

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,

W.D. Harrington

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

MTL/fej

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PDR ADOCK 05000293
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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 than 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

Cygnal Analytical Calculations for
Walls 188.10 and 63.4

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

EES**CALCULATION COVER SHEET**Job No. 80034File No. 29FCalc. Set No. 2251No. of Sheets 21**PROJECT** Pilgrim I Nuclear Power Station**CLIENT** Boston Edison Company**SUBJECT** Masonry Wall Analysis for NRC IE Bulletin 80-11Wall No. 188.10Problem 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, 10 (rev. 1), 10 (rev. 2)

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-188.10-5UFD No. PS ACT 2 > PS 2251Computer 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 analysisThe results of this Level 2 Analysis are E-Seismic PassE'-Seismic Pass PBOC Pass Tornado PassIn-Plane Loads NA Out-of-Plane PassSee Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. <u>2</u>
B.A. Bouton L.W. Silvia	P. Curry F. Tefighi		SUPERSEDES CALCULATION
S. Capobianco			SET NO. <u>2251 rev. 1</u>
J. Richard M. Kuntz	H. Morjan J. DEYINGENTIS		APPROVED BY: <u>JDMC</u> DATE: <u>8/22/82</u>

EES

CALCULATION COVER SHEET

Job No. 80034File No. 29FCalc. Set No. 2251No. 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. 188.10Problem 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. 0Computer Output Files EQ-RS-188.10-SSE-1, EQ-RS-188.10-PBE-1EQ-PBOC-188.10-6, SQ-RS-188.10-PBE-0, SQ-RS-188.10-SSE-0SQ-PBOC-188.10-5UFD No. PIACT2 > PI2251Computer 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

24000 Calc 2251-70 For Boundary LoadsThe results of this Level 2 Analysis are E-Seismic PASSE'-Seismic PASS PBOC PASS Tornado PASSIn-Plane Loads N/A Out-of-Plane N/ASee Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO.
B.A. BOUTON	P. CURRY		SUPERSEDES CALCULATION
L. SILVIA	J. Tofighi		SET NO. <u>2251 RENO</u>
S. CAPOBIANCO			APPROVED BY: <u>L. Kaur</u>
J. RICHARDS	M. MORYAN		DATE: <u>6/15/82</u>

EES

CALCULATION COVER SHEET

Job No. 80034File No. 29FCalc. Set No. 2251No. 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. 188.10Problem 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. 0Computer Output Files EQ-RS-188.10-SSE-1, EQ-RS-188.10-DBE-1EQ-PBOC-188.10-6, SQ-RS-188.10-DBE-0, SQ-RS-188.10-SSE-0SQ-PBOC-188.10-5UPD No. PIAET2 > PI2251Computer 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 PASSE'-Seismic PASS PBOC PASS Tornado PASSIn-Plane Loads NA Out-of-Plane NASee Results of Analysis (P. 3) for wall boundaries

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. <u>0</u>
B.A. BOUTON	P. CURRY		SUPERSEDES CALCULATION
L. SILVIA	<i>F. Tofighe</i>		SET NO. <u>NA</u>
S. CAPOBIANCO			APPROVED BY: <i>N. Duffy</i>
			DATE: <u>4/8/82</u>

EES**CALCULATION SHEET**

PREPARED BY

B. B. E.

DATE

3/30/82

CHECKED BY

F. Tofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251REV. NO. 0SHEET NO. 2251-1INTRODUCTION

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. S. E.

DATE

3/30/82

CHECKED BY

F. Tofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251REV. NO. 0SHEET NO. 2251-2SUMMARY 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):

$$\begin{aligned} M_{xx} &= 140.9 \frac{\text{IN-LB}}{\text{IN}} < 304 \frac{\text{IN-LB}}{\text{IN}} & \text{F.S.} &= 1.4 \\ M_{yy} &= 744.9 \frac{\text{IN-LB}}{\text{IN}} < 1056 \frac{\text{IN-LB}}{\text{IN}} \\ f_n &= 18.8 \text{ HZ} \end{aligned}$$

SSE (E'):

$$\begin{aligned} M_{xx} &= 218.8 \frac{\text{IN-LB}}{\text{IN}} < 452 \frac{\text{IN-LB}}{\text{IN}} \\ M_{yy} &= 1156.0 \frac{\text{IN-LB}}{\text{IN}} < 2112 \frac{\text{IN-LB}}{\text{IN}} & \text{F.S.} &= 1.8 \\ f_n &= 18.8 \text{ HZ} \end{aligned}$$

PRESSURE:

$$\begin{aligned} M_{xx} &= 403.7 \frac{\text{IN-LB}}{\text{IN}} < 452 \frac{\text{IN-LB}}{\text{IN}} & \text{F.S.} &= 1.1 \\ M_{yy} &= 907.4 \frac{\text{IN-LB}}{\text{IN}} < 2112 \frac{\text{IN-LB}}{\text{IN}} \end{aligned}$$

EES**CALCULATION SHEET**

PREPARED BY

L.W. SILVER

DATE

4-7-81

CHECKED BY

PR CURRY

DATE

5/11/81

JOB NO.

80034

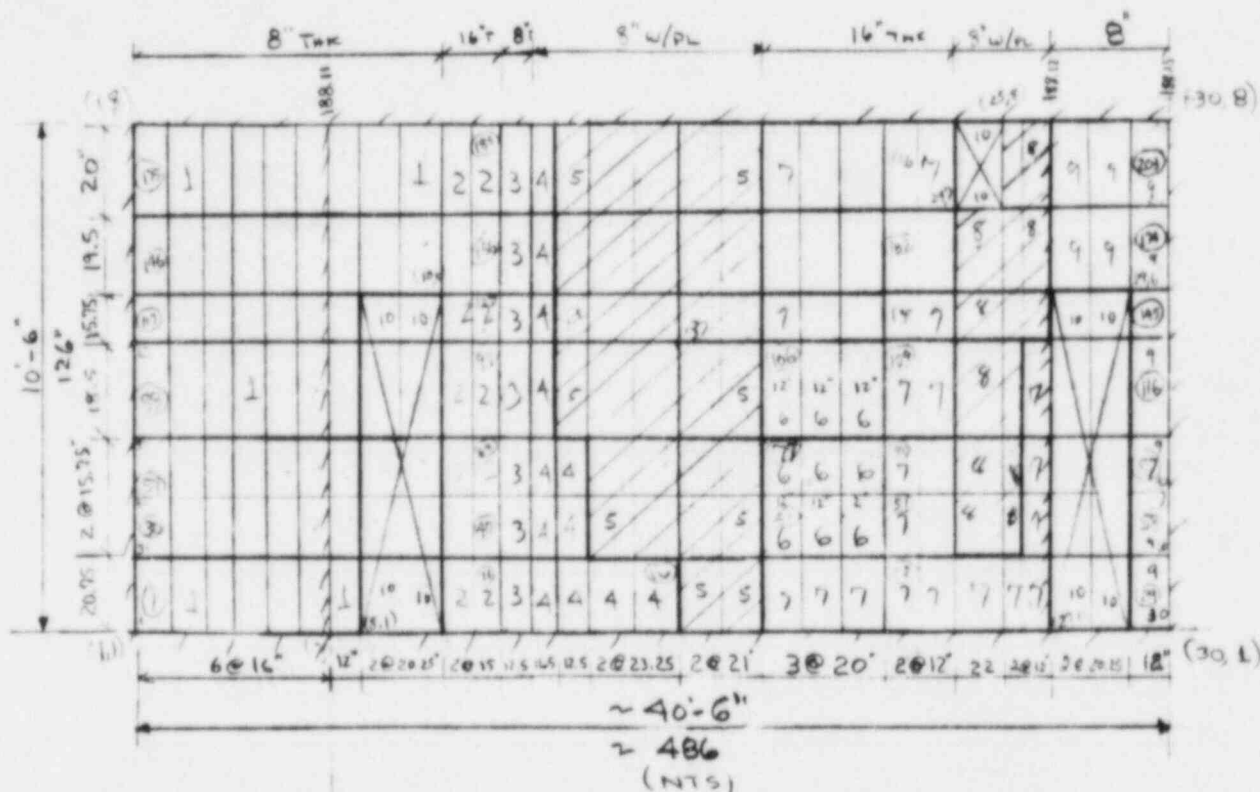
FILE NO.

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PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251 REV. NO. 0SHEET NO. 2251-3

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

FIGURE 1 $t_w = 8" (7.625")$ $t_w = 12" (11.625")$ $t_w = 16" (15.25")$
 $t_w = 8" w/p_l = (7.625 + .75) = 8.375"$

DENSITY OF WALL

$$\rho_8 = 1.383 \times 10^{-4} \text{ LB-SEC}^2/\text{IN}^4$$

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

$$\rho_{16} = 2.122 \times 10^{-4} \text{ LB-SEC}^2/\text{IN}^4$$

(ASSUMED FULLY GROUTED)



CALCULATION SHEET

PREPARED BY

L.W. SILVIA

DATE

4-9-81

CHECKED BY

PR CURRY

DATE

5/11/81

PROJECT

PILGRIM UNIT No. 1

SUBJECT

MASONRY WALL ANALYSIS

SYSTEM

WALL 188.10

ANALYSIS NO.

2251

REV. NO.

0

JOB NO.

80034

FILE NO.

29F

SHEET NO.

2251-4

EQUIVALENT DENSITY DUE TO ATTACHED EQUIPMENT

$$(MAT 6) \text{ 12" WALL} - \text{AREA} = 5'-2" \times 4'-2" = 62" \times 50" = \underline{3100 \text{ IN}^2}$$

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

$$4 - \text{FIRE EXTINGUISHERS} = 120 \text{ LBS.}$$

$$1 - \text{TELEPHONE BOX} = 19.6 \text{ LBS.}$$

$$\text{CABINETS } 5.0 \text{ LB/FT}^2 (36 \times 18/\text{in}) = \underline{22.5 \text{ LBS}}$$
$$\text{TOTAL} = 162 \text{ LBS}$$

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

8" WALL W/ LEAD PLATE (MAT 8)

(BY WALL 188.12)

$$\text{AREA} = 3'-10" \times 8'-4" - (1'-8" \times 1'-8") - (1'-0" \times 3'-8\frac{3}{4}")$$
$$= (46 \times 100) - (20 \times 20) - (12 \times 44.75) = \underline{3663 \text{ IN}^2}$$

$$\frac{3}{4}" \text{ LEAD P @ } 0.3082 \text{ LB/IN}^2$$

$$W_T = 1032.8 \text{ LBS.}$$

FIRE HOSE REEL

$$75 \text{ LBS.}$$

$$6 - 2\phi \text{ FIRE PROT. P.P.S @ } 6.3 \text{ LB/FT}$$

$$\underline{37.8 \text{ LBS.}}$$

$$\text{TOTAL} \approx 1150 \text{ LBS.}$$

$$P_{EQ,8" \times 100 \times 12} = \frac{1150}{3663 \times (7.625 \times 386.4)} = \underline{1.066 \times 10^{-4} \text{ LB-SEC}^2/\text{IN}^4}$$

EES**CALCULATION SHEET**

PREPARED BY

L.W. SILVIA

DATE

4-9-81

CHECKED BY

PA CURRY

DATE

5/11/81

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

JOB NO.

80034

FILE NO.

29F

SHEET NO. 2251-5Eq. DENSITY OF EQUIPMENT (CONTINUED)16" WALL AROUND 12" BLK (MAT 7)CABINETS, $(36 \times 11/4) @ 5 \text{ LBS/FT}^2 = 13.8 \text{ LBS.}$ 2" ϕ FIRE PROT. PIPE, $8.5' @ 6.3 = 53.6 \text{ LBS.}$

SWITCH

$$\begin{array}{r} 5 \\ \hline \text{TOTAL} \approx 72 \text{ LBS.} \end{array}$$

$$\text{AREA} = (7.0' \times 10.5') - (5'-0" \times 4'-2") + (2'-10" \times 2'-2") + (1'-0" \times 5'-10\frac{3}{4}")$$

$$= (84 \times 126) - (60 \times 50) + (34 \times 26) + (12 \times 70.75) = 9317 \frac{\text{LB-SEC}^2}{\text{IN}^4}$$

$$P_{\text{EQ. 16" WALL AROUND 12" BLK}} = \frac{72}{(9317)(15.25)(386.4)} = 1.03 \times 10^{-6} \text{ LB-SEC}^2/\text{IN}^4$$

8" WALL AT WALL 188.13 (MAT 9)

$$\text{AREA} = (126 \times 52.5) - (40.5 \times 86.5) = 3111.75 \text{ IN}^2$$

3/4" ϕ CONDUIT, $14' @ 1.4 \text{ LBS/FT} = 19.6 \text{ LBS}$

DOOR

100 LBS.

JUNCTION BOX $4" \times 6" \times 6" @ 50 \text{ LBS/FT}^2$

5.8 LBS

SWITCH

$$\begin{array}{r} 5 \\ \hline \text{TOTAL} \approx 131 \text{ LBS.} \end{array}$$

$$P_{\text{EQ. 8" @ WALL 188.13}} = \frac{131}{(3111.75)(7.025)(386.4)} = 1.43 \times 10^{-5} \text{ LB-SEC}^2/\text{IN}^4$$

EES**CALCULATION SHEET**

PREPARED BY

L.W. SILVIA

DATE

4-9-81

CHECKED BY

P. G. JERRY

DATE

5/11/81

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

JOB NO.

80034

FILE NO.

29F

SHEET NO. 2251-6EQ. DENSITY (CONTINUED)8" WALL W/3/4" LEAD R. (MAT 5)

$$\begin{aligned} \text{AREA} &= (10'-6" \times 8'-5") - (1'-4\frac{1}{2}" \times 3'-10\frac{1}{2}" - (1'-0\frac{1}{2}" \times 4'-6")) \\ &= (126 \times 101) - (16.5 \times 46.5) - (12.5 \times 54) = 11283.75 \text{ IN}^2 \end{aligned}$$

$$3/4" \text{ LEAD R} = (11283.75)(0.3082) = 3478 \text{ LBS.}$$

CVT - TRANSFORMER 32.8 LBS.

JUNCTION BOX - N612 39.6 LBS.

1" ϕ CONDUIT 17' @ 2.1 LBS. 35.7 LBS.3/4" ϕ CONDUIT 14'-0" @ 1.4 19.6 LBS.1 1/2" ϕ " 17' @ 3.6 61.2 LBS.2" ϕ " 23' @ 5.0 115 LBS.3" ϕ " 41' @ 11.0 451 LBS.2" ϕ FIBER 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 LBS/FT² 101.7 LBS.TOTAL \approx 4620 LBS.

$$P_{a, w/2} = \frac{4620}{(11283.75)(1.625)(396.4)} = 1.390 \times 10^{-4} \text{ LB-SEC}^2/\text{IN}$$

EES**CALCULATION SHEET**

PREPARED BY

L.W. SILVIA

DATE

4-9-81

CHECKED BY

PR Curry

DATE

5/11/81

JOB NO.

80034

FILE NO.

29F

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

SHEET NO. 2251-7EQ. DENSITY OF EQUIPMENT (CONTINUED)8" WALL @ COL (2.5) TO DOOR (SK-452) (MAT 1)2" ϕ DRAIN LINE, 19' @ 6.3 $\frac{\text{LBS}}{\text{FT}}$ = 119.7 LBS.3/4" ϕ CONDUIT, 13' @ 1.4 14.2 LBS.

DOOR 100 LBS.

JUNCTION BOX 4"X4"X6" @ 5 $\frac{\text{LBS}}{\text{FT}^2}$ 4.4 LBS.

220 OUTLET 6"X6"X6" @ " 7.5 LBS

DISCONNECT SWITCH 5

2" ϕ FIRE PROT. PIPE, 13' @ 6.3 $\frac{\text{LBS}}{\text{FT}}$ 81.9GATE AND BALL VALVES @ 50 $\frac{\text{LBS}}{\text{EA}}$ 100

SWITCH 5

TOTAL \approx 440 LBS.AREA OF 8" WALL = $(126 \times 148.5) - (86.5 \times 40.5) = 15207.75 \text{ IN}^2$ 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 = $(126 \times 30) = 3780 \text{ IN}^2$ CABINETS $(30 \times 29/144) @ 5 \frac{\text{LBS}}{\text{FT}^2} = 30.2 \text{ LBS.}$

4"X4"X6" JUNCT. BOX @ " " = 4.4 LBS.

SWITCH 5 LBS

EES**CALCULATION SHEET**

PREPARED BY

L. W. SILVIA

DATE

4-9-81

CHECKED BY

P. CURRY

DATE

5/11/81

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10

JOB NO.

80034

FILE NO.

29F

ANALYSIS NO. 2251 REV. NO. 0SHEET NO. 2251-8 $\frac{3}{4}" \phi$ CONDUITS, 8' @ 1.4 11.22" ϕ FIRE PROTECT. PIPE, 25' @ 6.3 15.8TOTAL \approx 67 LBS.

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

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

$$\text{AREA} = (126 \times 12.5) = 1575 \text{ IN}^2$$

2" ϕ FIRE PROT. PIPE $(12.5/12)' @ 6.3$ 6.6 LBS. $\frac{3}{4}" \phi$ CONDUIT, $(12.5/12)' @ 1.4$ 1.5CABINETS $(12.5 \times 29/144) @ 5 \text{ FT}^2$ 12.6 LBS.TOTAL \approx 21 LBS.

$$P_{EQ. 8" WALL W/SHEET} = \frac{21}{(1575)(7.625)(386.4)} = \underline{4.5 \times 10^{-6} \text{ LB-SEC}^2/\text{IN}^4}$$

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

$$\text{AREA} = (126 \times 11.5) + (54 \times 12.5) + (16.5 \times 46.5) = 2891.25 \text{ IN}^2$$

2" ϕ FIRE PROT. PIPE, $(11.5/12)' @ 6.3 \text{ FT}$ - 6.0 LBSCABINETS $(11.5 \times 29/144) @ 5 \text{ FT}^2$ 11.6 LBS $\frac{3}{4}" \phi$ CONDUIT $(11.5/12)' @ 1.4$ 1.3 LBS.TOTAL \approx 20 LBS.

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

EES**CALCULATION SHEET**

PREPARED BY

L.W. SILVIA

DATE

4-9-81

CHECKED BY

P.A. CURRY

DATE

5/11/81

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251 REV. NO. 0SHEET NO. 2251-9TOTAL DENSITY OF WALL SECTIONS (FIG. 1)

MAT. 1 $P_1 = 1.383 \times 10^{-4} + 9.8 \times 10^{-6} = \underline{1.481 \times 10^{-4}} \text{ LB-SEC}^2/\text{IN}^4$

1/16" MAT. 2 $P_2 = 2.122 \times 10^{-4} + 3.0 \times 10^{-6} = \underline{2.152 \times 10^{-4}}$ "

MAT. 3 $P_3 = 1.383 \times 10^{-4} + 4.5 \times 10^{-6} = \underline{1.428 \times 10^{-4}}$ "

1/16" MAT. 4 $P_4 = 2.122 \times 10^{-4} + 1.2 \times 10^{-6} = \underline{2.134 \times 10^{-4}}$ "

MAT. 5 $P_5 = 1.383 \times 10^{-4} + 1.39 \times 10^{-5} = \underline{2.773 \times 10^{-4}}$ "

1/16" MAT. 6 $P_6 = 1.222 \times 10^{-4} + 1.16 \times 10^{-5} = \underline{1.338 \times 10^{-4}}$ "

1/16" MAT. 7 $P_7 = 2.122 \times 10^{-4} + 1.03 \times 10^{-6} = \underline{2.132 \times 10^{-4}}$ "

MAT. 8 $P_8 = 1.383 \times 10^{-4} + 1.066 \times 10^{-5} = \underline{2.449 \times 10^{-4}}$ "

MAT. 9 $P_9 = 1.383 \times 10^{-4} + 1.43 \times 10^{-5} = \underline{1.526 \times 10^{-4}}$ "

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

EES**CALCULATION SHEET**

PREPARED BY

B. B. S.

DATE

3/29/82

CHECKED BY

F. Tofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1

SUBJECT MASONRY WALL ANALYSIS

SYSTEM WALL 188.10

ANALYSIS NO. 2251

REV. NO. 0

SHEET NO. 2251-10

EWALL INPUT - SEISMIC

* 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, 0, 1

1, 1, 1, 8, 1, 1, 1, 0

1, 8, 30, 8, 1, 1, 1, 0, 1

30, 1, 30, 8, 1, 1, 1, 0

7, 1, 7, 8, 1, 1, 1, 0

27, 1, 27, 8, 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., 0.00148, 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)

EES**CALCULATION SHEET**

PREPARED BY

B.S. H.

DATE

3/30/82

CHECKED BY

F. Jofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251 REV. NO. 0SHEET NO. 2251-11RESPONSE 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	0.45925E 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		PREPARED BY <i>B.R.</i>	DATE 3/30/82
PROJECT <u>PILGRIM UNIT No. 1</u>	CHECKED BY <i>F. Zighi</i>	DATE 4/2/82	
SUBJECT <u>MASONRY WALL ANALYSIS</u>	JOB NO. 80034	FILE NO. 29F	
SYSTEM <u>WALL 188.10</u>			
ANALYSIS NO. <u>2251</u>	REV. NO. <u>0</u>	SHEET NO. <u>2251-12</u>	

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 SAPIV 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

S. Caporale

DATE

3/25/82

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.

*2251-13*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

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

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

PM #9 ATTACH. 4

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

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

EES**CALCULATION SHEET**

PREPARED BY

S. Colaninno

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 MOMENTS8" THK PARTITION WALL (PM #9 - ATTACHMENT 3)

$$m_{xx} = 304 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{crx} = 904 \frac{\text{in-lb}}{\text{in}}$$

$$m_{yy} = 1056 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{cry} = 563 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{xx} = 1359 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{crx} = 1785 \frac{\text{in-lb}}{\text{in}}$$

$$m_{yy} = 2002 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{cry} = 1231 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{xx} = 1298 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{crx} = 2598 \frac{\text{in-lb}}{\text{in}}$$

$$m_{yy} = 2102 \frac{\text{in-lb}}{\text{in}}$$

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

$$m_{cry} = 1318 \frac{\text{in-lb}}{\text{in}}$$

EES**CALCULATION SHEET**

PREPARED BY

B.B.G.

DATE

3/30/82

CHECKED BY

F. Tofighi

DATE

4/2/82

PROJECT PILGRIM UNIT No. 1

SUBJECT MASONRY WALL ANALYSIS

SYSTEM WALL 188.10

JOB NO.

80034

FILE NO.

29F

ANALYSIS NO. 2251

REV. NO. 0

SHEET NO. 2251-15

OBE :

THE RESULTS OF THE DESIGN EARTHQUAKE ANALYSIS ARE SHOWN BELOW. (REF. SØ-R5-188.10-Ø3E-0)

$$f_n = 18.8 \text{ Hz}$$

$$M_{xx \text{ MAX}} = 108.4 \frac{\text{IN-LB}}{\text{IN}} < \begin{matrix} M_{CR_{8''}} = 904 \frac{\text{IN-LB}}{\text{IN}} \\ M_{ALLOW_x} = 304 \frac{\text{IN-LB}}{\text{IN}} \end{matrix} \quad (\text{ELEMENT 72})$$

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

∴ M_{xxE} IS ADEQUATE.

$$M_{yy \text{ MAX}} = 573.0 \frac{\text{IN-LB}}{\text{IN}} \approx \begin{matrix} M_{CR_{8''y}} = 563 \frac{\text{IN-LB}}{\text{IN}} \\ M_{ALLOW_y} = 1056 \frac{\text{IN-LB}}{\text{IN}} \end{matrix} \quad (\text{ELEMENT 100})$$

THE MAXIMUM M_{yy} FOR ALL ELEMENTS IS LESS THAN THE LEAST ALLOWABLE M_{yyE} MOMENT.

IT EXCEEDS THE LEAST CRACKING MOMENT BY 1.8%, AS ELEMENT 100 IS A 16" THICK ELEMENT THE $M_{CR_{16''}}$ IS $1318 \frac{\text{IN-LB}}{\text{IN}}$. ALL OTHER M_{yy} VALUES DO NOT EXCEED $563 \frac{\text{IN-LB}}{\text{IN}}$.

∴ M_{yyE} IS ADEQUATE AND THE WALL DOES NOT CRACK. THE OBE ANALYSIS IS COMPLETE.

INCREASE MOMENTS BY 1.3 TO ACCOUNT FOR HIGHER MODES.

EES**CALCULATION SHEET**

PREPARED BY

B.B. *B.B.*

DATE

3/30/82

CHECKED BY

F. Tofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1

SUBJECT MASONRY WALL ANALYSIS

SYSTEM WALL 188.10

ANALYSIS NO. 2251

REV. NO. 0

SHEET NO. 2251-16

OBE (CONTINUED)

$$M_{xx_{MAX}} = 1.3(108.4 \frac{IN-LB}{IN}) = 140.9 \frac{IN-LB}{IN} < 304 \frac{IN-LB}{IN}$$

$$M_{yy_{MAX}} = 1.3(573.0 \frac{IN-LB}{IN}) = 744.9 \frac{IN-LB}{IN} < 1056 \frac{IN-LB}{IN}$$

∴ O.K.

SSE:

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

$$f_n = 18.8 \text{ HZ}$$

$$M'_{xx_{MAX}} = 168.3 \frac{IN-LB}{IN} < \begin{matrix} M_{CR_{X3}} = 904 \frac{IN-LB}{IN} \\ M'_{ALLOW_X} = 452 \frac{IN-LB}{IN} \end{matrix}$$

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.

EES**CALCULATION SHEET**

PREPARED BY

B. B. But

DATE

3/30/82

CHECKED BY

F. Tofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 2251REV. NO. 0SHEET NO. 2251-17SSE :

$$M'_{YY \text{ MAX}} = 889.2 \frac{\text{IN-LB}}{\text{IN}} < M'_{\text{ALLOWY}} = 2112 \frac{\text{IN-LB}}{\text{IN}}$$

(ELEMENT 100)

THE MAXIMUM M'_{YY} FOR ALL ELEMENTS IS LESS THAN THE LEAST ALLOWABLE M'_{YY} FOR MAXIMUM EARTHQUAKE. $\therefore M'_{YY}$ IS ADEQUATE.

$M'_{YY \text{ MAX}}$ IS FOUND IN A 16" THICK SECTION OF THE WALL. THE CRACKING MOMENT OF A 16" SECTION IS $1318 \frac{\text{IN-LB}}{\text{IN}}$. \therefore 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. \therefore THIS WALL DOES NOT CRACK AND THE ANALYSIS IS COMPLETE.

INCREASE MOMENTS BY 1.3 TO ACCOUNT FOR HIGHER MODES.

$$M'_{XX} = 1.3(168.3 \frac{\text{IN-LB}}{\text{IN}}) = 218.8 \frac{\text{IN-LB}}{\text{IN}} < 452 \frac{\text{IN-LB}}{\text{IN}}$$

$$M'_{YY} = 1.3(889.2 \frac{\text{IN-LB}}{\text{IN}}) = 1156.0 \frac{\text{IN-LB}}{\text{IN}} < 2112 \frac{\text{IN-LB}}{\text{IN}}$$

\therefore O.K.

EES

CALCULATION SHEET		PREPARED BY <i>B.B.</i>	DATE 3/30/82
PROJECT <u>PILGRIM UNIT No. 1</u>	CHECKED BY <i>J. Tofighi</i>		DATE 4/2/82
SUBJECT <u>MASONRY WALL ANALYSIS</u>	JOB NO. 80034	FILE NO. 29F	
SYSTEM <u>WALL 188.10</u>			
ANALYSIS NO. <u>2251</u>	REV. NO. <u>0</u>	SHEET NO. <u>2251-18</u>	

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:

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

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

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.

EES**CALCULATION SHEET**

PREPARED BY

B.B.T.

DATE

3/30/82

CHECKED BY

J. Jofighi

DATE

4/2/82

JOB NO.

80034

FILE NO.

29F

PROJECT PILGRIM UNIT No. 1

SUBJECT MASONRY WALL ANALYSIS

SYSTEM WALL 188.10

ANALYSIS NO. 2251 REV. NO. 0

SHEET NO. 2251-19

PRESSURE ANALYSIS (CONTINUED)COMPUTE F_z DUE TO PRESSURE ON DOOR :

$$F_z = \frac{0.55 \text{ PSI} (40.5' \times 86.5'')}{13 \text{ NODE/OPENING}} = 148 \frac{\text{LB}}{\text{NODE}}$$

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)

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

(ELEMENT 104)

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

(ELEMENT 97)

WALL IS ADEQUATE FOR PBOC AND TORNADO.

EES**CALCULATION SHEET**

PREPARED BY

J. Richard

DATE

11/19/81

CHECKED BY

M. MORVAN

DATE

12/1/81

JOB NO.

80034

FILE NO.

29F

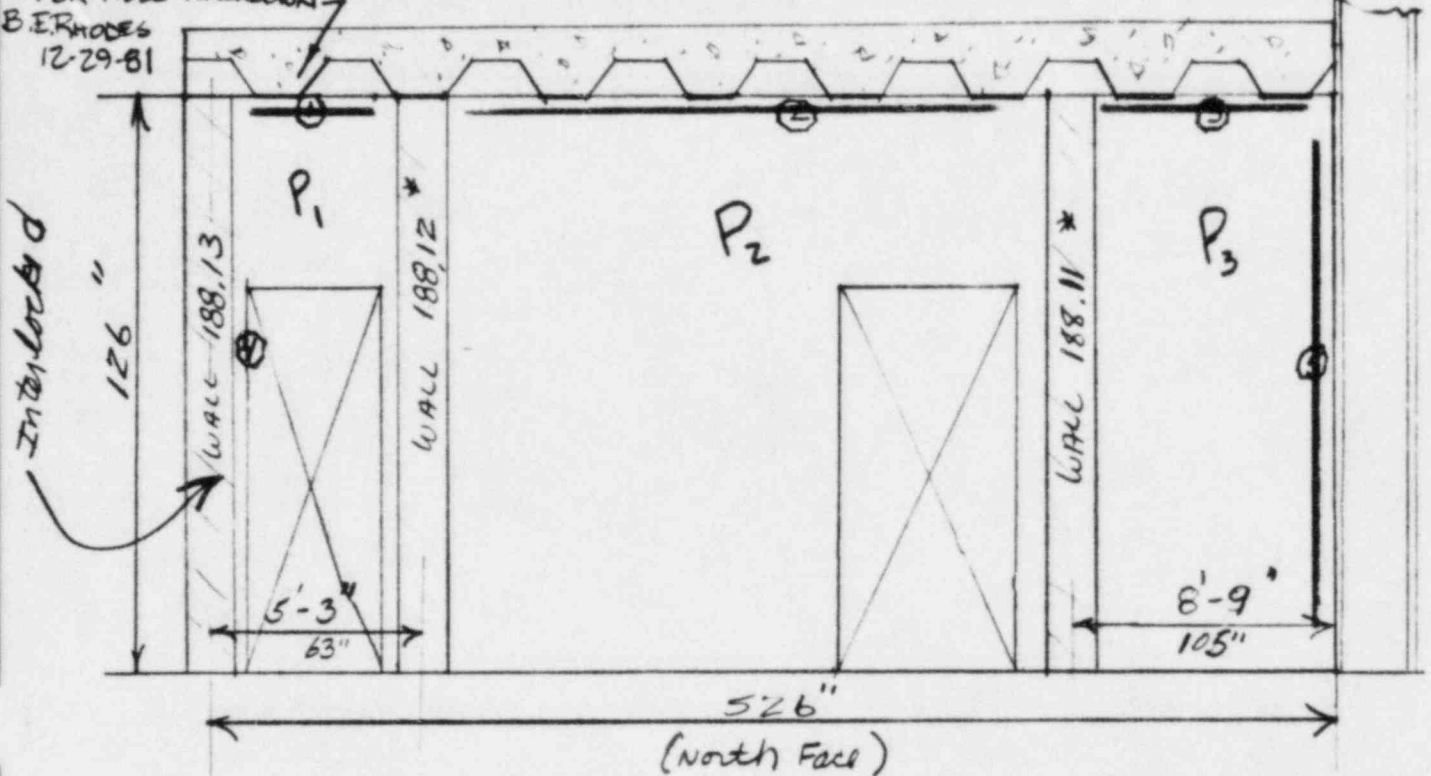
PROJECT Pilgrim Unit 1
 SUBJECT Masonry Wall Boundary Mod.
 SYSTEM Wall 188.10

ANALYSIS NO. 2251 REV. NO. 1

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)

$$P_{1OBE} = .092 \text{ psi}$$

$$P_{2OBE} = .239 \text{ psi}$$

$$P_{3OBE} = .089$$

$$P_{1SSE} = .142 \text{ psi}$$

$$P_{2SSE} = .368 \text{ psi}$$

$$P_{3SSE} = .137$$

(Ref calc 2251)

$$w_{side} = \frac{.55(63)}{2} = 17. \#/\text{in}$$

$$w_{top} = \frac{.55(126)}{2} = 35 \#/\text{in}$$

$$w_{side} = \frac{.55(105)}{2} = 29 \#/\text{in}$$

$$w_{top} = \frac{.55(126)}{2} = 35 \#/\text{in}$$

$$w_{side} = \frac{.55(358)}{2} = 98.5$$

$$w_{top} = \frac{.55(126)}{2} = 35 \#/\text{in}$$

$$P_{BOC} = .55 \text{ psi}$$

Ref. P.M. #4

$$P_{TOM} = .232 \text{ psi}, .243 \text{ psi}$$

Ref. P.M. #5



Calculation Sheet

Prepared By:

m. Kuntz

Date

7/27/82

Checked By:

D. V. Vendi

Date

8-6-82

Project Pilgrim Unit #1Subject Masonry Wall AnalysisSystem Wall No. 188.10Analysis No. 2251 Rev. No. 2

Job No.

80034

File No.

29F

Sheet No.

2251-21

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) Maximum Horizontal Acceleration is $g_{E(allow)} = 4.0$ and $g_{E'(allow)} = 6.0$ (Ref. PM #12, Attachment 2, pg 5 of 8)
- 5) Equivalent Static Pressure is $P = .912$ (assume max. static pressure-conservative)
 $\therefore P_E = .912 * .2 = .182 \text{ psi}$
 $P_{E'} = .912 * .3 = .274 \text{ psi}$
 $P_{Torn} = .243 \text{ psi}$ (ref. PM #4, rev. 1)
 $P_{BOC} = .55 \text{ psi}$ (ref. PM #5, rev. 1)
- 6) Maximum Allowable Pressure ($P_B = 1.384 * 10^{-4}$ ref pg. 3)
 $\therefore P_{E(allow)} = 1.384 * 10^{-4} * 8 * 4.0 * 386.4$
 $= 1.71 \text{ psi}$
 $P_{E'(allow)} = 1.384 * 10^{-4} * 8 * 6.0 * 386.4$
 $= 2.57 \text{ psi}$

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

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

$$P_{E'(allow)} = 2.57 > P_{Torn} = .243$$

$$P_{E'(allow)} = 2.57 > P_{BOC} = .55$$

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. 188.10Problem 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. 0Computer Output Files 50-FN-188.10, 50-ST-188.10,EO-TO-188.10, 50-TORN-188.10UFD No. Computer Binder No. 9.1F**SOURCES OF FORMULAE & REFERENCES**EES Work Instructions WI-1, Rev. 1 & WI-2, Rev. ²~~0~~

EES Design Criteria and Project Memoranda

EES PNPS Calc. Set No.

ADDED PAGES 22B, 2C, 23 THRU 30, SUPERSEDED PAGES 16, 17, 8

ADDED PAGES 16 THRU 22 FOR TORNADO

REMARKSThe results of this Level 1 Analysis are E-Seismic FAILE'-Seismic FAIL PBOC * Tornado FAILIn-Plane Loads PASS Out of Plane FAILSee 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. B. Bunt

S. CAPOBIANCO

F. TOFIGHI

DATE: 2/26/82

EES

CALCULATION COVER SHEET

Job. No. 80034

File No. 1-F155

Calc. Set No. 1251

No. of Sheets 219PROJECT Pilarim I Nuclear Power StationCLIENT Boston Edison Company

SUBJECT

Masonry Wall Analysis for NRC IE Bulletin 80-11Wall 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-16EES As-Built M.W.D.'s SK-452, 453Computer Run No.'s SO-FN-188.10, SO-ST-188.10
EO-TO-188.10, SO-TORN-188.10[COMPUTER OUTPUT
BINDER NO. 1-1-F]

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

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

ORIGINATORS	CHECKERS	DISTRIBUTION	REVISION NO. <u>0</u>
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. <u>WJA</u>
			APPROVED BY: <u>W. Duff</u>
			DATE: <u>5/8/81</u>

EES

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

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 - 2

SUMMARY

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

$$f_n = 4.76 \text{ HZ}$$

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

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

$$\Delta_E = 1.47 \text{ in}$$

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

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

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

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

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

$$\Delta_{E'} = 1.61 \text{ in}$$

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

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

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

EES**CALCULATION SHEET**

PREPARED BY

S. Capobianco

DATE

5/4/81

CHECKED BY

J. 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-E

SHEET NO.

1251-2A

S. Capobianco

Summary of Results (Tornado Analysis)

Using a tornado pressure equal to 1.54 psi

$$M_{xx} = 1135 \frac{\text{in-lb}}{\text{in}} < 1375 \frac{\text{in-lb}}{\text{in}} \quad \text{OK.}$$

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

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

J. Tofighi 8/4/81

V. RYAN 8/5/81

Wall 188.10 is not adequate to withstand
tornado loading per EES Design

Criteria DC-1.

PBOC Analysis

$$P_{POC} = .93 \text{ psi}$$

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

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

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

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

EES**CALCULATION SHEET**

PREPARED BY

F. Jofigliu

DATE

6/23/81

CHECKED BY

J. DEVINCENTIS

DATE

7/2/81

JOB NO.

80034

FILE NO.

9F

PROJECT PILGRIM #1SUBJECT MASONRY WALL ANALYSISSYSTEM Wall 188.10ANALYSIS NO. 1251REV. NO. 1SHEET NO. 1251-2B**SUMMARY****IN PLANE LOADING ANALYSIS***Shear Stress Comparison;*OBE $J_{OBE} = 49.3 \text{ */in}^2 < 69 \text{ */in}^2 \text{ OK,}$ SSE $J_{SSE} = 53.7 \text{ */in}^2 < 104 \text{ */in}^2 \text{ OK,}$ TORNADO $J_{TORNADO} = 8.6 \text{ */in}^2 < 104 \text{ */in}^2 \text{ OK,}$ PBOC $J_{PBOC} = 6.9 \text{ */in}^2 < 104 \text{ */in}^2 \text{ OK,}$ *wall 188.10 is qualified for in plane loading.*

EES

CALCULATION SHEET		PREPARED BY JDEVINCENTIS	DATE 8/12/81
PROJECT	PILGRIM UNIT ONE	CHECKED BY M. MORYAN	DATE 8/12/81
SUBJECT	OUT OF PLANE SHEAR	JOB NO. 80034	FILE NO. 9F
SYSTEM	WALL 188.10		
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 EARTH-
QUAKE, PBOC AND TORNADO. THE
RESULTS ARE:

DESIGN (OBE) EARTHQUAKE: P

MAXIMUM (SSE) EARTHQUAKE: P

PBOC : P

TORNADO : F

CALCULATION SHEET

PREPARED BY
L. DOWNS

DATE
2/19/81

PROJECT PILGRIM UNIT 1
SUBJECT MASONRY WALL ANALYSIS
SYSTEM WALL 188.10
ANALYSIS NO. 1251 REV. NO. 0

CHECKED BY
R. Richard
JOB NO.
80034





DATE
3-18-81

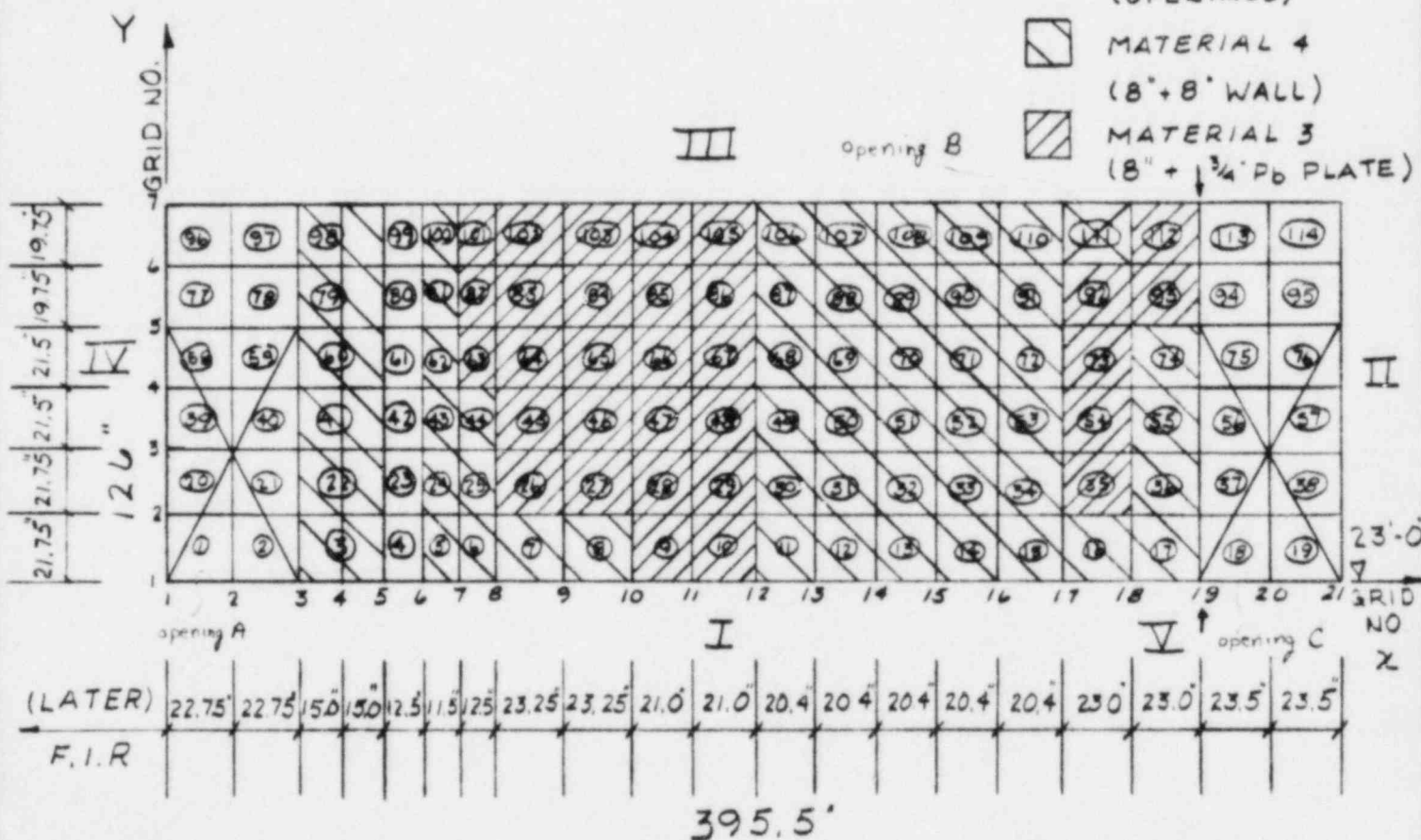
JOB NO. 80034	FILE NO. 9-F
SHEET NO. 1251-3	

WALL GEOMETRY & BOUNDARY CONDITIONS

PER SK - 452, 453.

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

-  MATERIAL 1
 (8" WALL)
 MATERIAL 2
 (OPENINGS)
 MATERIAL 4
 (8" + 8" WALL)
 MATERIAL 3
 (8" + 1 3/4" P.D. PLATE)



EDGE

CONDITION

I	PINNED
II	PINNED
III	PINNED
IV	PINNED
V	PINNED

REF. DC - 1
EXHIBIT C

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/19/81

CHECKED BY

RJ Richard

DATE

3-18-81

JOB NO.

80034

FILE NO.

9-F

PROJECT MILLSTONE UNIT 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251 - 4WALL 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

JOB NO.

80034

FILE NO.

9-F

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANALSYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251-5WEIGHT OF ATTACHED EQUIPMENT: 188.105

<u>ATTACHMENT & LENGTH</u> (ft)	<u>WT/LENGTH</u> (lbs/ft)	<u>ATTACHMENT WT.</u> (lbs)
18' - 3/4" ϕ C	1.4 DC - 1	25.2
	EXHIBIT D	
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 <u>PILGRIM UNIT 1</u>	CHECKED BY RJ Richard	DATE 3-18-81	
SUBJECT <u>MASONRY WALL ANAL.</u>	JOB NO. 80034	FILE NO. 9-F	
SYSTEM <u>WALL 188.10</u>	SHEET NO. <u>1251-6</u>		
ANALYSIS NO. <u>1251</u>	REV. NO. <u>0</u>		

WEIGHT OF ATTACHED EQUIPMENT : (CONT) 188.10 S

<u>ATTACHMENT & LENGTH</u> (ft)	<u>WT/LENGTH</u> (lbs/ft)	<u>ATTACHMENT WT</u> (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*/FT ²	39.6
1 - TRANSFORMER - CVT ~ 21" x 10.5" x 8"	5*/FT ²	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 10 S \approx 2199.0 lbs

WEIGHT OF $\frac{3}{4}$ " THICK LEAD PLATE : 188.10 S

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

$$W_{LEAD} = 710 \text{ lbs/ft}^3 = 0.411 \text{ lbs/in}^3$$

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

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/19/81

CHECKED BY

RJ Richard

DATE

3-18-81

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.105ANALYSIS NO. 1251REV. NO. 0

JOB NO.

80034

FILE NO.

9-F

SHEET NO. 1251-7ATTACHMENT WEIGHT : 188.10 N

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

TOTAL 188.10 N \approx 653.1 lbsTOTAL ATTACHMENT WEIGHT (MATERIAL 1)

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

TOTAL ATTACHMENT WEIGHT (MATERIAL 3)

$$W_{188.10-3} = 2852.1 + 0.3082 \frac{\text{lb}}{\text{in}^2} \times \text{AREA}_3$$

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/20/81

CHECKED BY

RJ Richard

DATE

3-18-81

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANALYSIS

JOB NO.

80034

FILE NO.

9-F

SYSTEM WALL 188.10ANALYSIS NO. 1251REV. NO. 0SHEET NO. 1251-8TOTAL ATTACHMENT WEIGHT (MATERIAL 4)

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

TOTAL ATTACHMENT LOADINGS

$$\begin{aligned} AREA_1 &= 39'-11" \times 10'-6" - 3'-4\frac{1}{2}" \times 7'-2\frac{1}{4}" \\ &\quad - 1'-8" \times 1'-8" - 3'-4\frac{1}{2}" \times 7'-2\frac{1}{4}" \\ &= 52968 \text{ in}^2 \end{aligned}$$

$$\begin{aligned} AREA_{3-1} &= 6'-0" \times 12\frac{1}{2}" + 9'-1\frac{1}{2}" \times 3'-10\frac{1}{2}" \\ &\quad + 10'-6" \times 3'-6" \\ &= 11284 \text{ in}^2 \end{aligned}$$

$$\begin{aligned} AREA_{3-2} &= 8'-4" \times 2'-10" + 6'-5" \times 1'-0" \\ &= 4324 \text{ in}^2 \end{aligned}$$

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

$$\begin{aligned} P_{188.10-3} &= 0.0560 \frac{\text{lbs}}{\text{in}^2} \xrightarrow{OK} + 0.3082 \frac{\text{lbs}}{\text{in}^2} \\ &= 0.3642 \frac{\text{lbs}}{\text{in}^2} \end{aligned}$$

$$\begin{aligned} P_{188.10-4} &= 0.0560 \frac{\text{lbs}}{\text{in}^2} + 0.428 \frac{\text{lbs}}{\text{in}^2} \\ &= 0.484 \frac{\text{lb}}{\text{in}^2} \end{aligned}$$

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 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251 - 9

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

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

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

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

$$P_{188.10-4} = \frac{0.484 \text{ lbs/in}^2}{7.625 \text{ in} (386.4 \text{ in/sec}^2)}$$

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

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

$$+ 3'-10\frac{1}{2}" \times 16\frac{1}{2}"$$

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

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

$$+ 6'-5" \times 1'-0"$$

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

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

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 1SUBJECT MASONRY WALL ANAL.SYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251-10MASS DENSITY AND EQUIVALENT STATIC
PRESSURE OF 8" MASONRY

$$p_{8"} = 1.383 \times 10^{-4} \frac{\text{lb} \cdot \text{sec}^2}{\text{in}^4}$$

REF DC-1

$$p_{8"} = 0.428 \frac{\text{lb}}{\text{in}^2}$$

EXHIBIT D-1b

TOTAL MASS DENSITY AND EQUIVALENT STATIC
PRESSURE

MATERIAL 1

$$\begin{aligned} p_1 &= 0.183 \times 10^{-4} + 1.383 \times 10^{-4} \\ &= 1.566 \times 10^{-4} \frac{\text{lb} \cdot \text{sec}^2}{\text{in}^4} \end{aligned}$$

$$\begin{aligned} p_1 &= 0.0560 + 0.428 \\ &= 0.484 \frac{\text{lb}}{\text{in}^2} \end{aligned}$$

MATERIAL 3

$$\begin{aligned} p_3 &= 1.235 \times 10^{-4} + 1.383 \times 10^{-4} \\ &= 2.618 \times 10^{-4} \frac{\text{lb} \cdot \text{sec}^2}{\text{in}^4} \end{aligned}$$

$$\begin{aligned} p_3 &= 0.3642 + 0.428 \\ &= 0.792 \frac{\text{lb}}{\text{in}^2} \end{aligned}$$

MATERIAL 4

$$p_4 = 1.643 \times 10^{-4} + 1.383 \times 10^{-4}$$

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 1SUBJECT MASONRY WALL ANALSYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251 - 11

MATERIAL 4 (CONT.)

$$p_4 = 3.026 \times 10^{-4} \frac{\text{lb} \cdot \text{sec}^2}{\text{in}^4}$$

$$p_4 = 0.484 + 0.428$$

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

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/23/81

CHECKED BY

RJ Richard

DATE

3-18-81

JOB NO.

80034

FILE NO.

9-F

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANAL.SYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251 - 12FREQUENCY ANALYSIS

EXECUTE EWALL TO GENERATE A SAPIV FREQUENCY ANALYSIS INPUT FILE. SELECT ORTHOTROPIC PLATE PROPERTIES FROM DC-1, EXHIBIT D-1C FOR CASE C AND CASE E**. EXECUTE SAPIV 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

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/23/81

CHECKED BY

RJ Richard

DATE

3-18-81

JOB NO.

80034

FILE NO.

9-F

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANAL.SYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251-13

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

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

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

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

$$G_{xy} = 4.150 E 04$$

FOR CASE C AND

CASE E**,

REF. DC-1

EXHIBIT D-1 c

FROM COMPUTER OUTPUT : 50 - FN - 188.10

$$f_N = 4.76 \text{ HZ}$$

EES**CALCULATION SHEET**

PREPARED BY L. DOWNS	DATE 2/24/81
CHECKED BY RJ Richard	DATE 3-18-81
JOB NO. 80034	FILE NO. 9-F
SHEET NO. 1251 - 14	

PROJECT MILLSTONE UNIT 1
 SUBJECT MASONRY WALL ANALYSIS
 SYSTEM WALL 188.10
 ANALYSIS NO. 1251 REV. NO. 0

STATIC ANALYSIS

MODIFY SAPIV INPUT FILE BY INDICATING A STATIC ANALYSIS ON THE MASTER CONTROL CARD. EXECUTE SAPIV 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 : 50-ST-188.10

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

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

$\Delta_{MAX} = 0.62 \text{ in}$ AT NODE 74

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

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

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

EES**CALCULATION SHEET**

PREPARED BY

L. DOWNS

DATE

2/24/81

CHECKED BY

RJ Richard

DATE

3-18-81

JOB NO.

80034

FILE NO.

9-F

PROJECT PILGRIM UNIT 1SUBJECT MASONRY WALL ANALYSISSYSTEM WALL 188.10ANALYSIS NO. 1251 REV. NO. 0SHEET NO. 1251-15STATIC ANALYSIS (CONT.)

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

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

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

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

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

$$P_{4E} = 0.912 \times 2.37 = 2.161 \frac{\text{lb}}{\text{in}^2}$$

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

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

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

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

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

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

EES**CALCULATION SHEET**

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

PREPARED BY <u>J. RYAN</u>	DATE <u>8/5/81</u>
CHECKED BY <u>F. Tofighi</u>	DATE <u>8/5/81</u>
JOB NO. <u>80034</u>	FILE NO. <u>9F</u>
SHEET NO. <u>1251-16</u>	

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.



CALCULATION SHEET

PREPARED BY <i>F. Tofighi</i>	DATE 8/4/81
CHECKED BY <i>J. RYAN</i>	DATE 8/5/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-17	

PROJECT <i>PILGRIM #1</i>	
SUBJECT <i>MASONRY WALL ANALYSIS</i>	
SYSTEM <i>wall 188-10</i>	
ANALYSIS NO. <i>1251</i>	REV. NO. <i>1</i>

TORNADO/PBOC ANALYSIS

OPENINGS:

$$\left\{ \begin{array}{l} P_{PBOC} = 0.93 \\ P_{TORNADO} = 1.54 \text{ } \frac{\text{lb}}{\text{in}^2} \end{array} \right.$$

$$\text{Area of opening A} = (45.5)(86.5) = 3936 \text{ } m^2$$

$$\text{Total load} = 1.54 \times 3936 = 6061 \text{ } \#$$

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

$$\text{Area of opening B} = (23.0)(19.75) = 454 \text{ } m^2$$

$$\text{Total load} = 1.54 \times 454 = 700 \text{ } \# \text{ over 4 nodes.}$$

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

$$\text{Area of opening C} = (47.0)(86.5) = 4067 \text{ } m^2$$

$$\text{Total load} = 1.54 \times 4067 = 6263 \text{ } \# \text{ over 11 nodes}$$

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

SECTION PROPERTIES;

- | | | |
|----------|---|---|
| MATERIAL | 1 | 8" wall |
| | 2 | opening |
| | 3 | 8" wall + 3/4" Pb plate (assumed 8" wall) |
| | 4 | 16" wall |

EES**CALCULATION SHEET**

PREPARED BY

F. Tofighi

DATE
8/4/81

CHECKED BY

V. KRYAN

DATE
8/5/81PROJECT PILGRIM #1SUBJECT MASONRY WALL ANALYSISSYSTEM wall 188.10ANALYSIS NO. 1251REV. NO. 1

JOB NO.

80034

FILE NO.

9F

SHEET NO. 1251-18WALL GEOMETRY & BOUNDARY CONDITIONS.

Material 1 (8" wall)



Material 2 (opening)



Material 3 (8" wall + 3/4" PL PLATE)



Material 4 (8" + 8" wall)

→ opening B

19.75	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
19.75	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
21.5	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
21.5	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
21.75	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
21.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

opening A

21.75 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

395.5'

opening C

EES**CALCULATION SHEET**

PREPARED BY

F. Tofighi

DATE

8/4/81

CHECKED BY

V. RYAN

DATE

8/5/81

JOB NO.

80034

FILE NO.

9F

PROJECT PILGRIM #1SUBJECT MASONRY WALL ANALYSISSYSTEM wall 188.10ANALYSIS NO. 1251 REV. NO. 1SHEET NO. 1251-19

Material 1)

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

$$C_{xx} = 9.960 \times 10^4 \text{ PSI}$$

$$C_{xy} = 2.080 \times 10^4 \text{ PSI}$$

$$C_{yy} = 1.080 \times 10^5 \text{ PSI}$$

$$G_{xy} = 4.150 \times 10^4 \text{ PSI}$$

Material 2)

OPENINGS.

Material 3)

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

$$C_{xx} = 9.960 \times 10^4 \text{ PSI}$$

$$C_{xy} = 2.080 \times 10^4 \text{ PSI}$$

$$C_{yy} = 1.080 \times 10^5 \text{ PSI}$$

$$G_{xy} = 4.150 \times 10^4 \text{ PSI}$$

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

Material 4)

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

$$C_{xx} = 78200 \text{ PSI}$$

$$C_{xy} = 22800 \text{ PSI}$$

$$C_{yy} = 166000 \text{ PSI}$$

$$G_{xy} = 45600 \text{ PSI}$$

EES**CALCULATION SHEET**

PREPARED BY <i>F. Tofighi</i>	DATE 8/4/81
CHECKED BY J. RYAN	DATE 8/5/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-20	

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

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 <i>J. Tofighi</i>	DATE 8/4/81
CHECKED BY <i>J. RYAN</i>	DATE 8/5/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-21	

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

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

EES**CALCULATION SHEET**

PREPARED BY <i>F. Jolygki</i>	DATE 8/4/81
CHECKED BY <i>V. RYAN</i>	DATE 8/5/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-22	

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

STATIC ANALYSIS (Ref. SO-TOR-188.10)

$$\delta_{2 \text{ max.}} = 1.01 \text{ in @ node 72}$$

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

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

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

$$M_{xx}' = 1375 \frac{\text{in-lb}}{\text{in}}$$

$$M_{yy}' = 2277 \frac{\text{in-lb}}{\text{in}}$$

(for 8" wall)

$$M_{xx}' = 3013 \frac{\text{in-lb}}{\text{in}}$$

$$M_{yy}' = 7279 \frac{\text{in-lb}}{\text{in}}$$

(for 16" wall)

CONCLUSION:

16" wall,

$$M_{xx} = 455 \frac{\text{in-lb}}{\text{in}} < 3013 \frac{\text{in-lb}}{\text{in}}$$

OK,

@ Elem. 56 ✓

$$M_{yy} = 8492 \frac{\text{in-lb}}{\text{in}} > 7279 \frac{\text{in-lb}}{\text{in}}$$

NG.

@ Elem. 66 ✓

8" wall,

$$M_{xx} = 561 \frac{\text{in-lb}}{\text{in}} < 1375 \frac{\text{in-lb}}{\text{in}}$$

OK,

@ Elem. 82 ✓

$$M_{yy} = 937 \frac{\text{in-lb}}{\text{in}} < 2277 \frac{\text{in-lb}}{\text{in}}$$

OK,

@ Elem. 68 ✓

wall 188.10 is not adequate to withstand max. tornado loading.

EES**CALCULATION SHEET**

PREPARED BY

F. Tofighi

DATE

6/23/81

CHECKED BY

J. Devincents

DATE

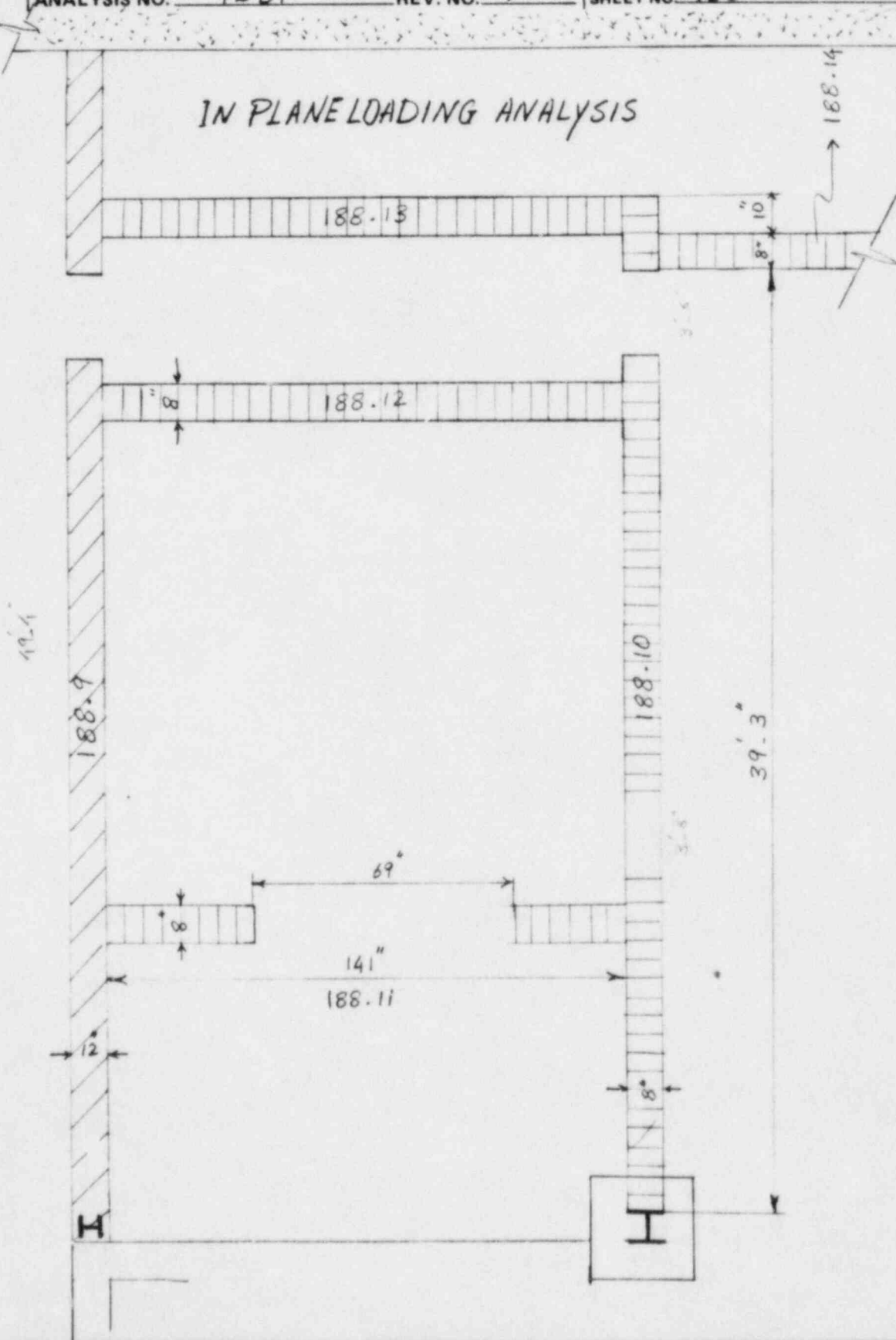
7/2/81

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. *1251-23***IN PLANE LOADING ANALYSIS**

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. 1251-24

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 $150 \frac{\text{lb}}{\text{ft}^3}$

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

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

$$= \text{Ama 1} \times 0.484 + \text{Ama 3} \times 0.792 + \text{Ama 4} \times 0.912$$

$$\text{Ama 1} = 45.5 \times 39.5 + 12.5 \times 126 + 47 \times 39.5 + 112 \times 126 = 19341$$

$$\text{Ama 3} = 12.5 \times 61 + 46.5 \times 104.25 + 42 \times 126 + 84.5 \times 23 + 23 \times 39.5$$

$$\text{Ama 3} = 13754 \text{ in}^2$$

$$\text{Ama 4} = 30 \times 126 + 11.5 \times 126 + 12.5 \times 65 + 46.5 \times 21.75 + 102 \times 126 + 23 \times 21.75 + 23 \times 21.75 + 23 \times 86.5$$

$$\text{Ama 4} = 22895 \text{ in}^2$$

$$\text{weight of wall 188.10,} = 19341 \times 0.484 + 13754 \times 0.792 + 22895 \times 0.912$$

$$= 41134 \text{ *}$$

$$\text{Total weight effecting 188.10,} = \frac{61507}{2} + 41134 = 71888 \text{ *}$$

(conservative)

EES**CALCULATION SHEET**

PREPARED BY

F. Jofighi

DATE

6/23/81

CHECKED BY

J. DEVINCENTO

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. *1251-25*

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

<i>Elev.</i>	<i>$S_a(0.02)$</i>	<i>$S_a(0.05)$</i>
<i>23'-0"</i>	<i>1.30</i>	<i>1.40</i>
<i>51'-0"</i>	<i>2.37</i>	<i>2.60</i>
<i>33'-6"</i>	<i>1.70</i>	<i>1.85</i>

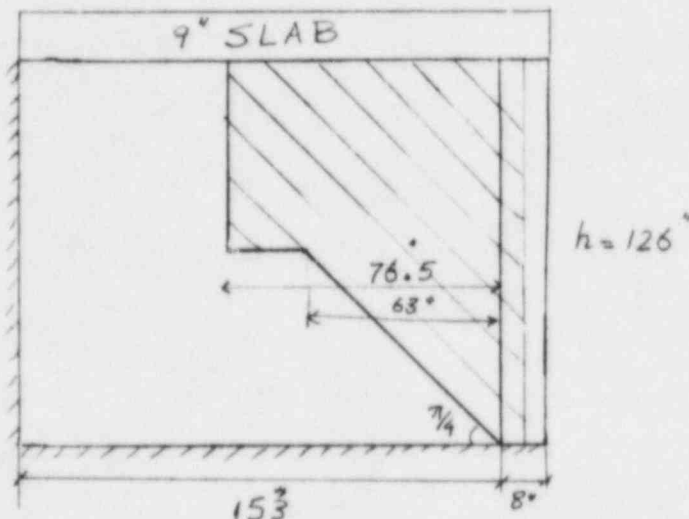
Forces,

$$\text{Due to OBE,} = 71888 \times 1.70 = 122210 *$$

$$\text{Due to SSE,} = 71888 \times 1.85 = 132993 *$$

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

FORCES EXERTED ON 188.10 By 188.11



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

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

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

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

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

FORCES EXERTED ON 188.10 By 188.12

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

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

$$F_{SSE} = 7308 (1.037 \times 1.85) = 14020 \text{ \#} \quad \text{* The highest pressure is used.}$$

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

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

EES**CALCULATION SHEET**

PREPARED BY

F. Tofighi

DATE

6/23/81

CHECKED BY

J. DEVINCENIS

DATE

7/2/81

JOB NO.

80034

FILE NO.

9F

PROJECT PILGRIM #1SUBJECT MASONRY WALL ANALYSISSYSTEM wall 188.10ANALYSIS NO. 1251 REV. NO. 1SHEET NO. 1251-27

FORCES EXERTED ON 188.10 BY 188.13

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

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

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

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

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

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

TOTAL FORCES EXERTED ON 188.10

$$\text{Due to OBE,} = 122210 + 5690 + 12883 + 5454 = 146237 \text{ #}$$

$$\text{Due to SSE,} = 132993 + 6192 + 14020 + 5935 = 159140 \text{ #}$$

$$\text{Due to TORNADO,} = 5846 + 8697 + 11108 = 25651 \text{ #}$$

$$\text{Due to PBOC,} = 6796 + 6796 + 6796 = 20388 \text{ #}$$

Shear Area.

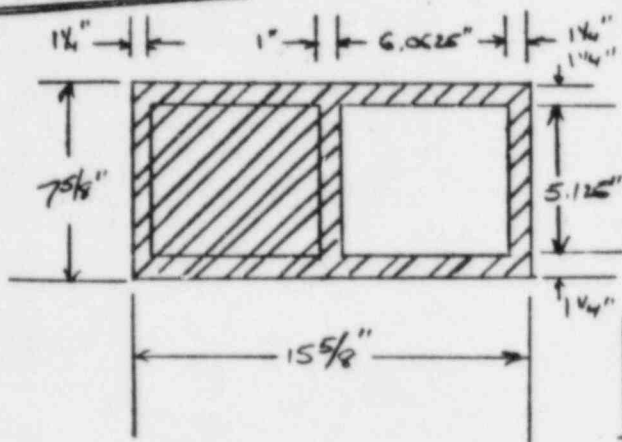
wall 188.10 is a variable wythe Partition wall.

The area of the $\frac{3}{4}$ " Pb Plate is conservatively neglected.

EES**CALCULATION SHEET**

PREPARED BY <i>F. Lofighi</i>	DATE 6/23/81
CHECKED BY <i>J. DEVINCENTIS</i>	DATE 7/2/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-28	

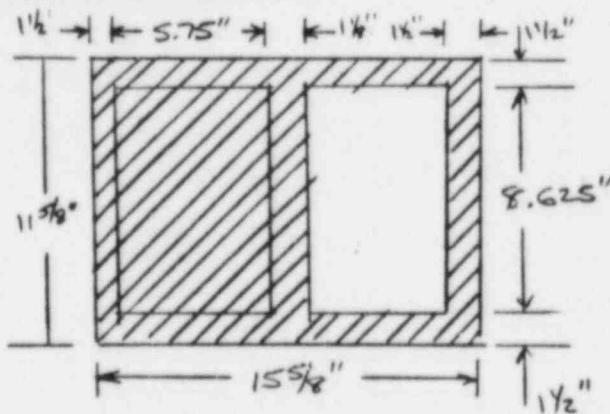
PROJECT PILGRIM UNIT 1
 SUBJECT MASONRY WALL ANALYSIS
 SYSTEM SHEAR AREA OF MASONRY BLOCKS
FOR PARTITION WALLS
 ANALYSIS NO. 1251 REV. NO. 1

8"x8"x16" BLOCK

$$A = (15.625" \times 7.625") - (5.125" \times 6.0625")$$

$$A = 88.07 \text{ IN}^2 / 16 \text{ IN BLOCK}$$

SHEAR AREA FOR 8" PARTITION WALL = $A_{8" \times 8" \times 16"} = 5.50 \text{ INCHES}^2 \text{ PER INCH OF WALL LENGTH}$

8"x12"x16" BLOCK

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

$$A = 132.05 \text{ IN}^2 / 16 \text{ IN BLOCK}$$

SHEAR AREA FOR 12" PARTITION WALL = $A_{8" \times 12" \times 16"} = 8.25 \text{ INCHES}^2 \text{ PER INCH OF WALL LENGTH}$

REFERENCE:

"REINFORCED MASONRY DESIGN"
 SCHNEIDER & DICKEY
 1980

EES**CALCULATION SHEET**

PREPARED BY <i>F. Topigli</i>		DATE 6/23/81
CHECKED BY <i>J. DEVINCENTIS</i>		DATE 7/2/81
JOB NO. 80034	FILE NO. 9F	
SHEET NO. 1251-29		

PROJECT PILGRIM #1
 SUBJECT MASONRY WALL ANALYSIS
 SYSTEM wall 189.10
 ANALYSIS NO. 1251 REV. NO. /

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

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

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 allowables;

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

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

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

EES**CALCULATION SHEET**

PREPARED BY <i>F. Tofighi</i>	DATE 6/23/81
CHECKED BY <i>J. DEVINCENTIS</i>	DATE 7/2/81
JOB NO. 80034	FILE NO. 9F
SHEET NO. 1251-30	

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

Shear stress comparison;

OBE $T_{OBE} = 49.3 \text{ ksi} < 69 \text{ ksi} \quad \text{OK,}$

SSE $T_{SSE} = 53.7 \text{ ksi} < 104 \text{ ksi} \quad \text{OK,}$

TORNADO $T_{TORNADO} = 5.6 \text{ ksi} < 104 \text{ ksi} \quad \text{OK,}$

PBOC $T_{PBOC} = 6.9 \text{ ksi} < 104 \text{ ksi} \quad \text{OK,}$

Wall 188.10 is — qualified for in plane loading.

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

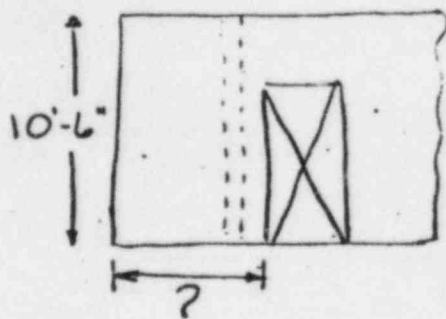
Analysis Problem No. 251

Wall I.D. No. 188.10

F.W.P. No. F-251

Location REACTOR 23'-0"
Bldg. 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

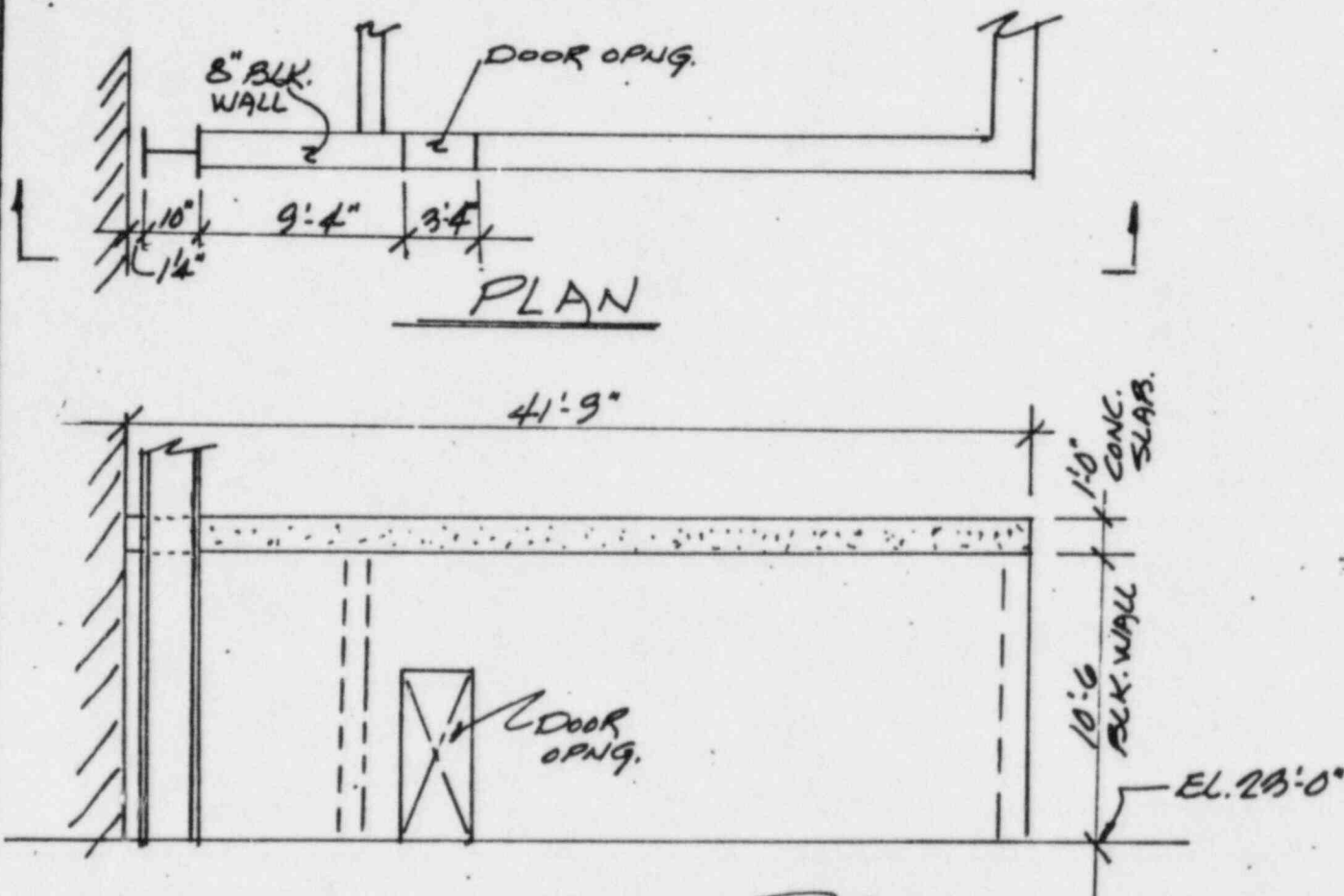
EES

Project: Pilgrim Nuclear Power Station

Client: Boston Edison Company

Job No. 8003

FIR No. 12

Response to F.I.R. 12 For Masonry Wall Plane SOUTHAnalysis Prob. No. 251 Wall I.D. No. 188.10 (SK-)F.W.P. No. F-251 is as follows:Prepared by Flanery Date 3/9/81Checked by Don't Date 3/9/81Sheet 1 of 1

EES

Project: Pilgrim Nuclear Power Station

Client: Boston Edison Company

Job No. 80034FIR 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. 26 & 52 (REV. 0)

Computer Output Files SO-FN-63.4, SO-ST-63.4, SO-FN-63.4A
and SO-ST-63.4A, EO-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,

EES PNPS Calc. Set No. N/A #7, #11 Rev. 1, #12, #10

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. Turch 9/18/81

BK Paul 9/21/81

Project Binder

SUPERSEDES CALCULATION

S. Turch 10/21/81

BK Paul 10/24/81

SET NO. N/A

APPROVED BY: MTDingman

DATE: 10/28/81



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 SQ-FN-63.4, SQ-ST-63.4, SQ-FN-63.4A
and SQ-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. Turch 9/18/81

BK Paul 9/21/81

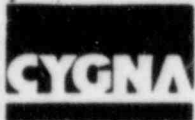
Project Binder

SUPERSEDES CALCULATION

SET NO. N/A

APPROVED BY: MT deBuzman

DATE: 09/22/81



CALCULATION SHEET

PREPARED BY

S. Tark

DATE

10/21/81

CHECKED BY

McPaul

DATE

10/26/81

JOB NO.

80034

FILE NO.

12/F

PROJECT Pilgrim Unit 1

SUBJECT Masonry Wall Analysis

SYSTEM Wall # 63.4

ANALYSIS NO. 1019 REV. NO. 1

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

$$M_{xxE} = \frac{59.2}{\text{in-lbs}} < \frac{2634}{\text{in-lbs}}$$

$$M_{yyE} = \frac{484}{\text{in-lbs}} < \frac{3926}{\text{in-lbs}}$$

$$\Delta \text{ Max.} = \frac{0.044}{\text{in.}} \text{ (From page } \underline{9} \text{)}$$

$$P \text{ Max.} = \frac{0.96}{\text{psi.}} \text{ (From page } \underline{9} \text{)}$$

$$F.S. \text{ Min.} = \frac{3926}{484} = \underline{8.11} \text{ (From page } \underline{9} \text{)}$$

SSE

$$M_{xxE'} = \frac{86.4}{\text{in-lbs}} < \frac{4742}{\text{in-lbs}}$$

$$M_{yyE'} = \frac{707}{\text{in-lbs}} < \frac{7068}{\text{in-lbs}}$$

$$\Delta \text{ Max.} = \frac{0.064}{\text{in.}} \text{ (From page } \underline{10} \text{)}$$

$$P \text{ Max.} = \frac{1.40}{\text{psi.}} \text{ (From Page } \underline{10} \text{)}$$

$$F.S. \text{ Min.} = \frac{7068}{707} = \underline{10.0} \text{ (From page } \underline{10} \text{)}$$

TORNADO OR PBOC

$$P \text{ Applied} = \underline{2.97} \text{ psi (Pg. } \underline{11} \text{)}$$

$$P \text{ Allowed} = \underline{14.0} \text{ psi (Pg. } \underline{11} \text{)}$$

$$\text{Ratio of Pressure} = \frac{P \text{ Allow}}{P \text{ Applied}} = \underline{4.71}$$

O.K



CALCULATION SHEET

PREPARED BY

S. Turk

DATE

9/16/81

CHECKED BY

B. K. Paul

DATE

10-26-81

JOB NO.

80034

FILE NO.

12/F

PROJECT Pilgrim Unit 1

SUBJECT Masonry Wall Analysis

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

$$M_{xxE} = \frac{49.6 \text{ in-lbs}}{\text{in}} \frac{2634 \text{ in-lbs}}{\text{in}}$$

$$M_{yyE} = \frac{611 \text{ in-lbs}}{\text{in}} \frac{3926 \text{ in-lbs}}{\text{in}}$$

$$\Delta \text{ Max.} = 0.05 \text{ in (From page 12)}$$

$$P \text{ Max.} = 1.02 \text{ psi (From page 12)}$$

$$F.S. \text{ Min.} = \frac{3926}{611} = 6.4 \text{ (From page 12)}$$

SSE

$$M_{xxE} = \frac{72 \text{ in-lbs}}{\text{in}} \frac{4742 \text{ in-lbs}}{\text{in}}$$

$$M_{yyE} = \frac{887 \text{ in-lbs}}{\text{in}} \frac{7068 \text{ in-lbs}}{\text{in}}$$

$$\Delta \text{ Max.} = 0.072 \text{ in (From page 13)}$$

$$P \text{ Max.} = 1.48 \text{ psi (From page 13)}$$

$$F.S. \text{ Min.} = \frac{7068}{887} = 7.97 \text{ (From page 13)}$$

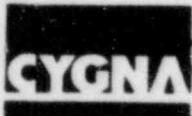
TORNADO OR PBOC - (if applicable)

$$P \text{ Applied} = 2.97 \text{ psi (Pg. 14)}$$

$$P \text{ Allow.} = 11.8 \text{ psi (Pg. 14)}$$

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

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



CALCULATION SHEET

PREPARED BY

S. Tuck

DATE

9/17/81

CHECKED BY

B K Paul

DATE

9-21-81

JOB NO.

80034

FILE NO.

12-F

PROJECT Pilgrim Unit 1

SUBJECT Masonry Wall Analysis

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. <u>15</u>)
SSE	-	(Pass)	Fail	(Pg. <u>15</u>)
PBOC	-	(Pass)	Fail	(Pg. <u>15</u>)
TORNADO	-	(Pass)	Fail	(Pg. <u>15</u>)

In Plane Shear

The results of In Plane Shear Analysis are listed below:

OBE	-	(Pass)	Fail	(Pg. <u>21</u>)
SSE	-	(Pass)	Fail	(Pg. <u>21</u>)
PBOC	-	(Pass)	Fail	(Pg. <u>21</u>)
TORNADO	-	(Pass)	Fail	(Pg. <u>21</u>)

EES**CALCULATION SHEET**

PREPARED BY

S. Tuck

DATE

9/16/81

CHECKED BY

B. K. Paul

DATE

9-24-81

JOB NO.

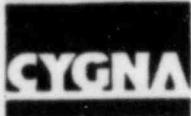
80034

FILE NO.

12/F

PROJECT PILGRIM UNIT No. 1SUBJECT Masonry Wall AnalysisSYSTEM Wall # 63.4ANALYSIS NO. 1019 REV. NO. 0SHEET NO. 1019-4INTRODUCTION

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) 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).



CALCULATION SHEET

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

PREPARED BY S. Tush

DATE 9/16/81

CHECKED BY B.K. Paul

DATE 9-21-81

JOB NO.
80034

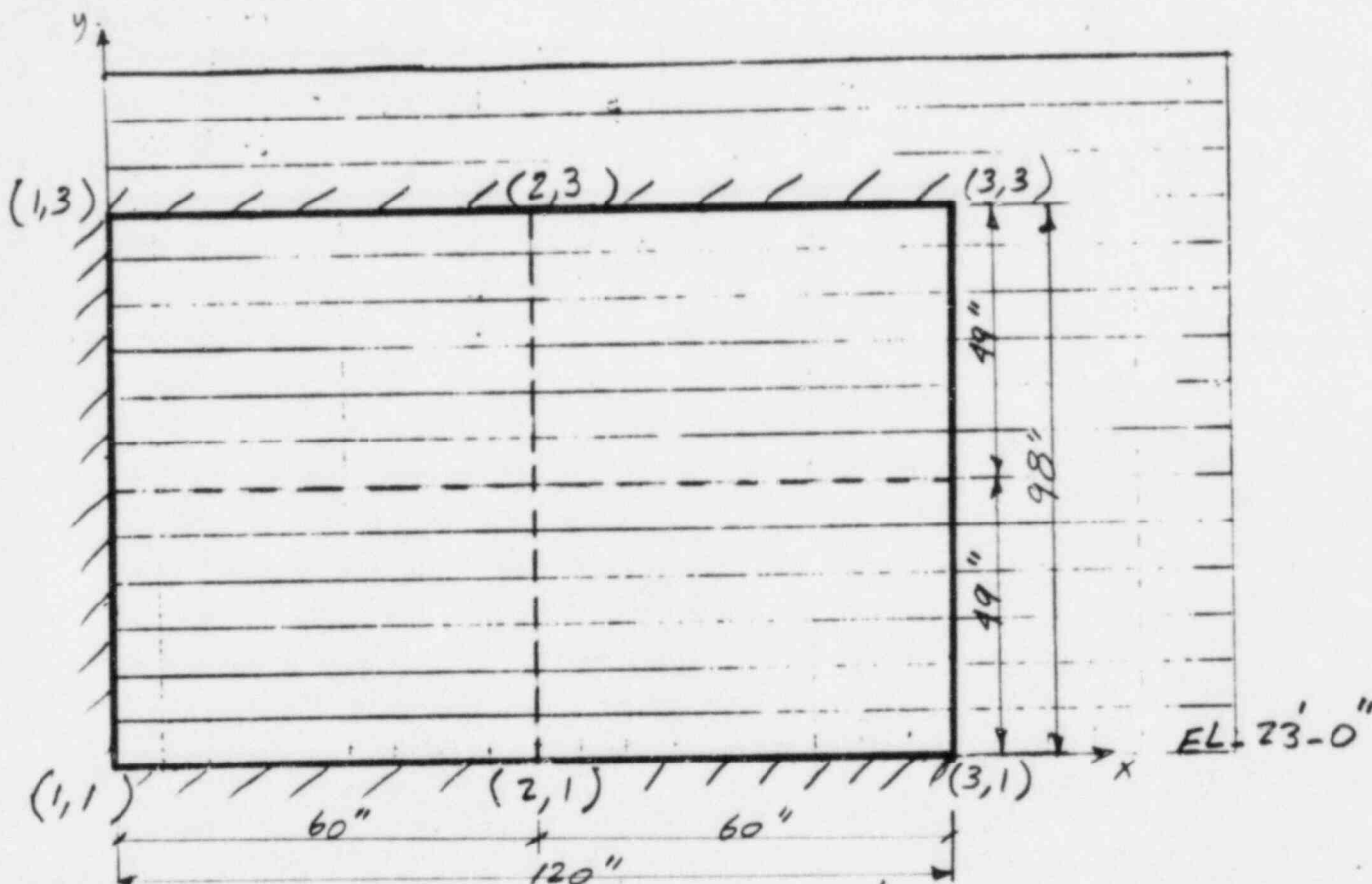
FILE NO.
12/F

SHEET NO. 1019-5

WALL MODEL

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

PINNED AT 3 SIDES



EES**CALCULATION SHEET**

PREPARED BY

S. Turk

DATE

9/16/81

CHECKED BY

H. K. Paul

DATE

9-21-81

PROJECT

PILGRIM UNIT 1

SUBJECT

MASONRY WALL ANALYSIS

SYSTEM

WALL 63.4

ANALYSIS NO.

1019

REV. NO.

0

JOB NO.

80034

FILE NO.

12/F

SHEET NO.

1019-6

EQUIPMENT AND WALL WEIGHTS AND DENSITIES

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

$$\text{Equivalent static pressure of wall} = 1.906 \text{ LB/IN}^2$$

Weight of equipment on wall

<u>EQUIPMENT</u>	<u>LENGTH</u>	<u>WT/FT</u> <u>Proj. Memo</u>	<u>WEIGHT (LBS)</u>
(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" \times 70" \times 6"	5.0 $\frac{\text{LBS}}{\text{FT}^2}$	104 LBS
			<u>TOTAL = 147.2 LBS</u>

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

Equivalent additional mass density due to Equipment

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

EES

CALCULATION SHEET		PREPARED BY	DATE
PROJECT <u>PILGRIM UNIT 1</u>		<u>S. Turk</u>	<u>9/16/81</u>
SUBJECT <u>Masonry Wall Analysis</u>		CHECKED BY <u>AK Paul</u>	DATE <u>9-21-81</u>
SYSTEM <u>WALL # 63.4</u>		JOB NO. <u>80034</u>	FILE NO. <u>12/F</u>
ANALYSIS NO. <u>1019</u> REV. NO. <u>0</u>		SHEET NO. <u>1019-7</u>	

TOTAL MASS DENSITIES AND EQUIPMENT STATIC PRESSURES

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

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



**EARTHQUAKE
ENGINEERING
SYSTEMS, INC.**

CALCULATION SHEET

PROJECT Pilgrimage Unit 1
SUBJECT Masonry Wall Analysis REV. 0
Wall # 63.4 Problem # 019

PREPARED BY S. Turk DATE 9/12/81
CHECKED BY AS Paul DATE 9-21-81
JOB NO. 80034 FILE NO. 12/F
SHEET NO. 1019-8

Frequency Analysis Wall 63.4

Orthotropic Properties (Project memo #9)

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

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

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

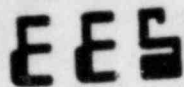
120.0, 98.0, 23.25

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



EARTHQUAKE
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SYSTEMS, INC.

CALCULATION SHEET

PROJECT Pilgrim Unit 1
SUBJECT Masonry Wall Analysis rev. 0
Wall # 63.4 Problem # 019

CHIEFED BY BK Paul DATE 9-21-81
JOB NO. 80034 FILE NO. 12/F
SHEET NO. 1019-9

Frequency Analysis

PINNED AT THREE SIDES

Run SO-FN-63.4

Base frequency of the wall $f = 11.64 \text{ Cycles/sec}$

OBE Earthquake Analysis

From project memo #10

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

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

Equivalent Static Pressure

$$P_{OBE} = 1.92 \times 0.5 = 0.96 \text{ psi}$$

Max Applied Moments

(run SO-ST-63.4)

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

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

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

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

OBE Allowable Moments

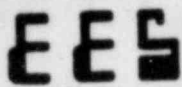
(From project memo #9)

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

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

Static Deflection

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



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CALCULATION SHEET

PROJECT Pilgrim Unit I
SUBJECT Masonry Wall Analysis REV. 0
Wall # 63.4 Problem # 019

CHECKED BY BK Paul DATE 9-21-81
JOB NO. 80034 FILE NO. 12/F
SHEET NO. 1019-10

SSE Earthquake Analysis

from project memo #10

Equivalent static Pressure

$$g_{SSE} = 0.73 \text{ g's}$$

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

Maximum Applied Moments (SSE)

SSE Allowable Moments (project memo #9)

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

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

Static Deflection

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

Wall 63.4 is adequate for DSE and SSE loads



CALCULATION SHEET

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

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

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.

$$P \text{ PBOC} = \underline{2.97} \text{ psi} \quad (\text{Project Memo 4})$$

$$P \text{ TORNADO} = \underline{0.055} \text{ psi} \quad (\text{Project Memo 5})$$

$$\text{Equivalent Static Pressure (P max. SSE)} = \underline{1.40} \text{ psi} \quad (\text{Pg. } \underline{9})$$

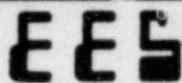
$$\text{Minimum Factor of Safety (SSE)} = \underline{10.0} \quad (\text{Pg. } \underline{1})$$

$$\text{Allowable Pressure (P Allow)} = \underline{1.4} \times \underline{10.0} \text{ psi} = \underline{14.0 \text{ psi}}$$

$$\text{Maximum Applied Pressure (P Applied)} = \underline{2.97} \text{ psi}$$

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

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



EARTHQUAKE
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CALCULATION SHEET

PROJECT Pilgrum Unit 1
SUBJECT Masonry Wall Analysis REV. 0
Wall # 63.4 Problem # 019

5. Turf 9/16/1
CHECKED BY BK Paul DATE 9-21-8
JOB NO. 80034 FILE NO. 12/F
SHEET NO. 1019-12

Frequency Analysis

Boundary Condition 2 - PINNED AT TOP & BOTTOM

Run SO-FN-63.4A

Base frequency of the wall $f = 10.54 \text{ Cycles/sec}$

OBE Earthquake Analysis

From project memo #10

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

$$f = 10.54 \text{ Cycles/sec} \quad g_{OBE} = 0.53 \text{ G's}$$

Equivalent Static Pressure

$$P_{OBE} = 1.92 \times 0.53 = 1.02 \text{ psi}$$

Max Applied Moments

(run SO-ST-63.4A)

$$M_{xx} = 93.54 \frac{\text{in-lb}}{\text{in}}$$

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

$$M_{yy} = 1152 \frac{\text{in-lb}}{\text{in}}$$

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

OBE Allowable Moments

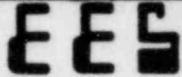
(From project memo #9)

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

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

Static Deflection

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



EARTHQUAKE
ENGINEERING
SYSTEMS, INC.

CALCULATION SHEET

PROJECT Pilgrim Unit I

SUBJECT Masonry Wall Analysis REV. 0

Wall # 63.4 Problem # 019

S. Turk		9/16/5
CHECKED BY	BK Paul	DATE
JOB NO.	80034	FILE NO.
		12/F
SHEET NO.		1019-13

SSE Earthquake Analysis

from project memo #10

$$g_{SSE} = 0.77 \text{ G's}$$

Equivalent static Pressure

$$P_{SSE} = 1.92 \times 0.77 = 1.48 \text{ psi}$$

Maximum Applied Moments (SSE)

SSE Allowable Moments (project memo #

$$M_{AXSE} = 93.54 \times 0.77 = 72 \frac{\text{in-lb}}{\text{in}} < 4742 \frac{\text{in-lb}}{\text{in}} \quad \underline{O.K.}$$

$$M_{VYSE} = 1152 \times 0.77 = 887 \frac{\text{in-lb}}{\text{in}} < 7068 \frac{\text{in-lb}}{\text{in}} \quad \underline{O.K.}$$

Static Deflection

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

Wall 63.4 is adequate for OSE and SSE loads for 2nd

Boundary Conditions.



CALCULATION SHEET

PREPARED BY <u>S. Turk</u>	DATE <u>10/21/81</u>
CHECKED BY <u>B. K. Paul</u>	DATE <u>10-26-81</u>
JOB NO. <u>80034</u>	FIVE NO. <u>12/F</u>
SHEET NO. <u>1019 - 14</u>	

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

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



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JOB NO. 80034 FILE NO. 12 F
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 = $1.872 \times 10^{-4} \frac{\text{lb-sec}^2}{\text{in}^4}$

OBE

$h = \underline{8.167}$ ft. Acceleration = 6.60 g's (Ref. Attach. 2)

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

$P \text{ Allow.} = \underline{5.73}$ psi > OBE 0.96 psi

SSE, PBOC, TORN.

$h = \underline{8.167}$ ft. Acceleration = 10.0 g's (Ref. Attach. 2)

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

$P \text{ Allow} = \underline{8.68}$ 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**

PREPARED BY

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DATE

9/17/81

CHECKED BY

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DATE

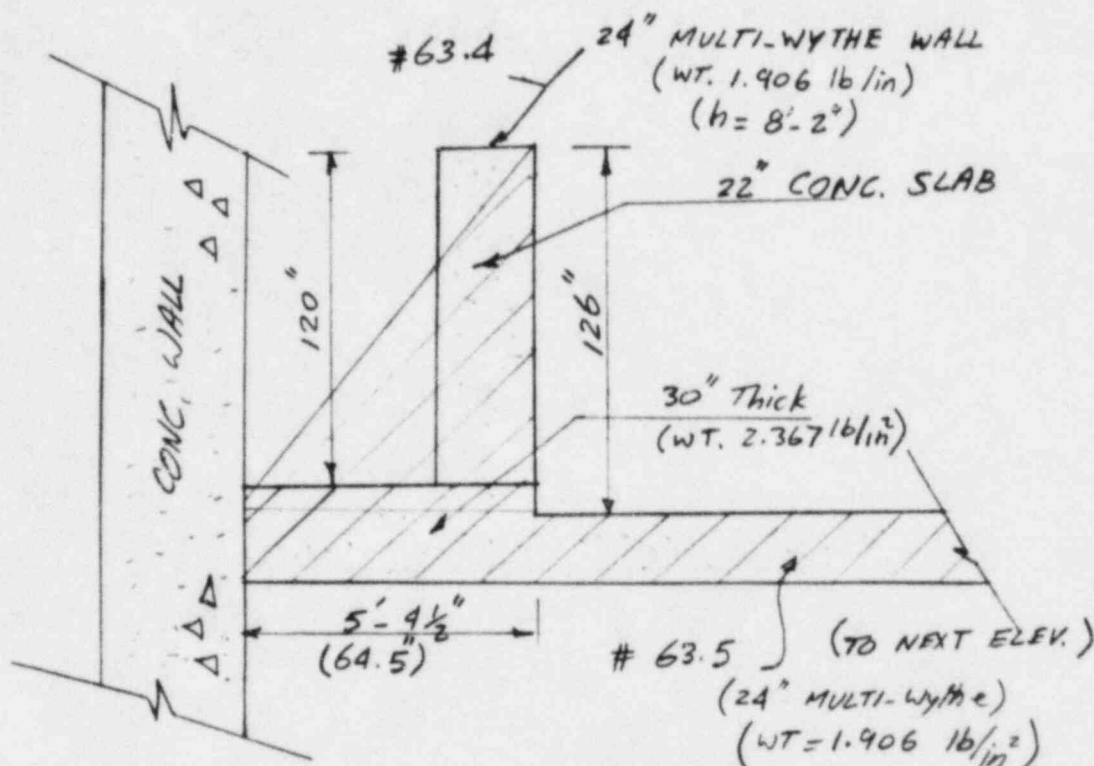
9-21-81

JOB NO.

80034

FILE NO.

12/F

PROJECT *PILGRIM UNIT 1*SUBJECT *Masonry Wall Analysis*SYSTEM *Wall # 63.4*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 = $w/d = 98/120 = 0.82$

LOADS :- (DUE TO SLABS & WALLS)

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

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

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

$$\Sigma W_T = 38,809 \#$$

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PROJECT PILGRIM UNIT 1SUBJECT Masonry Wall AnalysisSYSTEM Wall # 63.4ANALYSIS NO. 1019REV. NO. 0SHEET NO. 1019-17

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

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

FORCES DUE TO CONCRETE SLAB & WALL WEIGHT

(CAUSED BY EARTHQUAKE)

$$F = MA = \frac{W}{g} \times Ng = W \times N$$

OBE $38809 \times 2.37 = 91,977 \text{ #}$

SSE $38809 \times 2.60 = 100,903 \text{ #}$

FORCES ON 63.4 By SLAB & WALLS (carries $\frac{1}{2} F$)

OBE = 45989 #

SSE = 50452 #

PRESSURES:

FOR WALL 63.5 (ASSUME CONSTANT 24" THICKNESS)

THICKNESS

24" $\left\{ \begin{array}{l} \text{OBE} = 1.906 \times 2.37 = 4.52 \\ \text{SSE} = 1.906 \times 2.60 = 4.96 \end{array} \right.$

30" $\left\{ \begin{array}{l} \text{OBE} = 2.367 \times 2.37 = 5.60 \\ \text{SSE} = 2.367 \times 2.60 = 6.20 \end{array} \right.$

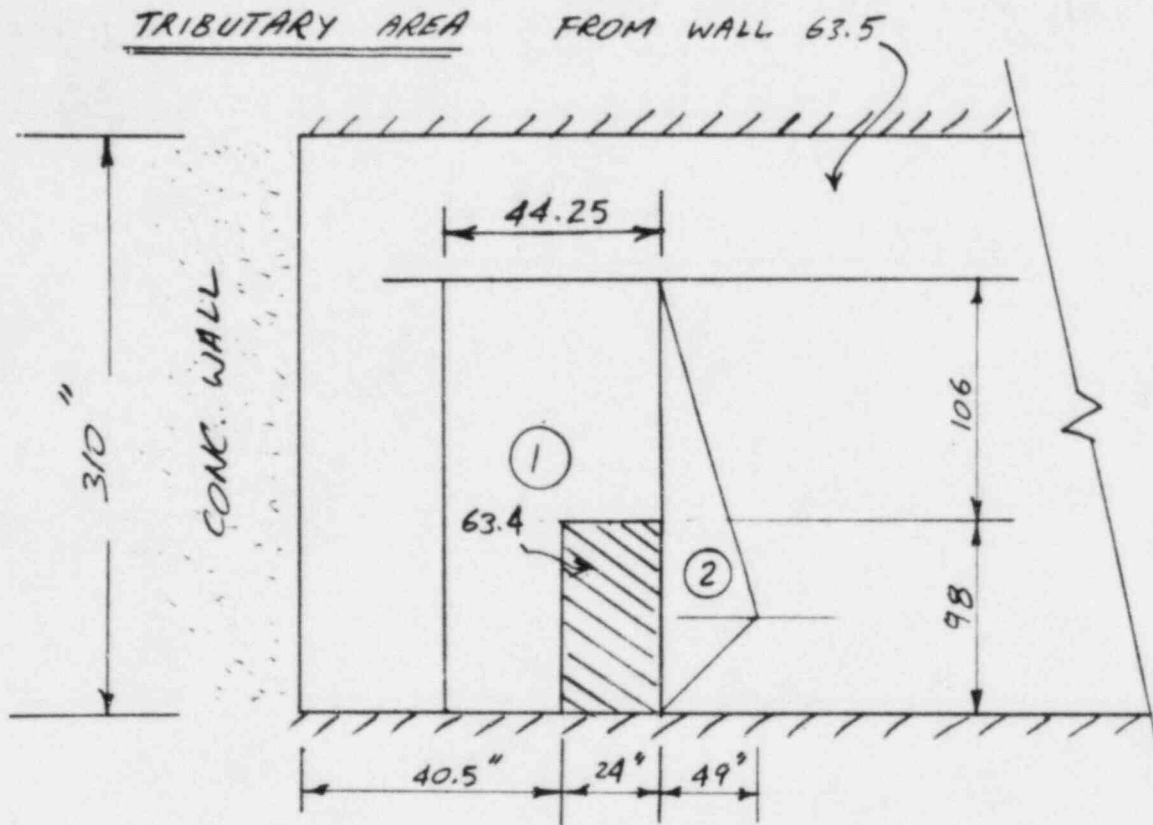
* IN THE ANALYSIS OF WALL 63.5, WALL 63.4 WAS USED AS A SUPPORT.

∴ THE FORCES FROM WALL 63.5 ON WALL 63.4 MUST BE CONSIDERED.

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JOB NO. <i>80034</i>	FILE NO. <i>12 F</i>
SHEET NO. <i>1019 - 18</i>	

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



- 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

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

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12/F

PROJECT PILGRIM UNIT ISUBJECT Masonry Wall AnalysisSYSTEM Wall # 63.4ANALYSIS NO. 1019 REV. NO. 1SHEET NO. 1019-19FORCES ON 63.4 FROM 63.5① ON 30" THICK SECTION ($A_{trib} = 9027 \text{ in}^2$)

$$OBE = 5.6 \times 9027 = 50551 \#$$

$$SSE = 6.2 \times 9027 = 55967 \#$$

$$TORNADO = 0.204 \times 9027 = 1842 \#$$

$$PBOC = 3.85 \times 9027 = 34754 \#$$

② ON 24" THICK SECTION ($A_{trib} = 4998 \text{ in}^2$)

$$OBE = 4.52 \times 4998 = 22,591 \#$$

$$SSE = 4.96 \times 4998 = 24,790 \#$$

$$TORNADO = 0.204 \times 4998 = 1020 \#$$

$$PBOC = 3.85 \times 4998 = 19242 \#$$

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

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

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

$$TORNADO = 1842 + 1020 = 2862 \#$$

$$PBOC = 34754 + 19242 = 53,996 \#$$

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PROJECT

PILGRIM UNIT 1

SUBJECT

Masonry Wall Analysis

SYSTEM

Wall # 63.4

JOB NO.

80034

FILE NO.

12/F

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 IN²/IN) OF WALL & h = 98"

$$A_s = 23.25 \text{ IN}^2/\text{IN} \times 98" = 2279 \text{ IN}^2$$

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

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

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

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

ALLOWABLE SHEAR STRESSES :-

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

∴ THE ALLOWABLE SHEAR STRESSES

$$OBE = 57 \text{ psi}$$

$$SSE = 86 \text{ psi} \quad \text{DC-1 EXG.}$$

$$PBOC = 86 \text{ psi}$$

$$TORNADO = 86 \text{ psi}$$



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Masonry Wall Analysis

SYSTEM

WALL # 63.4

JOB NO.

80034

FILE NO.

12-F

ANALYSIS NO.

1019

REV. NO.

1

SHEET NO.

1019-21

SHEAR STRESS COMPARISON

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