NRC FORM 366 (7-77)

U. S. NUCLEAR REGULATORY COMMISSION

# LICENSEE EVENT REPORT

EXHIBIT A

CONTROL BLOCK: (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1 | O R T N P 1 (2) | Ø Ø - Ø Ø Ø - Ø Ø Ø Ø Ø (3) | 4 1 1 1 1 (4) | (5)
LICENSEE CODE 9–14; LICENSE NUMBER 15–25; LICENSE TYPE 26–30; CAT 57–58

CON'T 0 1 | REPORT SOURCE L (6) | Ø 5 Ø - Ø 3 4 4 (7) | Ø 5 1 6 8 Ø (8) | Ø 5 3 Ø 8 Ø (9)
DOCKET NUMBER 61–68; EVENT DATE 69–74; REPORT DATE 75–80

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2 NO. 8Ø-Ø7: AUXILIARY BUILDING SOUTH WALL DISCOVERED TO NOT BE CONNECTED AT
0 3 TOP OF WALL TO INTERFACING STRUCTURES. AS-FOUND CONDITION OF WALL RESULTS
0 4 IN POTENTIAL STRESSES BEYOND ALLOWABLES UNDER FSAR DESIGN LOADING CON-
0 5 DITIONS. INVOLVES NON-COMPLIANCE WITH FSAR SECTION 3.8.1 AND TECHNICAL
0 6 SPECIFICATION 5.7.1.
0 7
0 8

| | SYSTEM CODE | CAUSE CODE | CAUSE SUBCODE | COMPONENT CODE | COMP. SUBCODE | VALVE SUBCODE |
|---|---|---|---|---|---|---|
| 0 9 | Z Z (11) | B (12) | C (13) | Z Z Z Z Z Z (14) | Z (15) | Z (16) |

| (17) LER/RO REPORT NUMBER | EVENT YEAR | | SEQUENTIAL REPORT NO. | | OCCURRENCE CODE | REPORT TYPE | | REVISION NO. |
|---|---|---|---|---|---|---|---|---|
| | 8 Ø | — | Ø Ø 7 | / | Ø 1 | T | — | Ø |

| ACTION TAKEN | FUTURE ACTION | EFFECT ON PLANT | SHUTDOWN METHOD | HOURS (22) | ATTACHMENT SUBMITTED | NPRD-4 FORM SUB. | PRIME COMP. SUPPLIER | COMPONENT MANUFACTURER |
|---|---|---|---|---|---|---|---|---|
| F (18) | X (19) | Z (20) | Z (21) | Ø Ø Ø Ø | Y (23) | N (24) | Z (25) | Z 9 9 9 (26) |

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0 UNCLEAR DESIGN DETAIL RESULTED IN UNSATISFACTORY CONNECTION DURING CON-
1 1 STRUCTION OF WALL. WALL IS BEING CONNECTED WITH GROUTED REBAR AND THRU-
1 2 BOLTS TO ADJACENT STRUCTURE. OTHER WALLS BEING REVIEWED FOR SIMILAR CON-
1 3 DITIONS AND WILL BE CORRECTED IF FOUND.
1 4

| | FACILITY STATUS | % POWER | OTHER STATUS (30) | METHOD OF DISCOVERY | DISCOVERY DESCRIPTION (32) |
|---|---|---|---|---|---|
| 1 5 | H (28) | Ø Ø Ø (29) | NA | C (31) | ENGINEER INSPECTION |

| | ACTIVITY RELEASED | CONTENT OF RELEASE | AMOUNT OF ACTIVITY (35) | LOCATION OF RELEASE (36) |
|---|---|---|---|---|
| 1 6 | Z (33) | Z (34) | NA | NA |

PERSONNEL EXPOSURES

| | NUMBER | TYPE | DESCRIPTION (39) |
|---|---|---|---|
| 1 7 | Ø Ø Ø (37) | Z (38) | NA |

PERSONNEL INJURIES

| | NUMBER | DESCRIPTION (41) |
|---|---|---|
| 1 8 | Ø Ø Ø (40) | NA |

LOSS OF OR DAMAGE TO FACILITY (43)

| | TYPE | DESCRIPTION |
|---|---|---|
| 1 9 | Z (42) | NA |

PUBLICITY

| | ISSUED | DESCRIPTION (45) | NRC USE ONLY |
|---|---|---|---|
| 2 0 | N (44) | NA | |

NAME OF PREPARER LIEF ERICKSON PHONE: 503-226-5610

8006060415 S

# REPORTABLE OCCURRENCE

1. Report Number: 80-07

2. a. Report Date: May 30, 1980

   b. Occurrence Date: May 16, 1980

3. Facility: Trojan Nuclear Plant, P. O. Box 439, Rainier, OR 97048

4. Identification of Occurrence:

   It was discovered that a masonry wall in the Auxiliary Building was not connected to the interfacing structures at its top, resulting in the potential for the wall to become stressed beyond allowable values under loading conditions specified in the FSAR.

5. Conditions Prior to Occurrence:

   The Plant was conducting refueling operations transferring fuel from the spent fuel pool to the reactor vessel at the time of the discovery. Reactor coolant temperature was 70°F with one RHR pump in operation.

6. Description of Occurrence:

   In the course of performing recent evaluations related to LER 79-15, Portland General Electric Company engineers found that the potential existed for an ambiguous interpretation of the details for the connection of the top of the south wall of the Auxiliary Building to the floor slab at Elevation 93 ft. A special in-plant inspection was initiated to determine the existing connection which is described in detail in Attachment 1.

   The wall connection nonconformance was reported to Mr. D. M. Sternberg of NRC I&E Region V on Friday, May 16, 1980 with written follow-up on November 19, 1979.

The subject wall consists of a single wythe of 12-in. thick reinforced grouted masonry approximately 80 ft. wide spanning from Elevation 61 ft. to Elevation 93 ft. in the south wall of the Auxiliary Building adjacent to column line 55 between column lines F and N. The wall is adequately connected by reinforcing steel to the wall below Elevation 61 ft. and the floor slabs at Elevation 61 ft. and Elevation 77 ft.; however, the top of the wall is not connected to the floor slab at Elevation 93 ft. The wall and the unusual configuration of the top-of-wall interface are described in more detail in Attachment 1.

The as-built condition resulted in a cantilevered wall from Elevation 77 ft. to approximately Elevation 91 ft. for most of the wall length between column lines F and N. In this condition, the wall cannot resist in-plane and out-of-plane design basis loads as intended. This is considered to be in nonconformance with the requirements of FSAR Section 3.8.1.5 and Technical Specification 5.7.1.

7. Designation of Apparent Cause of Occurrence:

Misinterpretation of the design drawings and typical construction details described in Attachment 1.

8. Analysis of Occurrence:

This occurrence has not affected the health and safety of the public.

The safety-related equipment attached to, or in the vicinity of, this wall is limited to train B cables in cable trays and conduits. The safety significance of this wall was evaluated assuming loss of all cables attached to, or within 2 ft. of, the wall. The only items of significance to cold shutdown or refueling operations (status of Plant at time of discovery) are power to: (1) the train B component cooling water makeup pump; and (2) the train B diesel fuel oil transfer pump. Since redundant train A equipment was unaffected and was operable, and CCW makeup and diesel fuel oil transfer are intermittent evolutions which can be performed by manual operation through cross connections with train A, no immediate compensatory actions were required.

The original Plant design did not rely on this wall to serve as a shear wall. It was, however, considered to participate as a minor structural shear-resisting element in the STARDYNE finite element analyses of the Control-Auxiliary-Fuel Building Complex (Complex) for the Control Building proceedings, Phase I (Interim Operation - As-Built Complex) and Phase II (Modified Complex). Since this wall is in close proximity to a parallel 4-ft. thick shield wall and its relative strength and stiffness are comparatively low, removal of this wall from the STARDYNE model or reduction of its shear capacity to zero would not reduce the capability of the as-built structure below that required to resist the Safe Shutdown Earthquake.

9. <u>Corrective Action</u>:

To restore the structural capability, a positive connection is being made between the wall and floor slab at Elevation 93 ft. with grouted reinforcing steel, and between the wall and adjacent structural steel with through-bolts and structural steel shapes as described in Attachment 2. Also in Attachment 2 is a description of the design basis and justification of adequacy of the corrective action being taken. This corrective action is expected to be complete prior to June 10, 1980.

Following identification of this wall connection nonconformance, an engineering review was initiated to identify from design drawings and then inspect in the Plant any similar non-typical wall interface conditions where connection requirements were not specifically detailed and where application of typical details could be subject to misinterpretation. This review, which is described in Attachment 3, is 90 percent complete and will be finished by June 6, 1980. Any corrective action resulting from this review will be performed consistent with the safety significance of the wall, in connection with the operational mode and configuration of Plant systems.

LER 80-07
Attachment 1

## Design Description of Wall on Column Line 55

The south wall of the Auxiliary Building along column line 55 and between Elevations 45 ft. and 61 ft. is of composite construction with reinforced concrete core between two wythes of reinforced grouted masonry. This portion of the wall, which encases the structural steel framing system, was considered as a shear wall in the original design and, accordingly, the reinforcing steel arrangement was shown on the Civil drawings. The upper elevations of the wall from Elevations 61 ft. to 93 ft. were not considered as a shear wall in the original design of the Control-Auxiliary-Fuel Building Complex and are of 12-inch thick standard weight reinforced grouted masonry. This single wythe wall is different from other walls in the Complex in that it is offset with respect to the steel framing system, and therefore the reinforcing steel in the wall is not interrupted at intersecting column lines and floor elevations. Details on the Civil drawings show the dowels for the slab-wall connections at Elevation 61 ft. and Elevation 77 ft. along column line 55. The detail of the connection on the Civil drawings does not show how the slab-wall connection at Elevation 93 ft. is to be made. To determine this, one must refer to the typical details and notes on Architectural drawings which specify that all concrete block walls which extend from floor slab to floor slab shall be connected by dowels to match the wall reinforcement.

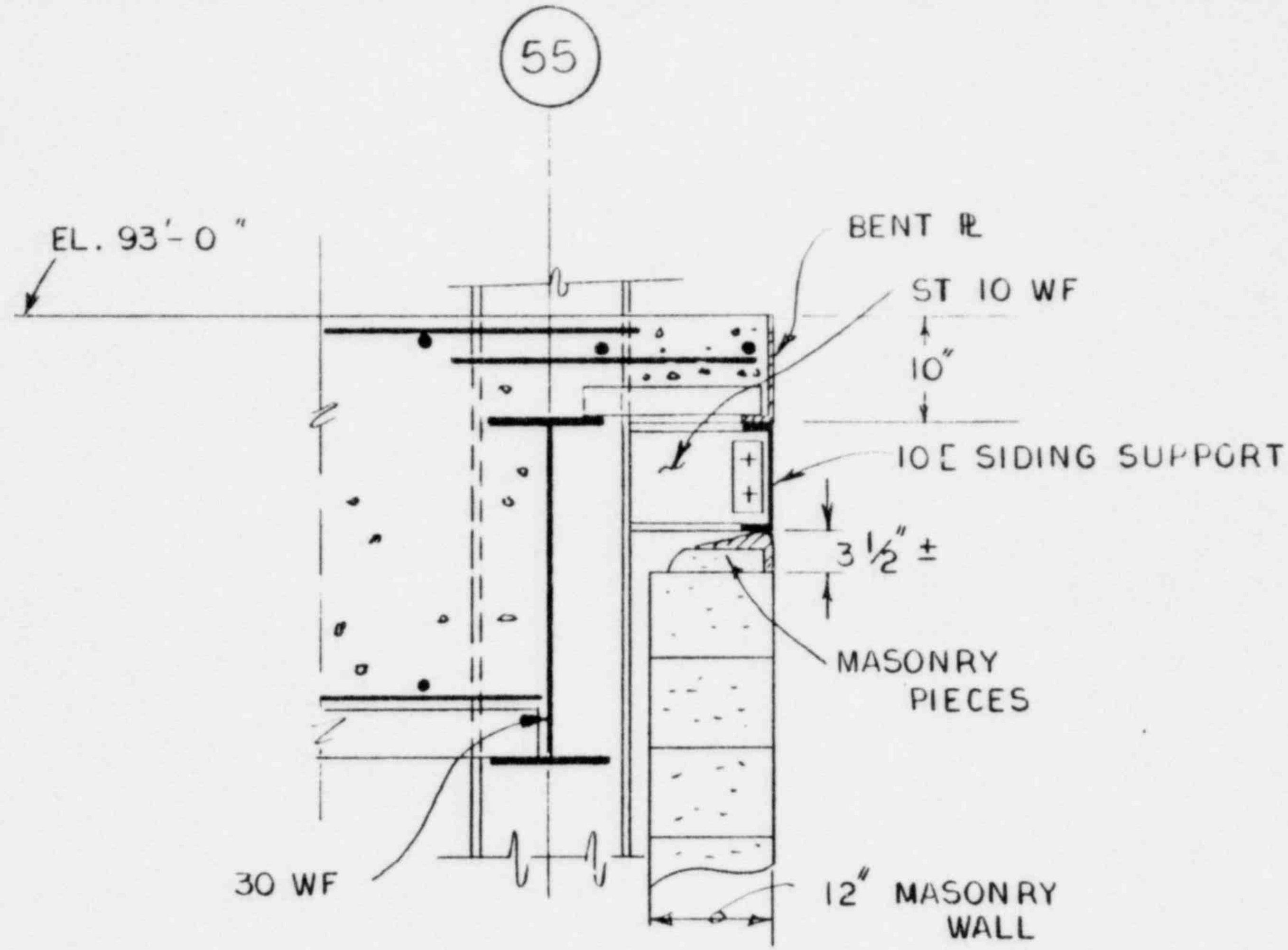
In the particular connection at Elevation 93 ft. this interface had an interference with a 10-in. steel siding support channel at the base of the insulated siding from above and an adjacent structural steel floor beam. The nature of this structural framing detail coupled with the absence of a specific dowel detail on the Civil drawing caused the ambiguity that we believe led to the non-conformance.

As-Built Condition of 12-in. Masonry Wall on Column Line 55, Between F and N, at the Elevation 93 ft. Slab Interface

The as-built configuration of the 12-in. masonry wall interface with the Elevation 93 ft. reinforced concrete slab and adjacent steel elements is shown in Figure A1. The masonry wall was constructed after the structural steel framing, reinforced concrete slab, and siding support framing were completed. The interference of the 10-in. siding support channel with the continuation of the masonry wythe is apparent from Figure A1.

Detailed inspection of the interface could not be performed from either inside or outside of the Auxiliary Building without special techniques because of the difficult access. However, with use of mirrors and remote camera photographs, the as-built condition at the top of the wall was determined. For the length of the wall from about 3 ft. west of column line L to about 5 ft. west of column line F (approximately 56 ft.) it was observed that the wall masonry was terminated at the standard course dimension which is approximately 3-1/2 in. below the bottom of the siding support channel. No reinforcing steel dowels were observed projecting down from the reinforced concrete slab to match with the masonry reinforcing spacing, no masonry reinforcing projected above the top of the masonry, and no lateral ties were observed between the masonry and adjacent structural steel beam. The top-of-wall closure was finished to the underside of the siding support channel with cut sections of masonry block mortared to the top of the wall and finished on the exterior with mortar.

For the length of wall from about 3 ft. west of column line L to column line N (approximately 16 ft.), the containment airlock access slab extends over the masonry wall. In this length of wall, the existence of reinforcing steel dowels from the slab into the wall was confirmed by visual observation after removal of some of the mortar with a pneumatic chipping tool.



55
EL. 93'-0"
BENT ℄
ST 10 WF
10"
10[ SIDING SUPPORT
3 1/2" ±
MASONRY
PIECES
30 WF
12" MASONRY
WALL


FIGURE A1

DESIGN OF MODIFICATION TO WALL ON COLUMN LINE 55

To connect the top of the 12-inch thick single wythe masonry wall in the Auxiliary Building on column line 55 (between 3'-0" west of column line L to 4'-10" west of column line F) to the floor slab at el. 93 ft., the following design is provided. The design of the connection is based on the following load combination:

$$U = 1.4(D + L + E) + 1.0\ T_o + 1.25H_o$$

The modification details are shown in Figure 1.

<u>Material Properties and Design Parameters</u>

Existing slab concrete, $f'_c$ = 3000 psi
Existing block, $f'_m$ = 2000 psi
Grout, $f'_c$ = 5000 psi
New reinforcing steel, $f_y$ = 60 ksi
New structural steel, $f_y$ = 36 ksi
New rod material, $f_y$ (minimum) = 36 ksi
Coefficient of friction at interface, $\mu$ = 0.7

Allowable stresses:

Concrete bearing, $f_{ca} = (\phi)(0.85f'_c)$
$= (0.7)(0.85)(3000)$
$= 1.8$ ksi

Masonry bearing, $f_{ma} = 1.5(0.3\ f'_m)$
$= (1.5)(0.3)(2000)$
$= 900$ psi

Steel bending stress, $f_{ba} = 0.9\ f_y$
$= (0.9)(36)$
$= 32.4$ ksi

Bolt tensile stress, $f_a = 0.9\ f_y$
$= (0.9)(36)$
$= 32.4$ ksi

In-Plane Loads

The in-plane shear force generated at el. 93' will be transferred to the wall by the mechanism of shear friction. This will be developed by drilling 3-inch diameter holes through the slab and into the wall and grouting #10 reinforcing steel with non shrink grout. The top end of the bar will be threaded to 1-1/8 inch diameter, and the reinforcing steel will be anchored with a nut and a bearing plate at el. 93 ft. The space between the wall and the bottom of the slab as well as the space between the wall and the adjacent steel beam will be completely filled with non shrink grout.

V = Factored OBE shear force on 56 ft length of wall
= 536 kips
L = Spacing of reinforcing steel = 2 ft

Shear force tributary to each reinforcing steel bar equals:

$$V_1 = \frac{(536)(2)}{56}$$

$$= 19 \text{ kips}$$

Resistance provided by each 1-1/8 inch diameter threaded reinforcing steel bar with tensile stress area, $A_s = 0.763$ in$^2$, is given by:

$$
\begin{aligned}
V &= \phi(\mu A_s f_y) \\
&= (0.85)(0.7)(0.763)(60) \\
&= 27.2 \text{ kips} > V_1 \qquad \text{O.K.}
\end{aligned}
$$

Note: Although a coefficient of friction, $\mu$, is taken as 0.7 for design purpose, the effective coefficient of friction required to mobilize the shear-friction capacity is $\frac{19}{27.2} \times 0.7 = 0.49$

The maximum allowable force in the reinforcing steel is

$$
\begin{aligned}
F &= A_s f_y \\
&= (0.763)(60) \\
&= 45.8 \text{ kips}
\end{aligned}
$$

the corresponding bearing stress under the 6" x 6" bearing plate,

$$
\begin{aligned}
f_c &= \frac{45.8}{6 \times 6} \\
&= 1.27 \text{ ksi} < f_{ca} \qquad \text{O.K.}
\end{aligned}
$$

The bending stress in the 1-1/2 inch thick bearing plate is given by:

$$
\begin{aligned}
f_b &= \frac{(1.27)(3)^2(6)}{(2)(1.5)^2} \\
&= 15.2 \text{ ksi} < f_{ba} \qquad \text{O.K.}
\end{aligned}
$$

Out-of-Plane Loads

Out-of-plane loads due to seismic effects are resisted by the wall spanning from el. 77 ft to el. 93 ft. The lateral support reactions at el. 93 ft will be transferred to the floor system at el. 93 ft by an 8" x 8" x 1" angle bolted to the wall and welded to the bottom of the existing floor beam. The 3/4" diameter rod will be attached to the outside face of the wall by 6" x 6" x 1/2" plates. The spacing of the connections will be 2'-8".

a) Inertial loading

Frequency, $f = \frac{9.87}{2\pi L^2} \sqrt{\frac{EIg}{A\gamma}}$

where,
$I = 713 \text{ in}^4/\text{block}$
$E = 4.0(10)^6 \text{ psi}$
$g = 386.4 \text{ in/sec}^2$
$A = 181.6 \text{ in}^2/\text{block}$
$\gamma = 122 \text{ pcf}$
$L = 13 \text{ ft.} = 156 \text{ inches}$

$f = 18.9 \text{ cps}$

Corresponding spectral acceleration for OBE, 2% damping:
el. 93 ft = 0.95 g
el. 77 ft = 0.55 g
average acceleration = 0.75 g
inertial load = (0.75)(122) = 92 $\text{lbs/ft}^2$

w = transverse load due to factored OBE

= (1.4)(92)

= 128 $lbs/ft^2$

End reaction = $(128)\frac{13}{2}$

= 833 lbs/ft width

b) Interstory displacement

Transverse shear for OBE as predicted by STARDYNE elastic analysis is 87 lbs/ft*

Total reaction at el. 93 ft = 833 + 87(1.4)

= 954 lbs/ft**

Reactión resisted by each 3/4" diameter rod = (0.95)(2.67)

= 2.55 kips

Tensile stress $= \frac{2.55}{0.334}$

$= 7.63$ ksi $< f_a$ O.K.

The bearing stress in the 6" x 6" plate is:

$$f_c = \frac{2550}{6 \times 6}$$

$= 71$ psi $< f_{ma}$ O.K.

* The bolt connection assembly can accomodate an interstory displacement greatly in excess of the STARDYNE elastic displacement.

** The attachment load, $H_o$, is negligible for this wall. The effect of thermal, $T_o$, is also negligible for the connection design since simply supported end conditions were used in this analysis.

The bending stress in the 1/2 inch thick bearing plate is given by:

$$f_b = \frac{(.07)(3)^2(6)}{(2)(0.5)^2}$$

$$= 7.6 \text{ ksi} < f_{ba} \quad \text{O.K.}$$

## Conclusions

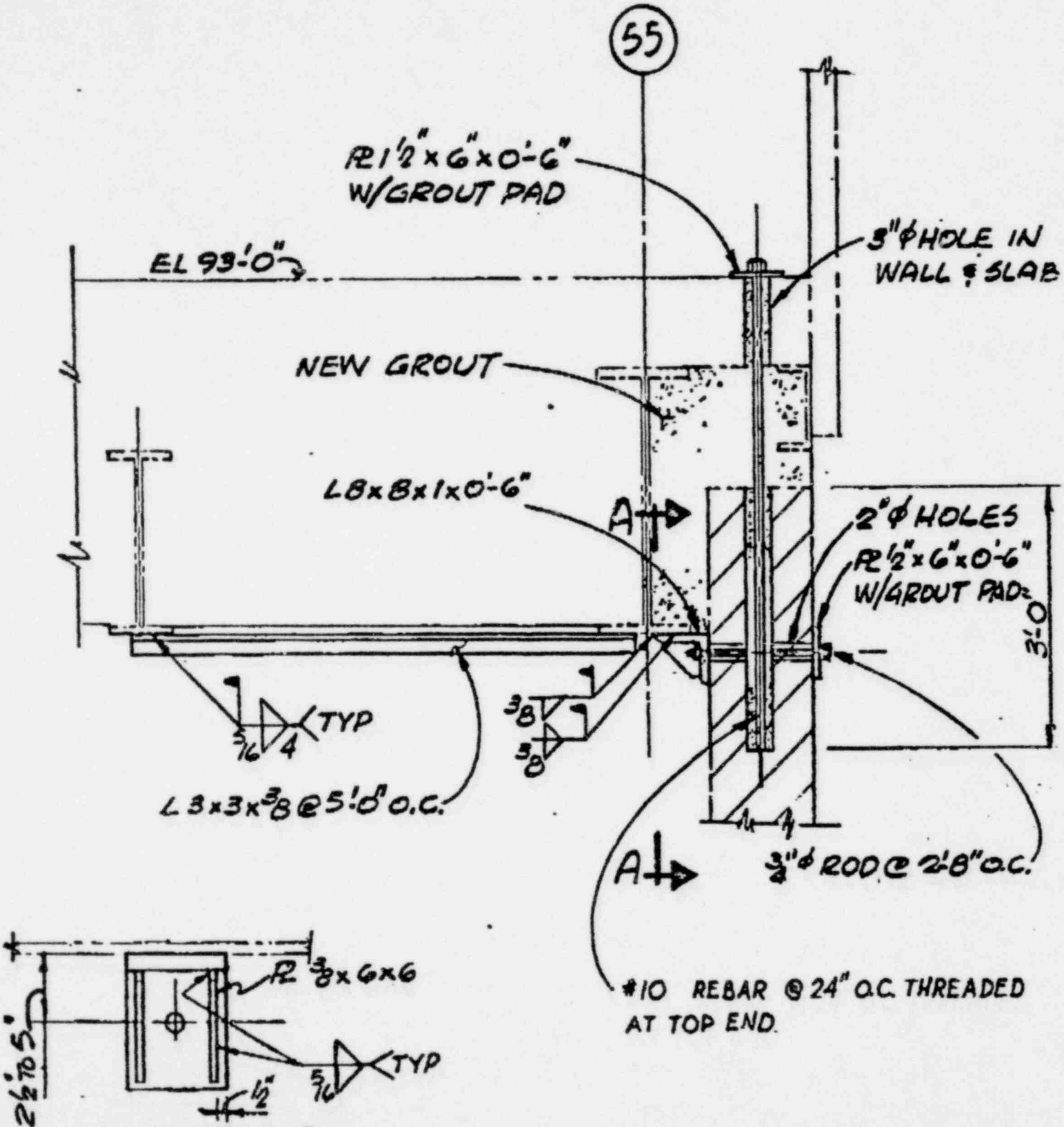
The above calculations demonstrate that the design of the connection shown in Figure 1 can adequately resist both the in-plane and out-of-plane seismic loads.

## Grouting Program

All nonshrink grout will be vibrated to assure complete filling and removal of air pockets. All high points beneath the floor slab (ie, decking pockets, etc) will be vented to assure complete filling.

## Test

Three additional reinforcing steel dowels will be installed and will be tested to demonstrate the adequacy of the bond between the dowel and the masonry wall. Following development of grout design strength, these dowels will be tension tested to the design yield strength of the reinforcing steel, based on the 1-1/8 in. threaded diameter. Following testing, the annular space between the dowels and grout above the masonry wall will be filled with grout and then anchored in the same fashion as the rest of the dowels.




SECTION A-A

ATTACHMENT 2

FIGURE No 1

## Engineering Review of Top-of-Wall Interfaces

Following identification of the wall connection non-conformance, an engineering review was initiated to identify from design drawings and then inspect in the Plant any similar non-typical top-of-wall interface conditions where connection requirements were not specifically detailed and where application of typical details could be subject to misinterpretation. The scope of this review included all masonry walls in safety-related structures in the Plant (single wythe, double wythe, and composite). The review was conducted by registered Civil Engineers in the employ of PGE. Special efforts were made to inspect any obscure top-of-wall interface conditions including, in some cases, removal of local areas of interferences.

Following completion of the investigation based on the drawing review, the inspection effort was extended to verify the top-of-wall interface of all masonry walls in the Plant to provide further assurance that no other incomplete connection conditions exist. This portion of the investigation is approximately 90 percent complete, with no such non-conformances identified. The balance of this inspection is expected to be completed by June 6, 1980.