BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

WILLIAM D. HARRINGTON
SENIOR VICE PRESIDENT
NUCLEAR

July 26, 1985

BECo 85-134

Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

License DPR-35
Docket 50-293

References 1) NRC letter dated Feb. 7, 1985 (BECo.# 1.85-038)
2) Telecon N. Chokshi to T. J. Tracy dated March 21, 1985

Dear Sir,

During the telephone conversation between your Mr. N. Chokshi and our Mr. T. J. Tracy (Ref. 2), Mr. Chokshi requested a written response to items 2, 3 and 5 from Attachment 10 of your letter dated Feb. 7, 1985. (Ref 1). Attached are our responses to these items.

In reviewing our correspondence on this subject, please note that we are still awaiting your response to item 4 and 7 (from Attachment 10).

Should you have any further questions, please contact us.

Very truly yours,

WD Harrington

Attachments: 1) Response to NRC Action Items
2) Cygna Calculations for Masonry Walls 188.10 and 63.4

MTL/fej

A001
1/1

Attachment 1

RESPONSE TO NRC ACTION ITEMS

Item 2 - The NRC staff accepted the block-out criteria proposed by the licensee, provided the following conditions are met:

a. The licensee to survey all block-outs (except 116.3) for cracks on boundaries - acceptance of criteria based on no evidence of through cracks;

b. provide the results of survey for the staff's review and acceptance, and,

c. for block-out 116.3, provide modifications (on one face) to boundaries to resist peak load resulting from the load combination involving PBOC load components. Notify the staff if tornado differential pressures are greater than 1.5 psi and not acting in the same direction as the PBOC load.

RESPONSE

Boston Edison surveyed all blockouts in question to examine for cracking along the bottom edge. During the examinations, seventeen (17) out of the twenty (20) blockouts met the acceptance criteria after a visual examination of the bottom joint.

Of the remaining three, two (2) were further examined by cutting approximately 3/4" into the bed joint with a masonry saw. Both of these walls revealed that the hairline cracks observed were manifestations of surface shrinkage only - the cut samples proved to be sound with no cracking. The third of these was inaccessible for a test, however, we concluded that the hairline crack observed on one face was similar to the surface shrinkage seen on the two (2) examined walls above.

On the strength of the 19 blockouts closely examined and meeting the acceptance criteria, and the technical assessment of this joint as a compression joint (dead weight of the blockout), we accept all 20 blockouts.

Boston Edison agrees to schedule a modification to blockout 116.3 to resist the PBOC load condition only. The PBOC load is a unidirectional load and the modification will not address reverse direction loads. An examination of the load data shows that this blockout is not subject to tornado depressurization loads. Seismic forces acting on blockout 116.3 are an order of magnitude less that the PBOC and therefore of no concern.

Item 3 - The licensee will provide representative calculations to show differences between prior Cygna analysis and subsequent refined analysis for walls qualified without reliance on the statistically determined line loads.

RESPONSE

Nine (9) walls rely on actual test data for determination of boundary allowable line loading. This differs from prior Cygna analysis. A listing of these walls and the line loading allowables, calculated using actual anchorage and the statistically determined values, was previously provided to the NRC at the June 6-7 meeting and is reflected in an NRC letter dated February 6, 1985, ("Meetings on June 6-7, 1984 and July 18, 1984 with Boston Edison Company regarding masonry walls at Pilgrim Station" Attachment 6, Table 3.7). Since preparation of the reference criteria document, BECo has qualified wall 66.18 similarly by using the actual anchorage observed in tests.

BECo continues to examine the analytical assumptions of the boundary geometry as part of the design process on walls scheduled for construction. Wherever possible, we will take credit for the directional nature of PBOC and Tornado loads. For example, BECo assumes no interlocking of walls forming a "T" intersecting joint. In the limited case where the controlling load is Tornado or PBOC and where the peak load acts to place a "T" joint in compression, we will take credit for support. In such a case, the calculations will also examine the effects of loads in the opposite direction as part of the overall analysis.

The above items do not represent "refined analysis" over the approach used by Cygna. These items rely on the same acceptance criteria and analytical methods previously established. With the exception of the introduction of the statistically determined boundary line load allowables, and the criteria for masonry blockouts, BECo continues to apply the criteria and analytical techniques used by Cygna in the earlier stages of the program. We have included as Attachment 2 Cygna's analytical calculations for walls 188.10 and 63.4 for your review and comparison with the Bechtel/Computech calculations, which were provided to you at our July 18, 1984 meeting.

Item 5 - The licensee is still reviewing alternate qualification scheme for walls 209.13 and 209.14 and will discuss with the staff at a later date.

RESPONSE

This item relates to safety related switches mounted on blockout 929.3 which lie within the failure zone of influence of blockwalls 209.13 and 209.14. BECo had expressed an interest in armoring the safety related switches in lieu of modifying the two walls. After considerable investigation, BECo has determined that wall 209.14 will not impact the safety related switches, and we have elected to modify wall 209.13 to resolve this issue.

Attachment 2

Cygna Analytical Calculations for
Walls 188.10 and 63.4

Note: Cygna Energy Services (Formerly Earthquake Engineering Services (EES)) calculations attached.

EES

CALCULATION COVER SHEET

Job No. 8003
File No. 29F
Calc. Set No. 2251
No. of Sheets 21

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 188.10 Problem No. 251

STATEMENT OF PROBLEM

Re-evaluation of Masonry Walls will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

SOURCES OF DATA

EES Design Criteria (DC-1), Rev. 1.0
Project Memoranda Nos. 4,5,8,9 (rev. 1), 10 (rev. 1)
EES MWD Sketch Nos. SK-252 & 253 (rev. 0)
Computer Output Files EO-RS-188.10-SSE-1, EO-RS-188.10-OBE-1, EO-PBOC-188.10-6, SO-RS-188.10-OBE-0, SO-RS-188.10-SSE-0, SO-PBOC-188.10-5

UFD No. PJ ACT 2 >PJ 2251 Computer Binder No. 29.4F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI3, Rev. 2
EES Design Criteria and Project Memoranda
EES PNPS Calc. Set No. 1251 (rev. 0)

REMARKS Added pg. 21 for out-of-plane shear analysis

The results of this Level 2 Analysis are E-Seismic Pass
E'-Seismic Pass PBOC Pass Tornado Pass
In-Plane Loads NA Out-of-Plane Pass
See Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 2
B.A. Boutin L.M. Silvia	P. Curry F. Tofighi		SUPERSEDES CALCULATION
S. Capobianco			SET NO. 2251 rev. 1
J. Richard M. Kuntz	M. Morgan J. DeVincentis		APPROVED BY: J.D. McCarthy DATE: 8/27/82

EES

CALCULATION COVER SHEET

Job No. 80034
File No. 29F
Calc. Set No. 2251
No. of Sheets 20

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 188.10 Problem No. 251

STATEMENT OF PROBLEM

Re-evaluation of Masonry Walls will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

SUPERSEDED

SOURCES OF DATA

EES Design Criteria (DC-1), Rev. 1.0
Project Memoranda Nos. 4 REV.1, 5 REV1., 9 REV.2, 10 REV.1
EES MWD Sketch Nos. 452, 453 REV. 0
Computer Output Files EØ-RS-188.10-SSE-1, EØ-RS-188.10-ØBE-1
EØ-PBØC-188.10-6, SØ-RS-188.10-ØBE-0, SØ-RS-188.10-SSE-0
SØ-PBØC-188.10-5
UFD No. PIART2>PI2251 Computer Binder No. 29.4F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI3, Rev.2
EES Design Criteria and Project Memoranda
EES PNPS Calc. Set No. 1251 (REV 1)

REMARKS ΔA1000 CALC 2251-70 FOR BOUNDARY LOADS
The results of this Level 2 Analysis are E-Seismic PASS
E'-Seismic PASS PBOC PASS Tornado PASS
In-Plane Loads N/A Out-of-Plane N/A
See Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 1
B.A. BOUTON	P. CURRY		SUPERSEDES CALCULATION SET NO. 2251 REV 0
L. SILVIA	F. Tofighi		
S. CAPOBIANCO			APPROVED BY: L Kaun
J. RICHARD	M. MORYAN		DATE: 6/15/82

EES

CALCULATION COVER SHEET

Job No. 80034
File No. 29F
Calc. Set No. 2251
No. of Sheets 19

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 188.10 Problem No. 251

STATEMENT OF PROBLEM

Re-evaluation of Masonry Walls will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

SUPERSEDED

SOURCES OF DATA

EES Design Criteria (DC-1), Rev. 1.0
Project Memoranda Nos. 4 REV. 1, 5 REV. 1, 9 REV. 2, 10 REV. 1
EES MWD Sketch Nos. 452, 453 REV. 0
Computer Output Files EQ-RS-188.10-SSE-1, EQ-RS-188.10-OBE-1
EQ-PBOC-188.10-6, SQ-RS-188.10-OBE-0, SQ-RS-188.10-SSE-0
SQ-PBOC-188.10-5
UFD No. PIART2>PI2251 Computer Binder No. 29.4F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI3, Rev. 1
EES Design Criteria and Project Memoranda
EES PNPS Calc. Set No. 1251

REMARKS

The results of this Level 2 Analysis are E-Seismic PASS
E'-Seismic PASS PBOC PASS Tornado PASS
In-Plane Loads NA Out-of-Plane NA
See Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 0
B.A. BOUTON	P. CURRY		SUPERSEDES CALCULATION
L. SILVIA	F. Tofighi		SET NO. NA
S. CAPOBIANCO			APPROVED BY: [signature]
			DATE: 4/8/82

EES

CALCULATION SHEET

PREPARED BY: BJB	DATE: 3/30/82
CHECKED BY: F. Tofighi	DATE: 4/2/82
PROJECT: PILGRIM UNIT NO. 1	JOB NO.: 80034 / FILE NO.: 29F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-1

INTRODUCTION

WALL 188.10 IS A MULTI-THICKNESS WALL LOCATED AT ELEVATION 23'-0" OF THE REACTOR BUILDING. THE WALL WAS NOT QUALIFIED BY LEVEL 1 ANALYSIS. THIS ANALYSIS WILL ATTEMPT TO QUALIFY WALL 188.10 FOR DESIGN AND MAXIMUM EARTHQUAKE LOADS AS WELL AS PBOC AND TORNADO PRESSURES.

EES

CALCULATION SHEET

PREPARED BY: B.B.	DATE: 3/30/82
CHECKED BY: F. Tofighi	DATE: 4/2/82
PROJECT: PILGRIM UNIT No. 1	JOB NO.: 80034 / FILE NO.: 29F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-2

SUMMARY OF RESULTS

WALL 188.10 IS ADEQUATE FOR ALL APPLIED LOADING CONDITIONS. A LISTING OF RESULTANT MOMENTS COMPARED WITH THE ALLOWABLE MOMENTS IS PROVIDED BELOW.

OBE (E):

$M_{XX} = 140.9 \frac{IN-LB}{IN} < 304 \frac{IN-LB}{IN}$

$M_{YY} = 744.9 \frac{IN-LB}{IN} < 1056 \frac{IN-LB}{IN}$

$f_n = 18.8$ HZ

F.S. = 1.4

SSE (E'):

$M_{XX} = 218.8 \frac{IN-LB}{IN} < 452 \frac{IN-LB}{IN}$

$M_{YY} = 1156.0 \frac{IN-LB}{IN} < 2112 \frac{IN-LB}{IN}$

$f_n = 18.8$ HZ

F.S. = 1.8

PRESSURE:

$M_{XX} = 403.7 \frac{IN-LB}{IN} < 452 \frac{IN-LB}{IN}$

$M_{YY} = 907.4 \frac{IN-LB}{IN} < 2112 \frac{IN-LB}{IN}$

F.S. = 1.1

EES

CALCULATION SHEET

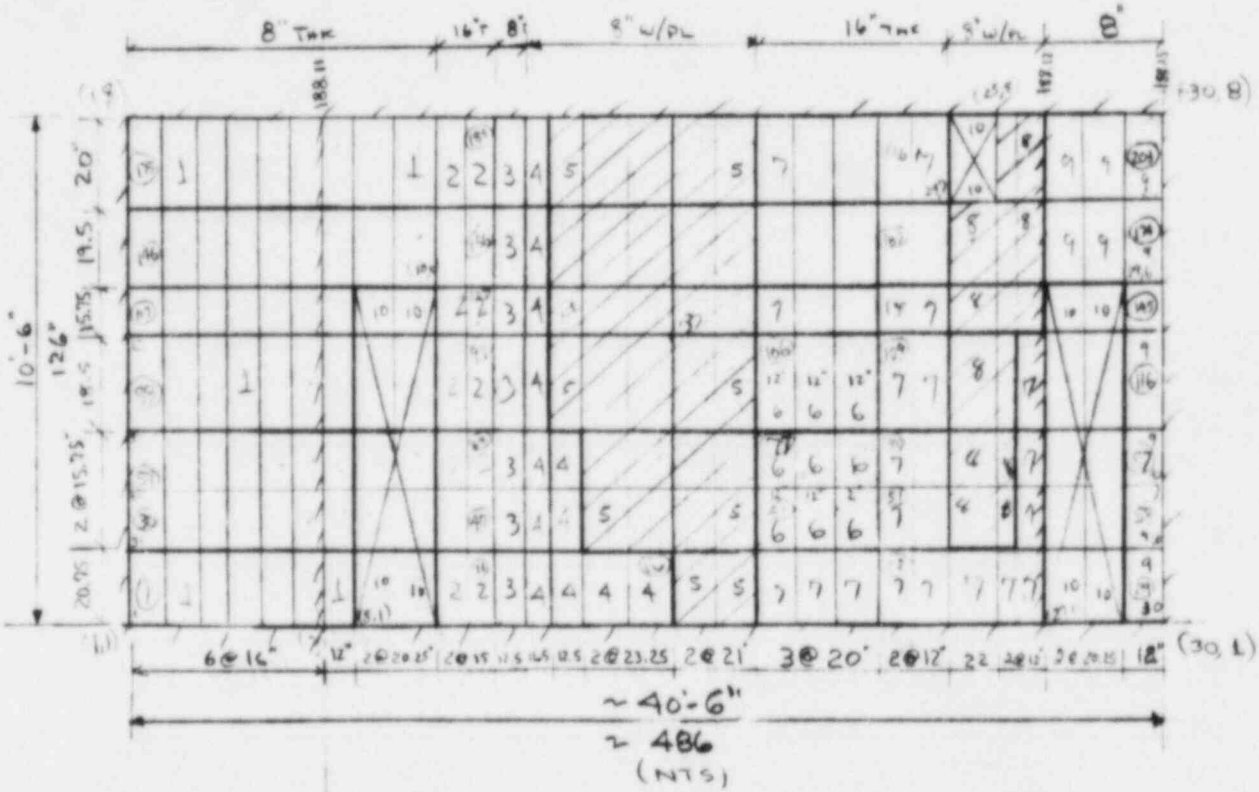
PROJECT	PILGRIM UNIT No. 1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	WALL 188.10
ANALYSIS NO.	2251 REV. NO. 0

PREPARED BY	L. W. SILVI
DATE	4-7-81
CHECKED BY	PR CURRY
DATE	5/22/81
JOB NO.	80034
FILE NO.	29F
SHEET NO.	2251-3

WALL MODEL - BOUNDARY CONDITIONS AND DIMENSIONS PER SK-452 AND 453 8", 12" AND 16" WALL

FIGURE 1 $t_w = 8"(7.625")$ $t_w = 12"(11.625)$ $t_w = 16"(15.25")$

$t_w = 8"\ w/DL = (7.625 + .75) = 8.375"$



DENSITY OF WALL

$\rho_{8"} = 1.383 \times 10^{-4}$ LB-SEC^2/IN^4

$\rho_{12"} = 1.222 \times 10^{-4}$ LB-SEC^2/IN^4

$\rho_{16"} = 2.122 \times 10^{-4}$ LB-SEC^2/IN^2
(ASSUMED FULLY GROUTED)

EES

CALCULATION SHEET

PREPARED BY: L.W. SILVIA	DATE: 4-9-81
CHECKED BY: PR CURRY	DATE: 5/11/81
PROJECT: PILGRIM UNIT No. 1	JOB NO.: 80034 / FILE NO.: 29F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-4

EQUIVALENT DENSITY DUE TO ATTACHED EQUIPMENT

(MAT 6) 12" WALL - AREA = 5'-2" X 4'-2" = 62" X 50" = 3100 IN²

(REF. CALC. SET No. 1251, Pgs 5-7)

4 - FIRE EXTINGUISHERS = 120 LBS.

1 - TELEPHONE BOX = 19.6 LBS.

CABINETS 5.0 LB/FT² (36 x 18/144) = 22.5 LBS

TOTAL = 162 LBS

$$\rho_{EQ_{12"}} = \frac{162}{3100\,IN^2 \times 11.625 \times 386.4} = 1.16 \times 10^{-5}\ LBS\text{-}SEC^2/IN^4$$

8" WALL W/LEAD PLATE (MAT 8)

(BY WALL 188.12)

AREA = 3'-10" x 8'-4" - (3'-8" x 1'-8") - (1'-0 x 3'-8¾")

= (46 x 100) - (20 x 20) - (12 x 44.75) = 3663 IN²

¾" LEAD @ 0.3082 LBS/IN² W_T = 1032.8 LBS.

FIRE HOSE REEL 75 LBS.

6 - 2ϕ FIRE PROT. PIPE @ 6.3 LB/FT 37.8 LBS.

TOTAL = 1150 LBS.

$$\rho_{EQ\ 8"\ @\ 12} = \frac{1150}{3663 \times (7.625) \times 386.4} = 1.066 \times 10^{-4}\ LD\text{-}SEC^2/IN^4$$

EES	CALCULATION SHEET	PREPARED BY L. W. SILVIA	DATE 4-9-81
		CHECKED BY P R CURRY	DATE 5/14/81
	PROJECT PILGRIM UNIT NO. 1	JOB NO. 80034	FILE NO. 29F
	SUBJECT MASONRY WALL ANALYSIS		
	SYSTEM WALL 188.10		
	ANALYSIS NO. 2251 REV. NO. 0	SHEET NO. 2251-5	

Eq. Density of Equipment (Continued)

16" Wall Around 12" Blk (Mat 7)

Cabinets, $(36 \times 11/144)^{1/2} \times 5^{LBS/FT^2}$ = 13.8 LBS.

2" ϕ Fire Prot. Pipe, 8.5' @ 6.3 = 53.6 LBS.

Switch 5

Total = 72 LBS.

Area = (7.0' x 10.5') − (5'-0" x 4'-2") + (2'-10 x 2'-2") + (1'-0" x 5'-10¾")

= (84 x 126) − (60 x 50) + (34 x 26) + (12 x 70.75) = 9317 $\frac{LB-SEC^2}{IN^2}$

$$\rho_{Eq.\ 16"\ Wall\ Around\ 12"\ Blk} = \frac{72}{(9317)(15.25)(386.4)} = 1.03 \times 10^{-6}\ LB\text{-}SEC^2/IN$$

8" Wall at Wall 189.13 (Mat 9)

Area = (126 x 92.5) − (40.5 x 86.5) = 3111.75 IN^2

¾" ϕ Conduit, 14' @ 1.4 LB/FT = 19.6 LBS

Door 100 LBS.

Junction Box 4" x 6" x 6 @ 5.0 $^{LB}/_{FT^2}$ 5.8 LBS

Switch 5

Total = 131 LBS.

$$\rho_{Eq.\ 8"\ @\ Wall\ 188.13} = \frac{131}{(3111.75)(7.625)(386.4)} = 1.43 \times 10^{-5}\ LB\text{-}SEC^2/IN^4$$

EES

CALCULATION SHEET

PREPARED BY: L.W. SILVIA	DATE: 4-9-81
CHECKED BY: PR GUFFEY	DATE: 5/12/81
PROJECT: PILGRIM UNIT NO. 1	JOB NO.: 80034
SUBJECT: MASONRY WALL ANALYSIS	FILE NO.: 29F
SYSTEM: WALL 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-6

EQ. DENSITY (CONTINUED)

8" WALL W/ 3/4" LEAD PL (MAT 5)

AREA = (10'-6" x 8'-5") - (1'-4½" x 3'-10½") - (1'-0½" x 4'-6")

= (126 x 101) - (16.5 x 46.5) - (12.5 x 54) = 11283.75 IN²

3/4" LEAD PL = (11283.75)(0.3082) = 3478 LBS.

CVT - TRANSFORMER		32.8 LBS.
JUNCTION BOX - N612		39.6 LBS.
1" ϕ CONDUIT	17' @ 2.1 #/FT	35.7 LBS.
3/4 ϕ CONDUIT	14'-0" @ 1.4	19.6 LBS.
1½" ϕ "	17' @ 3.6	61.2 LBS.
2" ϕ "	23' @ 5.0	115 LBS
3" ϕ "	41' @ 11.0	451 LBS.
2" ϕ FIRE PROT. PIPE	8.5' @ 6.3	53.6 LBS.
4" ϕ CAST IRON PIPE	11.5' @ 20.0	230. LBS.
CABINETS	8'-4" x 2'-5" @ 50 LB/FT²	101.7 LBS.

TOTAL ≈ 4620 LBS.

$$P_{Co^{60}\ 4/2} = \frac{4620}{(11283.75)(1.625)(386.4)} = 1.390 \times 10^{-4}\ \text{LB-SEC}^2/\text{IN}$$

EES	CALCULATION SHEET	PREPARED BY	DATE
		L.W. SILVIA	4-9-81
		CHECKED BY	DATE
	PROJECT PILGRIM UNIT No. 1	PR CURRY	5/11/81
	SUBJECT MASONRY WALL ANALYSIS	JOB NO. 80034	FILE NO. 29F
	SYSTEM WALL 188.10		
	ANALYSIS NO. 2251 REV. NO. 0	SHEET NO. 2251-7	

EQ. DENSITY OF EQUIPMENT (CONTINUED)

8" WALL @ COL (2.5) TO DOOR (SK-452) (MAT 1)

2" Ø DRAIN LINE, 19' @ 6.3 LB/FT =	119.7 LBS.
3/4" Ø CONDUIT, 13' @ 1.4	14.2 LBS.
DOOR	100 LBS.
JUNCTION BOX = 4"X4" X 6" @ 5 LB/FT²	4.4 LBS
220 OUTLET = 6"X6"X6" @ "	7.5 LBS
DISCONNECT SWITCH	5
2" Ø FIRE PROT. PIPE, 13' @ 6.3 LB/FT	81.9
GATE AND BALL VALVES @ 50 LBS/EA.	100
SWITCH	5
TOTAL =	440 LBS.

AREA OF 8" WALL = (126 X 148.5) − (86.5 X 40.5) = 15207.75 IN²

$$\text{REQ. 8" WALL @ COL (2.5)} = \frac{440}{15207.75(7.625)(386.4)} = 9.8 \times 10^{-6} \text{ LB-SEC}^2/\text{IN}^4$$

16" WALL BETWEEN DOOR AND SHEET METAL ENCLOSURE (MAT 2)

AREA = (126 X 30) = 3780 IN²

CABINETS (30X 29/144) @ 5 LBS/FT² =	30.2 LBS.
4"X4"X6" JUNCT. BOX @ " " =	4.4 LBS.
SWITCH	5 LBS

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT NO. 1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	WALL 188.10
ANALYSIS NO.	2251 REV. NO. 0

PREPARED BY	L. W. SILVIA
DATE	4-9-81
CHECKED BY	PR CURRY
DATE	5/11/81
JOB NO.	80034
FILE NO.	29F
SHEET NO.	2251-8

3/4" ∅ CONDUITS, 8' @ 1.4 — 11.2

2" ∅ FIRE PROTECT. PIPE, 2.5' @ 6.3 — 15.8

TOTAL ≈ 67 LBS.

$$\rho_{EQ.\ 16"\ @\ WALL\ 188.11} = \frac{67}{3780(15.25)(386.4)} = 3.0 \times 10^{-6}\ LD\text{-}SEC^2/IN^4$$

8" WALL W/SHEET METAL ENCLOSURE (MAT 3)

AREA = (126 × 12.5) = 1575 IN^2

2" ∅ FIRE PROT. PIPE (12.5/12)' @ 6.3 — 6.6 LBS.

3/4" ∅ CONDUIT, (12.5/12)' @ 1.4 — 1.5

CABINETS (12.5 × 29/144) @ 5 #/FT^2 — 12.6 LBS.

TOTAL ≈ 21 LBS.

$$\rho_{EQ.\ 8"\ WALL\ W/SHEET} = \frac{21}{(1575)(7625)(386.4)} = 4.5 \times 10^{-6}\ LD\text{-}SEC^2/IN^4$$

16" WALL FROM SHEET MAT. TO LEAD PLATE (MAT 4)

AREA = (126 × 11.5) + (54 × 12.5) + (16.5 × 46.5) = 2891.25 IN^2

2" ∅ FIRE PROT. PIPE, (11.5/12') @ 6.3 #/ — 6.0 LBS

CABINETS (11.5 × 29/144) @ 5 #/FT^2 — 11.6 LBS

3/4" ∅ CONDUIT (11.5/12') @ 1.4 — 1.3 LBS.

TOTAL ≈ 20 LBS.

$$\rho_{EQ.\ 16"\ WALL\ FROM\ SH.\ MAT\ TO\ LEAD\ PL} = \frac{20}{(2891.25)(5.25)(386.4)} = 1.2 \times 10^{-6}\ LD\text{-}SEC^2/IN^4$$

EES

CALCULATION SHEET

PREPARED BY: L. W. SILVIA	DATE: 4-9-81
CHECKED BY: P R CURRY	DATE: 5/22/81
PROJECT: PILGRIM UNIT NO. 1	JOB NO.: 80034 / FILE NO.: 29F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-9

TOTAL DENSITY OF WALL SECTIONS (FIG. 1)

MAT. 1 $\rho_1 = 1.383 \times 10^{-4} + 9.8 \times 10^{-6} = \underline{1.481 \times 10^{-4}}$ LB-SEC^2/IN^4

MAT. 2 $\rho_2 = 2.122 \times 10^{-4} + 3.0 \times 10^{-6} = \underline{2.152 \times 10^{-4}}$ "

MAT. 3 $\rho_3 = 1.383 \times 10^{-4} + 4.5 \times 10^{-6} = \underline{1.428 \times 10^{-4}}$ "

MAT. 4 $\rho_4 = 2.122 \times 10^{-4} + 1.2 \times 10^{-6} = \underline{2.134 \times 10^{-4}}$ "

MAT. 5 $\rho_5 = 1.383 \times 10^{-4} + 1.39 \times 10^{-4} = \underline{2.773 \times 10^{-4}}$ "

MAT 6 $\rho_6 = 1.222 \times 10^{-4} + 1.16 \times 10^{-5} = \underline{1.338 \times 10^{-4}}$ "

MAT 7 $\rho_7 = 2.122 \times 10^{-4} + 1.03 \times 10^{-6} = \underline{2.132 \times 10^{-4}}$ "

MAT 8 $\rho_8 = 1.383 \times 10^{-4} + 1.066 \times 10^{-4} = \underline{2.449 \times 10^{-4}}$ "

MAT 9 $\rho_9 = 1.383 \times 10^{-4} + 1.43 \times 10^{-5} = \underline{1.526 \times 10^{-4}}$ "

MAT 10 $\rho_{10} = 0.00 \times 10^{-4}$ LB-SEC^2/IN^4

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT No. 1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	WALL 188.10
ANALYSIS NO.	2251
REV. NO.	0

PREPARED BY	B.B. Butt
DATE	3/29/82
CHECKED BY	F. Tofighi
DATE	4/2/82
JOB NO.	80034
FILE NO.	29F
SHEET NO.	2251-10

EWALL INPUT - SEISMIC

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* WALL 188.10 , LEVEL 2 ANALYSIS
29, 7, 1, 1, 3, 0, 0, 6, 0, 0, 0
0, 1, 1, 0, 0
1, 1, 30, 1, 1, 1, 1, 0, 1
1, 1, 1, 8, 1, 1, 1, 1, 0
1, 8, 30, 8, 1, 1, 1, 0, 1
30, 1, 30, 8, 1, 1, 1, 1, 0
7, 1, 7, 8, 1, 1, 1, 1, 0
27, 1, 27, 8, 1, 1, 1, 1, 0
8, 1, 10, 6
24, 7, 25, 8
27, 1, 29, 6
486., 126., 7.625
16., 16., 16., 16., 16., 16., 12., 20.25
20.25, 15., 15., 12.5, 11.5, 12.5, 23.25, 23.25
21., 21., 20., 20., 20., 12., 12., 22.
12., 12., 20., 20.25, 12.
20.75, 15.75, 15.75, 18.5, 15.75, 19.5, 20.
0.0, 1350000., 562500., .000148, 0.0, 25.73, 31.57
452., 563., 0.5, 0.5, 0.00, 3.34
0.0, 0.0, 1.0, 1
RESPONSE SPECTRA REACTOR BUILDING ELEV. 51.0
NPTS, 386.4
```

(LOAD PISPEC > RB-ARS > O-RB-OBE4-EL.51.0
OR " " O-RB-SSE7-EL.51.0)
(SEE PAGE FOR THE RESPONSE SPECTRA VALUES)

CALCULATION SHEET

EES

PREPARED BY B.B.	DATE 3/30/82
CHECKED BY F. Tofighi	DATE 4/2/82
PROJECT PILGRIM UNIT No. 1	
SUBJECT MASONRY WALL ANALYSIS	JOB NO. 80034 / FILE NO. 29F
SYSTEM WALL 188.10	
ANALYSIS NO. 2251 REV. NO. 0	SHEET NO. 2251-11

RESPONSE SPECTRA REACTOR
BLDG ELEV 51.0 OBE 4%

PERIOD	ORDINATE
0.30300E-01	0.17767E 00
0.31240E-01	0.17819E 00
0.33850E-01	0.17931E 00
0.35710E-01	0.17992E 00
0.36360E-01	0.18469E 00
0.40000E-01	0.18469E 00
0.42340E-01	0.19252E 00
0.46580E-01	0.19252E 00
0.50000E-01	0.19382E 00
0.51750E-01	0.19751E 00
0.55560E-01	0.20472E 00
0.58040E-01	0.21006E 00
0.60610E-01	0.21879E 00
0.64390E-01	0.23296E 00
0.66670E-01	0.25385E 00
0.69930E-01	0.29838E 00
0.13333E 00	0.29838E 00
0.14286E 00	0.32750E 00
0.15385E 00	0.44180E 00
0.16667E 00	0.63203E 00
0.18182E 00	0.95048E 00
0.19815E 00	0.12353E 01
0.24218E 00	0.12353E 01
0.25000E 00	0.10538E 01
0.27778E 00	0.60673E 00
0.30303E 00	0.52685E 00
0.33333E 00	0.43270E 00
0.37037E 00	0.43270E 00
0.38462E 00	0.36656E 00
0.41322E 00	0.34665E 00
0.50505E 00	0.34665E 00
0.55556E 00	0.19031E 00
0.62500E 00	0.16628E 00
0.66667E 00	0.16583E 00
0.92593E 00	0.16583E 00
0.10000E 01	0.12242E 00
0.11111E 01	0.83156E-01
0.18518E 01	0.83156E-01
0.20000E 01	0.62828E-01
0.25000E 01	0.34049E-01
0.33333E 01	0.21811E-01
0.50000E 01	0.98150E-02

RESPONSE SPECTRA REACTOR
BLDG ELEV 51.0 SSE 7%

PERIOD	ORDINATE
0.30300E-01	0.28032E 00
0.31240E-01	0.28113E 00
0.33850E-01	0.28316E 00
0.35710E-01	0.28440E 00
0.40000E-01	0.29044E 00
0.42340E-01	0.29731E 00
0.46580E-01	0.29731E 00
0.50000E-01	0.30348E 00
0.51750E-01	0.30803E 00
0.55560E-01	0.31693E 00
0.58040E-01	0.32456E 00
0.60610E-01	0.33524E 00
0.64390E-01	0.35359E 00
0.66670E-01	0.36973E 00
0.69930E-01	0.38954E 00
0.12500E 00	0.38954E 00
0.13333E 00	0.41022E 00
0.14286E 00	0.48051E 00
0.15385E 00	0.62108E 00
0.16667E 00	0.81891E 00
0.18182E 00	0.10338E 01
0.19479E 00	0.12113E 01
0.23808E 00	0.12113E 01
0.25000E 00	0.11455E 01
0.27778E 00	0.85291E 00
0.30303E 00	0.68846E 00
0.33333E 00	0.58807E 00
0.37037E 00	0.58807E 00
0.38462E 00	0.49238E 00
0.41322E 00	0.45923E 00
0.50505E 00	0.45923E 00
0.55556E 00	0.31809E 00
0.56818E 00	0.29812E 00
0.62500E 00	0.24433E 00
0.92593E 00	0.24433E 00
0.10000E 01	0.17688E 00
0.11111E 01	0.13412E 00
0.12500E 01	0.11253E 00
0.15151E 01	0.11230E 00
0.18518E 01	0.11230E 00
0.20000E 01	0.89724E-01
0.25000E 01	0.56360E-01
0.33333E 01	0.36806E-01
0.50000E 01	0.17168E-01

EES

CALCULATION SHEET

PROJECT PILGRIM UNIT No. 1		PREPARED BY B.A.B.	DATE 3/30/82
SUBJECT MASONRY WALL ANALYSIS		CHECKED BY F. Tafazzoli	DATE 4/2/82
SYSTEM WALL 188.10		JOB NO. 80034	FILE NO. 29F
ANALYSIS NO. 2251	REV. NO. 0	SHEET NO. 2251-12	

THOSE ELEMENTS IDENTIFIED ON PAGE 9 & 3 AS BEING EITHER 12" OR 16' IN THICKNESS WILL HAVE THEIR MATERIAL SECTION PROPERTIES AND THICKNESSES ALTERED IN THE SAP IV INPUT FILE TO SUIT THE ACTUAL WALL DIMENSIONS. ALSO, THE MASS DENSITIES FOR EACH ELEMENT WILL BE MATCHED TO THE MASS DENSITY COMPUTED FOR THAT ELEMENT, THESE MASS DENSITIES ARE DEFINED ON PAGE 9 AND REFER TO THE MATERIAL NUMBERS SHOWN ON PAGE 3.

THE SECTION PROPERTIES OF THE 12" AND 16" THICKNESS WALL SECTIONS ARE SHOWN ON THE FOLLOWING PAGE.

EES

CALCULATION SHEET

PREPARED BY: A Capobianco	DATE: 3/25/82
CHECKED BY: F. Tofighi	DATE: 4/2/82
PROJECT: Pilgrim Unit 1	JOB NO.: 80034 / FILE NO.: 29F
SUBJECT: Masonry Wall Analysis	
SYSTEM: Wall 188.10	
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-13

Section Properties (UNCRACKED)

12 in THK Partition Wall

PM #9 ATTACH. 3

$$C_{xx} = \frac{E_c}{(1-\nu^2)} \cdot \frac{I_{gx}}{I_o} = \frac{1350000}{(1-.2^2)} \cdot \frac{77.45}{130.93} = 831850 \text{ psi}$$

$$C_{yy} = \frac{E_c}{(1-\nu^2)} \cdot \frac{I_{gy}}{I_o} = \frac{1350000}{(1-.2^2)} \cdot \frac{105.23}{130.93} = 1130220 \text{ psi}$$

$$C_{xy} = \frac{\nu E_c}{(1-\nu^2)} \cdot \frac{(I_{gx} \cdot I_{gy})^{1/2}}{I_o} = \frac{.2(1350000)}{(1-.2^2)} \cdot \frac{(77.45 \cdot 105.23)^{1/2}}{130.93} = 193925 \text{ psi}$$

$$G_{xy} = \frac{E_c}{2(1+\nu)} \cdot \frac{(I_{gx} \cdot I_{gy})^{1/2}}{I_o} = \frac{1350000}{2(1+.2)} \cdot \frac{(77.45 \cdot 105.23)^{1/2}}{130.93} = 387850 \text{ psi}$$

16 in THK MULTI-WYTHE Wall

$$C_{xx} = \frac{1350000}{(1-.2^2)} \cdot \frac{73.88}{295.5} = 351586 \text{ psi}$$

PM #9 ATTACH. 4

$$C_{yy} = \frac{1350000}{(1-.2^2)} \cdot \frac{73.88}{295.5} = 351586 \text{ psi}$$

$$C_{xy} = \frac{.2(1350000)}{(1-.2^2)} \cdot \frac{(73.88 \cdot 73.88)^{1/2}}{295.5} = 70317 \text{ psi}$$

$$G_{xy} = \frac{1350000}{2(1+.2)} \cdot \frac{(73.88 \cdot 73.88)^{1/2}}{295.5} = 140635 \text{ psi}$$

EES

CALCULATION SHEET

PREPARED BY: S. Capobianco	DATE: 3/26/82
CHECKED BY: F. Tofighi	DATE: 4/2/82
PROJECT: Pilgrim Unit 1	
SUBJECT: Masonry Wall Analysis	
SYSTEM: Wall 188.10	JOB NO.: 80034 / FILE NO.: 29F
ANALYSIS NO.: 2251 REV. NO.: 0	SHEET NO.: 2251-14

ALLOWABLE & CRACKING MOMENTS

8" THK PARTITION WALL (PM #9 - ATTACHMENT 3)

$m_{xx} = 304 \frac{in\text{-}lb}{in}$
$m_{xx'} = 452 \frac{in\text{-}lb}{in}$
$m_{cr_x} = 904 \frac{in\text{-}lb}{in}$

$m_{yy} = 1056 \frac{in\text{-}lb}{in}$
$m_{yy'} = 2112 \frac{in\text{-}lb}{in}$
$m_{cr_y} = 563 \frac{in\text{-}lb}{in}$

12" THK PARTITION WALL (PM #9 - ATTACHMENT 3)

$m_{xx} = 1359 \frac{in\text{-}lb}{in}$
$m_{xx'} = 2447 \frac{in\text{-}lb}{in}$
$m_{cr_x} = 1785 \frac{in\text{-}lb}{in}$

$m_{yy} = 2002 \frac{in\text{-}lb}{in}$
$m_{yy'} = 3603 \frac{in\text{-}lb}{in}$
$m_{cr_y} = 1231 \frac{in\text{-}lb}{in}$

16" THK MULTI-WYTHE WALL (PM #9 - ATTACHMENT 4)

$m_{xx} = 1298 \frac{in\text{-}lb}{in}$
$m_{xx'} = 1958 \frac{in\text{-}lb}{in}$
$m_{cr_x} = 2598 \frac{in\text{-}lb}{in}$

$m_{yy} = 2102 \frac{in\text{-}lb}{in}$
$m_{yy'} = 4206 \frac{in\text{-}lb}{in}$
$m_{cr_y} = 1318 \frac{in\text{-}lb}{in}$

EES

CALCULATION SHEET

PREPARED BY B.B.	DATE 3/30/82
CHECKED BY F. Tofighi	DATE 4/2/82
PROJECT PILGRIM UNIT NO. 1	JOB NO. 80034 / FILE NO. 29E
SUBJECT MASONRY WALL ANALYSIS	
SYSTEM WALL 188.10	
ANALYSIS NO. 2251 REV. NO. 0	SHEET NO. 2251-15

OBE:

THE RESULTS OF THE DESIGN EARTHQUAKE ANALYSIS ARE SHOWN BELOW. (REF. SØ-RS-188.10-Ø3E-0)

$f_n = 18.8$ HZ

$M_{xx\,MAX} = 108.4 \frac{IN-LB}{IN}$ (ELEMENT 72) $< M_{CR_{8"_X}} = 904 \frac{IN-LB}{IN}$ $< M_{ALLOW_X} = 304 \frac{IN-LB}{IN}$

THE MAXIMUM M_{xx} FOR ALL ELEMENTS IS LESS THAN THE ALLOWABLE AND CRACKING MOMENTS OF THE WEAKEST SECTION OF THE WALL.
∴ M_{xx_E} IS ADEQUATE.

$M_{YY\,MAX} = 573.0 \frac{IN-LB}{IN}$ (ELEMENT 100) $\approx M_{CR_{8"_Y}} = 563 \frac{IN-LB}{IN}$ $< M_{ALLOW_Y} = 1056 \frac{IN-LB}{IN}$

THE MAXIMUM M_{YY} FOR ALL ELEMENTS IS LESS THAN THE LEAST ALLOWABLE M_{YY_E} MOMENT. IT EXCEEDS THE LEAST CRACKING MOMENT BY 1.8%, AS ELEMENT 100 IS A 16" THICK ELEMENT THE $M_{CR_{16"}}$ IS 1318 $\frac{IN-LB}{IN}$. ALL OTHER M_{YY} VALUES DO NOT EXCEED 563 $\frac{IN-LB}{IN}$.
∴ M_{YY_E} IS ADEQUATE AND THE WALL DOES NOT CRACK. THE OBE ANALYSIS IS COMPLETE.

INCREASE MOMENTS BY 1.3 TO ACCOUNT FOR HIGHER MODES.

OBE (CONTINUED)

$$M_{xx\,MAX} = 1.3(108.4\ \tfrac{IN-LB}{IN}) = 140.9\ \tfrac{N-LB}{IN} < 304\ \tfrac{IN-LB}{IN}$$

$$M_{YY\,MAX} = 1.3(573.0\ \tfrac{IN-LB}{IN}) = 744.9\ \tfrac{IN-LB}{IN} < 1056\ \tfrac{IN-LB}{IN}$$

∴ O.K.

SSE:

THE RESULTS OF THE MAXIMUM EARTHQUAKE ANALYSIS ARE SHOWN BELOW. (REF. SØ-RS-188.10-SSE-0)

$f_n = 18.8$ HZ

$$M'_{xx\,MAX} = 168.3\ \tfrac{IN-LB}{IN} < \begin{matrix} M_{CR_{x\,3''}} = 904\ \tfrac{IN-LB}{IN} \\ M'_{ALLOW_x} = 452\ \tfrac{IN-LB}{IN} \end{matrix}$$

THE MAXIMUM M'_{xx} FOR ALL ELEMENTS IS LESS THAN THE ALLOWABLE AND CRACKING MOMENTS OF THE WEAKEST SECTION OF THE WALL.
∴ M'_{xx} IS ADEQUATE AND DOES NOT CRACK.

SSE:

$$M'_{YY_{MAX}} = \underset{(\text{ELEMENT } 100)}{889.2 \frac{\text{IN-LB}}{\text{IN}}} < M'_{ALLOW_{Y_{8"}}} = 2112 \frac{\text{IN-LB}}{\text{IN}}$$

THE MAXIMUM M'_{YY} FOR ALL ELEMENTS IS LESS THAN THE LEAST ALLOWABLE M_{YY} FOR MAXIMUM EARTHQUAKE. ∴ M'_{YY} IS ADEQUATE.

$M'_{YY\,MAX}$ IS FOUND IN A 16" THICK SECTION OF THE WALL THE CRACKING MOMENT OF A 16" SECTION IS 1318 $\frac{\text{IN-LB}}{\text{IN}}$. ∴ THE 16" SECTION DOES NOT CRACK. THE HIGHEST MOMENT IN A 12" OR 8" THICK SECTION OF WALL IS 531.2 $\frac{\text{IN-LB}}{\text{IN}}$ IN ELEMENT 77. THIS IS LESS THAN THE LESSER OF THE CRACKING MOMENTS FOR EITHER 8" OR 12" SECTIONS. ∴ THIS WALL DOES NOT CRACK AND THE ANALYSIS IS COMPLETE.

INCREASE MOMENTS BY 1.3 TO ACCOUNT FOR HIGHER MODES.

$$M_{XX}' = 1.3(168.3 \tfrac{\text{IN-LB}}{\text{IN}}) = 218.8 \tfrac{\text{IN-LB}}{\text{IN}} < 452 \tfrac{\text{IN-LB}}{\text{IN}}$$

$$M_{YY}' = 1.3(889.2 \tfrac{\text{IN-LB}}{\text{IN}}) = 1156.0 \tfrac{\text{IN-LB}}{\text{IN}} < 2112 \tfrac{\text{IN-LB}}{\text{IN}}$$

∴ O.K.

PRESSURE ANALYSIS:

WALL 188.10 IS SUBJECT TO PRESSURE LOADS FROM PBOC AND TORNADO. THIS ANALYSIS WILL BE DONE TREATING THE WALL AS AN 8" PARTITION WALL THROUGHOUT. IN THIS MANNER ONLY ONE WYTHE OF THE 16" SECTIONS IS CONSIDERED TO BE CARRYING THE LOAD AND THE ANALYSIS WILL BE CONSERVATIVE. ALSO, TREATING THE WALL THIS WAY FACILITATES THE USE OF EWALLS IN THE ITERATIVE SOLUTION OF THE RESULTANT MOMENTS.

THE NODES ALONG THE DOOR OPENINGS WILL BE SUBJECTED TO A FORCE IN THE Z DIRECTION WHICH WILL REPRESENT THE LOAD CAUSED BY PRESSURE ACTING ON A CLOSED DOOR.

THE PRESSURES ACTING ON THIS WALL ARE AS FOLLOWS:

$$P_{PBOC} = 0.55 \text{ PSI} \quad (\text{PM \#4 REV. 1})$$

$$P_{TORNADO} = 0.232 \text{ PSI} \quad (\text{PM \#5 REV. 1})$$
$$= 0.243 \text{ PSI}$$

THIS ANALYSIS WILL ATTEMPT TO QUALIFY THE WALL USING THE PBOC PRESSURE. SHOULD THE WALL QUALIFY FOR PBOC THEN THE TORNADO PRESSURE IS ALSO QUALIFIED.

PRESSURE ANALYSIS (CONTINUED)

COMPUTE F_z DUE TO PRESSURE ON DOOR:

$$F_z = \frac{0.55\ \text{psi}\ (40.5")(86.5")}{13\ \text{NODE/OPENING}} = 148\ ^{LB}/_{\text{NODE}}$$

THIS FORCE WILL BE INPUT AT GRID POINTS (8,2)(10,2)(29,2)(8,3)(10,3)(29,3)(8,4)(10,4)(29,4)(8,5)(10,5)(29,5)(8,6)(9,6)(10,6)(28,6)(29,6).

NODES THAT LIE ALONG WALL BOUNDARIES ARE NOT INPUT AS THEY WILL HAVE NO EFFECT ON THE RESULTS.

THE RESULTS OF THE PRESSURE ANALYSIS ARE SHOWN BELOW CONVERGENCE ON AN ITERATIVE SOLUTION WAS ACHIEVED. (REF. SØ-PBØC-188.10-5 AND EØ-PBØC-188.10-6)

$$M_{xx\ MAX} = 403.7\ \frac{IN-LB}{IN} < 452\ \frac{IN-LB}{IN}$$

(ELEMENT 104)

$$M_{yy\ MAX} = 907.4\ \frac{IN-LB}{IN} < 2112\ \frac{IN-LB}{IN}$$

(ELEMENT 97)

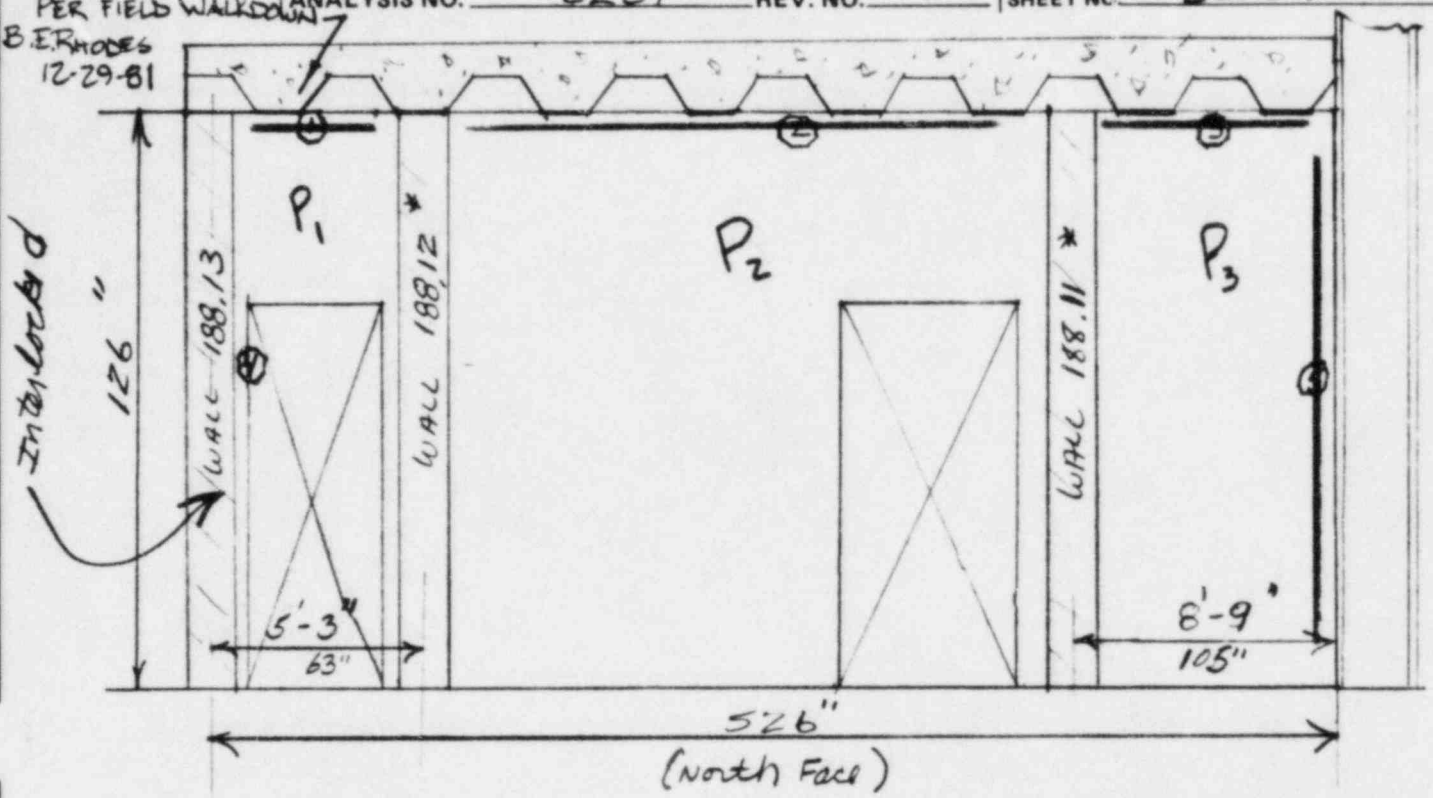
WALL IS ADEQUATE FOR PBOC AND TORNADO.

CALCULATION SHEET

EES

PREPARED BY: J. Richard	DATE: 11/19/81
CHECKED BY: M. MORYAN	DATE: 12/1/81
PROJECT: Pilgrim Unit 1	
SUBJECT: Masonry Wall Boundary Mod.	
SYSTEM: Walt 188.10	
ANALYSIS NO.: 2251 REV. NO.: 1	JOB NO.: 80034 FILE NO.: 29F
	SHEET NO.: 2251-20

Q-DECKING RUNS PARALLEL TO 188.10 PER FIELD WALKDOWN
B.E. RHODES 12-29-81



*Boundary @ WALL 188.12 will be done for both walls in the calc for wall 188.12 (calc. 5)
*Boundary @ WALL 188.11 will be done for both walls in the calc. for wall 188.11 (calc. 5252)

$P_{1OBE} = .092$ psi | $P_{2OBE} = .239$ psi | $P_{3OBE} = .089$

$P_{1SSE} = .142$ psi | $P_{2SSE} = .368$ psi | $P_{3SSE} = .137$ (Ref calc 2251)

$W_{side} = \frac{.55(63")}{2} = 17.\#/in$ | $W_{top} = \frac{.55(126")}{2} = 35\#/in$ | $W_{side} = \frac{.55(105)}{2} = 29\#/in$

$W_{top} = \frac{.55(126)}{2} = 35\#/in$ | $W_{side} = \frac{.55(358)}{2} = 98.5$ | $W_{top} = \frac{.55(126)}{2} = 35\#/in$

$P_{POOL} = .55$ psi Ref. P.M. #4

$P_{torn} = .232$ psi, $.243$ psi Ref. P.M. #5

Calculation Sheet	Prepared By: M. Kuntz	Date: 7/27/82
	Checked By: D'Ilmercli	Date: 8-6-82
Project: Pilgrim Unit #1	Job No: 80034	File No: 29F
Subject: Masonry Wall Analysis		
System: Wall No. 188.10	Sheet No: 2251-21	
Analysis No: 2251 Rev. No: 2		

CYGNA

OUT-OF-PLANE SHEAR ANALYSIS
(ANALYSIS PER PM #12, rev 0)

1) Assume 8" shield wall.
2) Height of the wall is 10'-6" (ref. pg 3)
3) Horizontal acceleration is $g_E = .2$ and $g_{E'} = .30$ ($f_N = 18.8$ [ref. pg. 2] ref. PM #10, rev. 1, pg. 5 and 6)
4) Maximumum Horizontal Acceleration is $g_{E(ALLOW)} = 4.0$ and $g_{E'(ALLOW)} = 6.0$ (Ref. PM#12, Attachment 2, pg 5 of 8)
5) Equivilent Static Pressure is P = .912 (assume max. static pressure - conservative)

$\therefore$ $P_E = .912 * .2 = .182$ psi
$P_{E'} = .912 * .3 = .274$ psi
$P_{Torn} = .243$ psi (ref. PM #4, rev. 1)
$P_{PBOC} = .55$ psi (ref. PM #5, rev. 1)

6) Maximum Allowable Pressure ($\beta_8 = 1.384 \times 10^{-4}$ ref pg. 3)

$\therefore$ $P_{E(ALLOW)} = 1.384 \times 10^{-4} * 8 * 4.0 * 386.4$
$= 1.71$ psi
$P_{E'(ALLOW)} = 1.384 \times 10^{-4} * 8 * 6.0 * 386.4$
$= 2.57$ psi

$P_{E(ALLOW)} = 1.71 > P_E = .182$

$P_{E'(ALLOW)} = 2.57 > P_{E'} = .274$

$P_{E'(ALLOW)} = 2.57 > P_{TORN} = .243$

$P_{E'(ALLOW)} = 2.57 > P_{PBOC} = .55$

Conclusion: Wall 188.10 is adequate for out-of-plane shear forces.

EES | **CALCULATION COVER SHEET**

Job. No. 80034
File No. 9F
Calc. Set No. 1251
No. of Sheets 33

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 188.10 Problem No. 251

STATEMENT OF PROBLEM

Re-evaluation of Masonry Wall will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

* THIS WALL WAS ANALYZED IN ACCORDANCE WITH DC-1 REV. 0 AND WI-2 REV. 0. AS IT FAILED THERE IS NO REANALYSIS FOR LEVEL 1. LEVEL 2 CALCULATIONS WILL QUALIFY THE WALL. ↑ ATTEMPT TO

SOURCES OF DATA

EES Design Criteria (DC-1) Rev. 0.0
Project Memoranda Nos.
EES MWD Sketch Nos. 452, 453 REV. 0
Computer Output Files SO-FN-188.10, SO-ST-188.10, EO-TO-188.10, SO-TORN-188.10

UFD No. — Computer Binder No. 9.1F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI-2, Rev. ~~0~~ 2
EES Design Criteria and Project Memoranda
EES PNPS Calc. Set No. —
ADDED PAGES 2A, 2B, 2C, 23 THRU 30, SUPERSEDED PAGES 16, 17, 8
ADDED PAGES 16 THRU 22 FOR TORNADO

REMARKS

The results of this Level 1 Analysis are E-Seismic FAIL
E'-Seismic FAIL PBOC * Tornado FAIL
In-Plane Loads PASS Out of Plane FAIL
See Results of Analysis (P. —) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 1
F. TOFIGHI	J. DEVINCENTIS		SUPERSEDES CALCULATION
J. DEVINCENTIS	J. RYAN		SET NO. 1251 REV. 0
L. DOWNS	R.J. RICHARD		APPROVED BY: B A Bryant
S. CAPOBIANCO	F. TOFIGHI		DATE: 2/26/82

EES 08/80 - 100 Rev. 0

EES

CALCULATION COVER SHEET

Job. No. 80034
File No. 1-F 155
Calc. Set No. 1251
No. of Sheets 19

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT
Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 188.10 Problem No. 1251

STATEMENT OF PROBLEM
Seismic Re-Evaluation of Masonry Wall 188.10 will be performed in accordance with Design Criteria (DC-1)

SUPERSEDED

SOURCES OF DATA
EES Design Criteria (DC-1) REV. 0

Bechtel Dwg No.'s C-188, 146, 147, M-16

EES As-Built M.W.D.'s SK-452, 453

[COMPUTER OUTPUT BINDER NO. 1.1.F]

Computer Run No.'s SO-FN-188.10, SO-ST-188.10
EO-TO-188.10, SO-TORN-188.10

SOURCES OF FORMULAE & REFERENCES
EES Work Instructions WI-1 to WI-2 REV. 0
EES Design Criteria (DC-1) REV. 0
EES PNPS Calc. Set No. G1000

REMARKS
This wall is NOT adequate by virtue of level ONE analysis.
NOT QUALIFIED FOR TORNADO
PASSED PBOC

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 0
L. DOWNS 2/25/81	R.J. RICHARD 3/18/81		SUPERSEDES CALCULATION
S. CAPOBIANCO 5/4/81	F. TOFIGHI 5/4/81		SET NO. N/A
			APPROVED BY: W. Duffy
			DATE: 5/8/81

EES 08/80 (100 Rev)

EES

CALCULATION SHEET

PREPARED BY L. DOWNS			DATE 2/19/81
CHECKED BY R.J. Richard			DATE 3-18-81
PROJECT PILGRIM UNIT 1		JOB NO. 80034	FILE NO. 9-F
SUBJECT MASONRY WALL ANALYSIS			
SYSTEM WALL 188.10			
ANALYSIS NO. 1251	REV. NO. 0	SHEET NO. 1251-1	

INTRODUCTION

WALL 188.10/PROBLEM 1251 IS A VARIABLE WYTH PARTITION WALL LOCATED AT EL. 23'-0" OF THE REACTOR BUILDING. WIDTHS OF 8", 12" AND 16" ARE FOUND THROUGHOUT ITS LENGTH. LEVEL 1 ANALYSIS AS DEFINED PER PILGRIM WI-2 WILL BE PERFORMED TO SATISFY DESIGN CRITERIA REQUIREMENTS.

WALL 188.10 WILL INITIALLY BE ANALYZED AS AN 8" PARTITION WALL ASSUMING NO REINFORCEMENT WITH IN THE ADDITIONAL WIDTH. REINFORCEMENT IN THE VERTICAL DIRECTION CORRESPONDS TO CASE C AND CASE E** IN THE HORIZONTAL DIRECTION. NOTE THAT WALL 188.11 AND WALL 188.12 ARE NONSAFETY RELATED, BUT ARE ASSUMED TO PROVIDED ADEQUATE SUPPORT TO WALL 188.10. HOWEVER, WALL 188.14 IS CONSERVATIVELY ASSUMED TO PROVIDED NO SUPPORT TO WALL 188.10.

WALL 188.10 WAS ALSO ANALYZED IN TWO SECTIONS DUE TO A LACK OF INFORMATION (SEE ENCLOSED FIR NO. 12). HOWEVER, THE RIGHT PORTION OF THIS WALL FAILED MAKING IT UNNECESSARY TO EVALUATE THE OTHER PORTION WITH LEVEL 1.

EES

CALCULATION SHEET

PREPARED BY: L. DOWNS	DATE: 2/25/81
CHECKED BY: RJ Richard	DATE: 3-18-81
PROJECT: PILGRIM UNIT 1	JOB NO.: 80034 / FILE NO.: 9-F
SUBJECT: MASONRY WALL ANAL.	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 1251 REV. NO.: 0	SHEET NO.: 1251 - 2

SUMMARY

FROM LEVEL 1 ANALYSIS, WALL 188.10 IS NOT ADEQUATE FOR THE SEISMIC EXCITATION AT ELEVATION 51'-0" OF THE REACTOR BLDG.

$f_n = 4.76$ HZ

E: $M_{XX_E} = 1370 \frac{in\text{-}lb}{in} > 763 \frac{in\text{-}lb}{in}$ N.G

$M_{YY_E} = 3500 \frac{in\text{-}lb}{in} > 1214 \frac{in\text{-}lb}{in}$ N.G.

$\Delta_E = 1.47$ in

$P_{1E} = 1.147 \frac{lb}{in^2}$

$P_{3E} = 1.877 \frac{lb}{in^2}$

$P_{4E} = 2.161 \frac{lb}{in^2}$

E': $M_{XX_{E'}} = 1510 \frac{in\text{-}lb}{in} > 1375 \frac{in\text{-}lb}{in}$ N.G.

$M_{YY_{E'}} = 3840 \frac{in\text{-}lb}{in} > 2277 \frac{in\text{-}lb}{in}$ N.G.

$\Delta_{E'} = 1.61$ in

$P_{1E'} = 1.258 \frac{lb}{in^2}$

$P_{3E'} = 2.059 \frac{lb}{in^2}$

$P_{4E'} = 2.371 \frac{lb}{in^2}$

EES

CALCULATION SHEET

PREPARED BY: S. Capobianco	DATE: 5/4/81
CHECKED BY: F. Tofighi	DATE: 5/4/81
PROJECT: Pilgrim Unit 1	
SUBJECT: Masonry Wall Analysis	
SYSTEM: Wall 188.10	
ANALYSIS NO.: 1251 REV. NO.: 1	JOB NO.: 80034 FILE NO.: 9-F
	SHEET NO.: 1251-2A

S. Capobianco

Summary of Results (Tornado Analysis)

Using a tornado pressure equal to 1.54 psi

$m_{xx} = 1135 \frac{in\text{-}lb}{in} < 1375 \frac{in\text{-}lb}{in}$ ok.

$m_{yy} = 3750 \frac{in\text{-}lb}{in} > 2277 \frac{in\text{-}lb}{in}$ N.G.

$F.S._{min} = 0.6$

1 F. Tofighi 8/4/81

1 V. RYAN 8/5/81

Wall 188.10 is not adequate to withstand tornado loading per EES Design Criteria DC-1.

PBOC Analysis

$P_{PBOC} = .93$ psi

$m_{xx} = \frac{.93}{1.54}(1311) = 792 \frac{in\text{-}lb}{in} < 1375 \frac{in\text{-}lb}{in}$ OK

$m_{yy} = \frac{.93}{1.54}(3108) = 1877 \frac{in\text{-}lb}{in} < 2277 \frac{in\text{-}lb}{in}$ OK

$F.S._{min} = 1.2$

Wall 188.10 is adequate to withstand PBOC loading per EES Design Criteria DC-1.

EES

CALCULATION SHEET

PREPARED BY F. Tofighi	DATE 6/23/81
CHECKED BY J DEVINCENTIS	DATE 7/2/81
PROJECT PILGRIM #1	
SUBJECT MASONRY WALL ANALYSIS	JOB NO. 80034 / FILE NO. 9F
SYSTEM Wall 188.10	
ANALYSIS NO. 1251 REV. NO. 1	SHEET NO. 1251-2B

SUMMARY

IN PLANE LOADING ANALYSIS

Shear Stress Comparison;

OBE	J_{OBE}	= 49.3 #/in²	< 69 #/in²	OK,
SSE	J_{SSE}	= 53.7 #/in²	< 104 #/in²	OK,
TORNADO	$J_{TORNADO}$	= 8.6 #/in²	< 104 #/in²	OK,
PBOC	J_{PBOC}	= 6.9 #/in²	< 104 #/in²	OK,

wall 188.10 is qualified for in plane loading.

EES

CALCULATION SHEET

PREPARED BY J DEVINCENTIS	DATE 8/14/81
CHECKED BY M. MORYAN	DATE 8/12/81
PROJECT PILGRIM UNIT ONE	
SUBJECT OUT OF PLANE SHEAR	
SYSTEM WALL 188.10	JOB NO. 80034 / FILE NO. 9F
ANALYSIS NO. 1251 REV. NO. 1	SHEET NO. 1251-2C

SUMMARY OF RESULTS (CONT)

OUT-OF-PLANE (SHEAR) LOADING

GROUP ACTION: BASED ON A REVIEW OF THE BUILDING STRUCTURE THERE IS NO INTERACTION ANALYSIS REQUIRED FOR THIS WALL.

SHEAR ANALYSIS: (REFERENCE CALC. G 3000)

WALL 188.10 HAS BEEN ANALYZED FOR OUT-OF-PLANE SHEAR EFFECTS FROM EARTHQUAKE, PBOC AND TORNADO. THE RESULTS ARE:

DESIGN (ODE) EARTHQUAKE: P

MAXIMUM (SSE) EARTHQUAKE: P

PBOC : P

TORNADO : F

EES

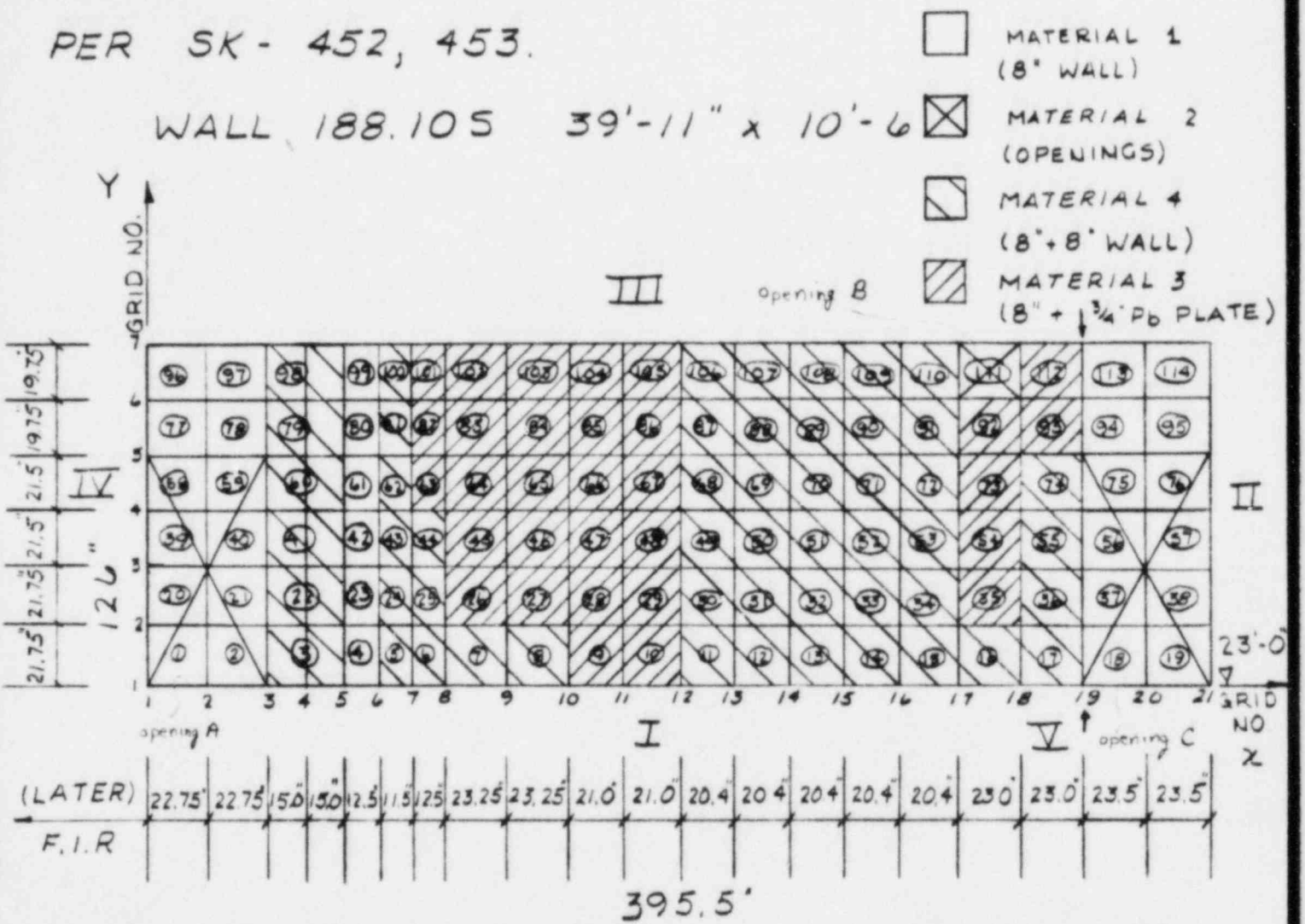
CALCULATION SHEET

PREPARED BY L. DOWNS	DATE 2/19/81
CHECKED BY RJ Reland	DATE 3-18-81
PROJECT PILGRIM UNIT 1	JOB NO. 80034 / FILE NO. 9-F
SUBJECT MASONRY WALL ANALYSIS	
SYSTEM WALL 188.10	
ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251-3

WALL GEOMETRY & BOUNDARY CONDITIONS

PER SK-452, 453.

WALL 188.105 39'-11" x 10'-6"



EDGE	CONDITION	
I	PINNED	REF. DC-1 EXHIBIT C
II	PINNED	
III	PINNED	
IV	PINNED	
V	PINNED	

EES

CALCULATION SHEET

PREPARED BY: L. DOWNS	DATE: 2/19/81
CHECKED BY: RJ Richard	DATE: 3-18-81
PROJECT: MILLSTONE UNIT 1	JOB NO.: 80034 / FILE NO.: 9-F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 1251 REV. NO.: 0	SHEET NO.: 1251-4

WALL DIMENSIONS

CHECK RATIOS OF FINITE ELEMENT DIMENSIONS PER WI-2, SECTION 5.4:

$$\text{GRID RATIO} = \frac{23.5"}{11.5"} = 2.0 \leq 2.0 \quad \text{OK}$$

$$\text{THICKNESS RATIO} = \frac{11.5"}{7.625"} = 1.5 \not\leq 2.0 \quad \text{N.G.}$$

EES

CALCULATION SHEET

PREPARED BY: L. DOWNS	DATE: 2/19/81
CHECKED BY: RJ Richard	DATE: 3-18-81
PROJECT: PILGRIM UNIT 1	JOB NO.: 80034 / FILE NO.: 9-F
SUBJECT: MASONRY WALL ANAL	
SYSTEM: WALL 188.10	
ANALYSIS NO.: 1251 REV. NO.: 0	SHEET NO.: 1251-5

WEIGHT OF ATTACHED EQUIPMENT : 188.105

ATTACHMENT & LENGTH (ft)	WT/LENGTH (lbs/ft)	ATTACHMENT WT. (lbs)
18' - 3/4" ϕ C	1.4 DC - 1 EXHIBIT D ↓	25.2
17' - 1" ϕ C	2.1	35.7
11.5'-1 1/2" ϕ - M982	3.6	41.4
6.5'- 1 1/2" ϕ C	3.6	23.4
11.5'-2" ϕ - M136	5.0	57.5
11.5'-2" ϕ - P903	5.0	57.5
19' - 2" ϕ DRAIN LINE	6.3	119.7
1 - GATE VALVE	50#/VALVE	50.0
1 - BALL VALVE	50#/VALVE	50.0
48.5'- 2" ϕ FIRE PROT.	6.3	305.6
2 - FIRE LINE VALVE	10#/VALVE	20.0
1 - FIRE HOSE REEL	75#/REEL	75.0
6.5' - 3" ϕ - P428	11.0	71.5
11.5' - 3" ϕ - M230	11.0	126.5
11.5' - 3" ϕ - M231	11.0	126.5

EES	CALCULATION SHEET	PREPARED BY L. DOWNS	DATE 2/19/81
	PROJECT PILGRIM UNIT 1	CHECKED BY RJ Richard	DATE 3-18-81
	SUBJECT MASONRY WALL ANAL.	JOB NO. 80034	FILE NO. 9-F
	SYSTEM WALL 188.10		
	ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251-6	

WEIGHT OF ATTACHED EQUIPMENT : (CONT) 188.10 S

ATTACHMENT & LENGTH (ft)	WT/LENGTH (lbs/ft)	ATTACHMENT WT (lbs)
11.5' - 3" ϕ C	11.0	126.5
11.5' - 4" ϕ GALV. PIPE	20.0	230.0
11.5' - 4" ϕ CAST IRON PIPE	20.0	230.0
3 - SWITCHES	5/SWIT.	15.0
1 - JUNCTION BOX - N612 ~ 15.5" x 19" x 8"	5#/FT²	39.6
1 - TRANSFORMER - CVT ~ 21" x 10.5" x 8"	5#/FT²	32.8
1 - TELEPHONE BOX ~ 14" x 12" x 3"		19.6
2 - DOORS	100#/DOOR	200.0
4 - FIRE EXTINGUISHERS	30#/EXT.	120.0

TOTAL 188 10S ≈ 2199.0 lbs

WEIGHT OF 3/4" THICK LEAD PLATE : 188.10S

PER AISC, 7th ED., PG 6-14

W_{LEAD} = 710 lbs/ft³ = 0.411 lbs/in³

P_{LEAD} = 0.411 lbs/in³ x 3/4" = 0.3082 $\frac{lbs}{in^2}$

EES

CALCULATION SHEET

PREPARED BY: L. DOWNS	DATE: 2/19/81
CHECKED BY: RJ Richard	DATE: 3-18-81
PROJECT: PILGRIM UNIT 1	JOB NO.: 80034 / FILE NO.: 9-F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: WALL 188.10S	
ANALYSIS NO.: 1251 REV. NO.: 0	SHEET NO.: 1251-7

ATTACHMENT WEIGHT : 188.10N

ATTACHMENT & LENGTH (ft)	WT/LENGTH (lbs/ft)	ATTACHMENT WT (lbs)
49' - 3/4" ϕ C	1.4	69
2 - JUNCTION BOXES ~ 4" x 4" x 6"	5.0 #/FT²	8.8
1 - JUNCTION BOX ~ 4" x 6" x 6"	5.0 #/FT²	5.8
15'-7" - CABINETS ~15'-7" x 2'-5" x 1'	5.0 #/FT²	557
1 - 220 OUTLET ~ 6" x 6" x 6"	5.0 #/FT²	7.5
1 - SWITCH	5.0 #/SWIT	5.0

TOTAL $_{188.10N}$ ≈ 653.1 lbs

TOTAL ATTACHMENT WEIGHT (MATERIAL 1)

$W_{188.10-1} = 2199.0 + 653.1 = 2852.1$ lbs

TOTAL ATTACHMENT WEIGHT (MATERIAL 3)

$W_{188\ 10-3} = 2852.1 + 0.3082 \frac{lb}{in^2} \times AREA_3$

TOTAL ATTACHMENT WEIGHT (MATERIAL 4)

$$W_{188.10-4} = 2852.1 + 0.428 \frac{lb}{in^2} \times AREA_4$$

TOTAL ATTACHMENT LOADINGS

$AREA_1$ = 39'-11" x 10'-6" - 3'-4½" x 7'-2¼"
- 1'-8" x 1'-8" - 3'-4½" x 7'-2¼"

= 52968 in^2

$AREA_{3-1}$ = 6'-0" x 12½" + 9'-1½" x 3'-10½"
+ 10'-6" x 3'-6"

= 11284 in^2

$AREA_{3-2}$ = 8'-4" x 2'-10" + 6'-5" x 1'-0"

= 4324 in^2

$$P_{188.10-1} = \frac{2852.1 \text{ lbs}}{52968 \text{ in}^2} = 0.0538 \frac{lbs}{in^2}$$

OK

$$P_{188.10-3} = 0.0560 \frac{lbs}{in^2} + 0.3082 \frac{lbs}{in^2}$$

$$= 0.3642 \frac{lbs}{in^2}$$

$$P_{188.10-4} = 0.0560 \frac{lbs}{in^2} + 0.428 \frac{lbs}{in^2}$$

$$= 0.484 \frac{lb}{in^2}$$

$$P_{188.10-1} = \frac{2852.1 \text{ lbs}}{52968 \text{ in}^2 (7.625 \text{ in})(386.4 \text{ in/sec}^2)}$$

$$= 0.183 \times 10^{-4} \frac{\text{lb-sec}^2}{\text{in}^4}$$

$$P_{188.10-3} = \frac{0.364 \text{ lbs/in}^2}{7.625 \text{ in } (386.4 \text{ in/sec}^2)}$$

$$= 1.235 \times 10^{-4} \frac{\text{lb-sec}^2}{\text{in}^4}$$

$$P_{188\,10-4} = \frac{0\,484 \text{ lbs/in}^2}{7.625 \text{ in } (386.4 \text{ in/sec}^2)}$$

$$= 1.643 \times 10^{-4} \frac{\text{lb-sec}^2}{\text{in}^4}$$

$$\text{AREA}_{4-1} = 10'-6" \times 11\tfrac{1}{2}" + 4'-6" \times 12\tfrac{1}{2}" + 3'-10\tfrac{1}{2}" \times 16\tfrac{1}{2}"$$

$$= 2891 \text{ in}^2$$

$$\text{AREA}_{4-2} = 10'-6" \times 8'-6" + 2'-2" \times 2'-10" + 6'-5" \times 1'-0"$$

$$= 14660 \text{ in}^2$$

$$\text{AREA}_{4-3} = 10'-6" \times 2'-6" = 3780 \text{ in}^2$$

EES

CALCULATION SHEET

PREPARED BY L. DOWNS	DATE 2/20/81
CHECKED BY R. Richard	DATE 3-18-81
JOB NO. 80034	FILE NO. 9-F
PROJECT PILGRIM UNIT 1	
SUBJECT MASONRY WALL ANAL.	
SYSTEM WALL 188.10	
ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251-10

MASS DENSITY AND EQUIVALENT STATIC PRESSURE OF 8" MASONRY

$$\rho_{8"} = 1.383 \times 10^{-4} \ \frac{lb\text{-}sec^2}{in^4}$$ REF DC-1

$$P_{8"} = 0.428 \ \frac{lb}{in^2}$$ EXHIBIT D-1b

TOTAL MASS DENSITY AND EQUIVALENT STATIC PRESSURE

MATERIAL 1

$$\rho_1 = 0.183 \times 10^{-4} + 1.383 \times 10^{-4}$$

$$= 1.566 \times 10^{-4} \ \frac{lb\text{-}sec^2}{in^4}$$

$$P_1 = 0.0560 + 0.428$$

$$= 0.484 \ \frac{lb}{in^2}$$

MATERIAL 3

$$\rho_3 = 1.235 \times 10^{-4} + 1.383 \times 10^{-4}$$

$$= 2.618 \times 10^{-4} \ \frac{lb\text{-}sec^2}{in^4}$$

$$P_3 = 0.3642 + 0.428$$

$$= 0.792 \ \frac{lb}{in^2}$$

MATERIAL 4

$$\rho_4 = 1.643 \times 10^{-4} + 1.383 \times 10^{-4}$$

EES

CALCULATION SHEET

PREPARED BY L. DOWNS	DATE 2/20/81
CHECKED BY RJ Richard	DATE 3-18-81
JOB NO. 80034	FILE NO. 9-F
PROJECT PILGRIM UNIT 1	
SUBJECT MASONRY WALL ANAL	
SYSTEM WALL 188.10	
ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251 - 11

MATERIAL 4 (CONT.)

$$\rho_4 = 3.026 \times 10^{-4} \ \frac{lb\text{-}sec^2}{in^4}$$

$$\rho_4 = 0.484 + 0.428$$

$$= 0.912 \ \frac{lb}{in^2}$$

EES	CALCULATION SHEET	PREPARED BY L. DOWNS	DATE 2/23/81
	PROJECT PILGRIM UNIT 1	CHECKED BY RJRichard	DATE 3-18-81
	SUBJECT MASONRY WALL ANAL.	JOB NO. 80034	FILE NO. 9-F
	SYSTEM WALL 188.10		
	ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251 - 12	

FREQUENCY ANALYSIS

EXECUTE EWALL TO GENERATE A SAP IV FREQUENCY ANALYSIS INPUT FILE. SELECT ORTHOTROPIC PLATE PROPERTIES FROM DC-1, EXHIBIT D-1c FOR CASE C AND CASE E**. EXECUTE SAP IV TO DETERMINE THE FUNDAMENTAL FREQUENCY.

EWALL INPUT : EI-FN-188.10

```
1  * LEVEL 1 ANALYSIS - WALL 188.10 - FREQUENCY AN
2    20, 6, 1, 1, 3, 0, 0, 5, 0, 15, 0
3    0, 1, 1, 0, 0
4    1, 1, 21, 1, 0, 0, 1, 0, 1
5    21, 1, 21, 7, 0, 0, 1, 1, 0
6    1, 7, 21, 7, 0, 0, 1, 0, 1
7    1, 1, 1, 7, 0, 0, 1, 1, 0
8    19, 1, 19, 7, 0, 0, 1, 1, 0
9    1, 1, 3, 5
10   17, 6, 18, 7
11   19, 1, 21, 5
12   395.5, 126.0, 7.625
13   22.75, 22.75, 15.0, 15.0, 12.5, 11.5, 12.5, 23.25
14   23.25, 21.0, 21.0, 20.4, 20.4, 20.4, 20.4, 20.4
15   23.0, 23.0, 23.5, 23.5
16   21.75, 21.75, 21.5, 21.5, 19.75, 19.75
17   1350., 810,000., 324,000., .0001573, 1800. ←
18   1, 1, 3, 7, 0.484 ← 3, 1, 5, 7, 0.912
19   5, 1, 6, 7, 0.484
20   6, 1, 7, 7, 0.912
21   7, 1, 8, 4, 0.912
22   7, 4, 8, 7, 0.792
23   8, 1, 10, 2, 0.912
24   8, 2, 10, 7, 0.792
     10, 1, 12, 7, 0.792
```

FREQUENCY ANALYSIS (CONT)

25	12, 1, 17, 7, 0.912
26	17, 1, 18, 2, 0.912
27	18, 1, 19, 5, 0.912
28	17, 2, 18, 7, 0.792
29	18, 5, 19, 7, 0.792
30	19, 1, 21, 7, 0.484

ORTHOTROPIC SECTION PROPERTIES

$C_{xx} = 9.960\ E\ 04$

$C_{xy} = 2.080\ E\ 04$

$C_{yy} = 1.080\ E\ 05$

$G_{xy} = 4.150\ E04$

} FOR CASE C AND CASE E**, REF. DC-1 EXHIBIT D-1c

FROM COMPUTER OUTPUT : SO-FN-188.10

$f_N = 4.76$ HZ

CALCULATION SHEET	PREPARED BY L. DOWNS	DATE 2/24/81
EES	CHECKED BY RJRichard	DATE 3-18-81
PROJECT MILLSTONE UNIT 1	JOB NO. 80034	FILE NO. 9-F
SUBJECT MASONRY WALL ANALYSIS		
SYSTEM WALL 188.10		
ANALYSIS NO. 1251 REV. NO. 0	SHEET NO. 1251 - 14	

STATIC ANALYSIS

MODIFY SAP IV INPUT FILE BY INDICATING A STATIC ANALYSIS ON THE MASTER CONTROL CARD. EXECUTE SAP IV TO DETERMINE EQUIVALENT STATIC FORCES UNDER A HORIZONTAL SEISMIC ACCELERATION OF 1 'g'.

FROM RESPONSE SPECTRA CURVES FOR LEVEL 1 MASONRY WALL SEISMIC ANALYSIS, PER DC-1, EXHIBIT A, AT MASS POINT 3 FOR THE REACTOR BLDG AT THE NEXT HIGHER ELEVATION THAN BASE OF WALL.

E HORIZONTAL ACCELERATION = 2.37 g

E' HORIZONTAL ACCELERATION = 2.60 g

FROM COMPUTER RUN : SO-ST-188.10

M_{xx} = 580 $\frac{in \cdot lb}{in}$ AT ELEMENT 99

M_{yy} = 1476 $\frac{in \cdot lb}{in}$ AT ELEMENT 51

Δ_{MAX} = 0.62 in AT NODE 74

FROM DC-1, EXHIBIT D-1c, CASES C & E**

$M_{xx\,E_{ALL}}$ = 763 $\frac{in \cdot lb}{in}$ $M_{xx\,E'_{ALL}}$ = 1375 $\frac{in \cdot lb}{in}$

$M_{yy\,E_{ALL}}$ = 1214 $\frac{in \cdot lb}{in}$ $M_{yy\,E'_{ALL}}$ = 2277 $\frac{in \cdot lb}{in}$

STATIC ANALYSIS (CONT.)

E: $M_{xx_E} = 580 \times 2.37 = 1370 \frac{in\text{-}lb}{in} > 763 \frac{in\text{-}lb}{in}$

$M_{yy_E} = 1476 \times 2.37 = 3500 \frac{in\text{-}lb}{in} > 1214 \frac{in\text{-}lb}{in}$

$\Delta_E = 0.62 \times 2.37 = 1.47 \text{ in}$

$P_{1E} = 0.484 \times 2.37 = 1.147 \frac{lb}{in^2}$

$P_{3E} = 0.792 \times 2.37 = 1.877 \frac{lb}{in^2}$

$P_{4E} = 0912 \times 2.37 = 2.161 \frac{lb}{in^2}$

E': $M_{xx_{E'}} = 580 \times 2.6 = 1510 \frac{in\text{-}lb}{in} > 1375 \frac{in\text{-}lb}{in}$

$M_{yy_{E'}} = 1476 \times 2.6 = 3840 \frac{in\text{-}lb}{in} > 2277 \frac{in\text{-}lb}{in}$

$\Delta_{E'} = 0.62 \times 2.6 = 1.61 \text{ in}$

$P_{1E'} = 0.484 \times 2.6 = 1.258 \frac{lb}{in^2}$

$P_{3E'} = 0.792 \times 2.6 = 2.059 \frac{lb}{in^2}$

$P_{4E'} = 0.912 \times 2.6 = 2.371 \frac{lb}{in^2}$

EES

CALCULATION SHEET

PREPARED BY J. RYAN	DATE 8/5/81
CHECKED BY F. Sofrigh	DATE 8/5/81
JOB NO. 80034	FILE NO. 9F
PROJECT PILGRIM #1	
SUBJECT MASONRY WALL ANALYSIS	
SYSTEM WALL 188.10	
ANALYSIS NO. 1251 REV. NO. 1	SHEET NO. 1251-16

THE ORIGINAL ANALYSIS WAS INCORRECT - THE WALL ELEMENTS BETWEEN NODES 3 & 5 ON THE X-GRID WERE ASSIGNED ONLY ONE NUMBER (SEE WALL MODEL P. 1251-3).

THE TORNADO ANALYSIS WAS REDONE WITH THE CORRECT WALL MODEL AND IT FAILED AGAIN.

THE MODIFICATION TO THE WALL WILL BE BASED ON THIS TORNADO ANALYSIS.

A LEVEL 2 ANALYSIS WILL BE PERFORMED AT A LATER DATE.

TORNADO / PBOC ANALYSIS

$P_{PBOC} = 0.93$
$P_{TORNADO} = 1.54$ #/in²

OPENINGS:

Area of opening A = (45.5)(86.5) = 3936 in²

Total load = 1.54 x 3936 = 6061 #

Concentrated load per node = $\frac{6061}{11}$ = 551 # over 11 nodes

Area of opening B = (23.0)(19.75) = 454 in²

Total load = 1.54 x 454 = 700 # over 4 nodes.

Concentrated load per node = $\frac{700}{4}$ = 175 #

Area of opening C = (47.0)(86.5) = 4067 in²

Total load = 1.54 x 4067 = 6263 # over 11 nodes

Concentrated load per node = $\frac{6263}{11}$ = 569 #

SECTION PROPERTIES:

MATERIAL 1 8" wall

2 opening

3 8" wall + 3/4" Pb plate (assumed 8" wall)

4 16" wall.

EES

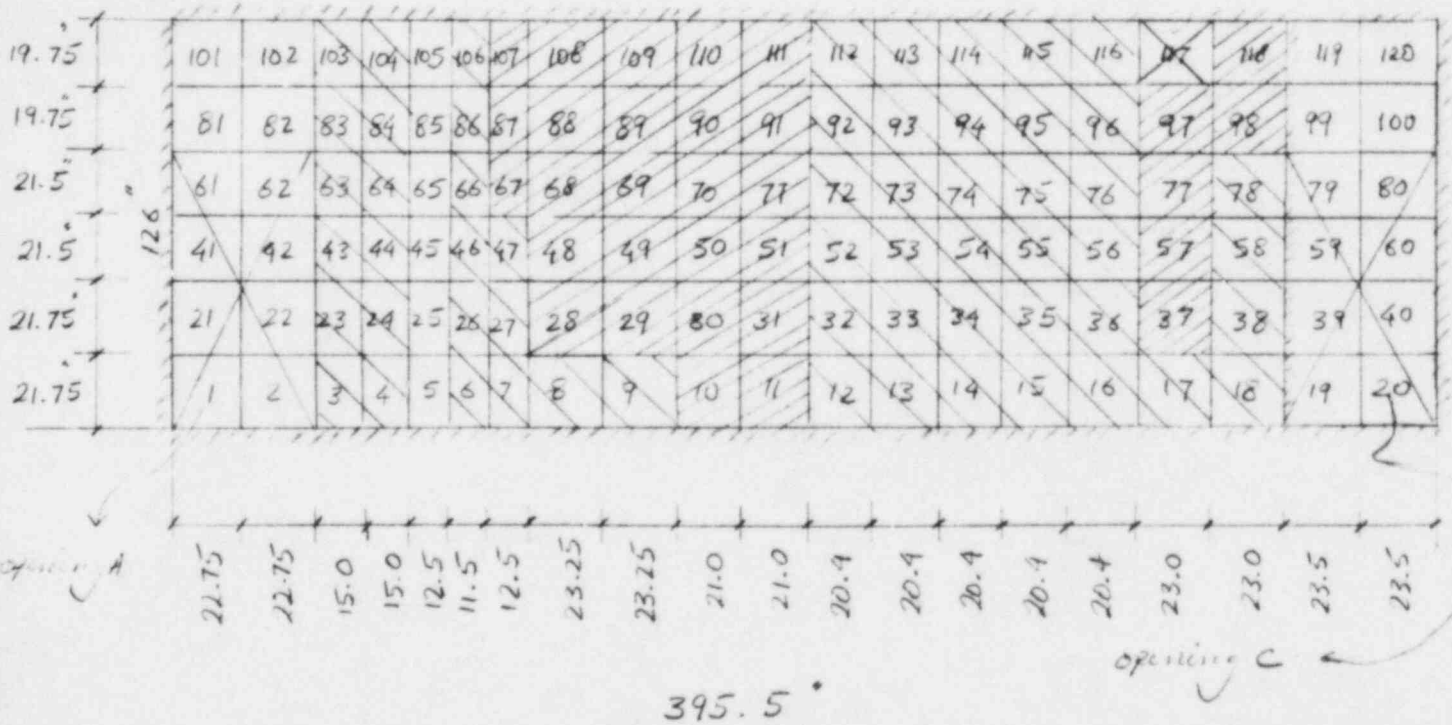
CALCULATION SHEET

PROJECT	PILGRIM #1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	wall 188.10
ANALYSIS NO.	1251 REV. NO. 1

PREPARED BY	J. Tofighi — DATE 8/4/81
CHECKED BY	V. RYAN — DATE 8/5/81
JOB NO.	80034
FILE NO.	9F
SHEET NO.	1251-18

WALL GEOMETRY & BOUNDRY CONDITIONS.

- ☐ Material 1 (8" wall)
- ☒ Material 2 (opening)
- ▨ Material 3 (8" wall + 3/4" Pb PLATE)
- ▧ Material 4 (8" + 8" wall)



395.5"

EES

CALCULATION SHEET

PREPARED BY: F. Tofighi	DATE: 8/4/81
CHECKED BY: V. RYAN	DATE: 8/5/81
JOB NO.: 60034	FILE NO.: 9F
SHEET NO.: 1251-19	

PROJECT: PILGRIM #1
SUBJECT: MASONRY WALL ANALYSIS
SYSTEM: wall 188.10
ANALYSIS NO.: 1251 REV. NO.: 1

Material 1)

$\rho = 1.566 \times 10^{-4}$ #-Sec^2/in^4 $C_{xx} = 9.960 \times 10^{4}$ PSI $C_{xy} = 2.080 \times 10^{4}$ PSI

$C_{yy} = 1.080 \times 10^{5}$ PSI $G_{xy} = 4.150 \times 10^{4}$ PSI

Material 2) OPENINGS.

Material 3)

$\rho = 2.618 \times 10^{-4}$ #-Sec^2/in^4 $C_{xx} = 9.960 \times 10^{4}$ PSI $C_{xy} = 2.080 \times 10^{4}$ PSI

$C_{yy} = 1.080 \times 10^{5}$ PSI $G_{xy} = 4.150 \times 10^{4}$ PSI

(Ref. DC-1, EX-D-2)

Material 4)

$\rho = 3.026 \times 10^{-4}$ #-Sec^2/in^4 $C_{xx} = 76200$ PSI $C_{xy} = 22800$ PSI

$C_{yy} = 166000$ PSI $G_{xy} = 45600$ PSI

EWALL INPUT (EI_TOR_188.10)

```
* WALL 188.10 TORNADO ANALYSIS

20, 6, 1, 1, 3, 0, 0, 5, 26, 1, 0
 0, 0, 0.0, 0
 1, 1, 21, 1, 1, 1, 1, 0, 1
21, 1, 21, 7, 1, 1, 1, 1, 0
 1, 7, 21, 7, 1, 1, 1, 0, 1
 1, 1, 1, 7, 1, 1, 1, 1, 0
19, 1, 19, 7, 1, 1, 1, 1, 0
 1, 1, 3, 5
17, 6, 18, 7
19, 1, 21, 5
395.5, 126.0, 7.625
22.75, 22.75, 15.0, 15.0, 12.5, 11.5, 12.5, 23.25,
23.25, 21.0, 21.0, 20.4, 20.4, 20.4, 20.4, 20.4,
23.0, 23.0, 23.5, 23.5
21.75, 21.75, 21.5, 21.5, 19.75, 19.75
 0.0, 810000., 337500., .0001573, 0.0
 1, 1, 21, 7, 1.54
 1, 1, 0, 0, 551., 0, 0
 3, 1, 0, 0, 551., 0, 0
19, 1, 0, 0, 569., 0, 0
21, 1, 0, 0, 569., 0, 0
 1, 2, 0, 0, 551., 0, 0
 3, 2, 0, 0, 551., 0.0
19, 2, 0, 0, 569., 0, 0
21, 2, 0, 0, 569., 0, 0
 1, 3, 0, 0, 551., 0, 0
 3, 3, 0, 0, 551., 0, 0
19, 3, 0, 0, 569., 0, 0
```

EES

CALCULATION SHEET

PREPARED BY: F. Tofighi	DATE: 8/4/81
CHECKED BY: J. RYAN	DATE: 8/5/81
PROJECT: PILGRIM #1	
SUBJECT: MASONRY WALL ANALYSIS	JOB NO.: 80034 / FILE NO.: 9F
SYSTEM: wall 188.10	
ANALYSIS NO.: 1251 REV. NO.: 1	SHEET NO.: 1251-21

EWALL INPUT (Cont.)

```
21,3, 0,0, 569., 0,0
1,4, 0,0, 551., 0,0
3,4, 0,0. 551., 0,0
19,4, 0,0, 569., 0,0
21,4, 0,0, 569., 0,0
1,5, 0,0, 551., 0,0
2,5, 0,0, 551., 0,0
3,5, 0,0, 551., 0,0
19,5, 0,0, 569., 0,0
20,5, 0,0, 569., 0,0
21,5, 0,0, 569., 0,0
17,6, 0,0, 175., 0,0
18,6, 0,0, 175., 0,0
17,7, 0,0, 175., 0,0
18,7, 0,0, 175., 0,0
```

CALCULATION SHEET

EES

PREPARED BY: F. Tofighi	DATE: 8/4/81
CHECKED BY: J. RYAN	DATE: 8/5/81
PROJECT: PILGRIM #1	JOB NO.: 80034 / FILE NO.: 9F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: wall 188.10	
ANALYSIS NO.: 1251 REV. NO.: 1	SHEET NO.: 1251-22

STATIC ANALYSIS (Ref. SO.TOR_188.10)

$\delta z_{max.} = 1.01$ in @ node 72

$M_{xx}{}_{max.} = 1135 \frac{in-\#}{in}$ @ Elem. 82

$M_{yy}{}_{max.} = 3750 \frac{in-\#}{in}$ @ Elem. 43

Allowable moments; (Ref. DC-1, EX D)

$M_{xx}' = 1375 \frac{in-\#}{in}$ $M_{yy}' = 2277 \frac{in-\#}{in}$ (for 8" wall)

$M_{xx}' = 3013 \frac{in-\#}{in}$ $M_{yy}' = 7279 \frac{in-\#}{in}$ (for 16" wall)

CONCLUSION:

16" wall,

$M_{xx} = 455 \frac{in-\#}{in} < 3013 \frac{in-\#}{in}$ OK, @ Elem. 56

$M_{yy} = 8492 \frac{in-\#}{in} > 7279 \frac{in-\#}{in}$ NG. @ Elem. 66

8" wall,

$M_{xx} = 561 \frac{in-\#}{in} < 1375 \frac{in-\#}{in}$ OK, @ Elem. 82

$M_{yy} = 937 \frac{in-\#}{in} < 2277 \frac{in-\#}{in}$ OK, @ Elem. 68

wall 188.10 is <u>not</u> adequate to withstand max. tornado loading.

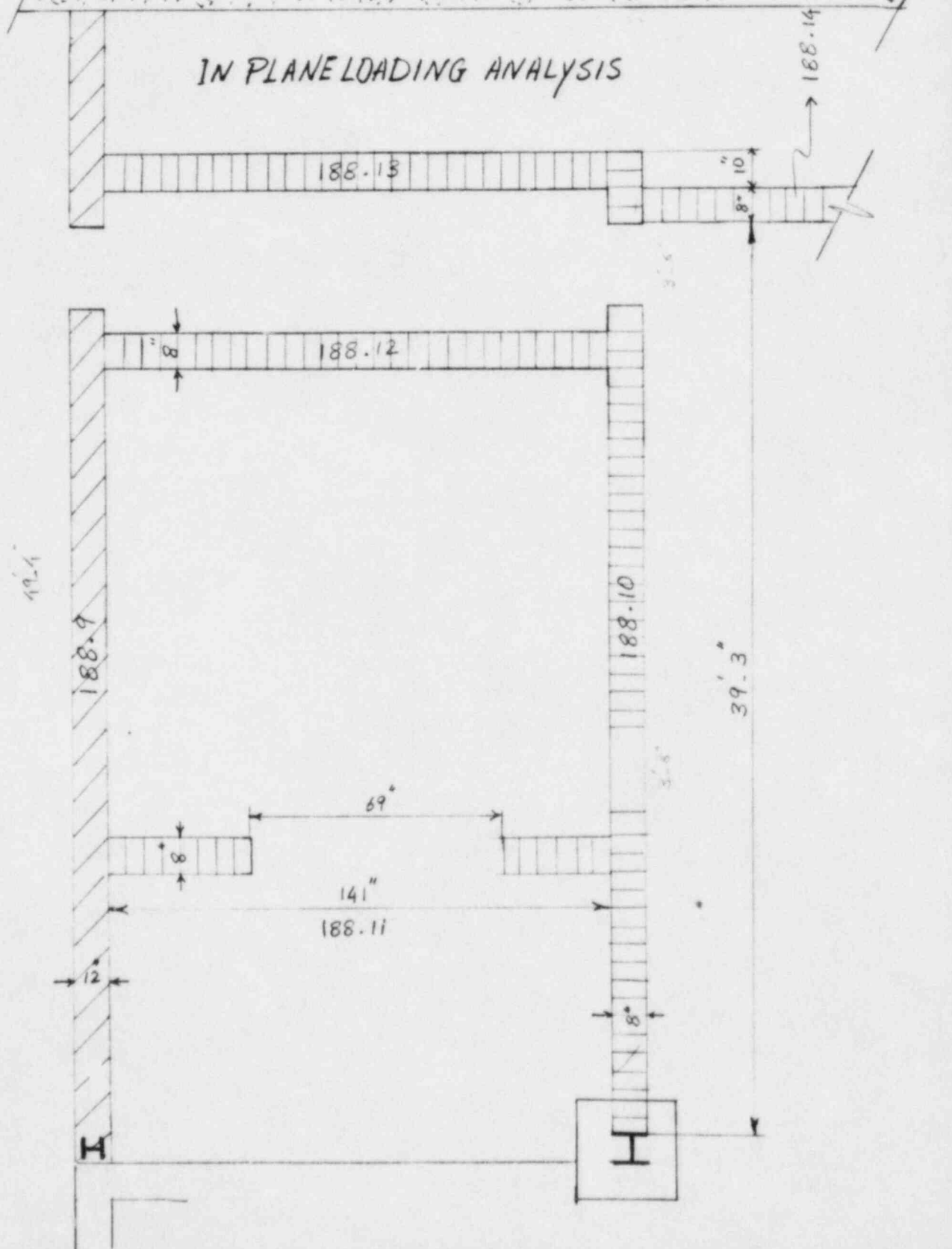
EES

CALCULATION SHEET

PROJECT	PILGRIM #1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	wall 188.10
ANALYSIS NO.	1251
REV. NO.	1

PREPARED BY	F. Tofighi
DATE	6/23/81
CHECKED BY	J DEVINCENTIS
DATE	7/2/81
JOB NO.	80034
FILE NO.	9F
SHEET NO.	1251-23

IN PLANE LOADING ANALYSIS



FORCES DUE TO SIESMIC EXCITATION:

There is a 9" thick concrete slab on wall 188.10 spanning from the wall panels to wall 188.13.

The weight of the concrete slab is assumed to be 150 #/ft³

weight of slab = $150 \times \frac{1}{1728} \times 489\,(141+8+12) \times 9 = 61507$ #

weight of wall 188.10, (SEE PG: 3, 10, 11, 17 of Calc. 188.10)

= Area 1 × 0.484 + Area 3 × 0.792 + Area 4 × 0.912

Area 1 = 45.5 × 39.5 + 12.5 × 126 + 47 × 39.5 + 112 × 126 = 19341

Area 3 = 12.5 × 61 + 46.5 × 104.25 + 42 × 126 + 84.5 × 23 + 23 × 39.5

Area 3 = 13754 in²

Area 4 = 30 × 126 + 11.5 × 126 + 12.5 × 65 + 46.5 × 21.75 + 102 × 126 + 23 × 21.75 + 23 × 21.75 + 23 × 86.5

Area 4 = 22895 in²

weight of wall 188.10, = 19341 × 0.484 + 13754 × 0.792 + 22895 × 0.912

, = 41134 #

Total weight effecting 188.10, = $\frac{61507}{2}$ + 41134 = 71888 # (conservative)

EES

CALCULATION SHEET

PROJECT	PILGRIM #1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	Wall 188.10
ANALYSIS NO.	1251
REV. NO.	/

PREPARED BY	F. Tofighi
DATE	6/23/81
CHECKED BY	J DeVincentis
DATE	7/2/81
JOB NO.	80034
FILE NO.	9F
SHEET NO.	1251-25

This wall is located at Elevation 23'-0" of the reactor building. Its' peak Sa values have been obtained by a linear interpolation.

Elev.	Sa (0.02)	Sa (0.05)
23'-0"	1.30	1.40
51'-0"	2.37	2.60
33'-6"	1.70	1.85

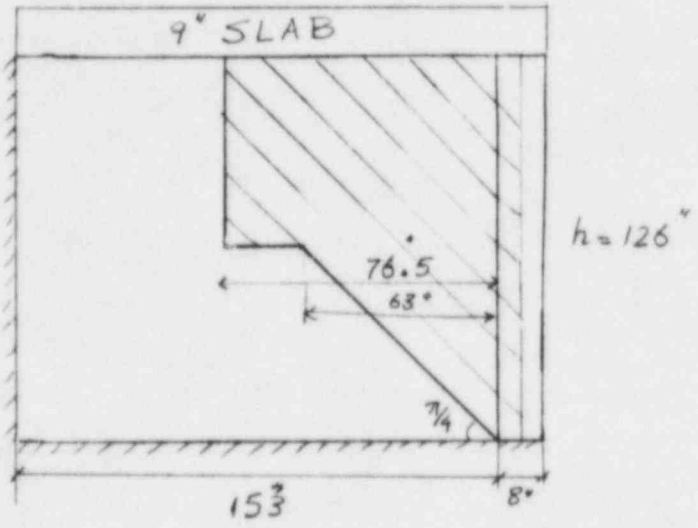
Forces,

Due to OBE, = 71888 x 1.70 = 122210 #

Due to SSE, = 71888 x 1.85 = 132993 #

CALCULATION SHEET	PREPARED BY	DATE
	F. Tofighi	6/23/81
	CHECKED BY	DATE
	√DEVincentis	7/2/81
PROJECT PILGRIM #1	JOB NO. 80034	FILE NO. 9F
SUBJECT MASONRY WALL ANALYSIS		
SYSTEM Wall 188.10		
ANALYSIS NO. 1251 REV. NO. 1	SHEET NO. 1251-26	

FORCES EXERTED ON 188.10 BY 188.11



TRIBUTARY AREA = $\frac{1}{2}(63 \times 63) + 76.5 \times 63 + 4 \times 126 = 7308$ in^2

$F_{OBE} = 7308\ (0.458 \times 1.70) = 5690$ # (Ref. Calc. 188.11/1252)

$F_{SSE} = 7308\ (0.458 \times 1.85) = 6192$ #

$F_{TORNADO} = 7308 \times 0.80 = 5846$ #

$F_{PBOC} = 7308 \times 0.93 = 6796$ #

FORCES EXERTED ON 188.10 BY 188.12

The tributary area is the same as the one calculated above.

$F_{OBE} = 7308\ (1.037^{*} \times 1.70) = 12883$ #

$F_{SSE} = 7308\ (1.037^{*} \times 1.85) = 14020$ #

* The highest pressure is used.

$F_{TORNADO} = 7308\ (1.19) = 8697$ #

$F_{PBOC} = 7308\ (0.93) = 6796$ #

EES

CALCULATION SHEET

PREPARED BY: F. Tofighi	DATE: 6/23/81
CHECKED BY: J. DeVincentis	DATE: 7/2/81
JOB NO.: 80034	FILE NO.: 9F
PROJECT: PILGRIM #1	
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: Wall 188.10	
ANALYSIS NO.: 1251 REV. NO.: 1	SHEET NO.: 1251-27

FORCES EXERTED ON 188.10 BY 188.13

Tributary area is the same as calculated for the previous connections of wall 188.10.

$F_{OBE} = 7308 (0.439 \times 1.70) = 5454$ #

$F_{SSE} = 7308 (0.439 \times 1.85) = 5935$ #

$F_{TORNADO} = 7308 \times 1.52 = 11108$ #

$F_{PBOC} = 7308 \times 0.93 = 6796$ #

It is assumed that there is no force exerted on 188.10 by the concrete column.

TOTAL FORCES EXERTED ON 188.10

Due to OBE, = 122210 + 5690 + 12883 + 5454 = 146237 #

Due to SSE, = 132993 + 6192 + 14020 + 5935 = 159140 #

Due to TORNADO, = 5846 + 8697 + 11108 = 25651 #

Due to PBOC, = 6796 + 6796 + 6796 = 20388 #

Shear Area.

Wall 188.10 is a variable wythe Partition wall.

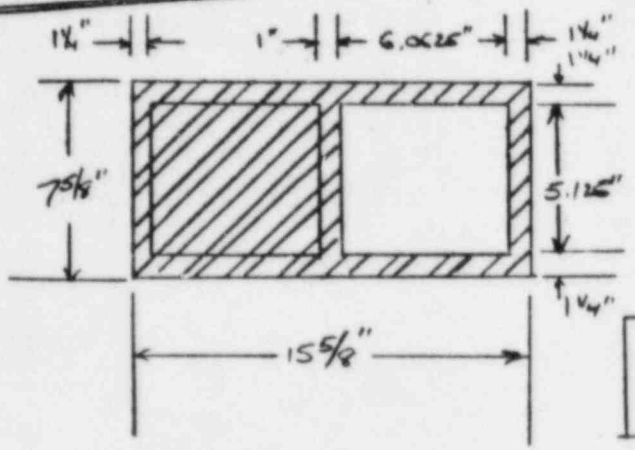
The area of the 3/4" Pb plate is conservatively neglected.

CALCULATION SHEET

EES

PREPARED BY: F. Tofighi	DATE: 6/23/81
CHECKED BY: J DEVINCENTIS	DATE: 7/2/81
PROJECT: PILGRIM UNIT 1	
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: SHEAR AREA OF MASONRY BLOCKS FOR PARTITION WALLS	
ANALYSIS NO.: 1251 REV. NO.: /	JOB NO.: 80034 FILE NO.: 9F
	SHEET NO.: 1251-28

8"x8"x16" BLOCK

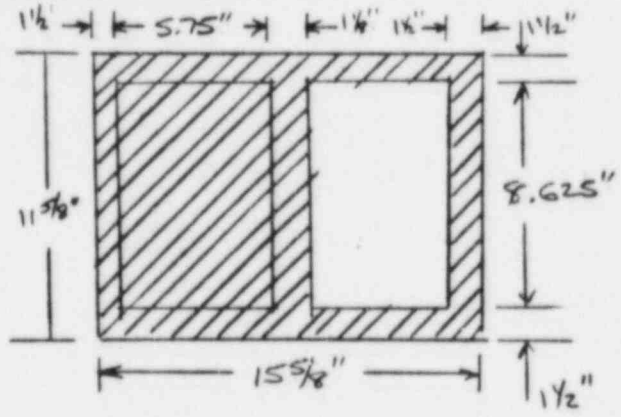


$A = (15.625" \times 7.625") - (5.125" \times 6.625")$

$A = 88.07\ IN^2 / 16\ IN\ BLOCK$

SHEAR AREA FOR 8" PARTITION WALL $= A_{8"\times8"\times16"} = 5.50$ INCHES^2 PER INCH OF WALL LENGTH

8"x12"x16" BLOCK



$A = (15.625" \times 11.625") - (8.625" \times 5.75")$

$A = 132.05\ IN^2 / KIN\ BLOCK$

SHEAR AREA FOR 12" PARTITION WALL $= A_{8"\times12"\times16"} = 8.25$ INCHES^2 PER INCH OF WALL LENGTH

REFERENCE:

"REINFORCED MASONRY DESIGN"
SCHNEIDER & DICKEY
1980

$A_S = (112 \times 5.5) + (30 \times 8.25) + (12.5 \times 5.5) + (70.5 \times 8.25) + (42 \times 5.5) + (148 \times 8.25)$

$A_S = 2966 \text{ in}^2$

SHEAR STRESSES.

$T_{OBE} = \frac{146237}{2966} = 49.3 \ \#/\text{in}^2$

$T_{SSE} = \frac{159140}{2966} = 53.7 \ \#/\text{in}^2$

$T_{TORNADO} = \frac{25651}{2966} = 8.6 \ \#/\text{in}^2$

$T_{PBOC} = \frac{20388}{2966} = 6.9 \ \#/\text{in}^2$

Shear allowable:

$\frac{M}{Vd_v} = \frac{h}{2D} = \frac{126}{2 \times 496} = 0.1 < 1$ (DC-1, EX. 4)

Allowable shear stress for OBE, = 69 $\#/\text{in}^2$

Allowable " " " SSE, PBOC, TORNADO = 104 $\#/\text{in}^2$

EES

CALCULATION SHEET

PREPARED BY: F. Tajirghi	DATE: 6/23/81
CHECKED BY: J DEVINCENTIS	DATE: 7/2/81
PROJECT: PILGRIM #1	JOB NO.: 80034 / FILE NO.: 9F
SUBJECT: MASONRY WALL ANALYSIS	
SYSTEM: Wall 188.10	
ANALYSIS NO.: 1251 REV. NO.: 1	SHEET NO.: 1251-30

Shear stress comparison;

OBE $\quad \tau_{OBE} = 49.3 \ \#/in^2 < 69 \ \#/in^2$ OK,

SSE $\quad \tau_{SSE} = 53.7 \ \#/in^2 < 104 \ \#/in^2$ OK,

TORNADO $\quad \tau_{TORNADO} = 5.6 \ \#/in^2 < 104 \ \#/in^2$ OK,

PBOC $\quad \tau_{PBOC} = 6.9 \ \#/in^2 < 104 \ \#/in^2$ OK,

wall 188.10 is — qualified for in plane loading.

FIELD INFORMATION REQUEST (F.I.R.)

9F

The following information is needed in the re-evaluation of the following wall plane.

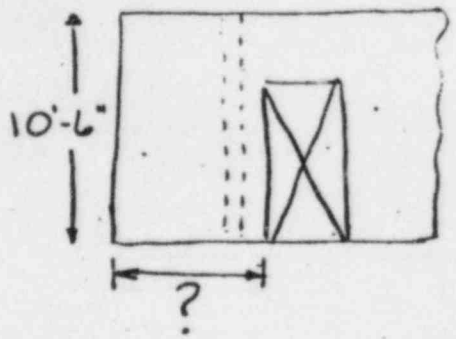
Analysis Problem No. 251

Wall I.D. No. 188.10

F.W.P. No. F-251

Location REACTOR Bldg. 23'-0" Elev.

Description



SK-452, WALL 188.10 S indicates an overall dimension of 40'-9" & the dim. in question as 9'-3". Please clarify these dimensions.

Prepared by L. DOWNS

Date 2/26/81

Sheet 1 of 1

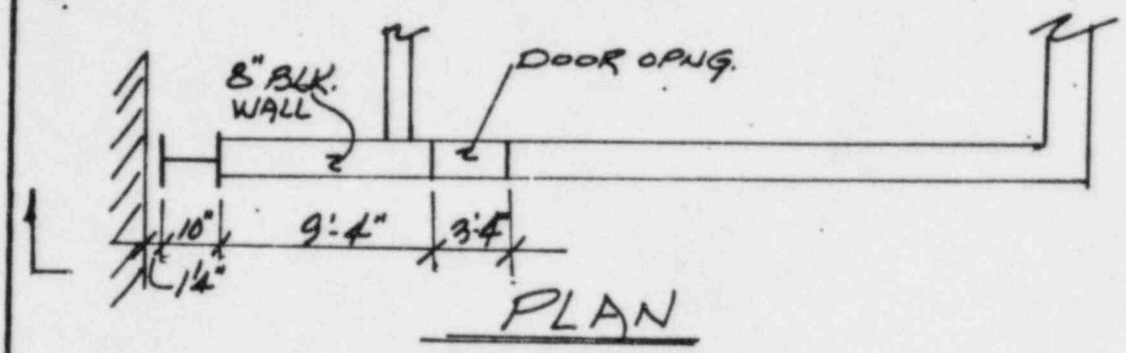
EES	Project: Pilgrim Nuclear Power Station Client: Boston Edison Company	Job No. 8003 FIR No. 12

'FIELD INFORMATION REQUEST (F.I.R.) RESPONSE 9F

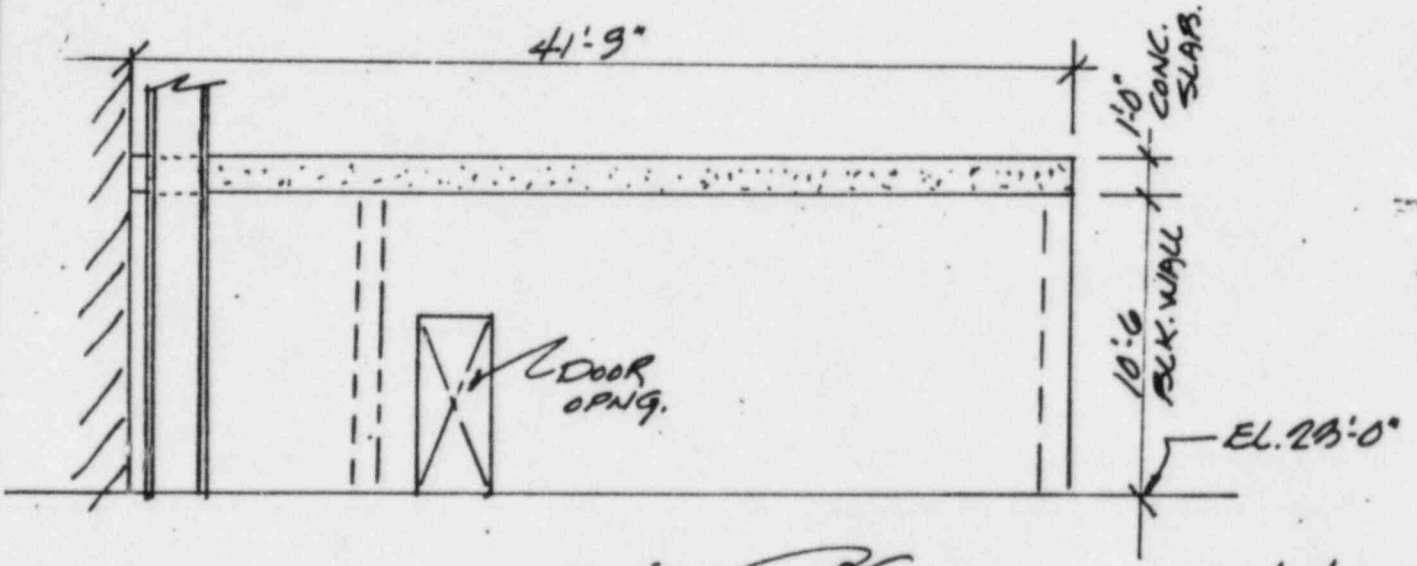
Response to F.I.R. 12 For Masonry Wall Plane SOUTH

Analysis Prob. No. 251 Wall I.D. No. 188.10 (SK-)

F.W.P. No. F-251 is as follows:



PLAN



Prepared by J Kenney Date 3/9/81

Checked by Donald Gray Date 3/9/81

Sheet 1 of 1

EES	Project: Pilgrim Nuclear Power Station Client: Boston Edison Company	Job No. 80034 FIR No. 12

EES

CALCULATION COVER SHEET

Job. No. 80034
File No. 12/F
Calc. Set No. 1019
No. of Sheets 21

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 63.4 Problem No. 019

STATEMENT OF PROBLEM

Re-evaluation of Masonry Wall will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

SOURCES OF DATA

EES Design Criteria (DC-1) Rev. 1.0
Project Memoranda Nos. 3, Rev. 0; and 4, Rev. 1
EES MWD Sketch Nos. 2V-26 & 52 (rev. 0)
Computer Output Files SO-FN-63.4, SO-ST-63.4, SO-FN-63.4A and SO-ST-63.4A, EQ-FN-63.4

UFD No. PIACT1 Computer Binder No. 12.1/F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI-2, Rev. 1
EES Design Criteria and Project Memoranda No. 3 & (4, 5) Rev. 1, #9 Rev. 2, #8, #7, #11 Rev. 1, #12, #10
EES PNPS Calc. Set No. N/A

REMARKS :. PBOC Loads has been Changed per PM # 4 Rev. 1 (load decreased)

The results of this Level 1 Analysis are E-Seismic PASS
E'-Seismic PASS PBOC PASS Tornado PASS
In-Plane Loads PASS Out of Plane PASS
See Results of Analysis (P. 5) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 1
S. Turk 9/18/81	BK Paul 9/21/81	Project Binder	SUPERSEDES CALCULATION SET NO. N/A
S. Turk 10/21/81	BK Paul 10/28/81		
			APPROVED BY: MT DiSangman
			DATE: 10/28/81

EES 08/80 - 100 Rev. 0

EES

CALCULATION COVER SHEET

Job. No. 80034
File No. 12_F
Calc. Set No. 1019
No. of Sheets 21

PROJECT Pilgrim I Nuclear Power Station

CLIENT Boston Edison Company

SUBJECT Masonry Wall Analysis for NRC IE Bulletin 80-11

Wall No. 63.4 Problem No. 019

STATEMENT OF PROBLEM

Re-evaluation of Masonry Wall will be performed in accordance with DC-1 and other applicable documents listed below. This re-evaluation considers loadings resulting from seismic and environmental activities, and plant faulted conditions.

SUPERSEDED

SOURCES OF DATA

EES Design Criteria (DC-1) Rev. 1.0
Project Memoranda Nos. 3, Rev. 0; and 4, Rev. 0
EES MWD Sketch Nos. 26 & 52
Computer Output Files SO-FN-63.4, SO-ST-63.4, SO-FN-63.4A and SO-ST-63.4A

UFD No. PIACT1 Computer Binder No. 12.1/F

SOURCES OF FORMULAE & REFERENCES

EES Work Instructions WI-1, Rev. 1 & WI-2, Rev. 0
EES Design Criteria and Project Memoranda No. 3 & 4
EES PNPS Calc. Set No. N/A

REMARKS

The results of this Level 1 Analysis are E-Seismic PASS
E'-Seismic PASS PBOC PASS Tornado PASS
In-Plane Loads PASS Out of Plane PASS
See Results of Analysis (P. 5) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. 0
S. Turk 9/18/81	B.K. Paul 9/21/81	Project Binder	SUPERSEDES CALCULATION SET NO. N/A
			APPROVED BY: M.T. deBruyn
			DATE: 09/22/81

EES 08/80 - 100 Rev. 0

CYGNA

CALCULATION SHEET

PROJECT	Pilgrim Unit 1
SUBJECT	Masonry Wall Analysis
SYSTEM	Wall # 63.4
ANALYSIS NO.	1019 REV. NO. 1

PREPARED BY: S. Tark	DATE: 10/21/81
CHECKED BY: MKSaul	DATE: 10/26/81
JOB NO.: 80034	FILE NO.: 12 F
SHEET NO.: 1019 - 1	

INTRODUCTION:

Wall # 63.4 is a 24" wall located

at Elev. 23'-0" in the REACTOR Building

SUMMARY OF RESULTS: THREE SIDES PINNED

SEISMIC

OBE

M_{xx_E} = 59.2 in-lbs/in < 2634 in-lbs/in

M_{yy_E} = 484 in-lbs/in < 3926 in-lbs/in

△ Max. = 0.044 in. (From page 9)

P Max. = 0.96 psi. (From page 9)

F.S. Min. = 3926/484 = 8.11 (From page 9)

SSE

$M_{xx_{E'}}$ = 86.4 in-lbs/in < 4742 in-lbs/in

$M_{yy_{E'}}$ = 707 in-lbs/in < 7068 in-lbs/in

△ Max. = 0.064 in. (From page 10)

P Max = 1.40 psi. (From Page 10)

F.S. Min. = 7068/707 = 10.0 (From page 10)

TORNADO OR PBOC

P Applied = 2.97 psi (Pg. 11)

P Allowed = 14.0 psi (Pg. 11)

Ratio of Pressure = P Allow / P Applied = 4.71 O.K

CYGNA	CALCULATION SHEET	PREPARED BY S. Tark	DATE 9/16/81
	PROJECT Pilgrim Unit 1	CHECKED BY B K Paul	DATE 10-26-81
	SUBJECT Masonry Wall Analysis	JOB NO. 80034	FILE NO. 12-F
	SYSTEM Wall # 63.4		
	ANALYSIS NO. 1019 REV. NO. 1	SHEET NO 1019-2	

SUMMARY OF RESULTS - Boundry Condition 2 - pinned top and bottom

SEISMIC

OBE	SSE
M_{xx_E} = 49.6 in-lbs/in 2634 in-lbs/in	M_{xx_E} = 72 in-lbs/in 4742 in-lbs/in
M_{yy_E} = 611 in-lbs/in 3926 in-lbs/in	M_{yy_E} = 887 in-lbs/in 7068 in-lbs/in
△ Max. = 0.05 in (From page 12)	△ Max. = 0.072 in (From page 13)
P Max. = 1.02 psi (From page 12)	P Max. = 1.48 psi (From page 13)
F.S. Min. = $\frac{3926}{611}$ = 6.4 (From page 12)	F.S. Min. = $\frac{7068}{887}$ = 7.97 (From page 13)

TORNADO OR PBOC - (if applicable)

P Applied = 2.97 psi (Pg. 14)

P Allow. = 11.8 psi (Pg. 14)

Ratio of Pressures = $\frac{\text{P Allow}}{\text{P Applied}}$ = 3.97 O.K

Note: If Tornado or PBOC loading condition failed with actual boundary conditions no further stress checks are necessary.

CYGNA	CALCULATION SHEET	PREPARED BY S. Tuck	DATE 9/17/81
	PROJECT Pilgrim Unit 1	CHECKED BY B K Paul	DATE 9-21-81
	SUBJECT Masonry Wall Analysis	JOB NO. 80034	FILE NO. 12-F
	SYSTEM Wall # 63.4		
	ANALYSIS NO. 1019 REV. NO. 0	SHEET NO. 1019-3	

SUMMARY OF RESULTS: (Cont'd.)

Out of Plane Shear

Wall # 63.4 has been analyzed for out of plane shear effects from OBE, SSE, PBOC and Tornado. The results are listed below.

OBE	-	(Pass)	Fail	(Pg. 15)
SSE	-	(Pass)	Fail	(Pg. 15)
PBOC	-	(Pass)	Fail	(Pg. 15)
TORNADO	-	(Pass)	Fail	(Pg. 15)

In Plane Shear

The results of In Plane Shear Analysis are listed below:

OBE	-	(Pass)	Fail	(Pg. 21)
SSE	-	(Pass)	Fail	(Pg. 21)
PBOC	-	(Pass)	Fail	(Pg. 21)
TORNADO	-	(Pass)	Fail	(Pg. 21)

EES

CALCULATION SHEET

PREPARED BY: S. Tuch			DATE: 9/16/81
CHECKED BY: B K Paul			DATE: 9-21-81
PROJECT: PILGRIM UNIT No. 1		JOB NO.: 80034	FILE NO.: 12/F
SUBJECT: Masonry Wall Analysis			
SYSTEM: Wall # 63.4			
ANALYSIS NO.: 1019	REV. NO.: 0	SHEET NO.: 1019-4	

INTRODUCTION

WALL 63.4 IS A 24" THICK, MULTI-WYTHE WALL LOCATED AT ELEVATION 23'-0" OF THE REACTOR BUILDING. THIS WALL IS CONSIDERED TO BE AN ALTERNATE II WALL AS SHOWN IN DETAIL (3/C-120) OF DRAWING C-120 (REF. 1). THIS ANALYSIS FOLLOWS THE LEVEL ONE PROCEDURE OF THE EES WORK INSTRUCTIONS (W.I.-2), AND SHALL MEET THE REQUIREMENTS OF THE EES DESIGN CRITERIA (DC-1).

CYGNA

CALCULATION SHEET

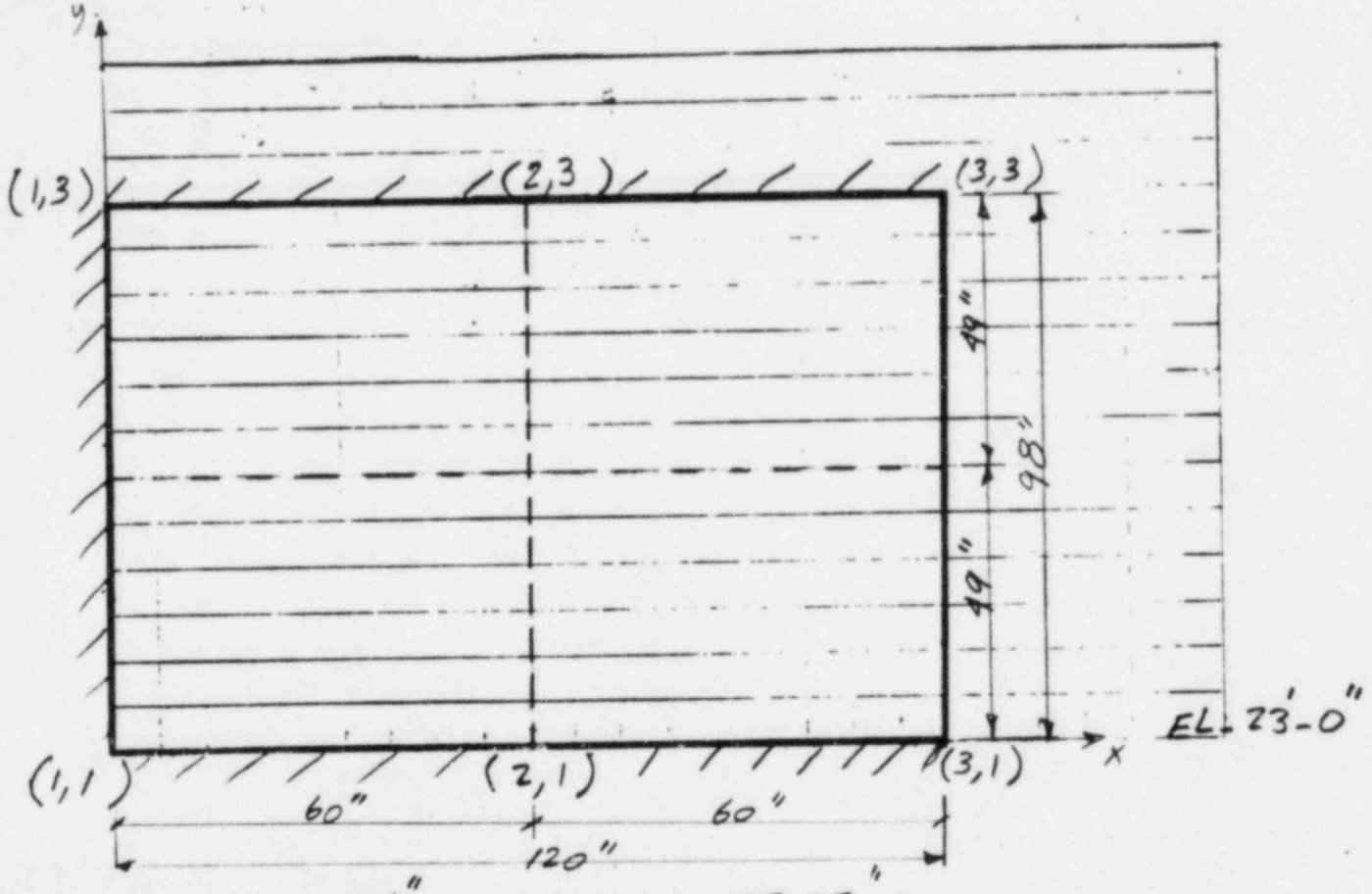
PROJECT	Pilgrim Unit 1
SUBJECT	Masonry Wall Analysis
SYSTEM	Wall # 63.4
ANALYSIS NO.	1019
REV. NO.	0

PREPARED BY: S. Tuch	DATE: 9/16/81
CHECKED BY: B K Paul	DATE: 9-21-81
JOB NO.: 80034	FILE NO.: 12-F
SHEET NO.: 1019-5	

WALL MODEL

Boundary Conditions and Dimensions are per EES MWD Sketch Nos. 26 & 52

PINNED AT 3 SIDES



Wall Thickness is 24" (Actual t = 23.25")

Grid Ratio = Largest / Smallest = 60 / 49 = 1.22 < 2:0 (OK) NG

Thickness Ratio = Smallest / Actual t = 49 / 23.25 = 2.11 > 2.0 (OK) NG

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT 1
SUBJECT	MASONRY WALL ANALYSIS
SYSTEM	WALL 63.4
ANALYSIS NO.	1019 REV. NO. 0

PREPARED BY	S. Turk
DATE	9/16/81
CHECKED BY	M K Paul
DATE	9-21-81
JOB NO.	80034
FILE NO.	12/F
SHEET NO.	1019-6

EQUIPMENT AND WALL WEIGHTS AND DENSITIES

Mass density of wall (W/O Equipment) $= 2.122 \times 10^{-4}$ $\frac{LB\text{-}SEC^2}{IN^4}$

Equivalent static pressure of wall $= 1.906$ LB/IN^2

Weight of equipment on wall

	EQUIPMENT	LENGTH	WT/FT Proj. Memo	WEIGHT (LBS)
(4)	$\frac{1}{2}$" ϕ CONDUIT (D167)	1.5	1.1	6.6
(4)	$1\frac{1}{2}$" ϕ CONDUIT (C-170, C-189, C-172)	1.5	3.6	21.6
(2)	2" ϕ CONDUIT (D172, D-189)	1.5	5.0	15.0
(2)	JUNCTION BOXES J-423, J-424	24"×20"×6"	5.0 LBS/FT²	104 LBS

TOTAL = 147.2 LBS

Static Pressure (Due to Equipment WT) $= \frac{147.2}{(120)(98)} = 0.0125$ LBS/IN^2

Equivalent additional mass density due to Equipment

$$\rho_{EQ} = \frac{0.0125}{(23.25)(386.4)} = 1.4 \times 10^{-6} \frac{LB\text{-}SEC^2}{IN^4}$$

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT 1
SUBJECT	Masonry Wall Analysis
SYSTEM	WALL # 63.4
ANALYSIS NO.	1019
REV. NO.	0

PREPARED BY	S. Turk
DATE	9/16/81
CHECKED BY	R.K. Paul
DATE	9-21-81
JOB NO.	80034
FILE NO.	12 F
SHEET NO.	1019-7

TOTAL MASS DINSITIES AND EQUIPMENT STATIC PRESSURES

$$\rho_{TOTAL} = 2.122 \times 10^{-4} + 1.4 \times 10^{-6} = 2.14 \times 10^{-4} \ \frac{LB-SEC^2}{IN^4}$$

$$P_{TOTAL} = 1.906 + 0.0125 = 1.92 \ LBS/IN^2$$

Frequency Analysis Wall 63.4

Orthotropic Properties (Project memo #9)

$C_{xx} = 0.14000 \times 10^5$ psi $C_{yy} = 0.20300 \times 10^5$ psi $I_{tx} = 17.37$ IN^4/IN

$C_{xy} = 0.3370 \times 10^4$ psi $G_{xy} = 0.6740 \times 10^4$ psi $I_{ty} = 25.18$ IN^4/IN

EWALL Input (EI_FN-63.4)

```
* WALL 63.4 FREQUENCY ANALYSIS
2,2,1,1,0,0,0,3,0,1,0
0,1,1,0,0
1,1,3,1,1,1,1,0,1
1,1,1,3,1,1,1,1,0
1,3,3,3,1,1,1,0,1
120.0,98.0,23.25
60.0,60.0
49.0,49.0
0.0,810000.0,337500.0,0.000214,0.0,17.37,25.18
1,1,3,3,1.92
```

Frequency Analysis

PINNED AT THREE SIDES

Run SO_FN_63.4

Base frequency of the wall $f = 11.64$ Cycles/sec

OBE Earthquake Analysis

From project memo #10

{ FROM ARS AT ELEVATION 51'-0" OF REACTOR BLDG. PROJ. MEMO #10

$f = 11.64$ Cycles/sec $g_{OBE} = 0.50$ g's

Equivalent Static Pressure $P_{OBE} = 1.92 \times 0.5 = 0.96$ psi

Max Applied Moments

(run SO_ST_63.4)

$M_{xx} = 118.3 \frac{in\text{-}lb}{in}$

$M_{xx_{OBE}} = 118.3 \times 0.5 = 59.2 \frac{in\text{-}lb}{in}$

$M_{yy} = 968 \frac{in\text{-}lb}{in}$

$M_{yy_{OBE}} = 968 \times 0.5 = 484 \frac{in\text{-}lb}{in}$

OBE Allowable Moments

(From project memo #9)

$M_{xx_{ALL}} = 2634 \frac{in\text{-}lb}{in}$

$M_{yy_{ALL}} = 3926 \frac{in\text{-}lb}{in}$

Static Deflection

$\Delta_{OBE} = 0.087 \times 0.5 = 0.044$ IN

SSE Earthquake Analysis

from project memo #10

$g_{SSE} = 0.73$ g's

Equivalent static Pressure

$P_{SSE} = 1.92 \times 0.73 = 1.4$ psi

Maximum Applied Moments (SSE)

SSE Allowable Moments (project memo #9)

$M_{XX_{SE}} = 118.3 \times 0.73 = 86.4 \frac{in\text{-}lb}{in} < 4742$ in-lb/in O.K

$M_{YY_{SE}} = 968 \times 0.73 = 707 \frac{in\text{-}lb}{in} < 7068$ in-lb/in O.K

Static Deflection

$\Delta_{SSE} = 0.087 \times 0.73 = 0.064$ IN

Wall 63.4 is adequate for OBE and SSE loads

CYGNA

CALCULATION SHEET

PROJECT	Pilgrim Unit 1
SUBJECT	Masonry Wall Analysis
SYSTEM	Wall # 63.4
ANALYSIS NO.	1019
REV. NO.	1

PREPARED BY	S. Turk
DATE	10/21/81
CHECKED BY	B K Paul
DATE	10-26-81
JOB NO.	80034
FILE NO.	12-F
SHEET NO.	1019-11

TORNADO OR PBOC ANALYSIS

This analysis is made using the maximum applied equivalent static pressure (P max.)of either [Tornado or PBOC] loading from Project Memo's 4 and 5.

A comparison of the [Tornado or PBOC] Pmax. pressure to the static seismic analysis pressure is made. For the seismic pressure analysis, the model did not include the effects of the doors over openings. When considering the [Tornado or PBOC] loading, the pressure on the door is considered to act on the opening.

The [Tornado or PBOC] allowable pressure (P allow) on the wall (assuming no openings) is calculated by multiplying the equivalent static pressure (SSE) times the minimum factor of safety for the SSE loading condition. P allow is then divided by P max. to determine the Ratio of Pressures. Using the ratio, and considering the effects of additional loading at wall openings, adequacy can be determined.

P PBOC = 2.97 psi (Project Memo 4)

P TORNADO = 0.055 psi (Project Memo 5)

Equivalent Static Pressure (P max. SSE) = 1.40 psi (Pg. 9)

Minimum Factor of Safety (SSE) = 10.0 (Pg. 1)

Allowable Pressure (P Allow) = 1.4 x 10.0 psi = 14.0 psi

Maximum Applied Pressure (P Applied) = 2.97 psi

$$\text{Ratio of Pressures} = \frac{\text{P Allow.}}{\text{P Applied}} = \frac{14.0}{2.97} = 4.71$$

Therefor, wall # 63.4 is adequate for PBOC & TORNADO LOADINGS.

Frequency Analysis — Boundary Condition 2 – PINNED AT TOP & BOTTOM

Run 50-FN-63.4A Base frequency of the wall $f = 10.54$ Cycles/sec

OBE Earthquake Analysis

From project memo #10

{ FROM ARS AT ELEVATION 51'-0" OF REACTOR BULDG. PROJ. MEMO # 10

$f = 10.54$ cycles/sec $g_{OBE} = 0.53$ G's

Equivalent Static Pressure $P_{OBE} = 1.92 \times 0.53 = 1.02$ psi

Max Applied Moments (run 50-ST-63.4A)

$M_{xx} = 93.54 \frac{in\text{-}lb}{in}$ $M_{xx_{OBE}} = 93.54 \times 0.53 = 49.6 \frac{in\text{-}lb}{in}$

$M_{yy} = 1152 \frac{in\text{-}lb}{in}$ $M_{yy_{OBE}} = 1152 \times 0.53 = 611 \frac{in\text{-}lb}{in}$

OBE Allowable Moments (From project memo #9)

$M_{xx_{ALL}} = 2634 \frac{in\text{-}lb}{in}$

$M_{yy_{ALL}} = 3926 \frac{in\text{-}lb}{in}$

Static Deflection

$\Delta_{OBE} = 0.094 \times 0.53 = 0.05$ IN

SSE Earthquake Analysis

from project memo #10 $g_{SSE} = 0.77$ G's

Equivalent static Pressure $P_{SSE} = 1.92 \times 0.77 = 1.48$ psi

Maximum Applied Moments (SSE)

SSE Allowable Moments (project memo

$M_{xx_{SE}} = 93.54 \times 0.77 = 72 \frac{in-lb}{in} < 4742 \frac{in-lb}{in}$ O.K

$M_{yy_{SE}} = 1152 \times 0.77 = 887 \frac{in-lb}{in} < 7068 \frac{in-lb}{in}$ O.K

Static Deflection

$\Delta_{SSE} = 0.094 \times 0.77 = 0.072$ IN

Wall 63.4 is adequate for OBE and SSE loads for 2nd Boundary Conditions.

CYGNA	CALCULATION SHEET	PREPARED BY S. Tuck	DATE 10/21/81
		CHECKED BY B K Paul	DATE 10-26-81
	PROJECT Pilgrim Unit 1	JOB NO. 80034	FILE NO. 12 F
	SUBJECT Masonry Wall Analysis		
	SYSTEM Wall # 63.4		
	ANALYSIS NO. 1019 REV. NO. 1	SHEET NO. 1019 - 14	

TORNADO OR PBOC ANALYSIS

This analysis is made using the maximum applied equivalent static pressure (P max.)of either [Tornado or PBOC] loading from Project Memo's 4 and 5.

A comparison of the [Tornado or PBOC] Pmax. pressure to the static seismic analysis pressure is made. For the seismic pressure analysis, the model did not include the effects of the doors over openings. When considering the [Tornado or PBOC] loading, the pressure on the door is considered to act on the opening.

The [Tornado or PBOC] allowable pressure (P allow) on the wall (assuming no openings) is calculated by multiplying the equivalent static pressure (SSE) times the minimum factor of safety for the SSE loading condition. P allow is then divided by P max. to determine the Ratio of Pressures. Using the ratio, and considering the effects of additional loading at wall openings, adequacy can be determined.

P PBOC = 2.97 psi (Project Memo 4)

P TORNADO = 0.055 psi (Project Memo 5)

Equivalent Static Pressure (P max. SSE) = 1.48 psi (Pg. 12)

Minimum Factor of Safety (SSE) = 7.97 (Pg. 2)

Allowable Pressure (P Allow) = 1.48 x 7.97 psi = 11.8 psi

Maximum Applied Pressure (P Applied) = 2.97 psi

Ratio of Pressures = $\frac{\text{P Allow.}}{\text{P Applied}} = \frac{11.8}{2.97} = 3.97$ O.K

CALCULATION SHEET			
	PREPARED BY S. Tuch		DATE 10/21/81
	CHECKED BY B K Paul		DATE 10-26-81
PROJECT Pilgrim Unit 1	JOB NO. 80034	FILE NO. 12-F	
SUBJECT Masonry Wall Analysis			
SYSTEM Wall # 63.4			
ANALYSIS NO. 1019 REV. NO. 1	SHEET NO. 1019 - 15		

Out Of Plane Shear Analysis

Multi - Wythe Walls

Procedure: For Multi-Wythe assume wall is a 12" Shield Wall and calculate allowable pressures using Attachments 1 and 2.

DATA: Wall # 63.4 is a 24" inch shield wall

Height 8.167 ft. Assume 1 #5 Bar

Mass Density = 1.872×10^{-4} $\frac{\text{lb-sec}^2}{\text{in}^4}$

OBE

h = 8.167 ft. Acceleration = 6.60 g's (Ref. Attach. 2)

F = MA ⟶ P Allow. = 1.872×10^{-4} $\frac{\text{lb-sec}^2}{\text{in}^4}$ x $\frac{6.60}{\text{(Acc.)}}$ x 386.4 $\frac{\text{in}}{\text{Sec}^2}$ x $\frac{12}{\text{(Thk.)}}$ in

P Allow. = 5.73 psi > OBE 0.96 psi

SSE, PBOC, TORN.

h = 8.167 ft. Acceleration = 10.0 g's (Ref. Attach. 2)

F = MA ⟶ P Allow. = 1.872×10^{-4} $\frac{\text{lb-sec}^2}{\text{in}^4}$ x $\frac{10.0}{\text{(Acc.)}}$ x 386.4 $\frac{\text{in}}{\text{Sec}^2}$ $\frac{12}{\text{(Thk.)}}$ in

P Allow = 8.68 psi > SSE 1.40 psi

> PBOC 2.97 psi

> TORN 0.055 psi

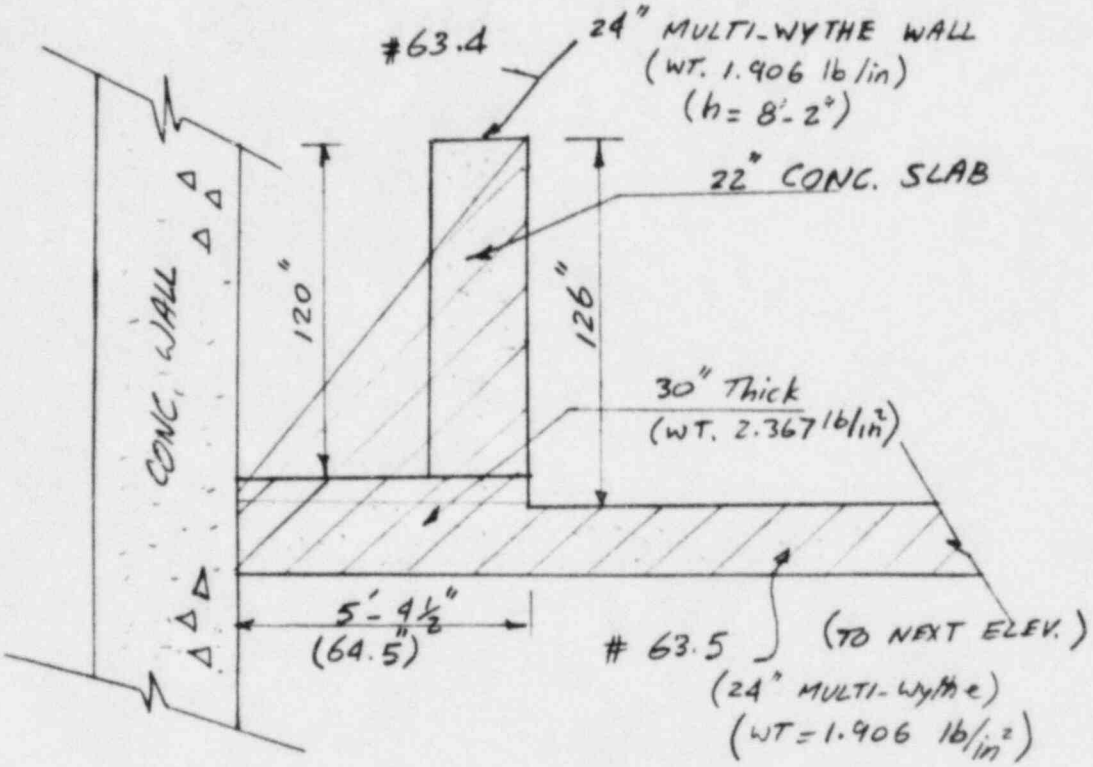
Conclusion: Wall is considered to be adequate to withstand out of Plane Shear.

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT 1	PREPARED BY: S. Tsak	DATE: 9/17/81
SUBJECT	Masonry Wall Analysis	CHECKED BY: B K Paul	DATE: 9-21-81
SYSTEM	Wall # 63.4	JOB NO.: 80034	FILE NO.: 12 F
ANALYSIS NO.	1019 REV. NO. 0	SHEET NO.	1019-16

IN-PLANE LOADING ANALYSIS



Length of wall 63.4 = 120" IN, and Thickness = 24" IN

ASPECT RATIO = h/D = 98/120 = 0.82

LOADS :- (DUE TO SLABS & WALLS)

SLAB $\frac{22}{12}(150)\left(\frac{64.5 \times 126}{144}\right)$ = 15,520 #

LINTEL (See SK. 26) $\frac{12}{12}(150)\left(\frac{64.5 \times 13}{144}\right)$ = 874 #

WALL 63.4 = $(1.906\ lb/in^2)(120 \times 98)$ = 22,415 #

ΣW_T = 38,809 #

EES	CALCULATION SHEET	PREPARED BY S. Turk	DATE 9/18/81
		CHECKED BY B K Paul	DATE 9-21-81
	PROJECT PILGRIM UNIT 1	JOB NO. 80034	FILE NO. 12-F
	SUBJECT Masonry Wall Analysis		
	SYSTEM Wall # 63.4		
	ANALYSIS NO. 1019 REV. NO. 0	SHEET NO. 1019-17	

PEAK ACCELERATION VALUES – between elevations 23'-0 & 51'-0 of Reactor BLD.

OBE ⇒ 2.37 g's
SSE ⇒ 2.60 g's
} From EL. 51'-0"

FORCES DUE TO CONCRETE SLAB & WALL WEIGHT.
(CAUSED BY EARTHQUAKE) $F = MA = \frac{W}{g} \cdot Ng = W \cdot N$

OBE 38809 × 2.37 = 91,977 #

SSE 38809 × 2.60 = 100,903 #

FORCES ON 63.4 BY SLAB & WALLS (carries ½ F)

OBE = 45989 #

SSE = 50452 #

PRESSURES:

FOR WALL 63.5 (ASSUME CONSTANT 24" THICKNESS)

THICKNESS

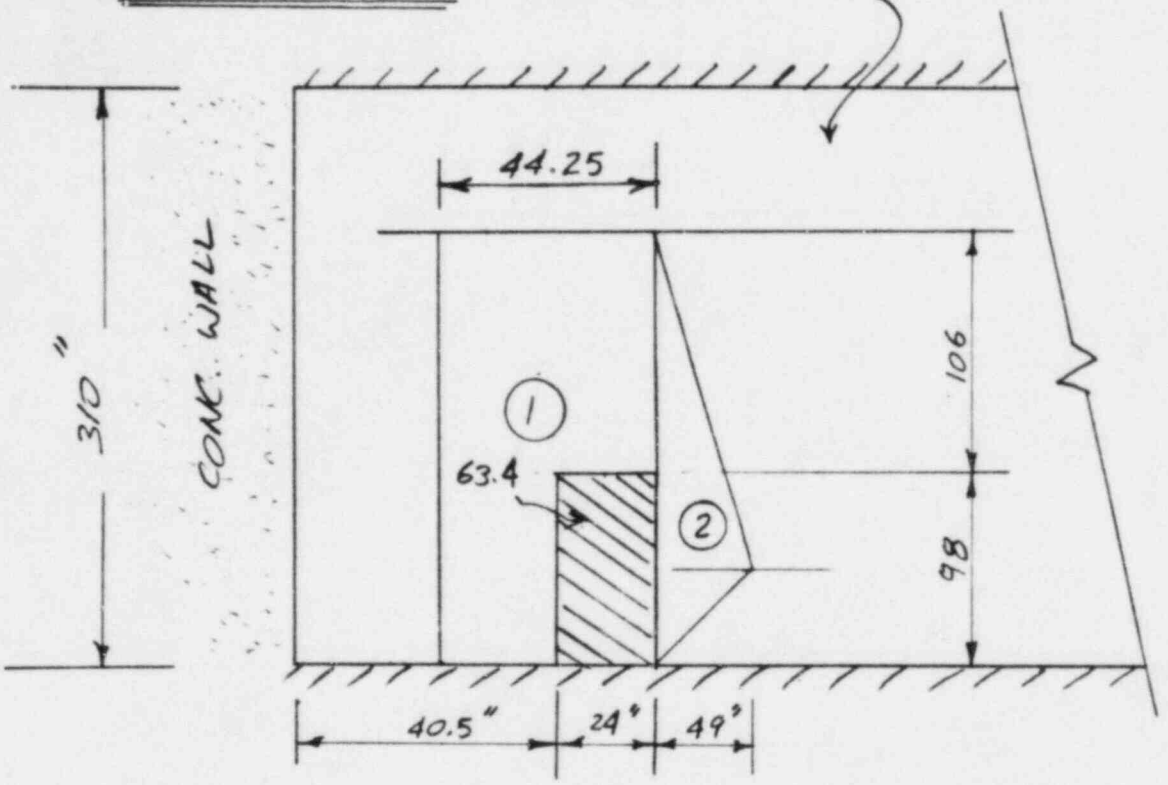
24" { OBE = 1.906 × 2.37 = 4.52
SSE = 1.906 × 2.60 = 4.96

30" { OBE = 2.367 × 2.37 = 5.60
SSE = 2.367 × 2.60 = 6.20

* IN THE ANALYSIS OF WALL 63.5, WALL 63.4 WAS USED AS A SUPPORT.
∴ THE FORCES FROM WALL 63.5 ON WALL 63.4 MUST BE CONSIDERED.

EES	CALCULATION SHEET	PREPARED BY S. Turk	DATE 9/18/81
		CHECKED BY B K Paul	DATE 9-21-81
	PROJECT PILGRIM UNIT 1	JOB NO. 80034	FILE NO. 12 F
	SUBJECT Masonry Wall Analysis		
	SYSTEM Wall # 63.4		
	ANALYSIS NO. 1019 REV. NO. 0	SHEET NO. 1019 - 18	

TRIBUTARY AREA FROM WALL 63.5



(1) From 30" Thick section OF #63.5

$$A_T = 44.25 \times 204 = \underline{9027} \text{ IN}^2$$

(2) From 24" Thick section OF # 63.5

$$A_T = \frac{1}{2}(49 \times 49) + \frac{1}{2}(49 \times 155) = \underline{4998} \text{ IN}^2$$

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT 1
SUBJECT	Masonary Wall Analysis
SYSTEM	Wall # 63.4
ANALYSIS NO.	1019
REV. NO.	1

PREPARED BY	S. Turk	DATE 10/21/81
CHECKED BY	BK Paul	DATE 10-26-81
JOB NO.	80034	FILE NO. 12 F
SHEET NO.	1019-19	

FORCES ON 63.4 FROM 63.5

① ON 30" THICK SECTION (A_{Trib} = 9027 IN^2)

OBE = 5.6 × 9027 = 50551 #

SSE = 6.2 × 9027 = 55967 #

TORNADO = 0.204 × 9027 = 1842 #

PBOC = 3.85 × 9027 = 34754 #

② ON 24" THICK SECTION (A_{Trib} = 4998 IN^2)

OBE = 4.52 × 4998 = 22,591 #

SSE = 4.96 × 4998 = 24,790 #

TORNADO = 0.204 × 4998 = 1020 #

PBOC = 3.85 × 4998 = 19242 #

TOTAL FORCE ON WALL 63.4 (FROM CONC. SLAB)
(BLOCK WALLS AND WALL 63.5)

OBE = 45989 + 50551 + 22591 = 119,131 #

SSE = 50,452 + 55967 + 24790 = 131,209 #

TORNADO = 1842 + 1020 = 2862 #

PBOC = 34754 + 19242 = 53,996 #

EES

CALCULATION SHEET

PREPARED BY S. Tusk			DATE 10/21/81
CHECKED BY B K Paul			DATE 10-26-81
PROJECT PILGRIM UNIT 1		JOB NO. 80034	FILE NO. 12 F
SUBJECT Masonry Wall Analysis			
SYSTEM Wall # 63.4			
ANALYSIS NO. 1019	REV. NO. 1	SHEET NO. 1019-20	

SHEAR STRESSES :- $\tau = F/A_s$

WALL 63.4 IS A 24" MULTI-WYTHE WALL,
THE SHEAR AREA EQUALS (23.25 IN^2/IN) OF WALL & h = 98"

$A_S = 23.25\ IN^2/IN \times 98" = \underline{2279\ IN^2}$

$\tau_{OBE} = \frac{119,131}{2279} = 52.3\ psi$

$\tau_{SSE} = \frac{131,209}{2279} = 57.6\ psi$

$\tau_{TORNADO} = \frac{2862}{2279} = 1.26\ psi$

$\tau_{PBOC} = \frac{53,996}{2279} = 23.7\ psi$

ALLOWABLE SHEAR SRESSES :-

$h/2D = 98/2 \times 120 = 0.4$

∴ THE ALLOWABLE SHEAR SRESSES

OBE = 57 psi

SSE = 86 psi DC-1 EXG.

PBOC = 86 psi

TORNADO = 86 psi

EES

CALCULATION SHEET

PROJECT	PILGRIM UNIT 1
SUBJECT	Masonry Wall Analysis
SYSTEM	WALL # 63.4
ANALYSIS NO.	1019 REV. NO. 1

PREPARED BY	S. Turk
DATE	10/21/81
CHECKED BY	BK Paul
DATE	10-26-81
JOB NO.	80034
FILE NO.	12-F
SHEET NO.	1019-21

SHEAR STRESS COMPARISON

CASE	ACTUAL (psi)	VS	Allowable (psi)	
OBE	52.3	<	57	OK
SSE	57.6	<	86	OK
TORNADO	1.26	<	86	OK
PBOC	23.7	<	86	OK