S.P. 336 PDR

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Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND PROJECT
INFORMATION REQUEST - SEISMIC CATEGORY I MASONRY WALLS
FILE: B3.8 UFI: 42*05 SERIAL: 9406

In response to the NRC information request on Category I Masonry Walls as transmitted by your cor .spondence of April 21, 1980, we are forwarding the attached information.

Included in our response are 41 drawings as listed showing the location of all masonry walls for Seismic Category I structures.

Please advise should you have any questions concerning this submittal.

James W. Cook

JWC/RLT/cr

CC JWCook
GSKeeley
RCBauman/TRThiruvengadam
DBMiller
TJSullivan/DMBudzik
RLTeuteberg

B001
S
1/1

SEND DRAWINGS to:
TERA (RETURN TO REG FILES after filming)

8009090347

MIDLAND PLANT UNITS 1 AND 2

JOB 7220

RESPONSE TO REQUEST FOR INFORMATION ON THE USE

OF SEISMIC CATEGORY I MASONRY WALLS

Question 1

Are there any concrete masonry walls being used in any of the Category I structures of your plant? If the answer is "No" to this question there is no need to answer the following questions.

Response

Yes, concrete masonry walls are being used in Seismic Category I structures of the Midland plant.

Question 2

Indicate the loads and load combinations to which the walls were designed to resist. If load factors other than one have been employed, please indicate their magnitudes.

Response

The Seismic Category I masonry walls were designed to resist the loads and load combinations specified for reinforced concrete in FSAR Subsection 3.8.6. The governing load combinations for the design of masonry walls are as follows:

A) $U = 1.0\ D + 1.0\ L + 1.0\ E' + 1.0\ T_o + 1.25\ Ho + 1.0\ R$

B) $U = 1.0\ D + 1.0\ L + 1.0\ T_o + 1.25\ H_o + 1.0\ W'$

where

D = dead loads

L = live loads including piping and cable

E' = safe shutdown earthquake (SSE) loads

T_o = thermal effects during normal operating conditions (these loads are small and self-limiting on these walls and are assumed to be zero)

H_o = force on the structure due to thermal expansion of pipes under operating conditions

W' = tornado wind loads, including differential pressure

R = local forces or pressure caused by the rupture of any one pipe

No pipe rupture restraints are supported by masonry walls.

Question 3

In addition to complying with the applicable requirements of the SRP sections 3.5, 3.7 and 3.8, is there any other code, such as the "Uniform Building Code" or the "Building Code Requirements for Concrete Masonry Structures" (proposed by the American Concrete Institute) which was or is being used to guide the design of these walls? Please identify and discuss any exceptions or deviations from the SRP requirements of the aformentioned codes.

Response

The Seismic Category I masonry walls were designed using the ultimate strength design methods provided in ACI 318-71. The acceptance criteria are consistent with Subsection 3.8.4 of the Midland FSAR, which, as noted in the responses to the NRC questions (Q/R 130.15), does deviate from portions of the SRP. However, the walls are now being reevaluated by the working stress method to satisfy the applicable clauses of Building Code Requirements for Concrete Masonry Structures (ACI 531-79) with stress increase factors for abnormal and severe environmental loads. All load factors are taken to be equal to unity.

Question 4

Indicate the method that you used to calculate the dynamic forces in masonry walls due to earthquake, i.e., whether it is a code's method such as Uniform Building Code, or a dynamic analysis. Identify the code and its effective date if the code's method has been used. Indicate the input motion if a dynamic analysis has been performed.

Response

In accordance with FSAR Subsection 3.7.3.1.1, the response spectrum method was used to develop the dynamic forces due to the earthquake appropriate for the masonry wall design. The response spectra for the buildings were developed in accordance with the methods and criteria described in FSAR Section 3.7.

The walls were analyzed as basic beam elements appropriately restrained, e.g., cantilever, simply supported, or other relevant configurations. The load caused by the component of an earthquake in the out-of-plane deformation was approximated as a uniformly distributed load corresponding to the maximum seismic acceleration. Because of the simplicity of the walls, only the primary frequency of the wall was considered. For the frequency calculation, an average moment of inertia for cracked and uncracked wall sections was considered. The dynamic forces were established from a floor response spectrum applicable to the specific floor where the masonry walls were located.

The masonry walls were designed using ultimate strength design methods. It had been determined that the SSE load combinations governed and the response spectra values were based on a damping value of 5%, consistent with FSAR Appendix 3.A, Response to Regulatory Guide 1.61 for Concrete Structures.

In the present reevaluation, operating basis earthquake (OBE) and SSE loadings are considered. The damping values used to establish the earthquake forces are as follows:

Element	OBE (%)	SSE (%)
Uncracked masonry walls	2	2
Cracked masonry walls	4	7

Seismic loading is computed for a partially cracked section corresponding to the acceleration of the response spectrum with a frequency of f_e and the applicable damping value, where f_e is the computed frequency of a partially cracked section. The frequency f_e of the wall corresponds to an effective moment of inertia, I_e, given by

$$I_e = \left[\frac{M_{cr}}{M_a}\right]^3 I_g + \left[1 + \left(\frac{M_{cr}}{M_a}\right)^3\right] I_{cr}$$

where

I_g = Uncracked moment of inertia of wall section (in^4)

I_{cr} = Cracked moment of inertia of wall section (in^4)

M_{cr} = Cracking moment (in-lb) = $\frac{bt^2}{6}$ (0.8 f_{tu})

M_a = Maximum bending moment in the wall (in-lb)

b = Width of section (in.), normally taken as 12 in.

t = thickness of wall (in.)

f_{tu} = Ultimate tensile stress of masonry (psi)

Question 5

How were the masonry walls and the piping/equipment supports attached to them designed? Provide enough numerical examples including details of reinforcement and attachments to illustrate the methods and procedures used to analyze and design the walls and the anchors needed for supporting piping/equipment (as applicable).

Response

Items supported by Seismic Category I masonry walls are limited to small piping, 2-1/2 inches and smaller in diameter, and lightweight equipment. They are attached by expansion anchors, grouted anchors, or through bolts. Below is the design information for typical attachments to the blockwalls.

	Expansion[1] Anchors	Grouted[1,3] Anchors	Through[1,3] Bolts
Detail	Figures 1, 2	Figures 1, 2	Figure 3
Tension capacity[2]	600 lb[2] (total loads)	1,600 lb	2,500 lb
Shear capacity[2]		3,000 lb	2,500 lb

Notes:

(1) Maximum total load per concrete block = 800 lb
(2) Values for 5/8-inch diameter bolt
(3) The following interaction equation for shear and tension loads is used: $\frac{t}{T} + \frac{s}{S} \leq 1.0$

where

s = applied shear load

t = applied tension load

S = allowable shear load

T = allowable tension load

A testing program for expansion and grouted anchors used in masonry walls was conducted at the Midland jobsite. The purpose of the test was to verify the acceptability of the anchor capacities listed above. The report evaluating the test is under review and all attachments to Seismic Category I masonry walls will be on hold until August 30, 1980, at which time the report will be finalized and issued. To ensure that the capacity of the masonry walls has not been exceeded, a drawing was issued showing the maximum allowable loads that can be attached to the Seismic Category I masonry walls. These values were based on the wall capacity considering the loads and load combinations, design method, and acceptance criteria indicated in the responses to Questions 2 and 3. Drawing 7220-A-52 shows the reinforcement details.

Question 6

Provide plan and elevation views of the plant structures showing the location of all masonry walls for your facility.

Response

Attached are the following drawings which show the location of all masonry walls for all Seismic Category I structures.

General masonry wall details:	7220-A-52, Sheets 1 and 2
Containment and auxiliary building plans:	7220-A-15
	7220-A-16
	7220-A-17
	7220-A-18
	7220-A-19
	7220-A-20
	7220-A-21
	7220-A-22
	7220-A-23
	7220-A-24
	7220-A-25
	7220-A-26
	7220-A-27
	7220-A-28
	7220-A-29, Sh 1
	7220-A-30
Sections:	7220-A-35
	7220-A-39
	7220-A-40
	7220-A-41

Elevations:	7220-A-201 7220-A-202 7220-A-203, Sh 1 and 2 7220-A-204 through A-213
Stair and elevator walls:	7220-A-53 7220-A-54 7220-A-57, Sh 1
Diesel generator building:	7220-A-350 7220-A-352

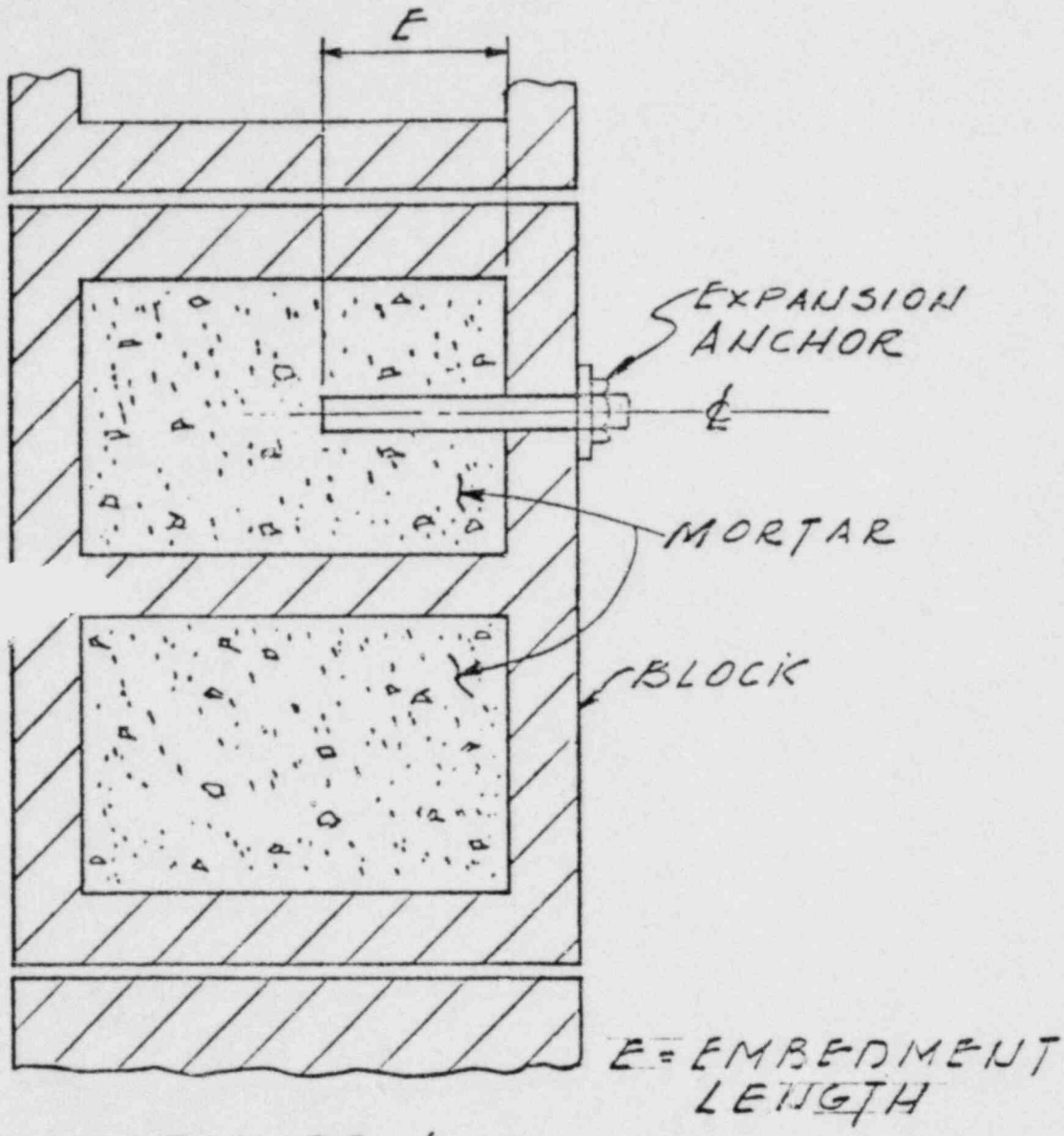
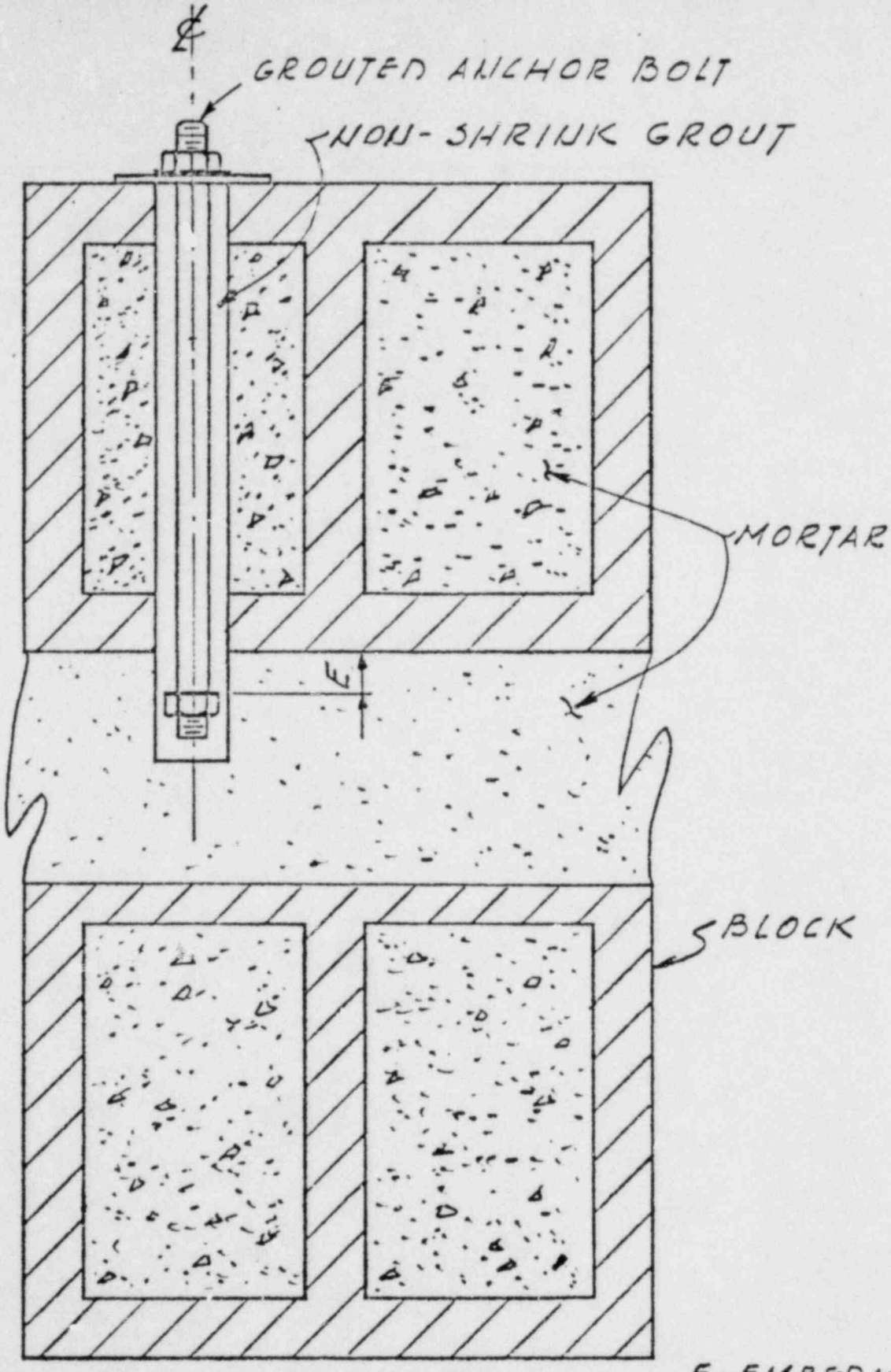


FIGURE 1

EXPANSION ANCHOR IN SINGLE WYTHE BLOCKWALL

NOTE:

GROUTED ANCHORS ALSO MAY BE USED IN THIS CONFIGURATION



NOTE:
EXPANSION ANCHORS ALSO MAY BE USED IN THIS CONFIGURATION

E = EMBEDMENT LENGTH

FIGURE 2

GROUTED ANCHOR BOLTS IN DOUBLE WYTHE BLOCKWALL

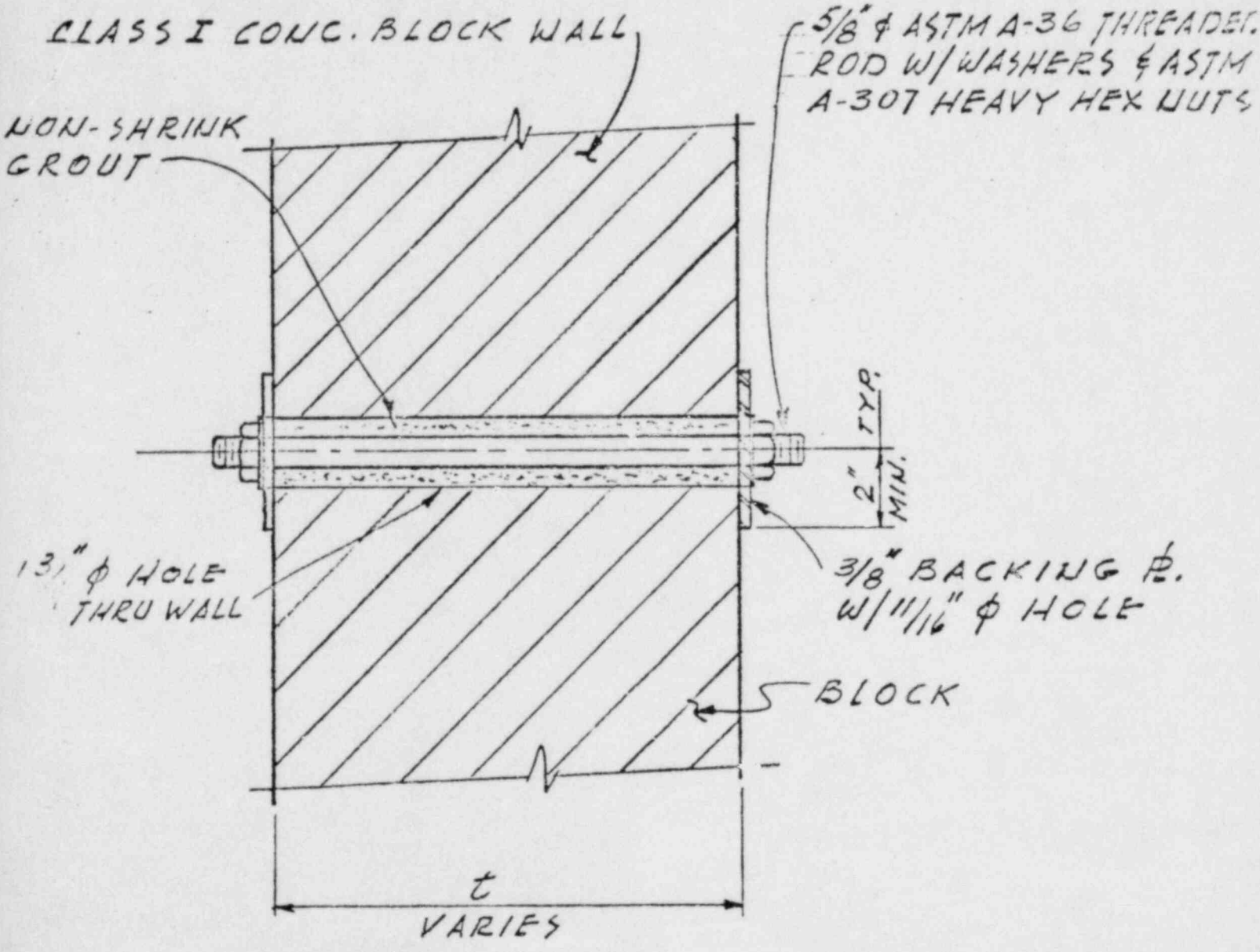


FIGURE 3

THROUGH-BOLT IN BLOCKWALLS

SEISMIC CATEGORY I MASONRY WALLS
DRAWING SUBMITTAL SUMMARY

7220-A-52 Sh 1, Rev 9
7220-A-52 Sh 2, Rev 4
7220-A-15, Rev 18
7220-A-16, Rev 8
7220-A-17, Rev 14
7220-A-18, Rev 10
7220-A-19, Rev 9
7220-A-20, Rev 11
7220-A-21, Rev 5
7220-A-22, Rev 12
7220-A-23, Rev 7
7220-A-24, Rev 6
7220-A-25, Rev 9
7220-A-26, Rev 6
7220-A-27, Rev 5
7220-A-28, Rev 4
7220-A-29 Sh 1, Rev 6 Under Revision
7220-A-30, Rev 10
7220-A-35, Rev 2
7220-A-39, Rev7 Under Revision
7220-A-40, Rev 8
7220-A-41, Rev 1 Under Revision
7220-A-201, Rev 2
7220-A-202, Rev 2
7220-A-203 Sh 1, Rev 1 Under Revision
7220-A-203 Sh 2, Rev 1 Under Revision
7220-A-204, Rev 1 Under Revision
7220-A-205, Rev 1 Under Revision
7220-A-206, Rev 1 Under Revision
7220-A-207, Rev 0
7220-A-208, Rev 1
7220-A-209, Rev 1 Under Revision
7220-A-210, Rev 0
7220-A-211, Rev 0
7220-A-212, Rev 0
7220-A-213, Rev 1
7220-A-53, Rev 6
7220-A-54, Rev 7
7220-A-57 Sh 1, Rev 6
7220-A-350, Rev 1
7220-A-352, Rev 3