# CEEn-2018CPST-002

# Erickson Anchorage of Roof-Top Equipment

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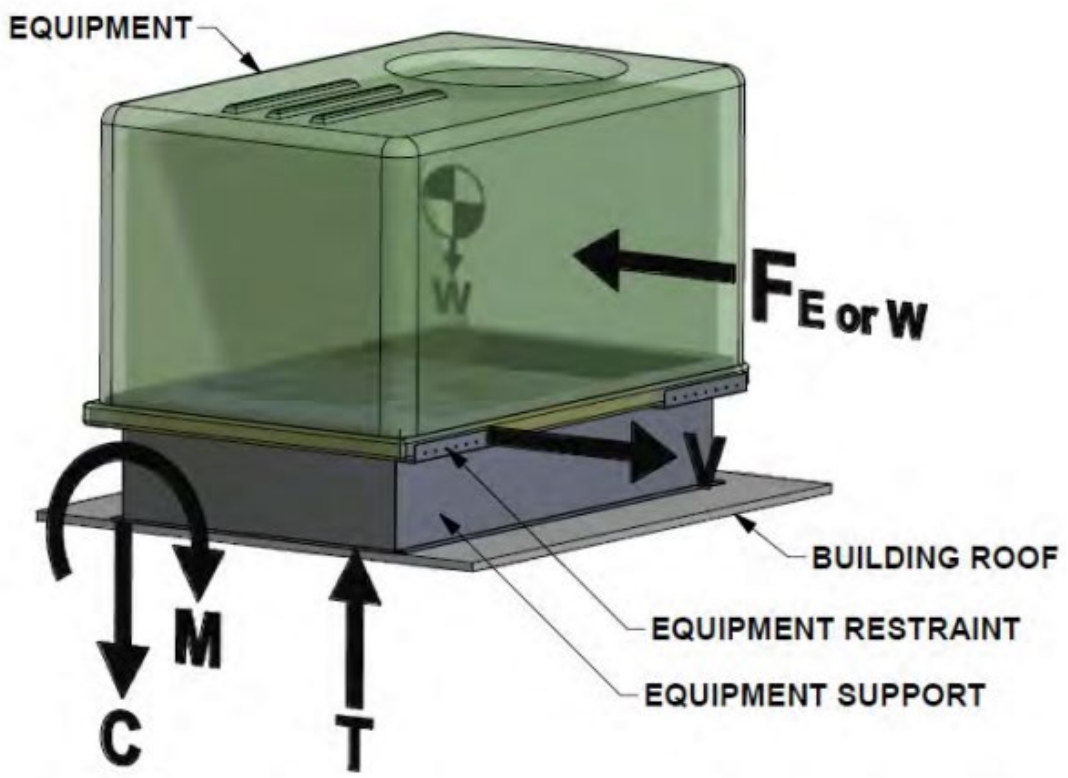
# Introduction

## Description

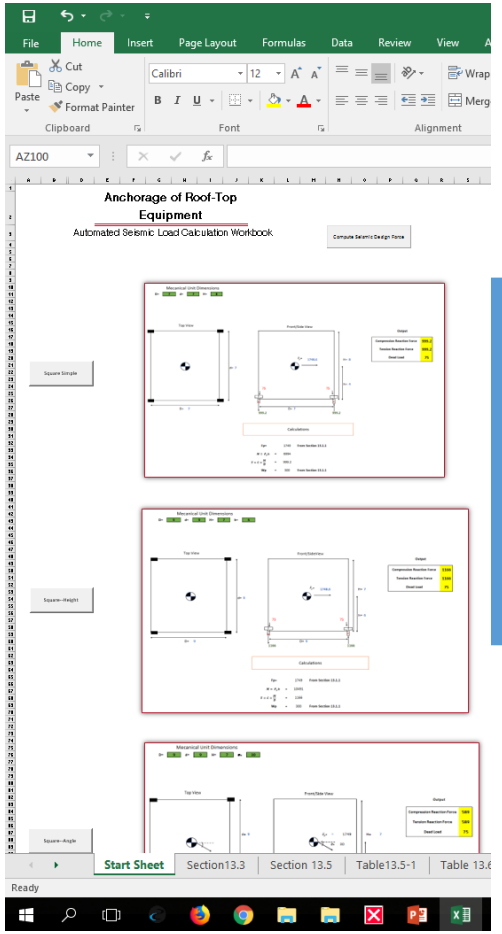
**Based on the ASCE 7-10 manual codes, create an automated tool to calculate lateral anchorage and wind loads of rooftop equipment**

# Project Tasks and Deliverables

- Create and Excel spreadsheet appropriate for calculating gravity and lateral anchorage of rooftop equipment (including solar panels, mechanical units, etc.)
- Create AutoCAD details to depict typical connections of rooftop equipment to the building structure.
- Create template proposal for use for such projects.
- Deliverables: Excel spreadsheet, AutoCAD model, Proposal template.

# Design and Analysis




Mecanical Unit Dimensions

D= 7 d= 7 H= 8

Top View

d= 7

D= 7

Front/Side View

$F_p$= 1748.6

H= 8

h= 4

75 75

999.2 D= 7 999.2

Output

| | |
|---|---|
| Compression Reaction Force | 999.2 |
| Tension Reaction Force | 999.2 |
| Dead Load | 75 |

Calculations

Fp= 1749 From Section 13.1.1

$M = F_p h$ = 6994

$T = C = \frac{M}{D}$ = 999

Wp = 300 From Section 13.1.1

# Design and Analysis Cont'd

**Do any of these conditions apply? (See Section 13.1.3)**
1. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.
2. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.
3. The component is in or attached to a Risk Category IV structure, and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
4. The component conveys, supports, or otherwise contains hazardous substances and is attached to a structure or portion thereof classified by the authority having jurisdiction as a hazardous occupancy.

(•) Yes ( ) No

Go to Vertical Cantilevered Systems

Go Back to Start Sheet

13.3 SEISMIC DEMANDS ON NONSTRUCTURAL COMPONENTS

**13.3.1 Seismic Design Force**

Note: Manually enter components in green. Yellow components are automated.

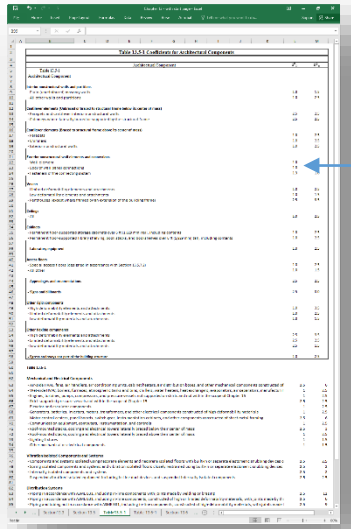
**For horizontal seismic design force (Fp)**

$$F_p = \frac{0.4 a_p S_{DS} W_p}{\left(\frac{R_p}{I_p}\right)}\left(1 + 2\frac{z}{h}\right) \qquad (13.3-1)$$

| | |
|---|---|
| $a_p$ | 1 |
| $S_{DS}$ | 10 |
| $W_p$ | 300 |
| $R_p$ | 2.5 |
| ← $I_p$ | 1.5 |
| z | 5 |
| h | 7 |
| $F_p$ = | 1748.57143 |

Select component from Table 13.5-1 and Table 13.6-1

- Limited deformability elements and attachments



*If $F_P$ is not required to be taken as greater than*

$$F_p = 1.6 S_{DS} I_p W_p \qquad (13.3-2)$$

$F_p$ = 7200 Design force from 13.3-1 required

*and Fp shall not be taken as less than*

$$F_p = 0.3 S_{DS} I_p W_p \qquad (13.3-3)$$

$F_p$ = 1575 Use Design force from 13.3-1

where

$F_p$ = seismic design force

$S_{DS}$ = spectral acceleration, short period, as determined from Section 11.4.4

$a_p$ = component amplification factor that varies from 1.00 to 2.50 (select appropriate value from Table 13.5-1 or 13.6-1)

$I_p$ = component importance factor that varies from 1.00 to 1.50 (see Section 13.1.3)

$W_p$ = component operating weight

$R_P$= component response modification factor that varies from 1.00 to 12 (select appropriate value from Table 13.5-1 or 13.6-1)

z = height in structure of point of attachment of component with respect to the base. For items at or below the base, z shall be taken as 0. The value of z/h need not exceed 1.0

# Design and Analysis Cont'd

- Challenges: first time for all of us. What would be useful and what wouldn't?
- Limited in-person help – Client is out of town and no faculty advisor.
- Based on the ASCE 7-10 codes, chapter 13 and 29.
- In accordance with IBC 2006, IBC 2015, and IBC 2018 manual codes

# Discussion of Results

- There are automated sheets for a number of scenarios, more sheets could be added as different scenarios are required.
- Could use further testing and altering as it is used in real world projects.

# Conclusions

- We created an automated spreadsheet to calculate gravity and lateral anchorage loads of rooftop equipment (including solar panels, mechanical units, etc.)
- The spreadsheet was automated to accommodate several different scenarios such as varying sizes of equipment and different seismic loading requirements.
- Using AutoCAD, we created details to depict typical connections of rooftop equipment to the building structure.

# Conclusions Cont'd

- We learned many lessons such as:
- How to communicate with a client far away.
- To create something based off our own design. Not just following orders.
- How to schedule our time wisely to complete the project.

- We hope our project will be useful to Erickson Structural

# Recommendations

- The spreadsheet can always be updated and altered to further help the engineers using it as new ideas pop up.
- We hope at the very least this spreadsheet can serve as a foundation to build upon to make it better.

## The End

# Any Questions?