Paramount/ S Series Unit

Structural Calculations
Seismic Anchorage

Prepared for:

Eaton
January 16, 2014
RMJ Job No. 14107

241 Joaquin Ave.
San Leandro, CA 94577
(510) 991-0977
## Paramount/ S Series Unit

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</table>
Project Description:

This project involves providing server anchorage support for units located throughout the United States. Calculations have been assembled according to two distinct seismic regions low & moderate, and high. A map has been created based on Figures 3.3-1 & 3.3-2 of ASCE 7-10 to define the two different seismic regions. Please note our seismic map shows three distinct regions low, moderate, and high, but for simplicity of our calculations low and moderate were combined into one region. The map also shows a solid line near the New Madrid Fault where the value of $S_s$ exceeds 2.75. In this area of extreme seismic potential, all anchorage is site specific. The other seismic regions have been determined according to the table included below;

<table>
<thead>
<tr>
<th>Seismic design region</th>
<th>Short period spectral response acceleration $S_s$</th>
<th>Short-period site coefficient $F_a$</th>
<th>Design spectral response acceleration at short periods $S_{ps}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.4</td>
<td>1.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>High</td>
<td>2.75</td>
<td>1.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

4.5” Concrete Slab

For allowable load refer to flow charts. Simpson Strong Bolt 2 expansion anchor bolts shall be used to anchor the Eaton equipment. Specific equipment model numbers are listed on next page. The design approach is conservative by considering that half of the bolts resist shear forces and the other half resist tension forces due to uplift. Calculations are based on the assumptions that anchors are not located within any boundary edges, 4.5” thick concrete minimum thickness, 2.75” minimum embedment, and 3000 psi concrete strength.

Concrete fill over Metal Deck

Units not located on ground level but below 50% of the buildings height has an assumed weight varies of Low and Moderate Seismic Regions and varies in High Seismic Regions. (see flow charts). Units to be raised a maximum height of 24” according to ICC report ESR-3037 the ½” dia. Strong Bolt 2 with an embedded 2.75” requires a minimum concrete thickness of 4.5”. We have included a hand calculation for the reported value.

Results

Please see the table below for a quick review of our results.

<table>
<thead>
<tr>
<th>Bolt Alignment</th>
<th>Max Tension (lbf.)</th>
<th>Max Shear (lbf.)</th>
<th>% Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Level</td>
<td>1,150 (937 actual)</td>
<td>1,250 (585 Actual)</td>
<td>99</td>
</tr>
<tr>
<td>50% Bld. Ht.</td>
<td>1,051</td>
<td>949</td>
<td>99</td>
</tr>
</tbody>
</table>

Our results show that units on the ground level the Simpson Strong Bolt 2 (½” Dia. with a 2.75” embedment) resists a max tension force of 1,150#, and max shear force of 1,250#. Anchorage for units located on the upper floor using the Simpson Strong Bolt 2 (½” Dia. with a 1¾” embedment) resists a max tension force of 1,051#, and max shear force of 949#. I have included the Simpson output files along with my hand calculations in the appendix section of this calculation packet. Site specific engineering is required where $S_s$ is greater than 2.75. Design is in accordance with the 2012 International Building Code along with the 2013 California Building Code.
Eaton –Paramount/ S Series Units
Scope, Assumptions, and Limitations
RMJ Job #14107
January 17, 2014

- Special Inspection shall be provided for expansion bolt installation.
- Existing concrete shall have a minimum compressive strength of 3,000 psi.
- Importance factor is assumed to be 1.5.
- Raised Units not to exceed 24”.
- Soil class is assumed to be D.
- Calculations and anchorage are done in accordance with the 2012 IBC, 2013 CBC and ASCE7-10.
- Maximum $S_s$ value is 2.75. Where value of $S_s$ exceeds 2.75, site specific calculations are required for all anchorages. $S_s$ values can exceed 2.75 near the New Madrid faults.
- The minimum slab on grade thickness is assumed to be 4”.
- The minimum concrete fill over metal deck thickness is 2½” (with 1½” metal deck).
- Maximum weight of enclosure and contents has been listed in the below:

<table>
<thead>
<tr>
<th>$Max Wt.$ of Enclosure and Contents (lb)</th>
<th>High Seismic</th>
<th>Low and Moderate Seismic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ground Level</td>
<td>≥50% of Bldg. Ht.</td>
</tr>
<tr>
<td>SEE FLOW CHART</td>
<td>SEE FLOW CHART</td>
<td>SEE FLOW CHART</td>
</tr>
</tbody>
</table>

- Enclosure is assumed to stay rigid during seismic loading (design by others).
- Computer access floor shall have strength to support compression and lateral loads.
- Floor slab and concrete filled metal deck shall have strength to resist uplift caused by overturning moment of cabinets.
- Any installation located in a high seismic region above the upper half of the building is not considered the upper half of the building.
- Ganged Units based on a Minimum of 3 Units.
- Calculations are for Eaton Paramount/ S Series units.
Calculations are for Eaton Paramount units.

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Product Name</th>
<th>Item Number</th>
<th>Product Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>JW772434</td>
<td>40Ux24&quot;Wx34.5&quot;</td>
<td>PMTFRM422440</td>
<td>42Ux24&quot;Wx40&quot;D</td>
</tr>
<tr>
<td>JW772440</td>
<td>40Ux24&quot;Wx40&quot;D</td>
<td>PMTFRM422445</td>
<td>42Ux24&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW772445</td>
<td>40U, 24W, 45D</td>
<td>PMTFRM423040</td>
<td>42Ux30&quot;Wx40&quot;D</td>
</tr>
<tr>
<td>JW773034</td>
<td>40Ux30&quot;Wx34.5&quot;D</td>
<td>PMTFRM423045</td>
<td>42Ux30&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW773040</td>
<td>40Ux30&quot;Wx40&quot;D</td>
<td>PMTFRM442434</td>
<td>44Ux24&quot;Wx34&quot;D</td>
</tr>
<tr>
<td>JW773045</td>
<td>40U, 30W, 45D</td>
<td>PMTFRM442440</td>
<td>44Ux24&quot;Wx40&quot;D</td>
</tr>
<tr>
<td>JW842434</td>
<td>84&quot;Hx24&quot;Wx34.5&quot;D</td>
<td>PMTFRM442445</td>
<td>44Ux24&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW842440</td>
<td>84&quot;Hx24&quot;Wx40&quot;D</td>
<td>PMTFRM442834</td>
<td>44Ux28&quot;Wx34&quot;D</td>
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<td>44U, 24W, 45D</td>
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<td>44Ux28&quot;Wx40&quot;D</td>
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<td>44Ux30&quot;Wx40&quot;D</td>
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<td>84&quot;Hx30&quot;Wx34.5&quot;D</td>
<td>PMTFRM443045</td>
<td>44Ux30&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW843040</td>
<td>84&quot;Hx30&quot;Wx40&quot;D</td>
<td>PMTFRM443645</td>
<td>44Ux36&quot;Wx45&quot;D</td>
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<tr>
<td>JW843045</td>
<td>44U, 30W, 45D</td>
<td>PMTFRM482440</td>
<td>48Ux24&quot;Wx40&quot;D</td>
</tr>
<tr>
<td>JW962434</td>
<td>96&quot;Hx24&quot;Wx34.5&quot;D</td>
<td>PMTFRM482445</td>
<td>48Ux24&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW962440</td>
<td>96&quot;Hx24&quot;Wx40&quot;D</td>
<td>PMTFRM483040</td>
<td>48Ux30&quot;Wx40&quot;D</td>
</tr>
<tr>
<td>JW962445</td>
<td>51U, 24W, 45D</td>
<td>PMTFRM483045</td>
<td>48Ux30&quot;Wx45&quot;D</td>
</tr>
<tr>
<td>JW963034</td>
<td>96&quot;Hx30&quot;Wx34.5&quot;D</td>
<td>PMTFRM512440</td>
<td>51Ux24&quot;Wx40&quot;D</td>
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<tr>
<td>JW963040</td>
<td>96&quot;Hx30&quot;Wx40&quot;D</td>
<td>PMTFRM512445</td>
<td>51Ux24&quot;W45&quot;D</td>
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<td>51Ux30&quot;Wx40&quot;D</td>
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<td></td>
<td>PMTFRM513045</td>
<td>51Ux30&quot;Wx45&quot;D</td>
</tr>
</tbody>
</table>

Responsibility of the Structural Engineer of Record

- Verify that the concrete meets the requirements of the applicable ICC ESR.
- Verify that the anchors are at an adequate distance from any slab opening or edges.
- Verify the adequacy of the structure to support the weight and forces shown in this pre-approval in addition to all other weights and forces that are imposed on it.
- Provide any supplementary structure required for strength and stability.
- Verify that the installation is in conformance with the 2010 CBC and with the notes and details shown in this pre-approval. Verify that the equipment’s actual weight, cg location, anchor locations, anchor details and the material and gage of the unit where attachments are made conform with the information shown in this pre-approval.
**DESIGN SCENARIOS AND CONDITIONS**

Eaton Enclosure Rack

Conc. Slab or Conc. Over Metal Deck (Direct Frame to Floor) Refer to Drawings SK3, SK6, SK7, SK10, SK11

Eaton Enclosure Rack

Raised Comp. Floor (Anchor Frame to Sub-Floor) Refer to Drawings SK3, SK5, SK7, SK9, SK11

**DESIGN CRITERIA**

- Provide special inspection for expansion anchor
- (E) Conc. Min Compressive Strength See Table
- Ground Floor
- Installation at <50% of building height
- Single & Ganged Units (Ganged Min. 3 Units)
- High, Moderate & Low Seismic Regions
- Calculation per IBC 2012/CBC 2013
- Importance Factor 1.5
- Weight of enclosure and contents; see flow charts provided with calculation packet

**FASTENER SELECTION**

Hilti KB-TZ 1/2" φ Bolt

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**RMJ**

Structural Engineers

Robinson
Meier
Jolly & Associates

241 Joaquin Ave.
San Leandro, CA 94577
510 991-0977

**EATON PARAMOUNT/ S SERIES UNIT ANCHORAGE**

**ALL SEISMIC REGIONS**

Job No. 14107

Sheet No. (SK2)

Signed by MAS  Date 01/2014
Summary: Paramount - Low & Moderate Seismic

| Assumptions | Importance Factor: 1.5 |

Single Paramount/ S Series Unit

1. Importance Factor:

2. Summary: Paramount - Low & Moderate Seismic

- Ground Floor
  - Concrete Slab (4" min)
    - >50% of building height
      - Concrete Fill over metal deck (2½" min. conc. Cover)
        - Site Specific
        - SK3
          - SK6
            - Max Content Wt.=1,800#
              - Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2.75" Min.
        - SK3
          - SK8
            - Max Content Wt.=1,800#
              - Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2.75" Min.
              & ½" Dia. Threaded Rod
    - 24" raised computer floor
      - SK3
        - SK7
          - SK8
            - Max Content Wt.=1,500#
              - Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 1¾" Min.
      - SK3
        - SK8
          - Max Content Wt.=900#
            - Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 1¾" Min.
              & ½" Dia. Threaded Rod

3. Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2.75" Min.

4. Use (4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2.75" Min. & ½" Dia. Threaded Rod
Summary: Paramount - Low & Moderate Seismic

Ganged Paramount Series/ S Series Units
(3 OR MORE UNITS GANGED)

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Importance Factor: 1.5</th>
</tr>
</thead>
</table>

Ground Floor
>0%, <50% of building height

Concrete Slab (4" min)

- no computer floor
  - Max Content Wt.=2,300#
    - SK4
    - SK6
  - Use (2) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 2" Min.

- 24" raised computer floor
  - Max Content
    - SK4
    - SK8
  - Use (2) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 2" Min. & ½" Dia.

Concrete Fill over metal deck (2½" min. conc. cover)

- no computer floor
  - Max Content Wt.=1,300#
    - SK4
    - SK7
  - Use (2) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¼" Min.

- 24" raised computer floor
  - Max Content Wt.=500#
    - SK4
    - SK9
  - Use (2) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¾" Min. & ½" Dia. Threaded

>50% of building height

Site Specific

Drawing Ref.
Summary: Paramount - High Seismic

Single Paramount/ S Series Unit

Assumptions

| Importance Factor: | 1.5 |

Ground Floor

- >0%, <50% of building height
- >50% of building height

Concrete Slab (4" min)

- no computer floor
- 24" raised computer floor

Concrete Fill over metal deck (2½"min. conc. cover)

- no computer floor
- 24" raised computer floor

Site Specific (2½" m in. conc. cover)

SK3

Max Content

Use
(4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2" Min.

SK6

Max Content

SK9

Use
(4) ½" Dia. Hilti Kwik Bolt KB-TZ, Embed 2" Min.

SK3

Max Content

Use
(4) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¾" Min.

SK6

Max Content

SK9

Use
(4) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¾" Min. & ½" Dia. Threaded Rod
**Summary: Paramount - High Seismic**

### Assumptions

| Importance Factor | 1.5 |

**Ganged Paramount/ S Series Units**

(3 OR MORE UNITS GANGED)

- **Ground Floor**
  - >0%, <50% of building height
  - Concrete Slab (4" min)

- **>50% of building height**
  - Concrete Fill over metal deck (2½" min. conc. cover)

#### Site Specific

- **SK5** (4" metal deck (2½" min. conc. cover))
- **SK4** (no computer floor)
- **SK6** (24" raised computer floor)
- **SK8** (no computer floor)
- **SK9** (24" raised computer floor)

**Use**

- (2) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 2" Min.
- (4) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 2" Min. & ½" Dia. Threaded Rod
- (2) 1¾" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¾" Min.
- (4) ½" Dia. Hilti Kwik Bolt KB-TZ per unit, Embed 1¾" Min.
Low & Moderate Seismic Calculations
Find the Seismic Design Category (SDC)  

Unit: Paramount/S Series

Project Location: Low & Moderate Seismic
Latitude: Varies  
Longitude: Varies

Soil Classification: D  
Occupancy Category: II

Table 1613.5.2 & Section 1613.5.2
Table 1604.5

Information from U.S. Geological Survey Website
http://earthquake.usgs.gov/research/hazmaps/

\[
\begin{align*}
S_S &= 1.500 \text{ g} \\
S_I &= 1.070 \text{ g} \\
F_a &= 1.000 \text{ g} & \text{Table 1613.5.3(1)} \\
F_v &= 1.500 \text{ g} & \text{Table 1613.5.3(2)} \\
S_{MS} &= 1.50 \text{ g} & \text{(Equation 16-37)} \\
S_{M1} &= 1.61 \text{ g} & \text{(Equation 16-38)} \\
S_{DS} &= 1.000 \text{ g} & \text{(Equation 16-39)} \\
S_{D1} &= 1.070 \text{ g} & \text{(Equation 16-40)}
\end{align*}
\]

Seismic Design Category (SDC): Varies
Load Case: Single Unit (Ground Flr.)

Unit Dimensions

| Width(w) (in) | 24 | Edge Length | 3 in |
| Depth(D) (in) | 34.5 |
| Frame Height (in) | 96 |
| Unit Weight (lb.) | 230 |

Center of Gravity Location

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame + Contents</td>
<td>2,030</td>
<td>12</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24
Transverse Anchorage Spacing (in) = 18

Seismic Force

- $S_{DS} = 1.0$ (Low & Moderate Seismic)
- $I_p = 1.5$ (Importance)
- $a_p = 1.0$ (Cabinets)
- $R_p = 2.5$ (Cabinets)
- $z/h = 0.0$ (Ground Floor)
- $F_p = 0.240$ W
- $F_{p,min} = 0.45$ W
- $F_{p,max} = 2.40$ W

Use $F_p = 0.45$ W

Longitudinal Overturning

Overturning Moment = $0.45 \times (48\,\text{in.} \times 2030\,\text{lbs.}) = 43,848\,\text{lb-in}$

0.9xResisting Moment = $0.9 \times (2030\,\text{lbs.} \times (9\,\text{in.})) = 16,443\,\text{lb-in}$

Total # of Bolts = 4
Anchorage Force = 761 lbs/per bolt
Shear Force = 457 lbs/per bolt

Design Bolts for 761 lbs tension, 457 lbs. shear, longitudinal direction

Transverse Overturning

Overturning Moment = $0.45 \times (48\,\text{in.} \times 2030\,\text{lbs.}) = 43,848\,\text{lb-in}$

0.9xResisting Moment = $0.9 \times (2030\,\text{lbs.} \times (12\,\text{in.})) = 21,924\,\text{lb-in}$

Total # of Bolts = 4
Anchorage Force = 457 lbs/per bolt
Shear Force = 457 lbs/per bolt

Design Bolts for 0 lbs tension, 457 lbs. shear, transverse direction

Drawing Reference See: SK-3 & SK-6
Load Case: **Single Unit on 24" Raised Computer Floor (Ground Flr.)**

### Unit Dimensions

<table>
<thead>
<tr>
<th>Width(w) (in)</th>
<th>Edge Length (in)</th>
<th>Depth(D) (in)</th>
<th>Raised Floor Height (in)</th>
<th>Frame Height (in)</th>
<th>Unit Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>3</td>
<td>34.5</td>
<td>24</td>
<td>96</td>
<td>230</td>
</tr>
</tbody>
</table>

### Seismic Force

- $S_{DS} = 1.0$ (Low & Moderate Seismic)
- $I_p = 1.5$ (Importance)
- $a_p = 1.0$ (Cabinets)
- $R_p = 2.5$ (Cabinets)
- $z/h = 0.0$ (Ground Floor)
- $F_p = 0.240$ W
- $F_{p,min} = 0.45$ W
- $F_{p,max} = 2.40$ W

**Use $F_p = 0.45$ W**

### Longitudinal Overturning

- **Overturning Moment** = 0.45 (72 in. x 2030 lbs.) = 65,772 lb-in

- **0.9xResisting Moment** = 0.9 (2030 lbs. x 12 in.) = 21,924 lb-in

**Total # of Bolts = 4**

- **Anchorage Force** = 914 lbs/per bolt
- **Shear Force** = 457 lbs/per bolt

**Paramount/S Series unit Plan**

- **Longitudinal Seismic Force ($F_p$)**
  - 24 in.
  - 18 in.

**Design Bolts for 914 lbs tension, 457 lbs. shear, longitudinal direction**

### Transverse Overturning

- **Overturning Moment** = 0.45 (72 in. x 2030 lbs.) = 65,772 lb-in

- **0.9xResisting Moment** = 0.9 (2030 lbs. x 12 in.) = 21,924 lb-in

**Total # of Bolts = 4**

- **Anchorage Force** = 914 lbs/per bolt
- **Shear Force** = 457 lbs/per bolt

**Paramount/S Series unit Plan**

- **Transverse Seismic Force ($F_p$)**
  - 24 in.
  - 18 in.

**Design Bolts for 914 lbs tension, 457 lbs. shear, transverse direction**

**Drawing Reference See:** SK-3 & SK-8
Load Case: **Ganged Unit (Ground Flr.)**

# of Units ganged (min.) = 3

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th>Center of Gravity Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width(w) (in) = 24</td>
<td></td>
</tr>
<tr>
<td>Edge Length = 3 in</td>
<td></td>
</tr>
<tr>
<td>Depth(D) (in) = 34.5</td>
<td></td>
</tr>
<tr>
<td>Frame Height (in) = 96</td>
<td></td>
</tr>
<tr>
<td>Frame Weight (lb.) = 230</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - Paramount/S Series</td>
<td>Frame +Contents</td>
<td>7,590</td>
<td>21</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24
Transverse Anchorage Spacing (in) = 42

### Longitudinal Overturning

- **Overturning Moment** = 0.45 (96/2 in. x 7590 lbs.) = 163,944 lb-in
- **0.9xResisting Moment** = 0.9 (7590 lbs x 21 in.) = 143,451 lb-in

Anchorage Force = 488 lbs
Shear Force = 1,139 lbs/per bolt

Use \( F_p = 0.45 \) W

### Transverse Overturning

- **Overturning Moment** = 0.45 (96/2 in. x 7590 lbs.) = 163,944 lb-in
- **0.9xResisting Moment** = 0.9 (7590 lbs x 12 in.) = 81,972 lb-in

Anchorage Force = 1,139 lbs/per bolt
Shear Force = 1,139 lbs/per bolt

Design Bolts for 0 lbs tension, 1,139 lbs. shear, longitudinal direction

Design Bolts for 1 lbs tension, 1,139 lbs. shear, transverse direction

Drawing Reference See: SK-4 & SK-6
Load Case: **Ganged Unit on 24” Raised Comp. Flr. (Ground Flr.)**

# of Units ganged (min.) = 3  
Raised Floor = 24 in

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Frame Weight (lb.)</td>
<td>230</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Center of Gravity Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X (in)</td>
<td>66</td>
</tr>
<tr>
<td>Y (in)</td>
<td>12</td>
</tr>
<tr>
<td>Z (in)</td>
<td>72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seismic Force</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S_DS</td>
<td>1.0</td>
</tr>
<tr>
<td>I_p</td>
<td>1.5</td>
</tr>
<tr>
<td>a_p</td>
<td>1.0</td>
</tr>
<tr>
<td>R_p</td>
<td>2.5</td>
</tr>
<tr>
<td>z/h</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SDS</th>
<th>Seismic Force</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low &amp; Moderate</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Importance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cabinets)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cabinets</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cabinets)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

| (Ground Floor) | 0.0 |

<table>
<thead>
<tr>
<th>SDS</th>
<th>Seismic Force</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low &amp; Moderate</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resisting Moment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9 x (7590 lbs. x 66 in.)</td>
<td>450,846 lb-in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anchorage Force</th>
<th>0 lbs/per bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td># of bolts per unit = 2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Longitudinal Overturning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overturning Moment =</td>
<td>0.5 (72 in. x 7590 lbs.) = 245,916 lb-in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Longitudinal Anchorage Spacing (in)</th>
<th>34.5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Transverse Overturning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overturning Moment =</td>
<td>0.5 (72 in. x 7590 lbs.) = 245,916 lb-in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transverse Anchorage Spacing (in)</th>
<th>54</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Anchorage Force</th>
<th>1,238 lbs/per bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td># of bolts per unit = 2</td>
<td></td>
</tr>
</tbody>
</table>

Design Bolts for 0 lbs tension, 1,139 lbs. shear, longitudinal direction

Design Bolts for 1,238 lbs tension, 1,139 lbs. shear, transverse direction

Drawing Reference See: SK-4 & SK-9
**Load Case:** Single Unit (≤ 50% of Bldg. Ht.)  
(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

<table>
<thead>
<tr>
<th>Unit Dimensions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24 Edge Length</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb)</td>
<td>230</td>
</tr>
</tbody>
</table>

**Center of Gravity Location**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame +Contents</td>
<td>1,430</td>
<td>12</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 18  
Transverse Anchorage Spacing (in) = 24

### Longitudinal Overturning

**Overturning Moment**

\[ 0.48 \times (48 \text{ in.} \times 1430 \text{ lbs.}) = 32,947 \text{ lb-in} \]

**0.9xResisting Moment**

\[ 0.9 \times [1430 \text{ lbs.} \times (12 \text{ in.})] = 15,444 \text{ lb-in} \]

Add 30% increase due to 13.4.2. ASCE-7-10

**Total # of Bolts = 4**

- **Anchorage Force = 365 lbs/per bolt**
- **Shear Force = 446 lbs/per bolt**

### Transverse Overturning

**Overturning Moment**

\[ 0.48 \times (48 \text{ in.} \times 1430 \text{ lbs.}) = 32,947 \text{ lb-in} \]

**0.9xResisting Moment**

\[ 0.9 \times [1430 \text{ lbs.} \times (9 \text{ in.})] = 11,583 \text{ lb-in} \]

Add 30% increase due to 13.4.2. ASCE-7-10

**Total # of Bolts = 4**

- **Anchorage Force = 771 lbs/per bolt**
- **Shear Force = 446 lbs/per bolt**

### Seismic Force

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low &amp; Moderate Seismic Force ( S_{DS} )</td>
<td>1.0</td>
</tr>
<tr>
<td>Importance ( I_p )</td>
<td>1.5</td>
</tr>
<tr>
<td>Importance ( a_p )</td>
<td>1.0</td>
</tr>
<tr>
<td>Cabinet Size ( R_p )</td>
<td>2.5</td>
</tr>
<tr>
<td>50% of Bldg. Ht. ( z/h )</td>
<td>0.5</td>
</tr>
<tr>
<td>( F_p )</td>
<td>0.480</td>
</tr>
<tr>
<td>( F_{p,\text{min}} )</td>
<td>0.45</td>
</tr>
<tr>
<td>( F_{p,\text{max}} )</td>
<td>2.40</td>
</tr>
</tbody>
</table>

Use \( F_p = 0.48 \) W

**Paramount/S Series unit Plan**

- **Longitudinal Seismic Force (Fp)**
  - 24 in.
  - 18 in.
  - Design Bolts for 365 lbs tension, 446 lbs. shear, longitudinal direction

- **Transverse Seismic Force (Fp)**
  - 24 in.
  - 18 in.
  - Design Bolts for 1 lbs tension, 446 lbs. shear, transverse direction

Drawing Reference See: SK-3 & SK-7
**Load Case:** Single Unit on 24" Raised Comp. Flr. (≤ 50% of Bldg. Ht.)
(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

<table>
<thead>
<tr>
<th>Unit Dimensions</th>
<th>Raised Floor = 24 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)   =</td>
<td>24</td>
</tr>
<tr>
<td>Depth (D) (in)   =</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in) =</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb) =</td>
<td>230</td>
</tr>
</tbody>
</table>

**Center of Gravity Location**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame +Contents</td>
<td>1,130</td>
<td>12</td>
<td>12</td>
<td>72</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24
Transverse Anchorage Spacing (in) = 18

**Longitudinal Overturning**

Overturning Moment = 0.48 (72 in. x 1130lbs.) = 39,053 lb-in
0.9xResisting Moment = 0.9 (1130 lbs. x (12in.)) = 12,204 lb-in

**Add 30% increase due to 13.4.2. ASCE-7-10**

Total # of Bolts = 4
Anchorage Force = 970 lbs/per bolt
Shear Force = 353 lbs/per bolt

**Design Bolts for 970 lbs tension, 353 lbs. shear, longitudinal direction**

**Transverse Overturning**

Overturning Moment = 0.48 (72 in. x 1130lbs.) = 39,053 lb-in
0.9xResisting Moment = 0.9 (1130 lbs. x (12in.)) = 12,204 lb-in

**Add 30% increase due to 13.4.2. ASCE-7-10**

Total # of Bolts = 4
Anchorage Force = 727 lbs/per bolt
Shear Force = 353 lbs/per bolt

**Design Bolts for 727 lbs tension, 353 lbs. shear, transverse direction**

**Seismic Force**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Seismic Force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S_DS = 1.0</td>
</tr>
<tr>
<td></td>
<td>I_p = 1.5</td>
</tr>
<tr>
<td></td>
<td>a_p = 1.0</td>
</tr>
<tr>
<td></td>
<td>R_p = 2.5</td>
</tr>
<tr>
<td></td>
<td>z/h = 0.5</td>
</tr>
<tr>
<td></td>
<td>F_p,min = 0.45</td>
</tr>
<tr>
<td></td>
<td>F_p,max = 2.40</td>
</tr>
</tbody>
</table>

Use F_p = 0.48 W

**Paramount/S Series unit Plan**

**Longitudinal Seismic Force (F_p)**

24 in.

18 in.

**Transverse Seismic Force (F_p)**

24 in.

18 in.

Drawing Reference See: SK-3 & SK-9
Load Case: **Ganged Unit (≤ 50% of Bldg. Ht.)**

# of Units ganged (max) = 3

---

**Single Unit Dimension**

| Width(w) (in) | 24 | Edge Length | 3 in |
| Depth(D) (in) | 34.5 |
| Frame Height (in) | 96 |
| Frame Weight (lb.) | 230 |

---

**Center of Gravity Location**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - Paramount/S Series</td>
<td>Frame + Contents</td>
<td>4,590</td>
<td>21</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

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**Seismic Force**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S_{DS} )</td>
<td>1.0 (Low &amp; Moderate Seismic)</td>
</tr>
<tr>
<td>( I_p )</td>
<td>1.5 (Importance)</td>
</tr>
<tr>
<td>( a_p )</td>
<td>1.0 (Cabinets)</td>
</tr>
<tr>
<td>( R_p )</td>
<td>2.5 (Cabinets)</td>
</tr>
<tr>
<td>( z/h )</td>
<td>0.5 (50% of bldg ht.)</td>
</tr>
<tr>
<td>( F_p )</td>
<td>0.480 W</td>
</tr>
<tr>
<td>( F_{p, min} )</td>
<td>0.45 W</td>
</tr>
<tr>
<td>( F_{p, max} )</td>
<td>2.40 W</td>
</tr>
</tbody>
</table>

**Use \( F_p = 0.48 \) W**

---

**Longitudinal Overturning**

- **Overturning Moment** = \( 0.48 \times (96/2 \text{ in.} \times 4590 \text{ lbs.}) = 105,754 \text{ lb-in} \)

**0.9xResisting Moment** = \( 0.9 \times (4590 \text{ lbs.} \times 21 \text{ in.}) = 86,751 \text{ lb-in} \)

**Add 30% increase due to 13.4.2. ASCE-7-10**

- **Anchorage Force** = 294 lbs
- **Shear Force** = 955 lbs/per bolt

**Ganged Paramount/S Series unit Plan**

**Longitudinal Seismic Force**

**Design Bolts for 294 lbs tension, 955 lbs. shear, longitudinal direction**

---

**Transverse Overturning**

- **Overturning Moment** = \( 0.48 \times (96/2 \text{ in.} \times 4590 \text{ lbs.}) = 105,754 \text{ lb-in} \)

**0.9xResisting Moment** = \( 0.9 \times (4590 \text{ lbs.} \times 12 \text{ in.}) = 49,572 \text{ lb-in} \)

**Add 30% increase due to 13.4.2. ASCE-7-10**

- **Anchorage Force** = 1,014 lbs/per bolt
- **Shear Force** = 955 lbs/per bolt

**Ganged Paramount/S Series unit Plan**

**Transverse Seismic Force**

**Design Bolts for 1 lbs tension, 955 lbs. shear, transverse direction**

---

**Drawing Reference See:** SK-4 & SK-7
Load Case: Ganged Unit on 24" Raised Comp. Flr. (≤ 50% of Bldg. Ht.)

# of Units ganged (max) = 3  Raised Floor = 24 in

Seismic Force

<table>
<thead>
<tr>
<th>Frame Height (in) = 96</th>
<th>SDS = 1.0</th>
<th>Low &amp; Moderate Seismic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame Weight (lb.) = 230</td>
<td>Ip = 1.5</td>
<td>Importance</td>
</tr>
<tr>
<td>Unit Part</td>
<td>Weight (lbs)</td>
<td>X (in)</td>
</tr>
<tr>
<td>3 - Paramount/S Series Frame +Contents</td>
<td>2,190</td>
<td>66</td>
</tr>
</tbody>
</table>

Center of Gravity Location

<table>
<thead>
<tr>
<th>Width(w) (in) = 24 in</th>
<th>Edge Length = 3 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth(D) (in) = 34.5</td>
<td></td>
</tr>
<tr>
<td>Frame Height (in) = 96</td>
<td></td>
</tr>
<tr>
<td>Frame Weight (lb.) = 230</td>
<td></td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24

Transverse Anchorage Spacing (in) = 42

Longitudinal Overturning

Overturning Moment = 0.48 (72 in. x 2190 lbs.) = 75,686 lb-in

0.9 x Resisting Moment = 0.9 (2190 lbs x 66 in.) = 130,086 lb-in

Add 30% increase due to 13.4.2. ASCE-7-10

Anchorage Force = 0 lbs/per bolt

Shear Force = 456 lbs/per bolt

Use $F_p = 0.48 W$

3 ganged units

Design Bolts for 0 lbs tension, 456 lbs. shear, longitudinal direction

Transverse Overturning

Overturning Moment = 0.5 (72in. x 2190lbs.) = 75,686 lb-in

0.9 x Resisting Moment = 0.9 (2190 lbs x 12 in.) = 23,652 lb-in

Add 30% increase due to 13.4.2. ASCE-7-10

Anchorage Force = 940 lbs/per bolt

Shear Force = 456 lbs/per bolt

3 ganged units

Design Bolts for 940 lbs tension, 456 lbs. shear, transverse direction

Drawing Reference See: SK-4 & SK-9
High Seismic Calculations
Find the Seismic Design Category (SDC)  
Unit : Paramount/S Series

Project Location:  
High Seismic

Latitude:  
Varies

Longitude:  
Varies

Soil Classification:  
D

Table 1613.5.2 & Section 1613.5.2

Occupancy Category:  
II

Table 1604.5

Information from U.S. Geological Survey Website

http://earthquake.usgs.gov/research/hazmaps/

\[ S_S = 2.750 \text{ g} \]
\[ S_1 = 1.070 \text{ g} \]
\[ F_a = 1.000 \text{ Table 1613.5.3(1)} \]
\[ F_v = 1.500 \text{ Table 1613.5.3(2)} \]
\[ S_{MS} = 2.75 \text{ g (Equation 16-37)} \]
\[ S_{M1} = 1.61 \text{ g (Equation 16-38)} \]
\[ S_{DS} = 1.833 \text{ g (Equation 16-39)} \]
\[ S_{D1} = 1.070 \text{ g (Equation 16-40)} \]

Seismic Design Category (SDC):  
Varies
**Load Case: Single Unit (Ground Flr.)**

### Unit Dimensions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24</td>
</tr>
<tr>
<td>Edge Length</td>
<td>3 in</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb.)</td>
<td>230</td>
</tr>
</tbody>
</table>

### Center of Gravity Location

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame + Contents</td>
<td>1,030</td>
<td>12</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24
Transverse Anchorage Spacing (in) = 18

### Seismic Force

- $S_{DS} = 1.83$ (High Seismic)
- $I_p = 1.5$ (Importance)
- $a_p = 1.0$ (Cabinets)
- $R_p = 2.5$ (Cabinets)
- $z/h = 0.0$ (Ground Floor)
- $F_p = 0.440$ W
- $F_{p,min} = 0.83$ W
- $F_{p,max} = 4.40$ W

Use $F_p = 0.83$ W

### Longitudinal Overturning

- **Overturning Moment** = 0.83 \((48 \text{ in.} \times 1030\text{lbs.}) = 40,788 \text{ lb-in}\)

- **0.9xResisting Moment** = \(0.9 [(1030 \text{ lbs.} - \text{Vert. Comp.)} \times 12\text{in.}] = 7,045 \text{ lb-in}\)

- Vertical Component \(0.2^*S_{DS}*W_p = 378 \text{ lbs}\)

- **Total # of Bolts** = 4

- **Anchorage Force** = 937 lbs/per bolt
- **Shear Force** = 425 lbs/per bolt

### Transverse Overturning

- **Overturning Moment** = 0.83 \((48 \text{ in.} \times 1030\text{lbs.}) = 40,788 \text{ lb-in}\)

- **0.9xResisting Moment** = \(0.9 [(1030 \text{ lbs.} - \text{Vert. Comp.)} \times (12\text{in.})] = 7,045 \text{ lb-in}\)

- Vertical Component \(0.2^*S_{DS}*W_p = 378 \text{ lbs}\)

- **Total # of Bolts** = 4

- **Anchorage Force** = 703 lbs/per bolt
- **Shear Force** = 425 lbs/per bolt

### Design Bolts for 937 lbs tension, 425 lbs. shear, longitudinal direction

### Design Bolts for 703 lbs tension, 425 lbs. shear, longitudinal direction

**Drawing Reference See:** SK-3 & SK-6
Load Case: Single Unit on 24" Raised Computer Floor (Ground Flr.)

Unit Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24</td>
</tr>
<tr>
<td>Edge Length (in)</td>
<td>3</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb.)</td>
<td>230</td>
</tr>
</tbody>
</table>

Center of Gravity Location

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame + Contents</td>
<td>630</td>
<td>12</td>
<td>12</td>
<td>72</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24
Transverse Anchorage Spacing (in) = 18

Longitudinal Overturning

Overturning Moment = 0.83 (72 in. x 630 lbs.) = 37,422 lb-in
0.9 x Resisting Moment = 0.9 [(630 lbs. - Vert. Comp.) x (12 in.)] = 4,309 lb-in
Vertical Component (0.2 * SDS * Wp) = 231 lbs

Total # of Bolts = 4
Anchorage Force = 920 lbs/per bolt
Shear Force = 260 lbs./per bolt

Transverse Overturning

Overturning Moment = 0.83 (72 in. x 630 lbs.) = 37,422 lb-in
0.9 x Resisting Moment = 0.9 [(630 lbs. - Vert. Comp.) x (12 in.)] = 4,309 lb-in
Vertical Component (0.2 * SDS * Wp) = 231 lbs

Total # of Bolts = 4
Anchorage Force = 690 lbs/per bolt
Shear Force = 425 lbs./per bolt

Design Bolts for 920 lbs tension, 260 lbs. shear, longitudinal direction

Design Bolts for 690 lbs tension, 425 lbs. shear, longitudinal direction

Drawing Reference See: SK-3 & SK-9
Load Case: **Ganged Unit (Ground Flr.)**

# of Units ganged (min)= 3

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24</td>
</tr>
<tr>
<td>Edge Length</td>
<td>3 in</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb.)</td>
<td>230</td>
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<table>
<thead>
<tr>
<th>Center of Gravity Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X (in)</td>
<td>21</td>
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<tr>
<td>Y (in)</td>
<td>12</td>
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<tr>
<td>Z (in)</td>
<td>48</td>
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<table>
<thead>
<tr>
<th>Seismic Force</th>
<th></th>
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<tbody>
<tr>
<td>$S_{DS}$</td>
<td>1.83</td>
</tr>
<tr>
<td>$I_p$</td>
<td>1.5</td>
</tr>
<tr>
<td>$a_p$</td>
<td>1.0</td>
</tr>
<tr>
<td>$R_p$</td>
<td>2.5</td>
</tr>
<tr>
<td>$z/h$</td>
<td>0.0</td>
</tr>
<tr>
<td>$F_p$</td>
<td>0.440 W</td>
</tr>
<tr>
<td>$F_{p,min}$</td>
<td>0.83 W</td>
</tr>
<tr>
<td>$F_{p,max}$</td>
<td>4.40 W</td>
</tr>
</tbody>
</table>

Use $F_p = 0.83$ W

Longitudinal Overturning

Overturning

Moment = $0.83 \times (96/2 \text{ in.} \times 3990 \text{ lbs.}) = 158,004 \text{ lb-in}

0.9xResisting

Moment = $0.9 \times (3990 \text{ lbs} - \text{Vert. Comp.}) \times 21 \text{ in.} = 47,760 \text{ lb-in}

Vertical Component $(0.2^*S_{DS}^*W_{p}) = 1,463 \text{ lbs}$

Anchorage Force = 656 lbs/per bolt

Shear Force = 549 lbs/per bolt

Total # of bolts = 4

Longitudinal Anchorage Spacing (in) = 24

Transverse Anchorage Spacing (in) = 42

Transverse Overturning

Overturning

Moment = $0.83 \times (96/2 \text{ in.} \times 3990 \text{ lbs.}) = 158,004 \text{ lb-in}$

0.9xResisting

Moment = $0.9 \times (3990 \text{ lbs} - \text{Vert. Comp.}) \times 12 \text{ in.} = 27,292 \text{ lb-in}$

Vertical Component $(0.2^*S_{DS}^*W_{p}) = 1,463 \text{ lbs}$

Anchorage Force = 908 lbs/per bolt

Shear Force = 549 lbs/per bolt

Total # of bolts = 4

Design Bolts for 656 lbs tension, 549 lbs. shear, longitudinal direction

Design Bolts for 908 lbs tension, 549 lbs. shear, transverse direction

Drawing Reference See: SK-4 & SK-6
Load Case: **Ganged Unit on 24" Raised Comp. Flr. (Ground Flr.)**

# of Units ganged (min)= 3

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th>Raised Floor = 24 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width(w) (in)</td>
<td>24</td>
</tr>
<tr>
<td>Depth(D) (in)</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb.)</td>
<td>230</td>
</tr>
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</table>

**Center of Gravity Location**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
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</thead>
<tbody>
<tr>
<td>3 - Paramount/S Series</td>
<td>Frame +Contents</td>
<td>2,490</td>
<td>21</td>
<td>12</td>
<td>72</td>
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Longitudinal Anchorage Spacing (in) = 24

Transverse Anchorage Spacing (in) = 57

**Seismic Force**

<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
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<tr>
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<td>High Seismic</td>
</tr>
<tr>
<td>I_p</td>
<td>= 1.5</td>
<td>(Importance)</td>
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<tr>
<td>a_p</td>
<td>= 1.0</td>
<td>(Cabinets)</td>
</tr>
<tr>
<td>R_p</td>
<td>= 2.5</td>
<td>(Cabinets)</td>
</tr>
<tr>
<td>z/h</td>
<td>= 0.0</td>
<td>(Ground Floor)</td>
</tr>
<tr>
<td>F_p</td>
<td>= 0.440</td>
<td>W</td>
</tr>
<tr>
<td>F_p,min</td>
<td>= 0.83</td>
<td>W</td>
</tr>
<tr>
<td>F_p,max</td>
<td>= 4.40</td>
<td>W</td>
</tr>
</tbody>
</table>

Use $F_p = 0.83 \, W$

**Longitudinal Overturning**

Overturning Moment = 0.8 (72 in. x 2490 lbs.) = 147,906 lb-in

0.9xResisting Moment = 0.9 [(2490 lbs. - Vert. Comp.) x 21 in.] = 29,805 lb-in

Vertical Component (0.2*SDS*Wp) = 913 lbs

Anchorage Force = 518 lbs/per bolt
Shear Force = 342 lbs/per bolt

# of bolts per unit = 4

**Transverse Overturning**

Overturning Moment = 0.8 (72 in. x 2490 lbs.) = 147,906 lb-in

0.9xResisting Moment = 0.9 [(2490 lbs. - Vert. Comp.) x 12 in.] = 17,032 lb-in

Vertical Component (0.2*SDS*Wp) = 913 lbs

Anchorage Force = 909 lbs/per bolt
Shear Force = 342 lbs/per bolt

# of bolts per unit = 4

**Drawing Reference See:** SK-5 & SK-9
Load Case: **Single Unit (≤ 50% of Bldg. Ht.)**  
(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

### Unit Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24 in</td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5 in</td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96 in</td>
</tr>
<tr>
<td>Unit Weight (lb.)</td>
<td>230 lb.</td>
</tr>
</tbody>
</table>

### Center of Gravity Location

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramount/S Series</td>
<td>Frame +Contents</td>
<td>730</td>
<td>12</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

### Longitudinal Overturning

Overturning Moment = 0.88 (48 in. x 730lbs.) = 30,835 lb-in

0.9xResisting Moment = 0.9 [(730 lbs. - Vert. Comp.) x (9in.)] = 4,993 lb-in

Vertical Component (0.2*SDS*Wp) = 268 lbs

Total # of Bolts = 4

| Anchorage Force       | 718 lbs/per bolt     |
| Shear Force           | 321 lbs/per bolt     |

Paramount/S Series unit Plan

### Transverse Overturning

Overturning Moment = 0.88 (48 in. x 730lbs.) = 30,835 lb-in

0.9xResisting Moment = 0.9 [(730 lbs. - Vert. Comp.) x (12in)] = 4,993 lb-in

Vertical Component (0.2*SDS*Wp) = 268 lb-in

Total # of Bolts = 4

| Anchorage Force       | 538 lbs/per bolt     |
| Shear Force           | 321 lbs/per bolt     |

Paramount/S Series unit Plan

### Design Bolts

- For 718 lbs tension, 321 lbs. shear, longitudinal direction
- For 538 lbs tension, 321 lbs. shear, longitudinal direction

Drawing Reference See: SK-3 & SK-7
Load Case: Single Unit on 24" Raised Comp. Flr. (≤ 50% of Bldg. Ht.)
(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

Unit Dimensions
- Width(w) (in) = 24
- Depth(D) (in) = 34.5
- Frame Height (in) = 96
- Frame Weight (lb) = 230
- Raised Floor = 24 in

Seismic Force
- SDS = 1.83 High Seismic
- Ip = 1.5 (Importance)
- ap = 1.0 (Cabinets)
- Rp = 2.5 (Cabinets)
- z/h = 0.5 (50% of bldg ht.)
- Fp = 0.880 W
- Fp,min = 0.83 W
- Fp,max = 4.40 W
- Use Fp = 0.88 W

Longitudinal Overturning
- Overturning Moment = 0.88 (72 in. x 530lbs.) = 33,581 lb-in
- 0.9xResisting Moment = 0.9 [(530 lbs. - Vert. Comp.) x (12in)] = 3,625 lb-in
- Vertical Component (0.2*SDS*Wp) = 194 lbs

Total # of Bolts = 4
- Anchorage Force = 832 lbs/per bolt
- Shear Force = 425 lbs/per bolt

Design Bolts for 832 lbs tension, 425 lbs. shear, longitudinal direction

Transverse Overturning
- Overturning Moment = 0.88 (72 in. x 530lbs.) = 33,581 lb-in
- 0.9xResisting Moment = 0.9 [(530 lbs. - Vert. Comp.) x (12in)] = 3,625 lb-in
- Vertical Component (0.2*SDS*Wp*12in) = 194 lbs

Total # of Bolts = 4
- Anchorage Force = 624 lbs/per bolt
- Shear Force = 425 lbs/per bolt

Design Bolts for 624 lbs tension, 425 lbs. shear, longitudinal direction

Drawing Reference See: SK-3 & SK-8
Load Case: **Ganged Unit (≤ 50% of Bldg. Ht.)**

# of Units ganged (min)= 3

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width(w) (in) =</td>
<td>24</td>
</tr>
<tr>
<td>Depth(D) (in) =</td>
<td>34.5</td>
</tr>
<tr>
<td>Frame Height (in) =</td>
<td>96</td>
</tr>
<tr>
<td>Unit Weight (lb.) =</td>
<td>230</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Center of Gravity Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (lbs) X (in) Y (in) Z (in)</td>
<td></td>
</tr>
<tr>
<td>3 - Paramount/S Series Frame +Contents</td>
<td>2,790</td>
</tr>
</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24

Transverse Anchorage Spacing (in) = 57

### Longitudinal Overturning

Overturning Moment = 0.88 (96/2 in. x 2790lbs.) = 117,850 lb-in

0.9xResisting Moment = 0.9 [(2790 lbs - Vert. Comp.) x21 in.] = 33,396 lb-in

Vertical Component (0.2*SDS*Wp) = 1,023 lbs

Anchorage Force = 370 lbs

Shear Force = 585 lbs/per bolt

Design Bolts for 370 lbs tension, 585 lbs. shear, longitudinal direction

### Transverse Overturning

Overturning Moment = 0.88 (96/2 in. x 2790lbs.) = 117,850 lb-in

0.9xResisting Moment = 0.9 [(2790 lbs - Vert. Comp.) x12 in.] = 19,084 lb-in

Vertical Component (0.2*SDS*Wp) = 1,023 lbs

Anchorage Force = 686 lbs/per bolt

Shear Force = 409 lbs/per bolt

Design Bolts for 686 lbs tension, 409 lbs. shear, longitudinal direction

Drawing Reference See: SK-4 & SK-7
Load Case: **Ganged Unit on 24" Raised Comp. Flr. (≤ 50% of Bldg. Ht.)**

# of Units ganged (min)= 3

<table>
<thead>
<tr>
<th>Single Unit Dimension</th>
<th>Raised Floor</th>
<th>24 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (w) (in)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Depth (D) (in)</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>Frame Height (in)</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Frame Weight (lb.)</td>
<td>230</td>
<td></td>
</tr>
</tbody>
</table>

**Center of Gravity Location**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Part</th>
<th>Weight (lbs)</th>
<th>X (in)</th>
<th>Y (in)</th>
<th>Z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - Paramount/S Series</td>
<td>Frame + Contents</td>
<td>1,590</td>
<td>21</td>
<td>12</td>
<td>72</td>
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</tbody>
</table>

Longitudinal Anchorage Spacing (in) = 24

Transverse Anchorage Spacing (in) = 57

**Longitudinal Overturning**

- Overturning Moment = 0.88 \( \times \) (72 in. \times 1590 lbs.) = 100,742 lb-in
- 0.9xResisting Moment = 0.9 \( \times \) (1590 lbs. \times 21 in.) = 30,051 lb-in
- Vert. Comp. (0.2*SDS*Wp) (To be resisted by 2 center bolts) = 583 lbs

**Seismic Force**

- \( S_{DS} = 1.83 \) (High Seismic)
- \( I_p = 1.5 \) (Importance)
- \( a_p = 1.0 \) (Cabinets)
- \( R_p = 2.5 \) (Cabinets)
- \( z/h = 0.5 \) (50% of bldg. ht.)

- \( F_p = 0.880 \) W
- \( F_{p, min} = 0.83 \) W
- \( F_{p, max} = 4.40 \) W

- Use \( F_p = 0.88 \) W

**Ganged Paramount/S Series unit Plan**

**Longitudinal Seismic Force**

- Anchorage Force = 310 lbs/per bolt
- Shear Force = 585 lbs/per bolt

- # of bolts per unit = 4

**Design Bolts for 310 lbs tension, 585 lbs. shear, longitudinal direction**

**Transverse Overturning**

- Overturning Moment = 0.9 (72 in. \times 1590 lbs.) = 100,742 lb-in
- 0.9xResisting Moment = 0.9 [(1590 lbs - Vert. Comp.) \times 12 in.] = 10,876 lb-in
- Vertical Component (0.2*SDS*Wp) = 583 lb-in

**Ganged Paramount/S Series unit Plan**

**Transverse Seismic Force**

- Anchorage Force = 624 lbs/per bolt
- Shear Force = 233 lbs/per bolt

- # of bolts per unit = 4

**Design Bolts for 624 lbs tension, 233 lbs. shear, longitudinal direction**

**Drawing Reference See:** SK-5 & SK-8
GENERAL NOTES

DESIGN


Design Criteria:
Importance Factor ............... 1.5
Seismic Design Category (SDC).... VARIES
Maximum Value of Ss.............. 2.75

Dimensions: Refer to rough concrete surfaces, face of studs, face of conc. block, top of sheathing, or top of slab, unless otherwise indicated.

Typical Details: Details and notes on these sheets shall apply unless specifically shown or noted otherwise. Construction details not fully shown or noted shall be similar to details for similar conditions. All work and construction shall comply with all applicable building codes, regulations, and safety requirements.

Discrepancies: The Contractor shall inform the Architect in writing, during the bidding period, of any discrepancies or omissions noted on the drawings or in the specifications, or of any variations needed in order to conform to codes, rules, and regulations. Upon receipt of such information, the Architect will send written instructions to all concerned. Any such discrepancy, omission, or variation not reported shall be the responsibility of the Contractor, and work shall be performed in a manner as directed by the Architect.

EXISTING CONSTRUCTION

Existing construction shown on the drawings was obtained from existing drawings or field surveys. The Contractor shall verify all existing conditions and shall notify the Architect of all exceptions before proceeding with the work. The removal, cutting, drilling, etc. of existing work shall be performed with great care and small tools in order not to jeopardize the structural integrity of the building. If existing structural members, not indicated for removal, interfere with the new work, the Structural Engineer shall be notified immediately, and approval obtained, before removal of the existing members.

FASTENERS

Wedge Anchors: Hilti Kwik Bolt Wedge Anchor, types as indicated per ICBO evaluation report No. 1917 or by manufacture having current ICBO evaluation report with values in shear and tension) equal or greater.
NOTES:
*POSITION BOLTS IN OUTER OR UPPER HALF OF SLOTTED BOLT HOLES WHERE APPLICABLE
*SEE MANUFACTURERS DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF PARAMOUNT UNITS

CONDITION SCHEDULE

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCRETE SLAB</td>
<td>SK6</td>
</tr>
<tr>
<td>CONCRETE FILL OVER METAL DECK</td>
<td>SK7</td>
</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. SLAB</td>
<td>SK8</td>
</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. FILL METAL DECK</td>
<td>SK9</td>
</tr>
<tr>
<td>CONCRETE SLAB</td>
<td>SK10</td>
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<td>CONCRETE FILL OVER METAL DECK</td>
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<td>RAISED COMP. FLOOR OVER CONC. SLAB</td>
<td>SK12</td>
</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. FILL METAL DECK</td>
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SINGLE UNIT BOTTOM PLAN VIEW

PLAN
1"=1'-0" 1

NOTE:
FOR THE TOTAL NUMBER OF BOLT SEE FLOWCHART & DETAIL

EATON PARAMOUNT/ S SERIES UNIT ANCHORAGE
ALL SEISMIC REGIONS

Signed by MAS Date 01/2014

Job No. 14107
Sheet No. SK3
SPECIAL NOTE:
TWO UNITS SHOWN GANGED THREE UNITS MINIMUM REQUIRED.

NOTES:
*POSITION BOLTS IN OUTER OR UPPER HALF OF SLOTTED BOLT HOLES WHERE APPLICABLE
*SEE MANUFACTURERS DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF PARAMOUNT UNITS

CONDITION SCHEDULE

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SEE</th>
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</thead>
<tbody>
<tr>
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<tr>
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<tr>
<td>RAISED COMP. FLOOR CONC. SLAB</td>
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<tr>
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</tr>
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<tr>
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<tr>
<td>RAISED COMP. FLOOR OVER CONC. SLAB</td>
<td>SK12</td>
</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. FILL METAL DECK</td>
<td>SK13</td>
</tr>
</tbody>
</table>

GANG UNIT BOTTOM PLAN VIEW
(3 UNITS MIN. GANGED TOGETHER)

PLAN
1"=1'-0"

NOTE:
FOR THE TOTAL NUMBER OF BOLT SEE FLOWCHART & DETAIL

EATON PARAMOUNT/S SERIES UNIT ANCHORAGE
ALL SEISMIC REGIONS

Signed by MAS Date 01/2014
NOTES:
*POSITION BOLTS IN OUTER OR UPPER HALF OF SLOTTED BOLT HOLES WHERE APPLICABLE
*SEE MANUFACTURERS DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF PARAMOUNT UNITS

SPECIAL NOTE:
TWO UNITS SHOWN GANGED THREE UNITS MINIMUM REQUIRED.

CONDITION SCHEDULE

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCRETE SLAB</td>
<td>SK6</td>
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<tr>
<td>CONCRETE FILL OVER METAL DECK</td>
<td>SK7</td>
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<tr>
<td>RAISED COMP. FLOOR CONC. SLAB</td>
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</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. FILL METAL DECK</td>
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</tr>
<tr>
<td>RAISED COMP. FLOOR CONC. FILL METAL DECK</td>
<td>SK13</td>
</tr>
</tbody>
</table>

GANG UNIT BOTTOM PLAN VIEW
(3 UNITS MIN. GANGED TOGETHER)

PLAN
1"=1'-0"

FOR SINGLE UNIT SEE SK1

NOTE:
FOR THE TOTAL NUMBER OF BOLTS SEE FLOWCHART & DETAIL

EATON PARAMOUNT/S SERIES UNIT ANCHORAGE
ALL SEISMIC REGIONS

Signed by MAS Date 01/2014
SECTION A-A

CONCRETE SLAB INSTALLATION

DETAIL
3"=1'-0"

EATON PARAMOUNT/S SERIES UNIT ANCHORAGE
ALL SEISMIC REGIONS

Signed by MAS  Date 01/2014

RMJ
Robinson
Meier
Jully & Associates

Eaton Paramount/S Series Unit Anchorage

Job No. 14107
Sheet No. SK6
CONCRETE FILL OVER METAL DECK INSTALLATION

DETAIL

3”=1’-0” SK7

EATON PARAMOUNT/S SERIES UNIT ANCHORAGE

ALL SEISMIC REGIONS

Signed by MAS Date 01/2014
RAISED COMPUTER FLOOR OVER CONC. SLAB INSTALLATION

DETAIL

3"=1'-0"

EATON PARAMOUNT/S SERIES UNIT ANCHORAGE

ALL SEISMIC REGIONS

Signed by MAS Date 01/2014
RAISED COMPUTER FLOOR OVER CONC.
FILLED METAL DECK INSTALLATION

SECTION A-A

1/2" HILTI KB-TZ WEDGE ANCHOR

EATON PARAMOUNT /
S SERIES UNIT FRAME

1/2" HILTI KB-TZ
WEDGE ANCHOR

1/2" THREADED
ROD

1 3/4" MIN.
EMBEDMENT

FOR USES OVER
24" SITE SPECIFIC
ENGINEERING
REQ'D

2 1/2" MIN.
CONC. COVER

1/4"-20 SCREWS 5 REQ'D (DRILL
9/32" HOLES AS REQUIRED)

LEVELER OPT., SEE
MANUFACTURER
DRAWINGS FOR INFO

COUPLER, IF REQ'D,

(E) CONC. SLAB

DETAIL
3"=1'-0"

RMJ
Robinson
Meier
Jully & Associates

STRUCTURAL ENGINEERS
241 Joaquin Ave.
San Leandro, CA 94577
510 991-0977

EATON PARAMOUNT/
S SERIES UNIT ANCHORAGE

ALL SEISMIC REGIONS

Job No. 14107

Sheet No. SK9

Signed by MAS Date 01/2014
SECTION A-A

CONCRETE SLAB INSTALLATION

DETAIL
3"=1'-0"
CONCRETE FILL OVER METAL DECK INSTALLATION
RAISED COMPUTER FLOOR OVER CONC. SLAB INSTALLATION

DETAIL

\[3''=1'-0''\]  

RMJ Structural Engineers  
241 Joaquin Ave.  
San Leandro, CA 94577  
510 991-0977

EATON PARAMOUNT/ S SERIES UNIT ANCHORAGE  
ALL SEISMIC REGIONS

Signed by MAS  
Date 01/2014
RAISED COMPUTER FLOOR OVER CONC.
FILLED METAL DECK INSTALLATION

SECTION A-A

(2) \( \frac{1}{2} \)"Ø HILTI KB-TZ WEDGE ANCHOR

EATON PARAMOUNT/S SERIES UNIT FRAME

\( \frac{1}{2} \)"Ø HILTI KB-TZ WEDGE ANCHOR

(2) \( \frac{1}{2} \)"Ø THREADED ROD PER CORNER

\( \frac{3}{4} \)" MIN. EMBEDMENT

\( \frac{1}{4} \)"-20 SCREWS 5 REQ'D (DRILL 9/32" HOLES AS REQUIRED)

LEVELER OPT., SEE MANUFACTURER DRAWINGS FOR INFO

COUPLER, IF REQ'D

24" MAX.

FOR USES OVER 24" SITE SPECIFIC ENGINEERING REQ'D

2\( \frac{1}{2} \)" MIN. CONC. COVER

DETAIL 1
3"=1'-0" SK13
1 Input data

Anchor type and diameter: Kwik Bolt TZ - CS 1/2 (2)
Effective embedment depth: \( h_{\text{rad}} = 2.000 \text{ in.}, h_{\text{nom}} = 2.375 \text{ in.} \)
Material: Carbon Steel
Evaluation Service Report: ESR-1917
Issued I Valid: 5/1/2013 | 5/1/2015
Stand-off installation: - (Recommended plate thickness: not calculated)
Profile: no profile
Base material: cracked concrete, 2500, \( f'_c = 2500 \text{ psi} \); \( h = 4.000 \text{ in.} \)
Installation: hammer drilled hole, installation condition: dry
Reinforcement: tension: condition B, shear: condition B; no supplemental splitting reinforcement present
  edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F) Tension load: yes (D.3.3.4.3 (c))
  Shear load: yes (D.3.3.5.3 (b))

Geometry [in.] & Loading [lb, in.lb]
2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

<table>
<thead>
<tr>
<th>Anchor</th>
<th>Tension force</th>
<th>Shear force</th>
<th>Shear force x</th>
<th>Shear force y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1150</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

<table>
<thead>
<tr>
<th>Steel Strength*</th>
<th>Load $N_{sa}$ [lb]</th>
<th>Capacity $\phi N_s$ [lb]</th>
<th>Utilization $\beta N = N_{sa}/\phi N_s$</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pullout Strength*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Concrete Breakout Strength**</td>
<td>1150</td>
<td>1172</td>
<td>99</td>
<td>OK</td>
</tr>
</tbody>
</table>

* anchor having the highest loading  **anchor group (anchors in tension)

3.1 Steel Strength

$$N_{sa} = \text{ESR value}$$

refer to ICC-ES ESR-1917

$$\phi N_{steel} \geq N_{sa}$$

ACI 318-11 Table D.4.1.1

Variables

<table>
<thead>
<tr>
<th>n</th>
<th>$A_{sa,N}$ [in.$^2$]</th>
<th>$f_{sa}$ [psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.10</td>
<td>106000</td>
</tr>
</tbody>
</table>

Calculations

$$N_{sa} [lb]$$

10705

Results

<table>
<thead>
<tr>
<th>$N_{sa}$ [lb]</th>
<th>$\phi N_{steel}$</th>
<th>$\phi N_{sa}$ [lb]</th>
<th>$N_{sa}$ [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10705</td>
<td>0.750</td>
<td>8029</td>
<td>1150</td>
</tr>
</tbody>
</table>
3.2 Concrete Breakout Strength

\[ N_b = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{cp,N} N_b \]

\[ \phi N_b \geq N_{ua} \]

\[ A_{Nc0} = 9 h_{ef}^{2/3} \]

\[ \psi_{ed,N} = \left( \frac{1}{1 + \frac{2 \varepsilon_c}{h_{ef}}} \right) \leq 1.0 \]

\[ \psi_{cp,N} = \text{MAX} \left( \frac{c_{\text{min}}}{c_{ac}}, 1.5h_{ef} \right) \leq 1.0 \]

\[ \psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{\text{min}}}{1.5h_{ef}} \right) \leq 1.0 \]

\[ \psi_{cp,N} = \text{MAX} \left( \frac{c_{\text{min}}}{c_{ac}}, 1.5h_{ef} \right) \leq 1.0 \]

\[ N_b = k_c \lambda_a \sqrt{f_c h_{ef}^{1.5}} \]

Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>h_{ef} [in.]</th>
<th>\varepsilon_{c,N} [in.]</th>
<th>\varepsilon_{c2,N} [in.]</th>
<th>c_{\text{min}} [in.]</th>
<th>\psi_{c,N}</th>
</tr>
</thead>
</table>
| \hline
| 2.000     | 0.000        | 0.000                  | 24.000                 | 1.000                |
| \hline
| c_{ac} [in.] | k_c | \lambda_a | f_c [psi] |
| \hline
| 5.500     | 17            | 1.000                  | 2500                   |
| \hline

Calculations

\[ A_{Nc} \left[ \text{in}^2 \right] A_{Nc0} \left[ \text{in}^2 \right] \psi_{ed,N} \psi_{cp,N} N_b [\text{lb}] \]

<table>
<thead>
<tr>
<th>Calculations</th>
<th>A_{Nc} [\text{in}^2]</th>
<th>A_{Nc0} [\text{in}^2]</th>
<th>\psi_{ed,N}</th>
<th>\psi_{cp,N}</th>
<th>N_b [\text{lb}]</th>
</tr>
</thead>
</table>
| \hline
| 36.00       | 36.00                | 1.000                | 1.000       | 1.000       | 2404            |
| \hline

Results

\[ N_{cb} [\text{lb}] \phi_{\text{concrete}} \phi_{\text{seismic}} \phi_{\text{nonductile}} \phi N_{ua} [\text{lb}] N_{ub} [\text{lb}] \]

<table>
<thead>
<tr>
<th>Results</th>
<th>N_{cb} [\text{lb}]</th>
<th>\phi_{\text{concrete}}</th>
<th>\phi_{\text{seismic}}</th>
<th>\phi_{\text{nonductile}}</th>
<th>\phi N_{ua} [\text{lb}]</th>
<th>N_{ub} [\text{lb}]</th>
</tr>
</thead>
</table>
| \hline
| 2404    | 0.650               | 0.750                  | 1.000                 | 1172                     | 1150                   |
| \hline
4 Shear load

<table>
<thead>
<tr>
<th>Steel Strength*</th>
<th>Load $V_{ua}$ [lb]</th>
<th>Capacity $\phi \phi \phi V_n$ [lb]</th>
<th>Utilization $\beta \beta \beta \beta V_n$</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength*                | N/A | N/A | N/A | N/A |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* anchor having the highest loading  **anchor group (relevant anchors)

5 Warnings

- To avoid failure of the anchor plate the required thickness can be calculated in PROFIS Anchor. Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading!
- Condition A applies when supplementary reinforcement is used. The $\Phi$ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-11 Appendix D, Part D.3.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Part D.3.3.4.3 (b), Part D.3.3.5.3 (a), or Part D.3.3.5.3 (c). The connection design (shear) shall satisfy the provisions of Part D.3.3.4.3 (a), Part D.3.3.4.3 (b), or Part D.3.3.5.3 (c).
- Part D.3.3.4.3 (b) / part D.3.3.5.3 (a) requires that the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Part D.3.3.4.3 (c) / part D.3.3.5.3 (b) waives the ductility requirements and requires that the anchors shall be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Part D.3.3.4.3 (d) / part D.3.3.5.3 (c) waives the ductility requirements and requires the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by $\Omega E$.
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-11, Part D.9.1

Fastening meets the design criteria!
1 Input data

Anchor type and diameter: Kwik Bolt TZ - CS 1/2 (2)
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Installation: hammer drilled hole, installation condition: dry
Reinforcement: tension: condition B, shear: condition B; no supplemental splitting reinforcement present
Seismic loads (cat. C, D, E, or F) Tension load: yes (D.3.3.4.3 (c))
Shear load: yes (D.3.3.5.3 (b))
2 Load case/Resulting anchor forces

Load case: Design loads

**Anchor reactions [lb]**

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<th>Shear force</th>
<th>Shear force x</th>
<th>Shear force y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1250</td>
<td>1250</td>
<td>0</td>
</tr>
</tbody>
</table>

max. concrete compressive strain: - [%]

max. concrete compressive stress: - [psi]

resulting tension force in (x/y)=(0.000/0.000): 0 [lb]

resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

<table>
<thead>
<tr>
<th>Load $N_{ua}$ [lb]</th>
<th>Capacity $\phi N_n$ [lb]</th>
<th>Utilization $\beta = N_{ua}/\phi N_n$</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Strength*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Pullout Strength*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Concrete Breakout Strength**</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* anchor having the highest loading  **anchor group (anchors in tension)
4.1 Steel Strength

\[ V_{seis} = ESR \text{ value} \]

\[ \phi V_{steel} \geq V_{ua} \quad \text{ACI 318-11 Eq. (D.4.1.1)} \]

**Variables**

<table>
<thead>
<tr>
<th>n</th>
<th>( A_{nc,V} , [\text{in.}^2] )</th>
<th>( f_{ut,a} , [\text{psi}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.10</td>
<td>106000</td>
</tr>
</tbody>
</table>

**Calculations**

\[ V_{sa} \, [\text{lb}] \]

\[ 5495 \]

**Results**

<table>
<thead>
<tr>
<th>( V_{sa,eq} , [\text{lb}] )</th>
<th>( \phi_{steel} )</th>
<th>( \phi V_{sa} , [\text{lb}] )</th>
<th>( V_{ua} , [\text{lb}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5495</td>
<td>0.650</td>
<td>3572</td>
<td>1250</td>
</tr>
</tbody>
</table>

4.2 Pryout Strength

\[ V_{cp} = k_{cp} \left[ \frac{A_{nc}}{A_{ns,0}} \psi_{ed,N} \psi_{cl,N} \psi_{cp,N} N_c \right] \quad \text{ACI 318-11 Eq. (D-40)} \]

\[ \phi V_{cp} \geq V_{ua} \quad \text{ACI 318-11 Table D.4.1.1} \]

**Variables**

<table>
<thead>
<tr>
<th>( k_{cp} )</th>
<th>( h_{ul} , [\text{in.}] )</th>
<th>( \epsilon_{01,N} , [%] )</th>
<th>( \epsilon_{02,N} , [%] )</th>
<th>( c_{a,min} , [\text{in.}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.000</td>
<td>0.000</td>
<td>0.000</td>
<td>24000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( \psi_{ed,N} )</th>
<th>( c_{a} , [\text{in.}] )</th>
<th>( k_{\lambda} )</th>
<th>( \lambda )</th>
<th>( f_{c} , [\text{psi}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td>5.500</td>
<td>17</td>
<td>1.000</td>
<td>25000</td>
</tr>
</tbody>
</table>

**Calculations**

\[ A_{nc} \, [\text{in.}^2] \quad A_{ns,0} \, [\text{in.}^2] \quad \psi_{ed,1,N} \quad \psi_{ed,2,N} \quad \psi_{ed,N} \quad \psi_{cp,N} \quad N_c \, [\text{lb}] \]

\[ 36.00 \quad 36.00 \quad 1.000 \quad 1.000 \quad 1.000 \quad 1.000 \quad 2404 \]

**Results**

<table>
<thead>
<tr>
<th>( V_{cp} , [\text{lb}] )</th>
<th>( \phi_{concrete} )</th>
<th>( \phi_{seismic} )</th>
<th>( \phi_{ductility} )</th>
<th>( \phi V_{cp} , [\text{lb}] )</th>
<th>( V_{ua} , [\text{lb}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2404</td>
<td>0.700</td>
<td>1.000</td>
<td>1.000</td>
<td>1683</td>
<td>1250</td>
</tr>
</tbody>
</table>
4.3 Concrete edge failure in direction x+

\[ V_{cb} = \left( \frac{A_{Vc}}{A_{Vc0}} \right)^{\psi_{c,V}} V_{c,V} \psi_{h,V} \psi_{\parallel,V} V_b \]  

ACI 318-11 Eq. (D-30)

\[ \phi V_{cb} \geq V_{ua} \]  

ACI 318-11 Table D.4.1.1

\[ A_{Vc} \text{ see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)} \]

ACI 318-11 Eq. (D-32)

\[ \psi_{c,V} = \left( 1 + \frac{2e_{V}}{3a_1} \right)^{0.2} \]  

ACI 318-11 Eq. (D-36)

\[ \psi_{h,V} = \sqrt{1.5c_a} \]  

ACI 318-11 Eq. (D-38)

\[ \psi_{\parallel,V} = \left( 7 \left( \frac{1}{a_1^2} \right)^{0.2} \right)^{\frac{1}{3}} \]  

ACI 318-11 Eq. (D-33)

\[ V_b = \frac{7}{\sqrt{\frac{\lambda_a^2 a_1^2}{\lambda_d^2 d_a^2} \sqrt{f'_c a_1^2}}} \]  

ACI 318-11 Eq. (D-33)

Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>c_a1 [in.]</th>
<th>c_a2 [in.]</th>
<th>e_{V} [in.]</th>
<th>\psi_{c,V}</th>
<th>h_a [in.]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16.000</td>
<td>24.000</td>
<td>0.000</td>
<td>1.000</td>
<td>4.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>\lambda_a</th>
<th>d_a [in.]</th>
<th>f_c [psi]</th>
<th>\psi_{\parallel,V}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.000</td>
<td>1.000</td>
<td>0.500</td>
<td>2500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

Calculations

<table>
<thead>
<tr>
<th>Variables</th>
<th>A_{Vc} [in.]</th>
<th>A_{Vc0} [in.]</th>
<th>\psi_{c,V}</th>
<th>\psi_{h,V}</th>
<th>V_b [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>192.00</td>
<td>1152.00</td>
<td>1.000</td>
<td>1.000</td>
<td>2.449</td>
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</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>\phi_{concrete}</th>
<th>\phi_{seismic}</th>
<th>\phi_{nonductile}</th>
<th>\phi V_{cb} [lb]</th>
<th>V_{ua} [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.700</td>
<td>1.000</td>
<td>1.000</td>
<td>5973</td>
<td>1250</td>
</tr>
</tbody>
</table>

5 Warnings

- To avoid failure of the anchor plate the required thickness can be calculated in PROFIS Anchor. Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading!
- Condition A applies when supplementary reinforcement is used. The \( \phi \) factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-11 Appendix D, Part D.3.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Part D.3.3.4.3 (b), Part D.3.3.4.3 (c), or Part D.3.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Part D.3.3.5.3 (a), Part D.3.3.5.3 (b), or Part D.3.3.5.3 (c).
- Part D.3.3.4.3 (b) / part D.3.3.5.3 (a) requires that the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Part D.3.3.4.3 (c) / part D.3.3.5.3 (b) waives the ductility requirements and requires that the anchors shall be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Part D.3.3.4.3 (d) / part D.3.3.5.3 (c) waives the ductility requirements and requires the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by \( \Omega_0 \).
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-11, Part D.9.1

Fastening meets the design criteria!
Design Expansion Anchor

Try: \( \frac{3}{8}" \) Hilti KE-TZ

\( h_{dc} = 1 \frac{3}{4}" \)

Shear

Concrete Breakout Strength Of Anchor In Shear [Sec. D.6.2]

\[
V_{cd} = \frac{A_{uc}}{A_{qc}} \cdot \psi_{cd,u} \cdot \psi_{c,u} \cdot V_u \quad [E2 \ D-21]
\]

*Note: Concrete anchors not near any edges. This will not condition will not govern.*

Concrete Peenout Strength Of Anchor In Shear [Sec. D.6.3]

\[
V_{cp} = K_{cp} \cdot N_{cb} \quad [E2, N, D-29]
\]

\( K_{cp} = 1 \)

\( N_{cb} = 2,150 \# \quad \text{(See Tension Core.)} \)

\( V_{cp} = 2,150 \# \)

\( \Phi = 0.7 \); \( \Phi_s = 0.75 \)

\( \Phi V_{cp} = 1,562 \# \)

Steel Strength Of Anchor In Shear [Sec. D.6.1.7]

\[
V_{sb} = 6,405 \# \quad (H.17, Eq. PG. 319)
\]

\( \Phi = 0.65 \quad [D.4.9] \)

\( \Phi V_{sb} = 0.75 \times 0.65 \times 6,405 \# = 3,122 \# \)
Tension

Steel Strength of Anchor in Tension [Sec. D.5.1]

\[ N_{sa} = n \cdot A_{se} \cdot f_{u,e} \quad [\text{Eqn. D-3}] \]

\[ n = 1 \quad A_{se} = 0.101 \text{ in}^2 \quad (\text{Hieli Car}) \]

\[ f_{u,e} = 115,000 \quad \# \]

\[ \phi = 0.75 \]

\[ \phi N_{sa} = 0.75 \times 0.101 \times 115,000 \]

\[ = 8,711 \quad \# \]

Concl. Breakout Strength of Anchor in Tension [Sec. D.5.2]

\[ N_{cb} = \frac{A_{nc}}{A_{nco}} \cdot \psi_{ed,n} \cdot \psi_{c,n} \cdot \psi_{cr,n} \cdot N_b \quad [\text{Eqn. D-4}] \]

\[ h_{et} = 1 \frac{3}{4} \text{ in} \]

\[ A_{nco} = A_{nc} = 9.604 = 9 \times 1.75^2 \]

\[ = 27.6 \text{ in}^2 \]

\[ \psi_{ed,n} = 1.0 \]

\[ \psi_{c,n} = 1.0 \quad [\text{Eqn. D-10 or D-11}] \]

\[ \psi_{cr,n} = 1.0 \quad [\text{Sec. D.5.2.6}] \]

\[ N_b = k_c \cdot \sqrt{f_c} \cdot h_{et}^{1.5} \quad [\text{Eqn. D-7}] \]

\[ k_c = 17 \]

\[ N_b = 17 \cdot \sqrt{5,000} \cdot 1.75^{1.5} \]

\[ = 2,156 \quad \# \]

\[ \phi = 0.65 \quad [\text{D.4.9}] \]

\[ \phi N_{cb} = 0.75 \times 0.65 \times 2,156 \]

\[ = 1,051 \quad \# \]
CONC PULLOUT STRENGTH OF ANCHOR IN TENSION [SEC. D.5.3]

\[ \phi N_{pc} = \frac{\psi_{cp} N_{f}}{f_{c}} \]
\[ = 0.65 \times 1.400 \text{ kips} \]
\[ = 949 \text{#} \quad \text{--- GOVERNS} \]

SIDE FACE BLOWOUT OF ANCHOR IN TENSION [SEC. D.5.9]

ANCHOR NOT CLOSE TO ANY EDGE

STEEL STRENGTH OF ANCHOR IN SHEAR [SEC. D.6.1]

\[ V_{sa} = n \cdot 0.60 A_{se} \cdot f_{y} \]
\[ = 1.0 - 0.60 \times 0.101 \times 106,000 \]
\[ = 6,424 \# \]
\[ \phi V_{sa} = 0.75 \times 0.65 \times 6,424 \# \]
\[ = 3,132 \# \]