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AUTH.NAME AUTHOR AFFILIATION
MCDUFFIE,M.A. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to draft SER Open Item 335 from Structural Engineering Branch.Response supersedes 831027 response, Factor of safety against overturning clarified,Supporting documentation from Ebasco encl.

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Carolina Power & Light Company

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NOV 08 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
DRAFT SAFETY EVALUATION REPORT RESPONSES
STRUCTURAL ENGINEERING BRANCH

Dear Mr. Denton:

In response to the Draft Safety Evaluation Report (DSER) Open Item No. 335 from the Structural Engineering Branch, Carolina Power & Light Company hereby submits additional information as requested by the reviewer. The attached response supersedes our previous response dated October 27, 1983.

We will be providing responses to other requests for additional information shortly.

Yours very truly,

M. A. McDuffie
Senior Vice President
Nuclear Generation

JHE/mf (8448COM)
Attachment

cc: Mr. B. C. Buckley (NRC)
Mr. S. B. Kim (NRC-SEB)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Travis Payne (KUDZU)
Mr. Daniel F. Read (CHANGE/ELP)
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Shearon Harris Nuclear Power Plant
Open Item 335
Second Supplementary Response

Provide additional clarification on factor of safety against overturning and document the overturning calculations.

Response:

The factor of safety against overturning was computed by dividing the resisting moments by the overturning moments, as stated in FSAR Section 3.8.5.5.

The overturning moment for Shearon Harris was calculated by the square root of the sum of the squares of the horizontal acceleration only in both the E-W and N-S directions. The vertical seismic overturning moment was added directly, as 0.4 times the actual moment.

$$M = \sqrt{M^2_{EW} + M^2_{NS}} + 0.4M_V \qquad (1)$$

A study was also conducted for Shearon Harris to compute the overturning moment by the SRSS method by taking the square root of the sum of the square of the overturning moments due to the horizontal acceleration in both the E-W and N-S directions, plus the overturning moments due to the vertical seismic uplift forces.

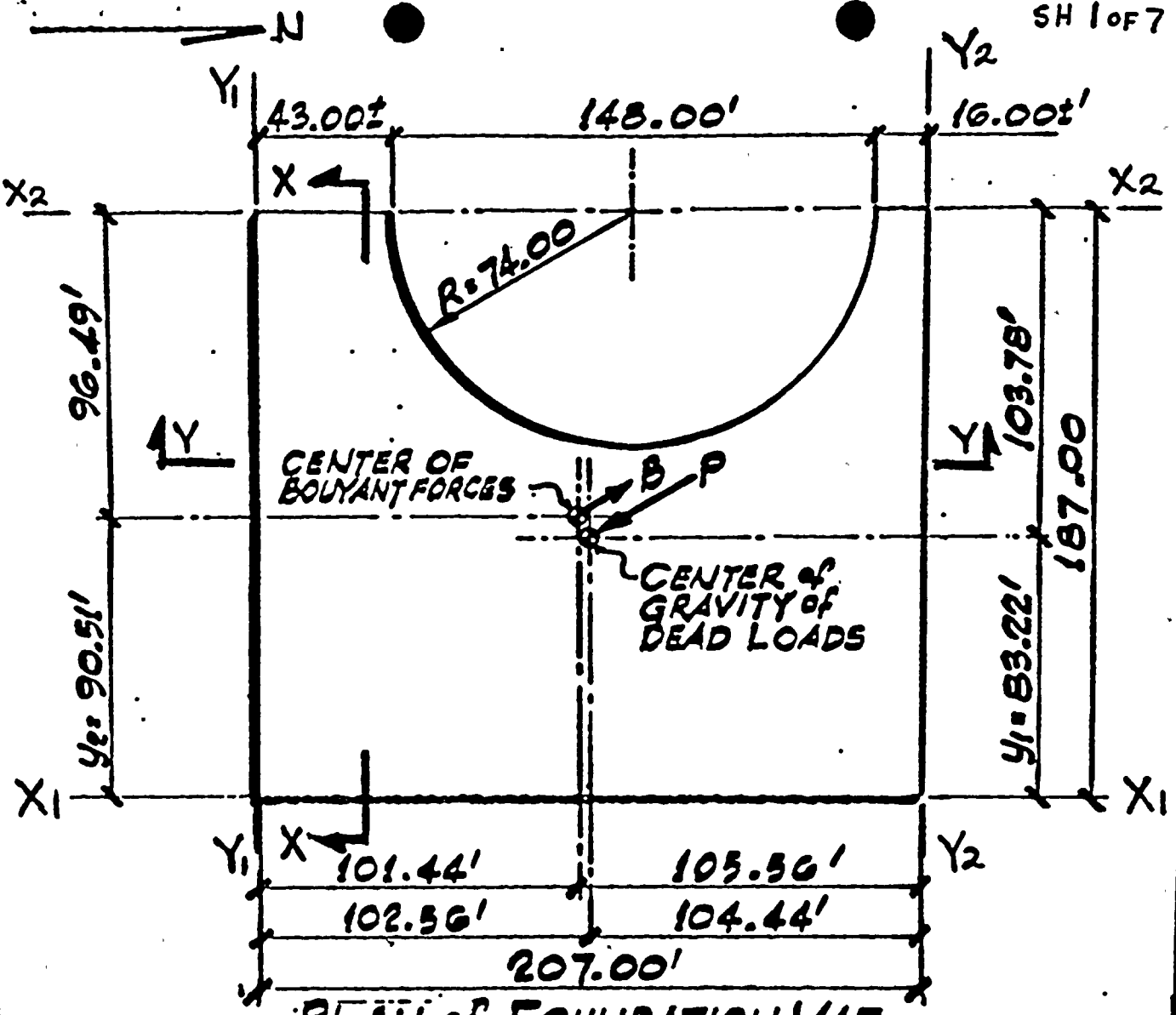
$$M = \sqrt{M^2_{EW} \text{ or } M^2_{NS} + M^2_V} \qquad (2)$$

The resisting moment is the vertical load of the building and mat (reduced by buoyancy) multiplied by the distance to the edge of the building.

The factor of safety against overturning computed by both the methods described above resulted in higher factor of safety than the minimum required by the FSAR.

The factor of safety for the RAB Unit #1 calculated in accordance with Method 1 above is 1.25 and for Method 2 is 1.33. Both are higher than the acceptable limit of 1.10.

(8448COM/mf)



PLAN of FOUNDATION MAT
REACTOR AUX. BLDG. - UNIT #1

SIMULTANEOUS EFFECT of EARTHQUAKE
(OVERTURNING ABOUT EDGE "X_1-X_1")

OVERTURNING MOMENTS:

$$SRSS\ M_O = \sqrt{M_{E\text{-}W}^2 + M_{VERT}^2}$$

RESISTING MOMENTS:

$$M_R = P \cdot y_1 - B \cdot y_2$$

FACTOR of SAFETY AGAINST OVERTURNING:

$$FS = M_R \div M_O$$

EBASCO SERVICES INC. CAROLINA POWER & LIGHT CO. - S.H.N.P.P. #1	DATE 11-2-83	FIG: 01-335.

JM

EBASCO SERVICES INCORPORATED

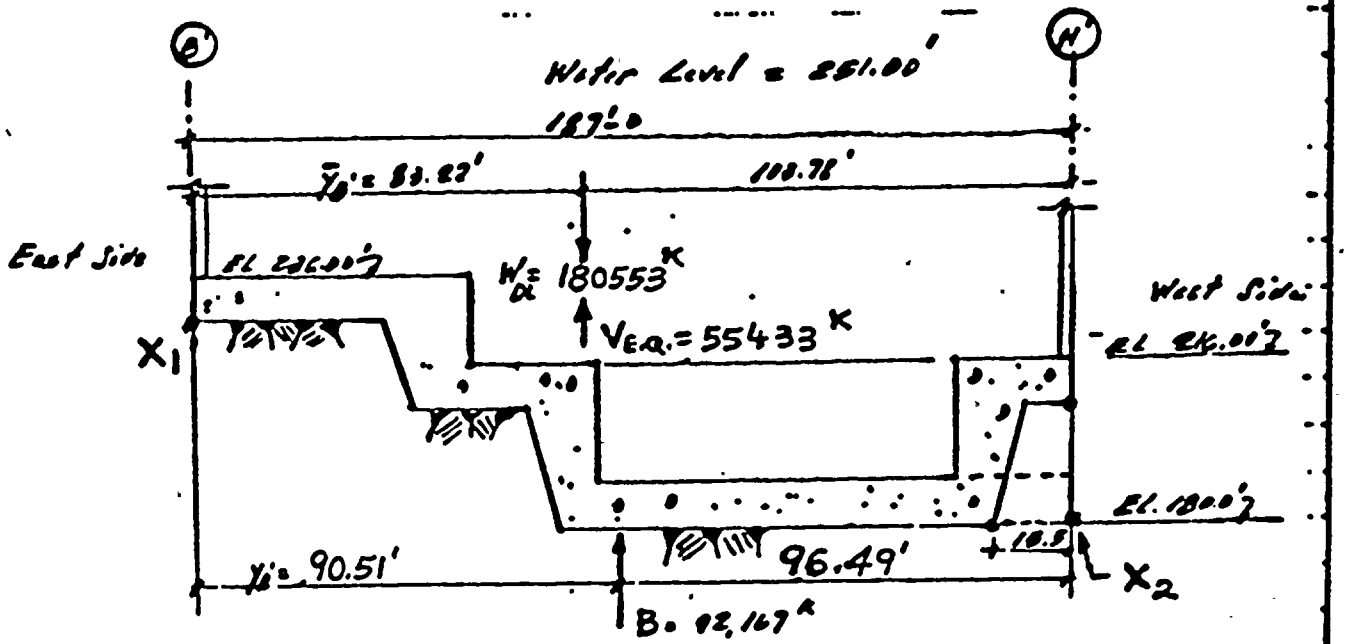
BY D. PATEL DATE 11-2-83 SHEET 2 OF 7

CHKD. BY A. BAIG DATE 11-2-83 OPS NO. 6415 DEPT. NO. 650

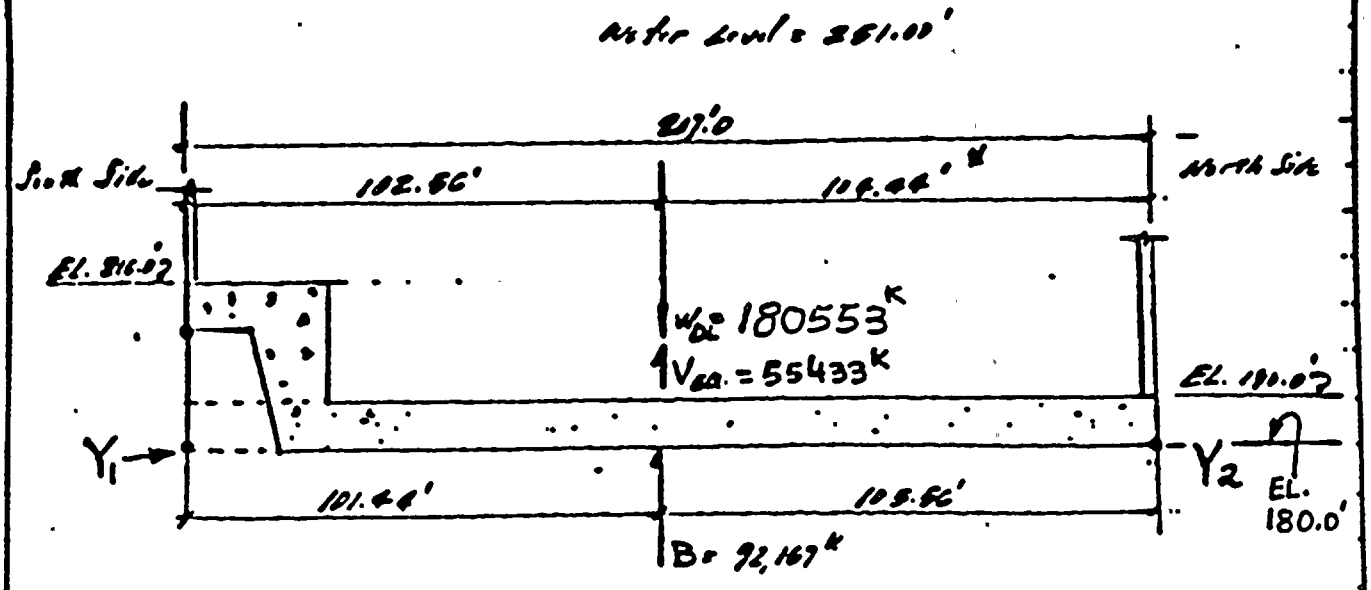
CLIENT CAROLINA POWER & LIGHT COMPANY

PROJECT ~~SHEARON HARRIS NUCLEAR POWER PLANT~~ 1984 86 900,000 KW UNITS 1, 2

SUBJECT RAB UNIT #1 - STABILITY AGAINST OVERTURNING



SECTION X-X



SECTION Y-Y

SUBJECT RAB - UNIT #1 - STABILITY AGAINST OVERTURNING

1. OVERTURNING ABOUT WEST FACE OF BLDG. WITH VERTICAL EARTHQUAKE (UPWARD) AND E-W EARTHQUAKE (EAST TO WEST)
(ABOUT LINE 'X_2')

OVERTURNING MOMENT:

OVERTURNING MOMENT DUE TO E-W EARTHQUAKE:

$M_{EQ} = 2,762,046^{k'}$ (AT EL. 180.00', ABOUT LINE X_2 - SEE SECT. X-X, SH2)

VERTICAL EARTHQUAKE FORCE:

$V_{EQ} = 55,433^{k}$

OVERTURNING MOMENT DUE TO VERT. EARTHQUAKE:

$M_{VEQ} = 55,433 \times 103.78 = 5,752,837^{k'}$

TOTAL OVERTURNING MOMENT: (USING SRSS)

$$M_O = \sqrt{(5,752,837)^2 + (2,762,046)^2} = 6,381,538^{k'}$$

RESISTING MOMENT:

RESISTING MOMENT DUE TO DEAD LOAD OF BLDG:

$W_{DL} = 180,553^{k}$

$M_{DL} = 180,553 \times 103.78 = 18,737,790^{k'}$

REDUCTION IN RESISTING MOMENT DUE TO BUOYANCY:
(GROUND WATER TABLE AT EL. 251.00')

$B = 92,167^{k}$.

$M_B = 92,167 \times 96.49 = 8,893,194^{k'}$

NET RESISTING MOMENT:

$M_R = 18,737,790 - 8,893,194 = 9,844,596^{k'}$

FACTOR OF SAFETY AGAINST OVERTURNING:

$$F.S. = \frac{9,844,596}{6,381,538} = 1.54 > 1.10$$

OK

REF: RAB DYNAMIC ANALYSIS BOOK #118
RAB STABILITY ANALYSIS BOOK #124 VOL 2.

2. OVERTURNING ABOUT EAST FACE OF BLDG. WITH VERTICAL EARTHQUAKE (UPWARD) AND E-W EARTHQUAKE (WEST TO EAST) (ABOUT LINE 'X_1')

OVERTURNING MOMENT:

OVERTURNING MOMENT DUE TO E-W EARTHQUAKE: (FROM SH 5)

M_{EWEQ} = 1,971,856 K' (AT EL. 226.00', ABOUT LINE X_1

VERTICAL EARTHQUAKE FORCE: SEE SECT. 'X-X', SH 2)

V_{EQ} = 55.433 K

OVERTURNING MOMENT DUE TO VERTICAL EARTHQUAKE:

M_{VEQ} = 55,433 x 83.22 = 4,613,134 K'

TOTAL OVERTURNING MOMENT:

$$M_O = \sqrt{(4,613,134)^2 + (1,971,856)^2} = 5,016,894 K'$$

RESISTING MOMENT:

RESISTING MOMENT DUE TO DEAD LOAD OF BLDG:

W_{DL} = 180,553 K

M_{DL} = 180,553 x 83.22 = 15,025,621 K'

REDUCTION IN RESISTING MOMENT DUE TO BUOYANCY:
(GROUND WATER TABLE AT EL. 251.00')

B = 92,167 K

M_B = 92,167 x 90.51 = 8,342,035 K'

NET RESISTING MOMENT:

M_R = 15,025,621 - 8,342,035 = 6,683,586 K'

FACTOR OF SAFETY AGAINST OVERTURNING:

$$F.S. = \frac{6,683,586}{5,016,894} = \underline{\underline{1.33}} > 1.10$$

OK

EBASCO SERVICES INCORPORATED

BY D. PATEL DATE 11-2-83 SHEET 5 OF 7

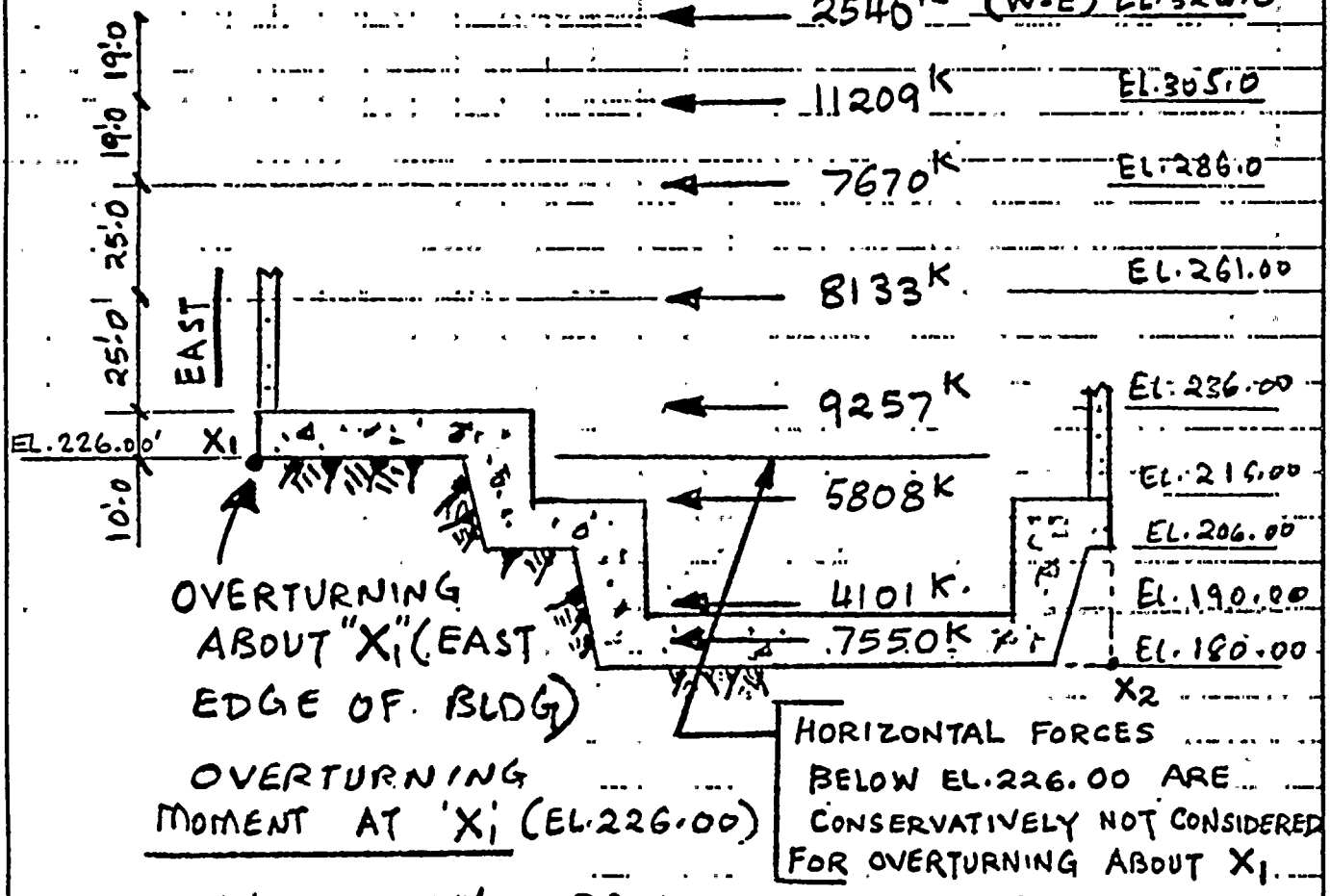
CHKD. BY A. BAIG DATE 11-2-83 OES NO. 6418 DEPT. NO. 6D

CLIENT CAROLINA POWER & LIGHT COMPANY

PROJECT ~~SHEARON HARRIS NUCLEAR POWER PLANT~~ 900,000 KW UNITS 1, 2

SUBJECT RAB UNIT #1 - STABILITY AGAINST OVERTURNING

REF: DYNAMIC ANALYSIS BOOK A118 P.37
FOR HORZ. FORCES DUE TO EARTHQUAKE



HORIZONTAL FORCES BELOW EL.226.00 ARE CONSERVATIVELY NOT CONSIDERED FOR OVERTURNING ABOUT X_1.

OVERTURNING MOMENT AT 'X1' (EL.226.00)

$M_{EWEQ} = 2540 \times 98 + 11209 \times 79 + 7670 \times 60$
$+ 8133 \times 35 + 9257 \times 10$

$= 248{,}920 + 885{,}511 + 460{,}200$
$+ 284{,}655 + 92{,}570$

$M_{EWEQ} = 1{,}971{,}856$ KF

581/8-81

EBASCO SERVICES INCORPORATED

BY A. BAIG DATE 11-2-83 SHEET 6 OF

CHKD. BY D. Porter DATE 11.2.83 OFS NO. 6418

CLIENT CAROLINA POWER & LIGHT COMPANY

PROJECT SHEARON HARRIS NUCLEAR POWER PLANT
1984 86 900,000 KW UNITS 1, 2

SUBJECT RAB - UNIT #1 - STABILITY AGAINST OVERTURNING

2. OVERTURNING ABOUT NORTH FACE OF BLDG. WITH VERTICAL EARTHQUAKE (UPWARD) AND N-S EARTHQUAKE (SOUTH TO NORTH) (ABOUT LINE 'Y_2')

OVERTURNING MOMENT:

OVERTURNING MOMENT DUE TO N-S EARTHQUAKE:

$M_{NSEQ} = 3,106,305^{KF}$ (AT EL. 180.00', ABOUT LINE Y_2 - SEE SECT Y-Y, SH2)

VERTICAL EARTHQUAKE FORCE:

$V_{EQ} = 55,433^{K}$

OVERTURNING MOMENT DUE TO VERT. EARTHQUAKE;

$M_{VEQ} = 55,433 \times 104.44 = 5,789,423^{K'}$

TOTAL OVERTURNING MOMENT: (USING SRSS)

$M_O = \sqrt{(5,789,423)^2 + (3,106,305)^2} = 6,570,126^{K'}$

RESISTING MOMENT:

RESISTING MOMENT DUE TO DEAD LOAD OF BLDG:

$W_{DL} = 180,553^{K}$

$M_{DL} = 180,553 \times 104.44 = 18,856,955^{K'}$

REDUCTION IN RESISTING MOMENT DUE TO BUOYANCY:
(GROUND WATER TABLE AT EL. 251.00')

$B = 92,167^{K}$

$M_B = 92,167 \times 105.56 = 9,729,149^{K'}$

NET RESISTING MOMENT:

$M_R = 18,856,955 - 9,729,149 = 9,127,806^{K'}$

FACTOR OF SAFETY AGAINST OVERTURNING:

$$F.S. = \frac{9,127,806}{6,570,126} = 1.39 > 1.10$$

OK.

EBASCO SERVICES INCORPORATED

BY A BAIG DATE 11-2-83 SHEET 7 OF 7

CHKD. BY D PATEL DATE 11-2-83 OFS NO. 6418 DEPT. NO. 650

CLIENT CAROLINA POWER & LIGHT COMPANY
~~SHEARON HARRIS NUCLEAR POWER PLANT~~

PROJECT 1994 SR 900,000 KW UNITS 1, 2

SUBJECT RAB UNIT #1 - STABILITY AGAINST OVERTURNING

3. OVERTURNING ABOUT SOUTH FACE OF BLDG. WITH VERTICAL EARTHQUAKE (UPWARD) AND N-S EARTHQUAKE (NORTH TO SOUTH)
(ABOUT LINE 'Y_1')

OVERTURNING MOMENT:

OVERTURNING MOMENT DUE TO N-S EARTHQUAKE:

M_{NSEQ} = 3,106,305$^{k'}$ (AT EL. 180.00', ABOUT LINE

VERTICAL EARTHQUAKE FORCE: Y_1 - SEE SECT Y-Y, SH 2)

V_{EQ} = 55,433^{k}

OVERTURNING MOMENT DUE TO VERTICAL EARTHQUAKE:

M_{VEQ} = 55,433 × 102.56 = 5,685,208$^{k'}$

TOTAL OVERTURNING MOMENT: (USING SRSS)

$M_O = \sqrt{(5,685,208)^2 + (3,106,305)^2} = 6,478,482^{k'}$

RESISTING MOMENT:

RESISTING MOMENT DUE TO DEAD LOAD OF BLDG:

W_{DL} = 180,553^{k}

M_{DL} = 180,553 × 102.56 = 18,517,516$^{k'}$

REDUCTION IN RESISTING MOMENT DUE TO BUOYANCY:
(GROUND WATER TABLE AT EL. 251.00')

B = 92,167^{k}

M_B = 92,167 × 101.44 = 9,349,420$^{k'}$

NET RESISTING MOMENT:

M_R = 18,517,516 − 9,349,420 = 9,168,096$^{k'}$

FACTOR OF SAFETY AGAINST OVERTURNING:

$$F.S. = \frac{9,168,096}{6,478,482} = 1.42 > 1.10$$

OK.