

PACKAGE ID - 000332I303300 QMESH,RENUM,QPLOT

KWIC TITLE - Self-Organizing Mesh Generation

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LIMITATION CODE -UNL **AUDIENCE CODE** - UNL

COMPLETION DATE - 11/01/1991 **PUBLICATION DATE** - 11/01/1991

DESCRIPTION - A set of five programs which make up a self organizing mesh generation package. QMESH generates meshes having quadrilateral elements on arbitrarily shaped two-dimensional (planar or axisymmetric) bodies. It is designed for use with two-dimensional finite element analysis applications. A flexible hierarchical input scheme is used to describe bodies to QMESH as collections of regions. A mesh for each region is developed independently, with the final assembly and bandwidth minimization performed by the independent program, RENUM or RENUM8. RENUM is applied when four-node elements are desired. Eight node elements (with mid side nodes) may be obtained with RENUM8. QPLOT and QPLOT8 are plot programs for meshes generated by the QMESH/RENUM and QMESH/RENUM8 program pairs respectively. QPLOT and QPLOT8 automatically section the mesh into appropriately-sized sections for legible display of node and element numbers, An overall plot showing the position of the selected plot areas is produced.

PACKAGE CONTENTS - NESC Note; Software Abstract; SLA-73-1088;
SLA-74-0239;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 1 CD Rom

METHOD OF SOLUTION - The mesh generating process for each individual region begins with the installation of an initial mesh which is a transformation of a regular grid on the unit square. The dimensions and orientation of the initial mesh may be defined by the user or, optionally, may be chosen by QMESH. Various smoothing algorithms may be applied to the initial mesh. Then, the mesh may be restructured using an iterative scheme involving element pair restructuring, acute element deletion, and smoothing. In element pair restructuring, the interface side between two elements is removed and replaced between two different nodes belonging to the pair of elements, provided that the change produces an overall improvement in the shapes of the two elements. In acute element deletion, an element having one diagonal much shorter than the other is deleted by collapsing the short diagonal to zero length. The exact order in which restructuring, element deletion, and smoothing are performed may be controlled by use of scheme input card. The scheme input provision also allows the user to control plotting and printing. The resulting mesh descriptions for

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METHOD OF SOLUTION - (CONT) individual regions are melded into an integrated mesh by the companion program, RENUM, which also performs bandwidth minimization using a modified Cuthill-McKee algorithm. RENUM8 performs essentially the same process as RENUM, then interpolates (linearly or by circular fit) to find mid-side node positions, and relabels the entire mesh to maintain near-minimal bandwidth. QPLOT and QPLOT8 automatically plot meshes processed by RENUM and RENUM8, respectively. Appropriate sections of the mesh for plotting are selected by an iterative technique which determines the size and position of each section, so as to include the smallest as yet unlabelled element in each successive section.

COMPUTER - IBM3033

OPERATING SYSTEMS - MVS

PROGRAMMING LANGUAGES - FORTRAN IV (98%) and BAL (2%)

SOFTWARE LIMITATIONS - QMESH maxima of 1000 nodes, 400 lines, 100 sides, and 70 regions. RENUM maxima of 15,000 nodes and 10,000 elements. QPLOT maxima of 5,000 nodes and 4,800 elements. RENUM8 maxima of 10,000 output nodes, 5,000 input nodes and 4,800 elements. Non-straight lines should have at least two intervals, as mid-side node placement is always done linearly⁶ for lines with only one interval. Corner lines should not be used, as circular interpolation on region boundaries could produce unreasonable results near the actual corner. QPLOT8 maxima of 5,000 nodes and 4,800 elements.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - The hierarchal input system used in QMESH is quite natural and allows inclusion of such structures as cracks and sliding interfaces.

RELATED SOFTWARE - QMESH is a stand-alone mesh generation program intended for use with a variety of two-dimensional finite element analysis programs.

OTHER PROG/OPER SYS INFO - The mesh plotted by QMESH does not include any mid-side nodes, and RENUM8 input cannot refer to any mid-side nodes. Mid-side nodes appear only in QPLOT8 plots. The IBM3033 version produces graphical output using the proprietary CalComp subroutines PLOT, PLOTS, NUMBER, and SYMBOL. Subroutines DATE, CLOCK, and ITIMER are written in Basic Assembler Language and return the current date, current wall clock time, and elapsed CPU time, respectively.

HARDWARE REQS - 360 Kbytes (QMESH), 800 Kbytes (RENUM), 400 Kbytes (QPLOT), 430 Kbytes (RENUM8) and 400 Kbytes (QPLOT8).

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HARDWARE REQS - (CONT)

TIME REQUIREMENTS - Meshes of up to several hundred elements which do not require restructuring are handled by QMESH in a few seconds. Large meshes involving much restructuring and smoothing may require several minutes of execution time. RENUM and RENUM8 require a few seconds at most. QPLOT and QPLOT8 usually run in a fraction of the time required by QMESH on a nontrivial problem.

REFERENCES - R.E. Jones, QMESH: A Self-organizing Mesh Generation Program, SLA-73-1088, July 1974; R.E. Jones, User's Manual for QMESH, A Self Organizing Mesh Generation Program, SLA-74-0239, July 1974; QMESH,RENUM,QPLOT, NESC No. 612.3033, QMESH,RENUM,QPLOT IBM Version Tape Description and Sample Problem Output, National Energy Software Center Note 92-29, November 15, 1991.

ABSTRACT STATUS - Abstract first distributed December 1974. IBM360 version submitted November 1977, replaced November 1991 by revised IBM3033 derived November 1984, Sample problem executed by NESC December 1984 on an IBM3033.

SUBJECT CLASS CODE - N

KEYWORDS -

COMPUTER PROGRAM DOCUMENTATION
Q CODES
MESH GENERATION
TWO-DIMENSIONAL CALCULATIONS
FINITE ELEMENT METHOD
INTERPOLATION

EDB SUBJECT CATEGORIES -
990200

SPONSOR - DOE/DP

PACKAGE TYPE - SCREENED