1568 Air Broadway is a 45-story building that was constructed around and over a 4-story landmarked theater. 1568 Air Broadway is to be partially demolished.

Phase 1: Demolition from roof to 16th Floor

Phase 2: Demolition from 16th Floor to 1st Floor

I. STRUCTURE CAPACITY AND SURVEY FOR TYPICAL SLABS.

A. BASED ON STRUCTURAL DRAWINGS

Full sets of structural plans are available.

The live load capacity for floors 9-43 is 40 PSF.
The live load capacity for EMR and mechanical floors is 100 PSF.
The live load capacity for floors 1-8 is 100 PSF.

Floors 9 through 44 (Roof) are comprised of 8" reinforced concrete two-way flat slabs, supported over shear walls and columns.

Floors 1 through 8 are comprised of concrete slab on metal deck, supported by steel framing.

B. BASED ON SURVEY AND STRUCTURAL INVESTIGATION

Although the area of observation and access were limited, no sign of weakness or damage were noted during the structural assessment walkthrough of the building.
C. **Floor construction from structural plans**

![Diagram of typical floor construction](image)

**Typical Floor Construction - Roof to 17th Floor**

Scale: 1/2" = 1'-0"

![Diagram of typical slab demolition sequence](image)

**Typical Slab Demolition Sequence Diagram**

Scale: 3/32" = 1'-0"

Typical two-way slab removal diagram as shown on means and methods.
Floor Construction (floors 1 through 8) Concrete slab on 20 Ga Metal Deck

<table>
<thead>
<tr>
<th>Floor</th>
<th>Conc. Depth (t_c) in.</th>
<th>Concrete Weight</th>
<th>Deck Depth (t_d) in.</th>
<th>Conc. Strength (f'_c) psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>5&quot;</td>
<td>N.W.</td>
<td>3&quot;</td>
<td>4,000</td>
</tr>
<tr>
<td>2nd</td>
<td>4 1/2&quot;</td>
<td>N.W.</td>
<td>3&quot;</td>
<td>5,000</td>
</tr>
<tr>
<td>3rd-6th</td>
<td>3 3/4&quot;</td>
<td>L.W.</td>
<td>3&quot;</td>
<td>3,000</td>
</tr>
<tr>
<td>7th</td>
<td>5&quot;</td>
<td>N.W.</td>
<td>3&quot;</td>
<td>4,000</td>
</tr>
<tr>
<td>8th</td>
<td>7&quot;</td>
<td>N.W.</td>
<td>3&quot;</td>
<td>4,000</td>
</tr>
</tbody>
</table>

Floors 9 through 44 are 8" N.W. two-way concrete slabs.
Floors 9-16 have 6,000 psi concrete.
Floors 17-44 have 4,000 psi concrete.
## II. ANALYSIS OF UPPER FLOORS.

### A. DEMOLITION EQUIPMENT

<table>
<thead>
<tr>
<th>Machine type</th>
<th>Operating weight</th>
<th>Capacity</th>
<th>Tipping load</th>
<th>Width</th>
<th>Wheelbase/Track</th>
<th>Tire/Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caterpillar 226 Skid steer loader</td>
<td>5,830</td>
<td>1,500</td>
<td>2,710</td>
<td>72</td>
<td>38</td>
<td>12</td>
</tr>
<tr>
<td>BOBCAT S160 skid steer loader</td>
<td>6,115</td>
<td>1,600</td>
<td>3,301</td>
<td>66</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>BOBCAT 331 mini excavator</td>
<td>7,185</td>
<td></td>
<td></td>
<td>61</td>
<td>61</td>
<td>12.6</td>
</tr>
<tr>
<td>BOBCAT 430 mini excavator</td>
<td>8,025</td>
<td></td>
<td></td>
<td>68</td>
<td>75</td>
<td>12.6</td>
</tr>
<tr>
<td>TAKEUCHI TB135</td>
<td>7,831</td>
<td></td>
<td></td>
<td>63</td>
<td>64</td>
<td>14</td>
</tr>
<tr>
<td>BROKK 150 demolition robot</td>
<td>3,595</td>
<td></td>
<td></td>
<td>31</td>
<td>33</td>
<td>8</td>
</tr>
<tr>
<td>BROKK 180 demolition robot</td>
<td>4,300</td>
<td></td>
<td></td>
<td>44</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Caterpillar 303.5D CR mini excavator</td>
<td>7,800</td>
<td></td>
<td></td>
<td>70</td>
<td>87</td>
<td>12</td>
</tr>
<tr>
<td>Caterpillar 303 CR mini excavator</td>
<td>7,835</td>
<td></td>
<td></td>
<td>61</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>Caterpillar 303.5C CR mini excavator</td>
<td>8,200</td>
<td></td>
<td></td>
<td>70</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>Caterpillar 304E CR mini excavator</td>
<td>8,500</td>
<td></td>
<td></td>
<td>77</td>
<td>76</td>
<td>13</td>
</tr>
<tr>
<td>Caterpillar 304D CR mini excavator</td>
<td>8,500</td>
<td></td>
<td></td>
<td>77</td>
<td>76</td>
<td>13</td>
</tr>
<tr>
<td>CASE CX31B</td>
<td>7,679</td>
<td></td>
<td></td>
<td>61</td>
<td>61</td>
<td>11.8</td>
</tr>
</tbody>
</table>
The heaviest loader is the Bobcat S160 which weighs 9.4 kips if you consider the tipping load.

The heaviest mini-excavator is the CAT 304E which weighs 8.5 kips.

B. ANALYSIS OF STRUCTURE UNDER DEMOLITION

The existing structure will be modeled to evaluate the impact of the equipment, and debris load over the slabs. The critical area of operation is the east portion of the slabs, where the support spacing is at its maximum and the tributary area supporting the loads is largest.

The load cases will be modeled in RISA 3D.

The load cases considered are:
Original building Design loads:
LC1 (Intact Slab): 1.2 Dead Load (100PSF) + 1.6 LL (40PSF)

LC1 will be used as a reference to verify the validity of the modeling and as a comparison benchmark.

Demolition loads:
The first seven load cases will check a 9,000 LB mini-excavator working on floors 9-17 with no debris and a 1.6 Live Load factor.
LC2 to LC6 -Three heavy Mini-Excavators on intact Slab:
1.2 Dead Load (100PSF) + 1.6 Machine Load (9 Kip loader/2 tracks)

LC7 to LC8 -Three heavy Mini-Excavators on partially demolished Slab:
1.2 Dead Load (100PSF) + 1.6 Machine Load (9 Kip loader/2 tracks)

The next eight load cases will check the Bobcat S160 working on floors 9-17 with debris and a 1.6 Live Load factor. The machine is only permitted to operate on these floors if they are shored as shown in the plans.
LC9 to LC16- Three heavy loaders on intact:
1.2 Dead Load (100PSF) + 1.6 Debris Load (60PSF) + 1.6 Machine Load (9.42 Kip loader/2 wheels)

The debris is taken as the dead load of the slab above (100PSF) adjusted by the ratio of the slab demolished (without strips remaining)/ total area:
Typical bay area: 17.75’ x 24’ = 426 Sq.Ft
Typical area of strips to remain at each bay: 4’ x (24’ + 17.75’) = 167 Sq.Ft
Total ratio of slab removal at one time: (426 – 167) / 426 = 0.607 ~ 60%
- Debris load = 100PSF x 0.6 = 60PSF
Machine Loading 3

Machine Loading 4
Machine Loading 7

Machine Loading 8
The flexural strength for the slab is as follow:

I. **Long span direction - Mx:**

Compressive strength of concrete at 28 days = 6,000 PSI

**POSITIVE BENDING – inner bay**

**Column strip:**
Minimum bottom reinforcement at column strip: (10) #4 on a 6'-3” strip ~ #4 @ 7.5"

\[
\phi M_n = 0.9 \times A_s \times f_y \times (d - a/2)
\]

\[
A_s = 0.196 \times 12/7.5 = 0.31 \text{ sq.in/ft}
\]

\[
a = 0.31 \times 60000 / (0.85 \times 6000 \times 12) = 0.31 \text{ in.}
\]

\[
\phi M_n = 0.9 \times 0.31 \times 60000 \times (8 - .75 - .25 - 0.31/2) = 114585 \# \cdot \text{in} = 114.5 \text{ K.in/ ft at slab strip}
\]

Demand load in bay: 71 K.in/ft **Check**

**Slab strip:**
Minimum bottom reinforcement at slab strip: (13) #4 on a 13'-3” strip ~ #4 @ 12"

\[
A_s = 0.196 \text{ sq.in/ft}
\]

\[
a = 0.196 \times 60000 / (0.85 \times 6000 \times 12) = 0.192 \text{ in.}
\]

\[
\phi M_n = 0.9 \times 0.196 \times 60000 \times (8 - .75 - .25 - 0.192/2) = 73072 \# \cdot \text{in} = 73 \text{ K.in/ ft at column strip}
\]

Demand load in bay LC1: 67.5 K.in/ft **Check**

**POSITIVE BENDING – outer bays**

**Column strip:**
Minimum bottom reinforcement at column strip: (6) #4 on a 4'-7½” strip ~ #4 @ 9"

\[
\phi M_n = 0.9 \times A_s \times f_y \times (d - a/2)
\]

\[
A_s = 0.196 \times 12/9 = 0.261 \text{ sq.in/ft}
\]

\[
a = 0.261 \times 60000 / (0.85 \times 6000 \times 12) = 0.26 \text{ in.}
\]

\[
\phi M_n = 0.9 \times 0.261 \times 60000 \times (8 - .75 - .25 - 0.26/2) = 96825 \# \cdot \text{in} = 96.8 \text{ K.in/ ft at slab strip}
\]

Demand load in bay: 71 K.in/ft **Check**

**Slab strip:**
Minimum bottom reinforcement at slab strip: (7) #4 on a 6'-3” strip ~ #4 @ 10"

\[
A_s = 0.196 \times 12/10 = .235 \text{ sq.in/ft}
\]

\[
a = 0.235 \times 60000 / (0.85 \times 6000 \times 12) = 0.23 \text{ in.}
\]

\[
\phi M_n = 0.9 \times 0.235 \times 60000 \times (8 - .75 - .25 - 0.23/2) = 85510 \# \cdot \text{in} = 85.5 \text{ K.in/ ft at column strip}
\]

Demand load in bay LC1: 67.5 K.in/ft **Check**
NEGATIVE BENDING – inner bay

Column strip:
Minimum top reinforcement at column: (19) #5 on a 6'-3" strip ~ #5 @ 4"

\[ A_s = 0.31 \times 12/4 = 0.93 \text{ sq.in/ft} \]

\[ a = 0.93 \times 60000 / (0.85 \times 6000 \times 12) = 0.91 \text{ in.} \]

\[ \phi M_n = 0.9 \times 0.93 \times 60000 \times (8 - .75 - 5/16 - 0.91/2) = 325551 \text{ #.in} = 325K \text{ in/ ft at column strip} \]

Demand load in most loaded bay: 261 K.in/ft 

Slab strip:
Minimum top reinforcement at column: (13) #4 on a 13'-3" strip ~ #4 @ 12"

\[ A_s = 0.196 \text{ sq.in/ft} \]

\[ a = 0.196 \times 60000 / (0.85 \times 6000 \times 12) = 0.192 \text{ in.} \]

\[ \phi M_n = 0.9 \times 0.196 \times 60000 \times (8 - .75 - .25 - 0.192/2) = 73072 \text{ #.in} = 73 K \text{ in/ ft at slab strip} \]

Demand load in most loaded bay: 72.5 K.in/ft

NEGATIVE BENDING – outer bays

Column strip:
Minimum top reinforcement at column: (7) #6 on a 4'-7½" strip ~ #6 @ 8"

\[ A_s = 0.44 \times 12/8 = 0.66 \text{ sq.in/ft} \]

\[ a = 0.66 \times 60000 / (0.85 \times 6000 \times 12) = 0.65 \text{ in.} \]

\[ \phi M_n = 0.9 \times 0.65 \times 60000 \times (8 - .75 - 3/8 - 0.65/2) = 229905 \text{ #.in} = 230K \text{ in/ ft at column strip} \]

Demand load in most loaded bay: 133.4 K.in/ft

Slab strip:
Minimum top reinforcement at column: (6) #4 on a 6'-3" strip ~ #4 @ 12"

\[ A_s = 0.196 \text{ sq.in/ft} \]

\[ a = 0.196 \times 60000 / (0.85 \times 6000 \times 12) = 0.192 \text{ in.} \]

\[ \phi M_n = 0.9 \times 0.196 \times 60000 \times (8 - .75 - .25 - 0.192/2) = 73072 \text{ #.in} = 73 K \text{ in/ ft at slab strip} \]

Demand load in most loaded bay: 73.5 K.in/ft
II. Short span direction - Mx:

Compressive strength of concrete at 28 days = 6,000 PSI

**POSITIVE BENDING**

**Column strip:**
Minimum bottom reinforcement at slab strip: (12) #4 on a 6'-3” strip ~ #4 @ 7”
As = 0.196 x 12 / 7 = .336 sq.in/ft  
a = 0.336 x 60000 / (0.85 x 6000 x 12) = 0.32 in.  
ϕMn = 0.9 x 0.336 x 60000 x (8 - .75 - .25 - 0.32/2) = 124104 #.in = 124.1 K.in/ ft at column strip

Demand load in most loaded bay: 56.8 K.in/ft  
Check

**Slab strip:**
Minimum bottom reinforcement: (13) #4 on a 17'-9” strip ~ #4 @ 15”
As = 0.196 x 12 / 15 = .157 sq.in/ft  
a = 0.157 x 60000 / (0.85 x 6000 x 12) = 0.154 in.  
ϕMn = 0.9 x 0.157 x 60000 x (8 - .75 - .25 - 0.192/2) = 58680 #.in = 58.6 K.in/ ft

Demand load in most loaded bay: 22.5 K.in/ft  
Check

**NEGATIVE BENDING**

**Column strip:**
Minimum top reinforcement at column: (10) #8 on a 6'-3” strip ~ #8 @ 8”
As = 0.79 x12/8 = 1.2 sq.in/ft  
a = 1.2 x 60000 / (0.85 x 6000 x 12) = 1.2 in.  
ϕMn = 0.9 x 1.2 x 60000 x (8 - .75 - .5 - 1.2/2) = 398,520 #.in = 398.5K.in/ ft

Demand load in most loaded bay: 199 K.in/ft  
Check

**Slab strip:**
Minimum top reinforcement at column: (15) #4 on a 16'-9” strip ~ #4 @ 14”
As = 0.196 x 12/14 = .17 sq.in/ft  
a = 0.17 x 60000 / (0.85 x 6000 x 12) = 0.17 in.  
ϕMn = 0.9 x 0.17 x 60000 x (8 - .75 - .25 - 0.17/2) = 65,775 #.in = 65.5 K.in/ ft at slab strip

Demand load in most loaded bay: 1.1 K.in/ft  
Check

The analysis for LC1 (original building loads, 100 PSF DL + 40PSF LL) shows that the modeling done is accurate enough to obtain capacities that are fairly close the member strengths and can be used for comparison with demolition loads.
**Conclusion:** The mini-ex is 1% over capacity for the inner bay positive slab bendering in Load Case 3. However, since the calcs are conservative in assuming the load is applied as a point load and not a uniform load over the length of the track, this is acceptable. Therefore, the mini-ex is permitted to operate on floors 9- roof assuming there is no debris with no shoring required. For the skid-steer loaders the slab must be shored in order to operate on the slab with or without debris.

<table>
<thead>
<tr>
<th>Load Case</th>
<th>Long span (Mx) – K.in/ft</th>
<th>Short span (My) – K.in/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mx+c columns strip</td>
<td>Mx+s slab strip</td>
</tr>
<tr>
<td>40 PSF LL</td>
<td>Outer Bay</td>
<td>Inner Bay</td>
</tr>
<tr>
<td>LC1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>LC2</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC3</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC4</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC5</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC6</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC7</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC8</td>
<td>Mini 3</td>
<td>NO</td>
</tr>
<tr>
<td>LC9</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC10</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC11</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC12</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC13</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC14</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC15</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
<tr>
<td>LC16</td>
<td>Heavy 3</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Slab capacity**

96.8 | 114.5 | 85.5 | 73.0 | 230.0 | 325.0 | 73.0 | 73.0 | 124 | 58.6 | 398.5 | 65.5

**Notes:**
- The mini-ex with debris and no shoring is not recommended for use in the inner bay.
- The mini-ex with no debris and no shoring is recommended for use in the inner bay.
- The shored floor with loader and debris is not recommended for use in the inner bay.
- The lower floor with no EQ and no debris, posts only is not recommended for use in the inner bay.
- The slab capacity is based on the assumption that there is no debris with no shoring required.
Timber Post Allowable Loads - 4x4

Use 4"x4" Actual Dimension = 3.5" x 3.5"

d = 3.5 in
A = 12.25 in²
F_c = 1350 psi
C_D = 2.0 (Impact = 2.0, Cons = 1.25)
C_M = 0.9 wet service condition
C_t = 1.0 ordinary range of temperature
C_F = 1.0 (12/d)¹/⁹

F* = F C_D C_M C_t C_F

K_E = 0.8
E' = 580,000 psi
E' = 1,600,000 psi

c = 0.8
A = (1 + (F_E/F*) ) / 2c
B = (F_E/F*) / c
C_P = A - sqrt( A² - B )
F* = F*C_P

<table>
<thead>
<tr>
<th>Clear Ht.(ft)</th>
<th>F_E (psi)</th>
<th>F* (psi)</th>
<th>A</th>
<th>B</th>
<th>C_P</th>
<th>F'_c (psi)</th>
<th>P_ALL (k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00</td>
<td>617</td>
<td>2430</td>
<td>0.8</td>
<td>0.3</td>
<td>0.24</td>
<td>580</td>
<td>7.1</td>
</tr>
<tr>
<td>8.50</td>
<td>546</td>
<td>2430</td>
<td>0.8</td>
<td>0.3</td>
<td>0.21</td>
<td>518</td>
<td>6.3</td>
</tr>
<tr>
<td>8.71</td>
<td>520</td>
<td>2430</td>
<td>0.8</td>
<td>0.3</td>
<td>0.20</td>
<td>495</td>
<td>6.1</td>
</tr>
<tr>
<td>9.00</td>
<td>487</td>
<td>2430</td>
<td>0.8</td>
<td>0.3</td>
<td>0.19</td>
<td>465</td>
<td>5.7</td>
</tr>
<tr>
<td>9.50</td>
<td>437</td>
<td>2430</td>
<td>0.7</td>
<td>0.2</td>
<td>0.17</td>
<td>420</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Applied Load: 5.3 kips
Post Length: 8.71 feet
The shear strength for the slab is as follow:

Face of column strip shear: \( \phi V_c = 2 \lambda \sqrt{f_c'} \times l \times d = 0.85 \times 2 \times 1.0 \times (4000)^{1/2} \times (15 \times 12) \times 8 = 155 \text{ kips} \)
Punching shear: \( \phi V_p = 4 \lambda \sqrt{f_c'} \times b_o \times d = 0.85 \times 4 \times 1.0 \times (4000)^{1/2} \times (4 \times 20) \times 8 = 138 \text{ kips} \)

Contributory area for face of column shear: \( 24' \times 8.83' / 2 = 106 \text{ Sq.ft} \)

Critical demand loads for loader operation and 60PSF debris, assuming the machine wheel is at the edge of the column with up one machine each bay:

\[ V_{uc} = (1.2 \times 100PSF + 1.6 \times 60PSF) \times 106 \text{ Sq.ft} + 1.6 \times 9,416 \text{ Lbs} = 38.0 \text{ kips} \]
\[ < \phi V_c = 155 \text{ kips} \quad \text{OK} \]

\[ V_{up} = 1.6 \times 9,416 \text{ Lbs} / 2 = 7.5 \text{ kips} \]
\[ < \phi V_p = 138 \text{ kips} \quad \text{OK} \]
III. ANALYSIS OF LOWER FLOORS (1-8).

Floor Construction (floors 1 through 8) Concrete slab on 20 Ga Metal Deck

<table>
<thead>
<tr>
<th>Floor</th>
<th>Conc. Depth ((t_c)) in.</th>
<th>Concrete Weight</th>
<th>Deck Depth ((t_d)) in.</th>
<th>Conc. Strength ((f'_c)) psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>5”</td>
<td>N.W.</td>
<td>3”</td>
<td>4,000</td>
</tr>
<tr>
<td>2nd</td>
<td>4.5”</td>
<td>N.W.</td>
<td>3”</td>
<td>5,000</td>
</tr>
<tr>
<td>3rd-6th</td>
<td>3 ¾”</td>
<td>L.W.</td>
<td>3”</td>
<td>3,000</td>
</tr>
<tr>
<td>7th</td>
<td>5”</td>
<td>N.W.</td>
<td>3”</td>
<td>4,000</td>
</tr>
<tr>
<td>8th</td>
<td>7”</td>
<td>N.W.</td>
<td>3”</td>
<td>4,000</td>
</tr>
</tbody>
</table>

A. DEMOLITION EQUIPMENT (same as above on page 6)

The Bobcat S160 skidsteer load will be used once again as the governing machine.

6,115# (base weight) + 3,200# (tipping load) = 9,315# (on 1 axle when tipping) /2wheels = 4,658#/wheel

Since some of these slabs and beams will remain, we will utilize the following load cases:
1.2 DL + 1.6 Demolition Live load +1.6 Debris load for the machine load checks

B. ANALYSIS OF SLABS

For flexure place axle at center of slab span.

For shear, place axle at distance “d” from support
1st Floor Slab

**Deck Construction**
- Deck depth \( t_d \): 8 in.
- Deck gage
- Deck Strength \( F_y \)
- Deck area \( A_d \)
- Conc Depth \( t_c \)
- Total Depth \( h \)
- Conc Strength \( f'c \)
- Conc. Area \( A_d \)
- Reinforcement
- Reinf. Area \( A_r \)
- Reinf. Cover
- Reinf. Strength
- Conc Weight
- Conc. DL
- Debris Load

**Positive Bending**
- \( \Phi \)
- \( a = 0.60 \) in
- \( d = 6.5 \) in
- \( \Phi M_n = 129 \) kip-in

**Shear Capacity**
- \( \Phi V_n = \Phi V_d + \Phi V_c \leq 4 \sqrt{f'c A_c} \)
- \( \Phi V_c = \Phi 2 \lambda \sqrt{f'c A_c} \)
- \( b_e = b_m + (1 - \frac{X}{L})X \leq 8.9 \left( \frac{t_c}{h} \right) \)
- \( V_u = 1.2 V_{DL} + 1.6 V_{Debris} + 1.6 V_{EQ} \)
- \( V_{DL} = \frac{W_{DL} \times L}{2} \)
- \( V_{Debris} = \frac{W_{Debris} \times L}{2} \)
- \( V_{EQ} = \frac{W_{EQ} \times L}{2} \times \text{Spread} \)

**Bending Capacity**
- \( a = \frac{A_s F_y}{0.85 f'c b} \)
- \( \Phi M_n = \Phi A_s F_y \left( d - \frac{a}{2} \right) \)
- \( b_m = b_2 \text{ (wheel width)} + 2 \times t_c \)
- \( M_{DL} = \frac{W_{DL} \times L^2}{8} \)
- \( M_{Debris} = \frac{W_{Debris} \times L^2}{8} \)
- \( M_u = 1.2 M_{DL} + 1.6 M_{Debris} + 1.6 M_{EQ} \)
## 2nd Floor Slab

### Deck Construction
- **Deck depth** ($t_d$): in.
- **Deck gage**:
- **Deck Strength** ($F_y$): ksi
- **Deck area** ($A_d$): in$^2$
- **Conc Depth** ($t_c$): in.
- **Total Depth** ($h$): 7.5 in.
- **Conc Strength** ($f'_c$): psi
- **Conc. Area** ($A_c$): in$^2$
- **Reinforcement**:
- **Reinf. Area** ($A_r$): in$^2$
- **Reinf. Cover**:
- **Reinf. Strength**:
- **Conc Weight**:
- **Conc. DL**:
- **Debris Load**:

### Shear Capacity
- **$\Phi$**:
- **$\lambda$**:
- **$\Phi V_d$**:
- **$\Phi V_c$**:
- **$\Phi V_d + \Phi V_c$**:
- **$4A_c f'_c$**:
- **$\Phi V_n$**:
- **Machine Loc. (x)**: 0.63 ft
- **be(calc)**: 2.17 ft
- **be check**:
- **$V_u$**:

### Positive Bending
- **$\Phi$**:
- **$a$**: 0.48 in
- **$d$**: 6 in
- **$\Phi M_n$**: 119.5 kip-in
- **Wheel Width**:
- **bm**: 1.58 ft
- **Span (L)**:
- **Machine loc. (X)**: 4.6 ft
- **be (calc)**: 6.17 ft
- **be_max**: 5.34 ft
- **bem**: 5.34 ft
- **Machine Width**:
- **Spread (flexure)**: 10.8 ft
- **Machine Weight**:
- **$Mu$**: 72.1 kip-in

### Check
- **OK**

- **$b_m = b_2(\text{wheel width}) + 2 \times t_c$**
- **$a = \frac{A_s F_y}{.85 f'_c b}$**
- **$\Phi M_n = \Phi A_s F_y \left( d - \frac{a}{2} \right)$**

### Displacement Factors
- **$\Phi V_n = \Phi V_d + \Phi V_c \leq 4 \sqrt{f'_c A_c}$**
- **$\Phi V_c = \Phi 2 \lambda \sqrt{f'_c A_c}$**
- **$b_e = b_m + \left( 1 - \frac{X}{L} \right) X \leq 8.9 \left( \frac{t_c}{h} \right)$**
- **$V_u = 1.2 V_{DL} + 1.6 V_{Debris} + 1.6 V_{EQ}$**
- **$V_{DL} = \frac{W_{DL} \times L}{2}$**
- **$V_{Debris} = \frac{W_{Debris} \times L}{2}$**
- **$V_{EQ} = \frac{W_{EQ} L}{2} \times \frac{L}{\text{Spread}}$**
- **$b_e = b_m + 2 \left( 1 - \frac{X}{L} \right) X \leq 8.9 \left( \frac{t_c}{h} \right)$**
- **$M_{DL} = \frac{W_{DL} \times L^2}{8}$**
- **$M_{Debris} = \frac{W_{Debris} \times L^2}{8}$**
- **$M_{EQ} = \frac{W_{EQ} \times L}{4} / \text{Spread}$**
- **$M_u = 1.2 M_{DL} + 1.6 M_{Debris} + 1.6 M_{EQ}$**
3rd Floor through 6th Floor Slabs

### Deck Construction
- Deck depth ($t_d$) [in.]
- Deck gage [ksi]
- Deck Strength ($F_y$) [ksi]
- Deck area ($A_s$) [in²]
- Conc Depth ($t_c$) [in.]
- Total Depth ($h$) [in.]
- Conc Strength ($f'_c$) [ksi]
- Conc. Area ($A_c$) [in²]
- Reinforcement [ksi]
- Reinf. Area ($A_r$) [in²]
- Reinf. Cover [ksi]
- Reinf. Strength [ksi]
- Conc Weight [pcf]
- Conc. DL [lbs in²]

### Positive Bending
- $\Phi$ [ksi]
- $\Phi M_n$ [kip-in]
- Wheel Width [in.]
- $b_m$ [ft]
- Span (L) [ft]
- Machine loc. (X) [ft]
- $b_e$ (calc) [ft]
- $b_{e\text{ max}}$ [ft]
- $b_m$ [ft]
- Machine Width [ft]
- Spread (flexure) [ft]
- Machine Weight [lbs]
- $\mu$ [kip-in]

### Shear Capacity
- $\phi V_d$ [lbs]
- $\phi V_c$ [lbs]
- $\phi V_d + \phi V_c$ [lbs]
- $4A_c f'_c$ [lbs]
- $\phi V_n$ [lbs]
- $\phi V_u$ [lbs]

### Positive Bending Check
- $b_e = b_m + \left(1 - \frac{X}{L}\right)X \leq 8.9\left(\frac{t_c}{h}\right)$

### Positive Bending Moment
- $M_{DL} = \frac{W_{DL} \times L^2}{8}$
- $M_{Debris} = \frac{W_{Debris} \times L^2}{8}$
- $M_{EQ} = \frac{W_{EQ} \times L}{4} / \text{Spread}$

### Bending Moment
- $M_u = 1.2M_{DL} + 1.6M_{Debris} + 1.6M_{EQ}$
5th Floor Alternate Slab

**Deck Construction**

- Deck depth ($t_d$) in.
- Deck gage
- Deck Strength ($F_y$) ksi
- Deck area ($A_d$) in²
- Conc Depth ($t_c$) in.
- Total Depth ($h$) in.
- Conc Strength ($f'_c$) psi
- Conc. Area ($A_c$) in²
- Reinforcement
- Reinf. Area ($A_r$) in²
- Reinf. Cover
- Reinf. Strength
- Conc Weight
- Conc. DL

**Shear Capacity**

- $\Phi$
- $\lambda$
- $\Phi V_d$
- $\Phi V_c$
- $\Phi V_d + \Phi V_c$
- $4A_c f'_c$
- $\Phi V_n$

**Positive Bending**

- $\Phi M_n$ kip-in

**Shear Capacity**

\[
\Phi V_n = \Phi V_d + \Phi V_c \leq 4 \sqrt{f'_c A_c}
\]

\[
\Phi V_c = \Phi 2\lambda \sqrt{f'_c A_c}
\]

\[
b_e = b_m + (1 - \frac{X}{L})X \leq 8.9 \left(\frac{t_c}{h}\right)
\]

\[
V_u = 1.2 V_{DL} + 1.6 V_{Debris} + 1.6 V_{EQ}
\]

\[
V_{DL} = \frac{W_{DL} \times L}{2}, V_{Debris} = \frac{W_{Debris} \times L}{2}, V_{EQ} = \frac{W_{EQ} \times L}{2} \times L/\text{Spread}
\]

\[
b_e = b_m + 2 \left(1 - \frac{X}{L}\right)X \leq 8.9 \left(\frac{t_c}{h}\right)
\]

\[
M_{DL} = \frac{W_{DL} \times L^2}{8}, M_{Debris} = \frac{W_{Debris} \times L^2}{8}, M_{EQ} = \frac{W_{EQ} \times L}{4} / \text{Spread}
\]

\[
M_u = 1.2 M_{DL} + 1.6 M_{Debris} + 1.6 M_{EQ}
\]

- Wheel Width
- bm ft
- Span (L) ft
- Machine loc. (X) ft
- be (calc) ft
- be_max ft
- bem ft
- Machine Width ft
- Spread (flexure) ft
- Machine Weight lbs
- Mu
- Check OK

\[
a = \frac{A_s F_y}{0.85 f'_c b}
\]

\[
\Phi M_n = \Phi A_s F_y \left( d - \frac{a}{2} \right)
\]

\[
b_m = b_2 (\text{wheel width}) + 2 \times t_c
\]
# 6th Floor Alternate Slab

## Deck Construction
- **Deck depth** ($t_d$): 78.54167 in.
- **Deck gage**
- **Deck Strength** ($F_y$): __ksi__
- **Deck area** ($A_d$): __in$^2__
- **Conc Depth** ($t_c$): __in__
- **Total Depth** ($h$): 8 in.
- **Conc Strength** ($f_c'$): 4000 psi
- **Conc. Area** ($A_t$): __in$^2__
- **Reinforcement**
- **Reinf. Area** ($A_s$): __in$^2__
- **Reinf. Cover**
- **Reinf. Strength**
- **Conc Weight**
- **Conc. DL**: 78.54167

## Positive Bending

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$\Phi M_n$</strong></td>
<td>127</td>
</tr>
<tr>
<td><strong>Wheel Width</strong></td>
<td></td>
</tr>
<tr>
<td>$b_m$</td>
<td>1.67</td>
</tr>
<tr>
<td><strong>Span (L)</strong></td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Machine loc. (X)</strong></td>
<td>7.33</td>
</tr>
<tr>
<td><strong>be (calc)</strong></td>
<td>5.56</td>
</tr>
<tr>
<td><strong>be_max</strong></td>
<td>5.56</td>
</tr>
<tr>
<td><strong>Machine Width</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Spread (flexure)</strong></td>
<td>10.1</td>
</tr>
</tbody>
</table>

## Shear Capacity
- **$\Phi$**
- **$\lambda$**
- **$\Phi V_d$**
- **$\Phi V_c$**
- **$\Phi V_d + \Phi V_c$**
- **$4*A_c * f_c'$**
- **$\Phi V_n$**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machine Loc. (x)</strong></td>
<td>0.67 ft</td>
</tr>
<tr>
<td><strong>be(calc)</strong></td>
<td>2.29 ft</td>
</tr>
<tr>
<td><strong>be check</strong></td>
<td>2.29 ft</td>
</tr>
<tr>
<td><strong>Check</strong></td>
<td>OK</td>
</tr>
</tbody>
</table>

## Check
- $\Phi V_n = \Phi V_d + \Phi V_c \leq 4 \sqrt{f_c'} A_c$
- $\Phi V_c = \Phi 2\lambda \sqrt{f_c'} A_c$
- $b_e = b_m + (1 - \frac{X}{L})X \leq 8.9 \left(\frac{t_c}{h}\right)$
- $V_u = 1.2 V_{DL} + 1.6 V_{Debris} + 1.6 V_{EQ}$

## Shear (flexure)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$b_m = b_z \text{(wheel width)} + 2 \times t_c$</strong></td>
<td></td>
</tr>
<tr>
<td><strong>$M_{DL} = \frac{W_{DL} \times L^2}{8}$</strong></td>
<td></td>
</tr>
<tr>
<td><strong>$M_{Debris} = \frac{W_{Debris} \times L^2}{8}$</strong></td>
<td></td>
</tr>
<tr>
<td><strong>$M_{EQ} = \frac{W_{EQ} X L}{4}$</strong></td>
<td></td>
</tr>
</tbody>
</table>

## Check
- $M_u = 1.2 M_{DL} + 1.6 M_{Debris} + 1.6 M_{EQ}$
7th Floor Slab

<table>
<thead>
<tr>
<th><strong>Deck Construction</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck depth ($t_d$)</td>
<td>in.</td>
</tr>
<tr>
<td>Deck gage</td>
<td></td>
</tr>
<tr>
<td>Deck Strength ($F_y$)</td>
<td>ksi</td>
</tr>
<tr>
<td>Deck area ($A_d$)</td>
<td>in²</td>
</tr>
<tr>
<td>Conc Depth ($t_c$)</td>
<td>in.</td>
</tr>
<tr>
<td>Total Depth ($h$)</td>
<td>8 in.</td>
</tr>
<tr>
<td>Conc Strength ($f'_c$)</td>
<td>psi</td>
</tr>
<tr>
<td>Conc. Area ($A_c$)</td>
<td>in²</td>
</tr>
<tr>
<td>Reinforcement</td>
<td></td>
</tr>
<tr>
<td>Reinf. Area ($A_s$)</td>
<td>in²</td>
</tr>
<tr>
<td>Reinf. Cover</td>
<td></td>
</tr>
<tr>
<td>Reinf. Strength</td>
<td></td>
</tr>
<tr>
<td>Conc Weight</td>
<td></td>
</tr>
<tr>
<td>Conc. DL</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Positive Bending</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Phi$</td>
<td></td>
</tr>
<tr>
<td>$a$</td>
<td>0.598 in</td>
</tr>
<tr>
<td>$d$</td>
<td>6.5 in</td>
</tr>
<tr>
<td>$\Phi Mn$</td>
<td>128.6 kip-in</td>
</tr>
<tr>
<td>Wheel Width</td>
<td></td>
</tr>
<tr>
<td>bm</td>
<td>1.67 in</td>
</tr>
<tr>
<td>Span (L)</td>
<td></td>
</tr>
<tr>
<td>Machine loc. (X)</td>
<td>6.3 ft</td>
</tr>
<tr>
<td>be (calc)</td>
<td>7.92 ft</td>
</tr>
<tr>
<td>be_max</td>
<td>5.56 ft</td>
</tr>
<tr>
<td>bem</td>
<td>5.56 ft</td>
</tr>
<tr>
<td>Machine Width</td>
<td></td>
</tr>
<tr>
<td>Spread (flexure)</td>
<td>10.13 ft</td>
</tr>
<tr>
<td>Machine Weight</td>
<td></td>
</tr>
<tr>
<td>$\mu$</td>
<td>114.8 kip-in</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Shear Capacity</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Phi$</td>
<td></td>
</tr>
<tr>
<td>$\lambda$</td>
<td></td>
</tr>
<tr>
<td>$\Phi V_d$</td>
<td></td>
</tr>
<tr>
<td>$\Phi V_c$</td>
<td></td>
</tr>
<tr>
<td>$\Phi V_d + \Phi V_c$</td>
<td></td>
</tr>
<tr>
<td>$4A_c$*$f'_c$</td>
<td></td>
</tr>
<tr>
<td>$\Phi V_n$</td>
<td></td>
</tr>
<tr>
<td>Machine Loc. (x)</td>
<td>0.67 ft</td>
</tr>
<tr>
<td>be (calc)</td>
<td>2.30 ft</td>
</tr>
<tr>
<td>be check</td>
<td>2.30 ft</td>
</tr>
<tr>
<td>$V_u$</td>
<td>4833 lbs</td>
</tr>
</tbody>
</table>

Check OK

$\Phi V_n = \Phi V_d + \Phi V_c \leq 4\sqrt{f'_c}A_c$

$\Phi V_c = \Phi 2\lambda \sqrt{f'_c}A_c$

$be = b_m + (1 - \frac{X}{L})X \leq 8.9\left(\frac{t_c}{h}\right)$

$V_u = 1.2V_{DL} + 1.6V_{Debris} + 1.6V_{EQ}$

$V_{DL} = \frac{W_{DL} \times L}{2}$

$V_{Debris} = \frac{W_{Debris} \times L}{2}$

$V_{EQ} = \frac{W_{EQ} \times L}{2} \times L/\text{Spread}$

$\Phi M_n = \Phi A_s F_y \left(d - \frac{a}{2}\right)$

$M_{DL} = \frac{W_{DL} \times L^2}{8}$

$M_{Debris} = \frac{W_{Debris} \times L^2}{8}$

$M_{EQ} = \frac{W_{EQ} \times L}{4} / \text{Spread}$

$\mu = b_m = 2(\text{wheel width}) + 2 \times t_c$

$M_{IT} = 1.2M_{DL} + 1.6M_{Debris} + 1.6M_{EQ}$

$b_m = b_2(\text{wheel width}) + 2 \times t_c$
### Deck Construction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck depth (t_d)</td>
<td>8.5 in</td>
</tr>
<tr>
<td>Deck gage</td>
<td></td>
</tr>
<tr>
<td>Deck Strength (F_y)</td>
<td>ksi</td>
</tr>
<tr>
<td>Deck area (A_d)</td>
<td>in²</td>
</tr>
<tr>
<td>Conc Depth (t_c)</td>
<td>in</td>
</tr>
<tr>
<td>Total Depth (h)</td>
<td>10 in</td>
</tr>
<tr>
<td>Conc Strength (f'_c)</td>
<td>psi</td>
</tr>
<tr>
<td>Conc. Area (A_c)</td>
<td>in²</td>
</tr>
<tr>
<td>Reinforcement</td>
<td></td>
</tr>
<tr>
<td>Reinf. Area (A_r)</td>
<td>in²</td>
</tr>
<tr>
<td>Reinf. Cover</td>
<td></td>
</tr>
<tr>
<td>Reinf. Strength</td>
<td>ksi</td>
</tr>
<tr>
<td>Conc Weight</td>
<td>pcf</td>
</tr>
<tr>
<td>Conc. DL</td>
<td>102.7</td>
</tr>
</tbody>
</table>

### Positive Bending

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel Width</td>
<td>in</td>
</tr>
<tr>
<td>bm</td>
<td>2 ft</td>
</tr>
<tr>
<td>Span (L)</td>
<td>ft</td>
</tr>
<tr>
<td>Machine loc. (X)</td>
<td>7.0 ft</td>
</tr>
<tr>
<td>be (calc)</td>
<td>9.0415 ft</td>
</tr>
<tr>
<td>be_max</td>
<td>6.23 ft</td>
</tr>
<tr>
<td>bem</td>
<td>6.23 ft</td>
</tr>
<tr>
<td>Machine Width</td>
<td>ft</td>
</tr>
<tr>
<td>Spread (flexure)</td>
<td>ft</td>
</tr>
<tr>
<td>Machine Weight</td>
<td>lbs</td>
</tr>
<tr>
<td>Mu</td>
<td>142.6 kip-in</td>
</tr>
</tbody>
</table>

### Shear Capacity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Phi )</td>
<td></td>
</tr>
<tr>
<td>( \lambda )</td>
<td></td>
</tr>
<tr>
<td>( \Phi V_d )</td>
<td>11389 lbs</td>
</tr>
<tr>
<td>( \Phi V_c )</td>
<td>7969 lbs</td>
</tr>
<tr>
<td>( \Phi V_d + \Phi V_c )</td>
<td>11389 lbs</td>
</tr>
<tr>
<td>( 4A_c f'_c )</td>
<td>21251 lbs</td>
</tr>
<tr>
<td>( \Phi V_n )</td>
<td>11389 lbs</td>
</tr>
<tr>
<td>Machine Loc. (x)</td>
<td>0.83 ft</td>
</tr>
<tr>
<td>be(calc)</td>
<td>2.78 ft</td>
</tr>
<tr>
<td>be check</td>
<td>2.78 ft</td>
</tr>
<tr>
<td>( V_u )</td>
<td>4671 lbs</td>
</tr>
</tbody>
</table>

Check: OK

\[
\Phi V_n = \Phi V_d + \Phi V_c \leq 4 \sqrt{f'_c A_c}
\]

\[
\Phi V_c = 2 \lambda \sqrt{f'_c A_c}
\]

\[
b_e = b_m + (1 - \frac{X}{L})X \leq 8.9 \frac{t_c}{h}
\]

\[
V_u = 1.2V_{DL} + 1.6V_{Debris} + 1.6V_{EQ}
\]

\[
V_{DL} = \frac{W_{DL} \times L}{2} \quad V_{Debris} = \frac{W_{Debris} \times L}{2}
\]

\[
V_{EQ} = \frac{W_{EQ} \times L}{2} \times L / \text{Spread}
\]

\[
b_m = b_2 \text{ (wheel width) } + 2 \times t_c
\]

\[
M_u = 1.2M_{DL} + 1.6M_{Debris} + 1.6M_{EQ}
\]

\[
a = \frac{A_d F_y}{0.85 f'_c b}
\]

\[
M_{DL} = \frac{W_{DL} \times L^2}{8}
\]

\[
\Phi M_n = \Phi A_d F_y \left( d - \frac{a}{2} \right)
\]

\[
M_{Debris} = \frac{W_{Debris} \times L^2}{8}
\]

\[
M_{EQ} = \frac{W_{EQ} \times L}{4} / \text{Spread}
\]
3" LOK-FLOOR

**3" x 12" deck**  \( F_c = 40 \text{ ksi} \)  \( f' = 3 \text{ ksl} \)  145 pcf concrete

Studs are not required for composite slab action. Studs on the cross-section indicate that it is possible to install studs at the beams.

### DECK PROPERTIES

<table>
<thead>
<tr>
<th>Gage</th>
<th>( t )</th>
<th>( w )</th>
<th>( A_t )</th>
<th>( A_w )</th>
<th>( S_t )</th>
<th>( S_w )</th>
<th>( #_{RM} )</th>
<th>( #_{RN} )</th>
<th>( #_{V} )</th>
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### COMPOSITE PROPERTIES

**Max Undeformed Spacing:**

- 50 ksi material is also available.
- See website for load tables.

---

**Note:** 50 ksi material is also available. See website for load tables.

---

3" LOK-FLOOR - NW
### DECK PROPERTIES

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### COMPOSITE PROPERTIES

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**Note:**
50 ksi material is also available. See website for load tables.
C. ANALYSIS OF FIRST FLOOR FRAMING

The framing will be analyzed for the load of the heaviest equipment allowed inside the building (Bobcat S160 Skid Steer Loader on 2 wheels at tipping – 9,315 lbs/2 wheels = 4658 lbs)

The Framing will be analyzed at multiple locations on each floor. See floor plans for which beams were analyzed. The following load cases were used:

1: Flexure Load Case 1

2: Flexure Load Case 2

3: Shear Load Case 3
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Studs

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| a | 1.0 | 2.0 | 0.7 | 3.8 | 1.2 | 0.7 | 1.4 | 2.2 | 2.2 | 2.2 | 2.3 | 2.5 | 2.4 | 2.5 | 2.5 | 2.5 | 2.7 | 1.8 |
| P_c | 116.1 | -5.5 | 45.4 | 248.6 | -2.6 | 13.2 | 89.0 | 1.9 | 2.2 | 2.3 | 2.6 | 2.3 | 2.5 | 2.4 | 2.5 | 1.5 | 2.7 | 1.8 |
| A_c | 3.22 | -0.15 | 1.26 | 6.91 | -0.07 | 0.37 | 2.47 | -0.10 | -0.07 | -0.10 | -0.13 | -0.01 | -0.001 | -0.01 | -0.01 | -0.01 | -0.01 | 1.66 |
| t_i | 0.46 | -0.02 | 0.25 | 0.58 | -0.01 | 0.09 | 0.27 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | 0.20 |
| StMB | 777 | 647 | 217 | 2898 | 498 | 203 | 1143 | 1465 | 230 | 806 | 186 | 293 | 186 | 982 | 193 | 226 | 881 |
| StMB | 699 | 583 | 195 | 2608 | 448 | 183 | 1028 | 1318 | 207 | 726 | 167 | 264 | 167 | 884 | 174 | 203 | 793 |
| m (k-ft) | 288 | 209 | 105 | 336 | 222 | 96 | 295 | 679 | 141 | 263 | 93 | 133 | 85 | 247 | 89 | 96 | 365 |
| % Used | 0.41 | 0.36 | 0.54 | 0.13 | 0.50 | 0.53 | 0.29 | 0.52 | 0.68 | 0.36 | 0.55 | 0.51 | 0.51 | 0.28 | 0.51 | 0.47 | 0.46 |
| Check | OK | OK | OK | DK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |

**C = min(A_wF_y + 2A_sF_y or 0.85f'cA_c or a∑Q_a)**

\[ A_c = \frac{P_c}{F_y} \]

\[ b_e = \min \left( \frac{t}{\sqrt{2}} \right) \text{ or Trib Width} \]

\[ a = \frac{C}{0.85f'c} \quad P_y = A_f F_y \quad P_c = \frac{P_y - C}{2} \]

\[ t_i = \frac{A_c}{b_e} \]
### Beam Check

**Machine Weight:** 5752 lbs  
**Tipping Load:** 3200 lbs  
**Total Weight:** 8592 lbs  
**Wheel 1 (P1):** 4476 lbs  
**Wheel 2 (P2):** 4476 lbs

### Bobcat S160

**Wheel or Outrigger Dimensions:**
- **Fy:** 36 ksi
- **Deb. load:** 25 psf

### Flexure Check

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<tr>
<td>Deck d (in)</td>
<td>3.0</td>
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<tr>
<td>Conc W</td>
<td>NW</td>
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<td>wsl (psf)</td>
<td>79</td>
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<td>46</td>
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<td>46</td>
<td>62</td>
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<tr>
<td>M db (k-ft)</td>
<td>33</td>
<td>22</td>
<td>10</td>
<td>33</td>
<td>24</td>
<td>9</td>
<td>34</td>
<td>99</td>
<td>18</td>
<td>35</td>
<td>10</td>
<td>14</td>
<td>8</td>
<td>33</td>
<td>10</td>
<td>10</td>
<td>50</td>
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<tr>
<td>M dl (k-ft)</td>
<td>111</td>
<td>74</td>
<td>33</td>
<td>133</td>
<td>78</td>
<td>27</td>
<td>109</td>
<td>310</td>
<td>35</td>
<td>74</td>
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<td>16</td>
<td>71</td>
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<td>Meq (k-ft)</td>
<td>64</td>
<td>52</td>
<td>30</td>
<td>77</td>
<td>57</td>
<td>31</td>
<td>69</td>
<td>93</td>
<td>44</td>
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<td>32</td>
<td>68</td>
<td>30</td>
<td>35</td>
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<tr>
<td>Mu (k-ft)</td>
<td>288</td>
<td>209</td>
<td>105</td>
<td>336</td>
<td>222</td>
<td>96</td>
<td>295</td>
<td>679</td>
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<td>93</td>
<td>133</td>
<td>85</td>
<td>247</td>
<td>89</td>
<td>96</td>
<td>365</td>
</tr>
<tr>
<td>$\Phi M N (k-ft)$</td>
<td>362</td>
<td>235</td>
<td>90</td>
<td>1569</td>
<td>180</td>
<td>67</td>
<td>540</td>
<td>659</td>
<td>90</td>
<td>362</td>
<td>67</td>
<td>119</td>
<td>67</td>
<td>478</td>
<td>67</td>
<td>90</td>
<td>389</td>
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<tr>
<td>% used</td>
<td>0.80</td>
<td>0.89</td>
<td>1.17</td>
<td>0.21</td>
<td>1.24</td>
<td>0.55</td>
<td>1.03</td>
<td>1.57</td>
<td>0.73</td>
<td>1.39</td>
<td>1.12</td>
<td>1.27</td>
<td>0.52</td>
<td>1.33</td>
<td>1.07</td>
<td>0.94</td>
<td></td>
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</tbody>
</table>

Since some beams have failed, see next page for a flexure strength check using the composite beam incorporating the shear studs.

### Shear Check

| d (in) | 23.6 | 13.9 | 13.7 | 35.9 | 17.9 | 12.2 | 23.9 | 26.7 | 13.7 | 23.8 | 15.7 | 12.2 | 23.7 | 17.2 | 23.8 | 17.2 | 23.8 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| tw (in) | 0.395 | 0.37 | 0.23 | 0.625 | 0.3 | 0.235 | 0.44 | 0.46 | 0.23 | 0.365 | 0.235 | 0.25 | 0.365 | 0.235 | 0.25 | 0.365 | 0.235 |
| Aw (in2) | 9.3 | 5.1 | 3.2 | 22.4 | 5.3 | 2.9 | 10.5 | 12.3 | 3.2 | 9.3 | 2.9 | 3.9 | 2.9 | 9.8 | 2.9 | 3.2 |
| Vdeb (k) | 4.0 | 3.2 | 2.3 | 3.4 | 3.1 | 1.9 | 3.8 | 8.6 | 3.0 | 3.8 | 2.1 | 2.1 | 1.8 | 3.8 | 2.3 | 2.1 |
| Veg (k) | 8.3 | 8.2 | 7.8 | 8.4 | 8.3 | 7.9 | 8.4 | 8.5 | 8.1 | 8.4 | 7.9 | 8.2 | 7.9 | 8.4 | 7.8 | 7.9 |
| Vdl (k) | 12.6 | 9.9 | 7.1 | 10.7 | 9.9 | 5.6 | 11.1 | 25.0 | 5.5 | 6.8 | 3.8 | 3.2 | 6.9 | 4.1 | 3.8 |
| Vu (k) | 34.8 | 30.1 | 24.7 | 31.8 | 30.1 | 22.3 | 32.8 | 57.4 | 24.5 | 27.6 | 20.5 | 20.9 | 19.4 | 27.7 | 21.1 | 20.6 |
| $\Phi V N (k)$ | 181.2 | 100.0 | 61.3 | 436.2 | 103.2 | 55.7 | 204.4 | 238.8 | 61.3 | 181.2 | 55.7 | 55.7 | 191.2 | 55.7 | 61.3 |
| % used | 0.19 | 0.30 | 0.40 | 0.07 | 0.29 | 0.40 | 0.16 | 0.24 | 0.40 | 0.15 | 0.37 | 0.27 | 0.35 | 0.14 | 0.38 | 0.34 |

| Check | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

\[ \Phi M_n = 0.95 f_y A_\ell \]

\[ M_{DL} = w_{DL} \times \text{Trib Width} \times L^2 / 8 \]

\[ M_{DB} = w_{DB} \times \text{Trib Width} \times L^2 / 8 \]

\[ M = 1.2 M_{DL} + 1.6 M_{DB} + 1.6 M_{EQ} \]

Check Composite Beam Strength with Shear Studs
D. CONCLUSION

The slab and framing on floors 1-8 can safely support the Bobcat S160 and other listed equipment.
MACHINE SHORING CONDITIONS REQUIREMENT DIAGRAM

MACHINE SHORING NOTES:
1. SHORING AS SHOWN IS REQUIRED FOR SKID-STEER LOADER USE.
2. SHORING TO BE PROVIDED TO SUPPORT THE SLAB THAT WILL RECEIVE THE DEMOLITION DEBRIS AND WHERE THE LOADERS ARE USED.
DESTRUCTION SEQUENCE

1. DEMOLISH EACH DEMOLITION ZONE TO THE 2ND FLOOR.

A. 1.0.0. DEMOLISH EACH DEMOLITION ZONE TO THE 2ND FLOOR.
   A. 1.0.1. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.2. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.3. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.4. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.5. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.6. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.7. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.8. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.0.9. REMOVE ELECTRICAL MACHINERY AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.

A. 1.1.0. DEMOLISH EACH DEMOLITION ZONE TO THE 2ND FLOOR.
   A. 1.1.1. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.1.2. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.1.3. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.1.4. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
   A. 1.1.5. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.
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   A. 1.1.8. REMOVE OR DEACTIVATE ALL ELECTRICAL AND MACHINERY EQUIPMENT AND ALL ASSOCIATED STEEL, ETC. DEMOLISH ALL DEVICES TO BE OPENED BY HAND ASSISTED BY MACHINE AND LOCKED TO OPEN USING DEVICES.

Diagram Notes:

- This diagram is a schematic representation of the proposed destruction area and methods.
- Prior to the actual destruction, all necessary permits and approvals must be obtained.
- The diagrams are intended to guide the demolition process and should not be relied upon as the sole source of information.
- All work must be performed in accordance with local, state, and federal regulations.
- The use of Personal Protective Equipment (PPE) is mandatory.

Howard L. Shapiro
350 West 34th St, 9th Fl, NY 10001
Ph: 212-667-0542

Full Demolition of 45 Story Commercial Building At 1557 2nd Avenue, NYC, 10028

Machinist: Jon E. Trego
Subcontractor: Luis Pons

DIRECTOR OF DEMOLITION: PAUL D. MCCARTHY
JUNIOR DIRECTOR OF DEMOLITION: ADAM J. LAMB

PROJECT: FULL DEMOLITION OF 45 STORY COMMERCIAL BUILDING
DATE: OCTOBER 2020

HOWARD L. SHAPIRO
ASSOCIATE

DME-101.00
2ND EMBARKMENT
BOBCAT S160 SKID STEER LOADER (OR S150)

CATERPILLAR 324 SKID STEER LOADER

Specifications:
- **Numerical Data:**
  - **Operating Weight:** 7,300 lbs
  - **Turning Radius:** 12.7 ft
  - **Ground Clearance:** 11.7 in
  - **Blade Size:** 1.3 ft

HOWA10T6 PC78 US-4 MIDI EXCAVATOR

CATERPILLAR 304C CR MIDI EXCAVATOR

BOBCAT T300 MULTI TERRAIN LOADER

Specifications:
- **Numerical Data:**
  - **Operating Weight:** 7,300 lbs
  - **Turning Radius:** 12.7 ft
  - **Ground Clearance:** 11.7 in
  - **Blade Size:** 1.3 ft