DISTRIBUTION SHEET

To C. P. Schroeder Instrument and Control Eng.		From A. H. Ziada Equipment Stress Analysis		Page 1 of 1 Date 5/17/94	
Project Title/Work Order Wind and Seismic Analysis For Liquid-Level Gauge Support				EDT No. 142169 ECN No. N/A	
Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
G. A. Barnes	H5-09	X			
L. W. Bartholf	H5-60		X		
M. N. Islam	R3-08	X			
F. M. Jones	L7-06	X			
C. P. Schroeder	L7-06	X			
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ENGINEERING DATA TRANSMITTAL

Page 1 of 1-3
1. EDT 142169

2. To: (Receiving Organization) Instrument and Control Eng. C.P. Schroeder	3. From: (Originating Organization) Equipment Stress Analysis	4. Related EDT No.: N/A
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16. KEY		
Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
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1	1	Cog. Mgr. C. P. Schroeder	<i>C. P. Schroeder</i>	11/17/94			
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1	1	Safety M. N. Islam	<i>M. N. Islam</i>	11/23/94			
		Env.					
3		G. A. Barnes		H5-09			

18. A. H. Zaida <i>A. H. Zaida</i> Signature of EDT Originator 5/18/94 Date	19. <i>F. M. Jones</i> F. M. Jones Authorized Representative for Receiving Organization 12/6/94 Date	20. <i>C. P. Schroeder</i> C. P. Schroeder Cognizant/Project Engineer's Manager 12/6/94 Date	21. DOE APPROVAL (if required) Ltr. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-DA-144, Rev. 0

Document Title: Wind and Seismic Analysis for Liquid-Level Gauge Support

Release Date: 12/06/94

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

V. L. Birkland

V.L. Birkland

12/06/94

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SUPPORTING DOCUMENT		1. Total Pages 24
2. Title Wind and Seismic Analysis for Liquid-Level Gauge Support	3. Number WHC-SD-WM-DA-144	4. Rev No. 0
5. Key Words Wind/Seismic Analysis APPROVED FOR PUBLIC RELEASE <i>V. Birkland 12/6/94</i>	6. Author Name: A. H. Ziada Signature Organization/Charge Code Equipment Stress Analysis/8D430/N3089	
7. Abstract This document provides the wind/seismic analysis and evaluation of the liquid level gage support stand. Simple hand calculations were applied for the analysis. UBC, AISC and UNISTRUT were used for the evaluations. The results indicate that the support stand meets the requirements.		
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9. Impact Level SQ		

WIND AND SEISMIC ANALYSIS FOR
LIQUID-LEVEL GAUGE SUPPORT

PREPARED BY:

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DATE: 5/18/94

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DATE: 5/18/94

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CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed WHC-SD-WM-DA-144, REVISION 0

Author A. H. Ziada

Yes No NA

☒	☐	☐	Problem completely defined.
☒	☐	☐	Necessary assumptions explicitly stated and supported.
☐	☐	☒	Computer codes and data files documented.
☒	☐	☐	Data used in calculations explicitly stated in document.
☒	☐	☐	Data checked for consistency with original source information as applicable.
☒	☐	☐	Mathematical derivations checked including dimensional consistency of results.
☐	☐	☒	Models appropriate and used within range of validity or use outside range of established validity justified.
☒	☐	☐	Hand calculations checked for errors.
☐	☐	☒	Code run streams correct and consistent with analysis documentation.
☐	☐	☒	Code output consistent with input and with results reported in analysis documentation.
☐	☐	☒	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
☒	☐	☐	Safety margins consistent with good engineering practices.
☒	☐	☐	Conclusions consistent with analytical results and applicable limits.
☒	☐	☐	Results and conclusions address all points required in the problem statement.

MANDATORY Software QA Log Number - NA -

Reviewer

5/18/94
Date

DESIGN VERIFICATION METHOD

The need for design verification has been reviewed with the method selected as indicated below: (ESR/Work Plan # WP-23480-302).

 X Independent Review
 Alternative Calculations
 Qualification Testing
 Formal Design Review

R. B. Pan 05/18/94
Cognizant/Project/Design Manger

SD # WHC-SD-WM-DA-144

ECN #

DWG(S) #

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WIND AND SEISMIC ANALYSIS FOR LIQUID-LEVEL GAUGE SUPPORT

1.0 INTRODUCTION

A wind and seismic analysis was performed for the liquid-level gauge installation support stand. The analysis includes the stand and footing only. All of these supports are classified as safety class 3. The analysis was based on safety class 2 requirements for conservatism. Conventional hand calculations were performed to evaluate the stresses and overturning of the structure.

The results and recommendations appear in Section 2.0. The configuration and loadings are discussed in Section 3.0; the analysis and evaluation appears in Section 4.0; and the detailed analysis is documented in Appendix A.

2.0 RESULTS AND RECOMMENDATIONS

The allowable restoring moments is two-thirds of the overturning moment based on the Uniform Building Code (UBC) requirements. Allowable loads and stresses are based on either American Institute of Steel Construction (AISC) or vendor (UNISTRUT) information.

Overturning of the support was checked in all directions; checking found that overturning will not occur as a result of an 80 mi/h wind or from 0.66 g horizontal and 0.44 g vertical seismic loadings.

Sliding of the support will not occur during an 80 mi/h wind or as a result of 0.66 g horizontal seismic loadings, but the concrete footing must be buried in the soil. Because the footing is 6-inches deep, it must then be buried at least 6 in.

The bending stresses in the UNISTRUT resulting from wind and seismic loadings are acceptable.

The stresses in the brackets and bolts due to wind and seismic loadings are acceptable.

Since wind and seismic loadings will not result in overturning and sliding, the flexible conduit will exert minimal loads (from vibration) on the stand and gauge assembly; therefore there is no concern for pullout or detachment from the overall assembly.

Table 2.1 summarizes the critical results for this analysis.

Table 2.1. Evaluation of the Liquid-Level Gauge Support

Component	Material	Strength (lb/in ²) ¹		Category	Allowable Stress, Moment or Force	Calculated Stress, Moment or Force	Design Margin ² (DM)
		S _y	S _u				
Gauge support stand (including concrete footing)	N/A	N/A	N/A	Overturning	1791 ³ in-lb	1735 in-lb	0.03
				Sliding (wind)	72.6 lb	57.8 lb	0.256
				Sliding (seismic)	3960 lb	3900 ⁴ lb	0.015
UNISTRUT Channel	A570 GR.33 (12 Gauge)	33,000	52,000	Bending	19,800 lbf/in ² (0.6 S _y) ⁵	3033 lbf/in ²	5.53
Bolts	ASTM A307	-	-	Shear	10,000 ⁵ lbf/in ²	1454 lbf/in ²	5.88
				Tension	2000 ⁶ lb	285 lb	6

1) S_y yield stress - AISC
S_u ultimate stress - AISC

2) DM = (Allowable stress/calculated stress) - 1

3) 2/3 Restoring moment - UBC

4) Conservative value

5) Allowable from AISC

6) Allowable from UNISTRUT

3.0 CONFIGURATION AND LOADING

3.1 CONFIGURATION

The configuration of the liquid-level gauge support is documented in the following drawings H-2-815467 and H-2-815302.

3.2 LOADING

The loadings applied were 80 mi/h wind, 0.66 g horizontal and 0.44 g vertical seismic loads, and the deadweight of the structure. All components analyzed had these loads applied. A dynamic analysis (for seismic analysis) using a finite-element model was not necessary because this is a simple structure with a cantilever beam response mode; therefore the loads are conservatively derived using static force methodology. The loading applied to each component is discussed in more detail in Appendix A along with the calculations.

4.0 ANALYSIS

The methodology used in the stress, sliding, and overturning calculations of the support stand is conventional hand calculations. The loads applied on the support stand resulted from the application of safety class 2 requirements obtained from SDC 4.1, Rev. 12, (HPS 1993) and ASCE 7-88 (ASCE 1988). The components of the support stand were evaluated against AISC, UBC (1991), and vendor (UNISTRUT 1988) information.

The overturning and stress analysis for the support stand is summarized in Appendix A of this report; Appendix A also addresses the evaluation of the calculated moments and stresses against corresponding allowables. The analysis results are tabulated in Section 2.0 of this report, Table 2.1.

5.0 REFERENCES

AISC, 1989, *Manual of Steel Construction, Allowable Strength Design*, Ninth edition, American Institute of Steel Construction, Chicago, Illinois.

ASCE 1988, *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-88 (formerly ANSI A58.1), American Society of Civil Engineers, New York, New York.

HPS 1993, *Standard Arch-Civil Design Criteria, Design Loads for Facilities*, ADC-4.1, Revision 12, Hanford Plant Standards, U. S. Department of Energy-Richland Field Office, Richland, Washington.

UBC, 1991, *Uniform Building Code*, International Conference of Building Officials, Whittier, California.

"UNISTRUT 1991 General Engineering Catalog, No. 11," Wayne, Michigan.

APPENDIX A
SAFETY CLASS 2
WIND/SEISMIC ANALYSIS AND EVALUATION

APPENDIX A
SAFETY CLASS 2
WIND/SEISMIC ANALYSIS AND EVALUATION

- A1.0 WIND PRESSURE LOADING ON SWITCH SUPPORT
 - A1.1 WIND FORCE
- A2.0 STRUCTURAL WEIGHT
 - A2.1 CONCRETE FOOTING WEIGHTS
- A3.0 WIND LOAD ON STRUCTURE
- A4.0 SLIDING OF STRUCTURE DUE TO WIND
- A5.0 OVERTURNING MOMENT - STRUCTURE IN CENTER DUE TO WIND
- A6.0 OVERTURNING MOMENT - STRUCTURE ON WINDWARD SIDE DUE TO WIND
- A7.0 OVERTURNING MOMENT - STRUCTURE ON LEEWARD SIDE DUE TO WIND
- A8.0 SEISMIC ACCELERATIONS
- A9.0 SLIDING OF STRUCTURE DUE TO WIND
- A10.0 OVERTURNING MOMENT DUE TO SEISMIC
- A11.0 BRACKETS AND BOLTS
- A12.0 UNISTRUT CHANNEL
- A13.0 SLIDING OF STRUCTURE DUE TO SEISMIC
- A14.0 REFERENCES

ANALYTICAL CALCULATIONS

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Subject Liquid Level Gase Support Wind/Seismic Analysis
 Originator A.H. ZIADA Date 5/2/94
 Checker C. J. HARRIS Date 5/4/94

A1.0 WIND PRESSURE LOADING ON SWITCH SUPPORT

Velocity (V) = 80 mph (Ref.1, pg 8, Rev 11)

For Safety Class 2: I = 1.0 Exposure Category = C

Wind Missile = NO wind missile will not be considered by this analysis. Wind pressure (q_z) is given by:

$$q_z = 0.00256 \times K_z \times (I \times V)^2 \quad \text{eq. (1)}$$

(Ref.2, pg 11, eq. 3)

Where:

$K_z = 0.80$ (for 0 to 15 ft above ground, Ref.2, pg 12, Table 6)

then:

$$q_z = 0.00256 \times 0.80 \times (1.0 \times 80)^2$$

$$q_z = \underline{13.107 \text{ psf}}$$

A1.1 WIND FORCE

From Ref.2, pg 10, Table 4, wind force (F) is given by:

$$F = q_z \times G_h \times C_f \times A_f$$

Table 8, pg 15 of Ref.2 gives the following value for G_h :

$$G_h = \underline{1.32}$$

To find C_f , calculate the ratio of the height to the width:

$$v = \frac{\text{height}}{\text{width}} = \frac{60}{4.25}$$

$$v = \underline{14.12}$$

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Then per Table 13, pg 22, Ref.2, $C_f = 1.75$ (conservative). A_f is the area normal to the wind direction. The largest area is assumed.

$$A_f = A_{sw} - A_{uni} - 2 \times A_c$$

Where:

A_{sw} = Area of the side of the switch

A_{uni} = Area of the double Unistrut

A_c = Area of the conduits

The concrete feet are assumed to be buried at grade for this calculation.

The area of the switch is 10" by 2". The area of the Unistrut is 3.25" by 60" (Ref.3, pg 8, P1001). The area of the conduit is 1" by 60" (Ref.3, pg 113, rigid conduit).

Then:

$$A_f = \frac{(10 \times 2)}{144} - \frac{(3.25 \times 60)}{144} - \frac{(1 \times 60)}{144}$$

$$A_f = \frac{20 - 195 - 60}{144}$$

$$A_f = 1.91 \text{ sqft}$$

Wind force can then be calculated by:

$$F = C_z \times G_s \times C_f \times A_f$$

$$F = 13.107 \times 1.32 \times 1.75 \times 1.91$$

$$F = 57.83 \text{ lb}_f$$

A2.0 STRUCTURAL WEIGHT

The minimum weight is assumed. The following equation is used for the structural weight.

Where the subscripts used here are the same as in the area calculation except the two concrete feet are now included.

ANALYTICAL CALCULATIONS

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$$W_{\text{foc}} = W_{\text{sw}} + W_{\text{uni}} + 2 \times W_{\text{c}} + 2 \times W_{\text{sp}} - 2 \times W_{\text{foc}}$$

The weight of the switch is assumed to be equivalent to the same length of Unistrut; then, W_{sw} is based on 10" at 3.8 lbs/ft (Ref.3, pg 8, P1001). The weight of the Unistrut is 60" at 3.8 lbs/ft (Ref.3, pg 8, P1001). The weight of the conduit is 60" at 1.13 lbs/ft (Ref.3, pg 113, rigid conduit). The weight of the triangle support is 1.34 lbs (Ref.3, pg 41, P2484).

A2.1 CONCRETE FOOTING WEIGHTS

The weight of the concrete footing can be calculated by figuring the weight of a solid 6 by 8 by 32 inch bar of concrete, subtracting the weight of the hole created by installing the Unistrut, and adding back in the weight of the channel as given in Ref.3, page 79, P3257. These calculations are shown below.

$$W_{\text{foc}} = W_{\text{solid}} - W_{\text{hole}} + W_{\text{channel}}$$

$$W_{\text{solid}} = \left(\frac{6 \times 8 \times 32}{1728} \right) \times (145 \frac{\text{lb}}{\text{ft}^3})$$

$$W_{\text{solid}} = 128.9 \text{ lbs}$$

$$W_{\text{hole}} = \left(\frac{1.625^2 \times 32}{1728} \right) \times (145 \frac{\text{lb}}{\text{ft}^3})$$

$$W_{\text{hole}} = 7.09 \text{ lbs}$$

Ref 1.3 lists the weight of the channel as 5.27 lbs/foot.

$$W_{\text{foc}} = 128.9 - 7.09 + 5.27$$

$$W_{\text{foc}} = 121.81 + 5.27$$

$$W_{\text{foc}} = 127.08 \text{ lbs}$$

ANALYTICAL CALCULATIONS

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The total structural weight can then be calculated as shown below:

$$W_T = \left(\frac{10}{12}\right) \times 3.8 + \left(\frac{60}{12}\right) \times 3.8 + 2 \times \left(\frac{60}{12}\right) \times 1.13 \\ + 2 \times 1.34 + 2 \times 127.08$$

$$W_T = 3.17 + 19 + 11.3 + 2.68 + 254.16$$

$$W_T = \underline{290.31 \text{ lbs}}$$

A3.0 WIND LOAD ON STRUCTURE

A very conservative estimate for the wind loading on this structure is to assume the center of the area (A_r) is 36 inches above grade (the center of the conduit run if it ran vertically).

A4.0 SLIDING OF THE STRUCTURE

Since the structure has the two concrete feet at 90 degrees to each other in the form of a 'T', sliding is not expected. Calculations will be shown later.

A5.0 OVERTURNING MOMENT CHECK - STRUCTURE IN CENTER

With the structure in the center, the center of mass is in the center and the shortest arm for the force to act on is 16 inches. The wind force is assumed to act on an arm of 30 inches. As long as the wind moment (M_N) is less than two thirds the restoring moment (M_R) [Ref.4, section 2317.(a)], the structure will not overturn.

$$M_N = F \times L_{wind}$$

$$M_N = 57.83 \times 30$$

$$M_N = \underline{1734.9 \text{ inch-lbs}}$$

$$M_R = \frac{2}{3} \times W_T \times \frac{L_{foot}}{2}$$

$$M_R = \frac{2}{3} \times 290.31 \times \frac{32}{2}$$

$$M_R = \underline{3096.64 \text{ inch-lbs}}$$

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$$M_R = 3096.64 > 1734.9 = M_N$$

$$\therefore M_R > M_N \text{ (Centered)}$$

A6.0 OVERTURNING MOMENT CHECK - STRUCTURE ON WINDWARD SIDE

With the structure to the windward side, the structure has two major centers of mass tied together. The first is the structure and one of the footers. The other is the other footer. The wind force is the same, but the restoring force is in two parts. The restoring moment is calculated below. The moment arm for the structure and one footer is assumed to be 32 inches, the full length of the concrete footer. The moment arm for the other footer is $L_{foot}/2$.

$$M_R = M_{STRUCT} + M_{FOOT}$$

$$M_{STRUCT} = (W_s - W_{foot}) \times L_{foot}$$

$$M_{STRUCT} = (290.31 - 127.08) \times 32$$

$$M_{STRUCT} = \underline{5223.36 \text{ inch-lbs}}$$

$$M_{FOOT} = W_{foot} \times \frac{L_{foot}}{2}$$

$$M_{FOOT} = 127.08 \times \frac{32}{2}$$

$$M_{FOOT} = \underline{2033.28 \text{ inch-lbs}}$$

$$M_R = \frac{2}{3} \times (5223.36 + 2033.28)$$

$$M_R = \underline{4837.76 \text{ inch-lbs}}$$

$$M_R = 4837.76 > 1734.9 = M_N$$

$$\therefore M_R > M_N \text{ (Windward)}$$

ANALYTICAL CALCULATIONS

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Subject Liquid Level Gage Support Wind/Seismic Analysis
Originator A.H. ZIADA Date 5/2/94
Checker G.J. HARRIS Date 5-4-94

A7.0 OVERTURNING MOMENT CHECK - STRUCTURE ON LEEWARD SIDE

With the structure on the leeward side, the structures has two major centers of mass tied together. The first is the structure and one of the footers. The second is the other footer. The wind force is the same, but the restoring force is in two parts. The restoring moment is calculated below. The moment arm for the structure and one footer is assumed to be 4 inches, the half thickness of the concrete footer. The moment arm for the other footer is still $L_{foot}/2$.

$$M_{struct} = (W_T - W_{foot}) \times \frac{L_{thick}}{2}$$

$$M_{struct} = (290.31 - 127.08) \times 4$$

$$M_{struct} = 652.92 \text{ inch-lbs}$$

$$M_{foot} = W_{foot} \times \frac{L_{foot}}{2}$$

$$M_{foot} = 127.08 \times \frac{32}{2}$$

$$M_{foot} = 2033.28 \text{ inch-lbs}$$

$$M_R = \frac{2}{3} \times (652.92 - 2033.28)$$

$$M_R = 1790.8 \text{ inch-lbs}$$

$$M_R = 1790.8 > 1734.9 = M_w$$

$$\therefore M_R > M_w \text{ (Leeward)}$$

DESIGN CALCULATION

(1) Drawing _____ (2) Doc. No. _____ (3) Page 7 of 12
(4) Building _____ (5) Rev. _____ (6) Job No. _____
(7) Subject Liquid Level Gage Support Wind / Seismic Analysis
(8) Originator A.H. ZIADA Date 5/2/94
(9) Checker G.J. HARRIS Date 5-4-94

(10) A8.0
Seismic accelerations (S.C.2)

Max $a_{hor.} = 0.33g$ at $\approx 7\%$ damping
(Ref. 1, fig. 5, Table 4, p. 23)
max. table value is used for conservatism

$$a_{ver.} = \left(\frac{2}{3}\right)a_{hor.} = \frac{2}{3}(0.33) = 0.22g$$

(Ref. 1, pg 5, pg 9)

Combine effect of 3 directions

$$a_{hor.} + 40\% a_{hor.2} + 40\% a_{ver.}$$

(Ref. 9, pg. 4-31)

$$F = Z I C_p W_p \quad (\text{Ref. 9, pg. 4-33})$$

where: I = importance factor = 2 (Ref. 1, pg. 9)

Z = g-factors =

C_p = horiz. force factor = 0.75 $\Rightarrow$ assume = 1 (conserv.)
(Ref. 4, Table 23-P)

$$\therefore F_{hor.} = (0.33)(2)(W_t) = (0.66)W_t$$

$$F_{ver.} = \frac{2}{3}(0.66)W_t = 0.44W_t$$

A dynamic analysis using an F.E. model will not be carried out as this is a simple structure with a cantilever beam response mode.

The loads are conservatively derived using the static force method.

DESIGN CALCULATION

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(10)

$$W_t = 290.31 - (127.02)(2) = 36.15 \text{ lbs} \Rightarrow \text{For overturning}$$

$$F_{\text{over}} = (0.66)(36.15) = 23.9 \text{ lb}$$

This is for tip over with side load only. But if we consider a vertical seismic component, this will reduce the restoring moment, since the weight of the structure will decrease relatively.

A 9.0

Check sliding of supportWind

$$F_{\text{wind}} = 57.83 \text{ lb}$$

$$W_{\text{sed}} = 290.31 \text{ lb}$$

Coefficient of friction $\mu = 0.25$ (Ref. 4, Table 29-B)
 Conservative

$$\begin{aligned} \text{Resisting Force} &= \mu \cdot W_t = 0.25(290.31 \text{ lb}) \\ &= 72.58 \text{ lbs} \end{aligned}$$

$$\therefore 72.58 \text{ lbs} > 57.83 \text{ lbs} \Rightarrow \text{O.K.}$$

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(10) SEISMIC (horizontal only)

$$F_{m1} = 23.9 \text{ lb} < 57.83 \text{ lb}_{\text{wind load}} \Rightarrow \text{Wind is the factor}$$

with vertical component

$$W_{\text{vert}} = W_t - F_{\text{vert}} = 290.31 - 0.44(290.31) \\ = 162.57 \text{ lb}$$

$$\mu = 0.25$$

$$\text{Resisting force} = \mu \cdot W_{\text{vert}} = (0.25)(162.57) \\ = 40.64 > 23.9 \text{ lb} \\ \Rightarrow \text{O.K.}$$

A10.0

Check overturning with horizontal + vertical seismic component

USE worst case, structure on leeward side

$$\begin{aligned} \text{Restoring Moment} \left\{ \begin{aligned} M_{\text{struc}} &= \left(\frac{W_{\text{vert}}}{\text{seis}} - \underset{\substack{\uparrow \\ \text{vertical}}}{W_{\text{foot}}(1-0.44)} \right) \times \frac{L_{\text{width}}}{2} \\ &= (162.57 - 127.08(1-0.44)) \times 4 = 365.64 \text{ in-lb} \\ M_{\text{Foot}} &= W_{\text{Foot}}(1-0.44) \times \frac{L_{\text{Foot}}}{2} \\ &= 127.08(1-0.44) \times \frac{32}{2} = 1138.6 \text{ in-lb} \end{aligned} \right. \end{aligned}$$

$$M_R = \frac{2}{3} (M_{\text{struc}} + M_{\text{Foot}}) = 1002.8 \text{ in-lb} > (23.9)(30 \text{ in}) = 717 \text{ in-lb}$$

$\Rightarrow$ O.K.

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(10)

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Check Brackets and bolts

$$M = 57.83 \times 30 = 1734.9 \text{ lb-in}$$

Bolt: $\frac{1}{2}$ - 13 UNC - 2A $1\frac{1}{2}$ LG

$$P_{\text{bolt}} = \frac{M}{d} + \frac{36.2}{2} = \frac{1734.9}{6.5} + 18.1 = 285 \text{ lb}$$

$$\text{Bracket capacity} = 3000 \text{ lb} \quad (\text{Ref. 3, P. 28})$$

$$\begin{matrix} 15,000 \text{ lb} \leftarrow 3000 > 285 \text{ lb} \\ 16 \text{ Gauge} \leftarrow 1500 \text{ lb} \end{matrix} \Rightarrow \text{O.K.}$$

$$\text{Bolt pull out strength} = 3000 \text{ lb} \gg 285 \text{ lb.} \quad (\text{Ref. 3, P. 9}) \Rightarrow \text{O.K.}$$

P1728

Capacity = 1000 lb (Ref. 3, P. 28)

$$\text{Same as above} \quad 1000 > 408.5 \text{ lb} \Rightarrow \text{O.K.}$$

Bolt shear: Bolts meets + exceeds ASTM A307 (Ref. 3, P. 5)

$$F_{\text{allow}} = 10 \text{ ksi} \quad (\text{Ref. 6, P. 5-73}) \quad A = 0.196 \text{ in}^2$$

$$\sigma_{\text{shear}} = \frac{P}{A} = \frac{285}{0.196} = 1454.1 \text{ psi} < 10,000 \text{ psi}$$

If only 1 bolt $\Rightarrow$ But there are more

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A12.0

Check Bending on Unistrut channel

For P1001 channel $S = 0.572 \text{ in}^3$ (Ref. 3, P.9)

$\sigma_y = 33 \text{ KSI}$ for A570 Gr 33
(Ref. 3; P.5)

From Ref. 6

$$\sigma_{allow} = 0.6 \sigma_y = 19,800 \text{ psi}$$

$$\therefore \sigma = \frac{M c}{I} = \frac{M}{S}$$

$M = 1734.9$ lb-in due to wind loading

$$\sigma = \frac{1734.9}{0.572} = 3033 \text{ psi} < 19,800 \text{ psi} \Rightarrow \text{O.K.}$$

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(10)

A13.0

Sliding Due to Seismic

Total Force Applied For seismic sliding :

$$F_T = F_r + P_o - P_p + F_w$$

where $F_r = \alpha_H C_v \gamma H^2$

$$P_o = \frac{1}{2} K_o \gamma H^2$$

$$P_p = \frac{1}{2} K_p \gamma H^2$$

$$F_w = 0.66 W_T$$

$$\gamma = 110 \text{ pcf (Ref. 1)}$$

$$C_v = 1.04$$

(Ref. 8)

since $V = 0.4$ (Ref. 7, P. 362)
(Conservative)

$$H = \text{height of soil} = 6''$$

$$K_o = \text{at rest earth pressure coefficient} = 0.5 \text{ (Ref. 1)}$$

Conservative $\rightarrow K_p = \frac{1}{K_o} = \frac{1}{0.5} = 2 \text{ (Ref. 1)}$

$$\alpha_H = 0.66 \text{ (accel. in g's)}$$

$$W_T = 290.31 \text{ lb}$$

$$\therefore F_r = 0.66(1.04)(110)(6)^2 = 2718.144 \text{ lb}$$

$$P_o = \frac{1}{2}(0.5)(110)(6)^2 = 990 \text{ lb}$$

$$P_p = \frac{1}{2}(2)(110)(6)^2 = 3960 \text{ lb}$$

$$F_w = 0.66(290.31) = 191.6$$

$$\therefore \text{IF } F_T \leq 0 \Rightarrow \text{O.K.}$$

$$F_T = -60.25 \text{ lb} \Rightarrow \text{O.K. No problem}$$

No sliding will occur due to seismic loading

A14.0 REFERENCES

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