

CRWMS/M&O

Non-Q Design Analysis Cover Sheet

Complete only applicable items.

1.

QA: N/A

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|---|---|---|---------------------|
| 2. DESIGN ANALYSIS TITLE NORTH PORTAL - DOMESTIC COLD WATER CALCULATION - SHOP BUILDING #5006 (SCP B:N/A) | | | |
| 3. DOCUMENT IDENTIFIER (Including Rev. No.) BABBAD000-01717-0200-00142 REV 01 | | 4. REV. NO. 01 | 5. TOTAL PAGES 5 |
| 6. TOTAL ATTACHMENTS 1 | 7. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH I-1 | 8. SYSTEM ELEMENT MGDS | |
| 9. Originator R. Blackstone | Print Name R. Blackstone | Signature <i>R. E. Flye</i> FOR R. BLACKSTONE | Date 1-24-96 |
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| 13. Remarks | | | |

Design Analysis Revision Record

Complete only applicable items.

1.

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2. DESIGN ANALYSIS TITLE

NORTH PORTAL - DOMESTIC COLD WATER CALCULATION- SHOP BUILDING #5006

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABBAD000-01717-0200-00142 REV 01

| 4. Revision No. | 5. Description of Revision |
|-----------------|--|
| 00 | Initial Issue |
| 01 | Reformatted to NAP-MG-013, Rev. 0 Revised Title Removed TBV-122 Changed QA Classification to QA: N/A Editorial changes |

1. PURPOSE

The purpose of this design analysis and calculation is to determine the demand for domestic cold water and to size the supply main for the Shop Building #5006 in accordance with the Uniform Plumbing Code (UPC) (Section 4.4.1) and the U.S. Department of Energy, Order 6430.1A-1540 (Section 4.4.2).

2. QUALITY ASSURANCE

This Analysis is non-Q because it is for a temporary item. The Determination of Importance Evaluation (Reference 5.1) of the shop building has determined that no quality assurance (QA) controls are applicable within the context of this analysis.

3. METHOD

The method used for the calculation is based on the UPC (Section 4.4.1). The first step is to determine the maximum pressure drop between the most remote cold water plumbing fixture and the main distribution supply. This is the difference between the supply pressure and the pressure which must be maintained at the plumbing fixture including the loss in static pressure due to changes in elevation. The developed length of pipe from the supply to the fixture is then determined from the plumbing drawings (Reference 5.5). The maximum pressure drop is then divided by the developed length which results in the friction loss per 100 feet of pipe when multiplied by 100. Equivalent fixture units are assigned from the UPC based on the actual fixture count which when totalled determines the water flow rate. The water flow rate and pressure drop are used to determine the pipe size based on a given velocity of flow.

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

Water supply main pressure = 60 psi (Reference 5.2)

Pressure at most remote fixture = 15 psi (Reference 5.3)

Velocity of flow = 5 feet/second (Reference 5.4)

Elevation of highest fixture above supply main = 12 feet (Reference 5.5)

Developed Length of pipe = 75 feet (Reference 5.5)

Number of fixture units = 139 (Attachment I)

4.2 CRITERIA

The plumbing design for the shop building will be designed in accordance with DOE Order 6430.1A (Section 4.4.2) and appropriate state and local codes (ESFDR Sections 3.2.1.Q, 3.2.1R, and 3.2.1S, Reference 5.6).

4.3 ASSUMPTIONS

Not used.

4.4 CODES AND STANDARDS

4.4.1 International Association of Plumbing and Mechanical Officials:

UPC 1991 Uniform Plumbing Code

4.4.2 U.S. Department of Energy (DOE):

DOE Order 6430.1A - 89 General Design Criteria

5. REFERENCES

- 5.1 Determination of Importance Evaluation for Exploratory Studies Facility Change House Facility and Shop Building, BABBAX000-01717-2200-00007 Rev 00
- 5.2 Water Supply Analysis B00000000-01717-0200-00074 Rev 01
- 5.3 Exploratory Studies Facility Basis for Design BAB000000-01717-6300-00002 Rev 05
- 5.4 Crane Technical Paper No. 410, "Flow of Fluids," Crane Co., 1988
- 5.5 Plumbing Drawings
 - 5.5.1 BABBAD000-01717-2100-27400-00 Shop-Building 5006 Plumbing and Piping First Floor Plan
 - 5.5.2 BABBAD000-01717-2100-27401-00 Shop-Building 5006 Plumbing and Piping Second Floor Plan
 - 5.5.3 BABBAD000-01717-2100-27402-00 Shop-Building 5006 Plumbing Isometrics and Details
- 5.6 Yucca Mountain Site Characterization Project Exploratory Studies Facility Design Requirements, YMP/CM-0019, Rev. 1, ICN 3.

6. USE OF COMPUTER SOFTWARE

Not used.

7. DESIGN ANALYSIS

The allowable pressure drop based on the design parameters in Section 4.1 is:

$$60 \text{ psi} - [15 \text{ psi} + (12 \text{ feet} \times .433 \text{ psi/feet})] = 39.80 \text{ psi}$$

The pressure available for friction loss per 100 feet of pipe and zero flow is:

$$39.80/75 \times 100 = 53.07 \text{ psi/100 feet}$$

The required quantity of cold water to be supplied is represented by the number of fixture units assigned by the UPC (Section 4.4.1). For the Shop Building, 139 fixture units are identified as shown in Attachment I. The demand load from UPC for 139 fixture units is 78 gallons per minute (gpm). The size of the building supply pipe is found to be 1-1/4 inches based on the available pressure drop per 100 feet of pipe and the total demand. However, the velocity of flow is 22 feet/second which exceeds the design parameter of 5 feet/second. Resizing the system based on the total demand and the velocity of flow results in a pipe size of approximately 3 inches.

8. CONCLUSIONS

Based on the total demand of 78 gpm and a velocity of flow equal to 5 feet/second a 3-inch building supply main is required.

9. ATTACHMENTS

| ATTACHMENT | TITLE |
|------------|--------------|
| I | Calculations |

CALCULATIONS

| DOMESTIC COLD WATER | | | | |
|-----------------------|--------------------|-----------------------------|---------------------------|---------|
| Fixture | No. Req'd A* | Units per Fixture B** | Fixture Units A X B | Remarks |
| Water Closet | 6 | 10 | 60 | |
| Urinal | 2 | 5 | 10 | |
| Lavatory | 5 | 2 | 10 | |
| Wash Fountain | | | | |
| Shower | | | | |
| Service Sink | 4 | 4 | 16 | |
| Mop Sink | 1 | 4 | 4 | |
| Lab Sink | | | | |
| Cup Sink | | | | |
| Kitchen Sink | 1 | 4 | 4 | |
| Electric Water Cooler | | | | |
| Hose Bibb | 7 | 5 | 35 | |
| Total Fixture Units | | 139 = 78 gpm*** | | |

* Number of Fixture Units required are obtained from References 5.5.1, 5.5.2, and 5.5.3.

** Units per Fixture values are obtained from Table 10-1 of UPC (Section 4.4.1).

*** Total GPM was taken from Chart A-2 of Appendix A of UPC (Section 4.4.1). See Section 7 for line size selection.