/ISDS, contact:      *
    *       RESEARCH ENGINEERS, Inc at (714) 974-2500      *
    *       Telex:  4994385     Fax:  (714) 974-4771       *
    ********************************************************
```