STRUCTURAL CALCULATIONS

FOR

Example 3 - 157' Building, flat terrain

Guide to Wind Load Procedures of ASCE 7-02
Code Search

Code: ASCE 7 - 02

Occupancy:

Occupancy Group = B Business

Occupancy Category & Importance Factors:

Occupancy Category = II
Wind factor = 1.00
Snow factor = 1.00
Seismic factor = 1.00

Type of Construction:

Fire Rating:
Roof = 0.0 hr
Floor = 0.0 hr

Building Geometry:

Roof angle (θ) 0.00 / 12 0.0 deg
Building length (L) 200.0 ft
Least width (B) 100.0 ft
Mean Roof Ht (h) 157.0 ft
Parapet ht above grd 160.0 ft
Minimum parapet ht 3.0 ft

Live Loads:

Roof
0 to 200 sf: 20 psf
200 to 600 sf: 24 - 0.02 Area, but not less than 12 psf
over 600 sf: 12 psf

Floor
Typical Floor 50 psf
Lobbies & first floor corridors 100 psf
Corridors above first floor 80 psf
Mechanical 100 psf
Stairs & Exitways 100 psf
Balcony / Deck 50 psf
Partitions 20 psf
Wind Loads:

Importance Factor: 1.00
Basic Wind speed: 120 mph
Directionality (Kd): 0.85
Exposure Category: B
Enclosure Classification: Partially Enclosed
Internal Pressure: +/-0.55
Kh case 1: 1.124
Kh case 2: 1.124
Type of roof: Monoslope

Topographic Factor (Kzt)
Topography: Flat
Hill Height (H): 80.0 ft
Half Hill Length (Lh): 100.0 ft
Actual H/Lh: 0.80
Use H/Lh: 0.50
Modified Lh: 160.0 ft
From top of crest: x: 50.0 ft
Bldg up/down wind?: Downwind

H/Lh = 0.50
K1 = 0.000
x/Lh = 0.31
K2 = 0.792
z/Lh = 0.98
K3 = 1.000
At Mean Roof Ht:
Kzt = (1+K1K2K3)^2 = 1.00

Gust Effect Factor
h = 157.0 ft
B = 100.0 ft
\( \frac{z}{(0.6h)} = 94.2 \) ft

Flexible structure if natural frequency < 1 Hz (T > 1 second).
However, if building h/B < 4 then probably rigid structure (rule of thumb).
h/B = 1.57
Therefore, probably rigid structure

\[ G = 0.83 \] Using rigid structure formula
Enclosure Classification

**Test for Enclosed Building:** A building that does not qualify as open or partially enclosed.

**Test for Open Building:** All walls are at least 80% open.
\[ Ao \geq 0.8 Ag \]

**Test for Partially Enclosed Building:**

<table>
<thead>
<tr>
<th>Input</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ao</td>
<td>( \geq 1.1 Aoi )</td>
</tr>
<tr>
<td>Ag</td>
<td>( &gt; 4' / 0.01 Ag )</td>
</tr>
<tr>
<td>Aoi</td>
<td>( &lt; 0.20 )</td>
</tr>
</tbody>
</table>

Building is NOT Partially Enclosed.

Conditions to qualify as Partially Enclosed Building. Must satisfy all of the following:

- \( Ao \geq 1.1 Aoi \)
- \( Ao > \) smaller of 4' or 0.01 Ag
- \( Aoi / Agi \leq 0.20 \)

Where:
- \( Ao \) = the total area of openings in a wall that receives positive external pressure.
- \( Ag \) = the gross area of that wall in which \( Ao \) is identified.
- \( Aoi \) = the sum of the areas of openings in the building envelope (walls and roof) not including \( Ao \).
- \( Agi \) = the sum of the gross surface areas of the building envelope (walls and roof) not including \( Ag \).

**Reduction Factor for large volume partially enclosed buildings (Ri):**

If the partially enclosed building contains a single room that is unpartitioned, the internal pressure coefficient may be multiplied by the reduction factor \( Ri \).

| Total area of all wall & roof openings (Aog) | 0 sf |
| Unpartitioned internal volume (Vi)          | 0 cf |
| \( Ri = \)                                 | 1.00 |

**Altitude adjustment to constant 0.00256:**

| Altitude | 0 feet |
| Constant | 0.00256 | Average Air Density = 0.0765 lbm/ft³ |
Wind Loads - MWFRS all h (Enclosed/partially enclosed only)

Kh (case 2) = 1.12
Base pressure \( q_h \) = 35.2 psf
Roof Angle = 0.0 deg
Roof tributary area - \((h/2)^2*B\): 15700 sf

\( h = 157.0 \text{ ft} \)
\( L = 200.0 \text{ ft} \)
\( B = 100.0 \text{ ft} \)

\( q_i = 30.0 \text{ psf for positive internal pressures} \)

\[ q = 35.2 \text{ psf} \]

\( G = 0.83 \)

**Surface Pressures (psf)**

<table>
<thead>
<tr>
<th>Surface</th>
<th>( B/L = 0.50 )</th>
<th>( h/L = 1.57 )</th>
<th>Dist.*</th>
<th>( C_p )</th>
<th>( q_h G_{p} )</th>
<th>( w/q_h G_{p} )</th>
<th>( w/-q_h G_{p} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward Wall (WW)</td>
<td>0.80</td>
<td>23.5</td>
<td></td>
<td>0.80</td>
<td>23.5</td>
<td>see table below</td>
<td></td>
</tr>
<tr>
<td>Leeward Wall (LW)</td>
<td>-0.50</td>
<td>-14.7</td>
<td>4.7</td>
<td>-0.30</td>
<td>-8.8</td>
<td>-25.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Side Wall (SW)</td>
<td>-0.70</td>
<td>-20.6</td>
<td>-1.2</td>
<td>-0.70</td>
<td>-20.6</td>
<td>-37.1</td>
<td>-1.2</td>
</tr>
<tr>
<td>Leeward Roof (LR)</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windward Roof: ( 0 ) to ( h/2^* )</td>
<td>-1.04</td>
<td>-30.5</td>
<td>-11.2</td>
<td>0 to ( h/2^* )</td>
<td>-0.98</td>
<td>-28.8</td>
<td>-45.3</td>
</tr>
<tr>
<td>Windward Roof: ( &gt; h/2^* )</td>
<td>-0.70</td>
<td>-20.6</td>
<td>-1.2</td>
<td>h/2 to ( h^* )</td>
<td>-0.79</td>
<td>-23.1</td>
<td>-39.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>h to ( 2h^* )</td>
<td>-0.61</td>
<td>-18.0</td>
<td>-34.6</td>
</tr>
</tbody>
</table>

**NOTE:**
See figure 6-9 of ASCE7 for the application of full and partial loading of the above wind pressures. There are 4 different loading cases.

**Windward Wall Pressures at "z" (psf)**

<table>
<thead>
<tr>
<th>( z )</th>
<th>( K_z )</th>
<th>( K_{zt} )</th>
<th>( q_h G_{p} )</th>
<th>( w/\pm q_h G_{p} )</th>
<th>( w/-q_h G_{p} )</th>
<th>Normal to Ridge</th>
<th>Parallel to Ridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 15'</td>
<td>0.57</td>
<td>1.00</td>
<td>12.0 psf</td>
<td>-4.5 psf</td>
<td>31.4 psf</td>
<td>26.7 psf</td>
<td>20.8 psf</td>
</tr>
<tr>
<td>30.0 ft</td>
<td>0.70</td>
<td>1.00</td>
<td>14.6 psf</td>
<td>-1.9 psf</td>
<td>34.0 psf</td>
<td>29.3 psf</td>
<td>23.4 psf</td>
</tr>
<tr>
<td>50.0 ft</td>
<td>0.81</td>
<td>1.00</td>
<td>16.9 psf</td>
<td>0.4 psf</td>
<td>36.3 psf</td>
<td>31.6 psf</td>
<td>25.7 psf</td>
</tr>
<tr>
<td>80.0 ft</td>
<td>0.93</td>
<td>1.00</td>
<td>19.4 psf</td>
<td>2.8 psf</td>
<td>38.7 psf</td>
<td>34.1 psf</td>
<td>28.2 psf</td>
</tr>
<tr>
<td>120.0 ft</td>
<td>1.04</td>
<td>1.00</td>
<td>21.8 psf</td>
<td>5.2 psf</td>
<td>41.1 psf</td>
<td>36.4 psf</td>
<td>30.6 psf</td>
</tr>
<tr>
<td>( h = 157.0 \text{ ft} )</td>
<td>1.12</td>
<td>1.00</td>
<td>23.5 psf</td>
<td>7.0 psf</td>
<td>42.9 psf</td>
<td>38.2 psf</td>
<td>32.3 psf</td>
</tr>
</tbody>
</table>

**NOTE:**
For monoslope roofs, entire roof surface is either windward or leeward surface.

**Parapet**

\( z = 160.0 \text{ ft} \)
\( K_z = 1.13 \)
\( K_{zt} = 1.00 \)
\( q_p = 35.4 \text{ psf} \)

Windward parapet: 63.7 psf (\( G_{cpn} = +1.8 \))
Leeward parapet: -39.0 psf (\( G_{cpn} = -1.1 \))
Wind Loads - Components & Cladding : h > 60'

<table>
<thead>
<tr>
<th>Kh (case 1)</th>
<th>h = 157.0 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base pressure (q_b) = 35.2 psf</td>
<td>a = 10.0 ft</td>
</tr>
<tr>
<td>Minimum parapet ht = 3.0 ft</td>
<td>GCpi = +/-0.55</td>
</tr>
<tr>
<td>Roof Angle = 0.0 deg</td>
<td>q_i = 30.0 psf for positive internal pressures</td>
</tr>
</tbody>
</table>

### Roof

<table>
<thead>
<tr>
<th>Area</th>
<th>Surface Pressure (psf)</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 sf</td>
<td>100 sf</td>
<td>500 sf</td>
</tr>
</tbody>
</table>

Negative zone 3 = zone 2, since parapet >= 3 ft.

### Parapet

| qp = 35.4 psf |

CASE A = pressure towards building

CASE B = pressure away from building

### Walls

<table>
<thead>
<tr>
<th>Area</th>
<th>Surface Pressure at &quot;h&quot;</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 sf</td>
<td>100 sf</td>
<td>500 sf</td>
</tr>
</tbody>
</table>

NOTE: Negative zones 4 & 5 pressures apply to all heights. Positive pressures vary with height, see below.

### Wall surface pressure at "z"

<table>
<thead>
<tr>
<th>z</th>
<th>Kz</th>
<th>Kzt</th>
<th>qz (psf)</th>
<th>Positive zone 4 &amp; 5 (psf)</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 15'</td>
<td>0.70</td>
<td>1.00</td>
<td>22.0</td>
<td>39.1</td>
<td>35.8</td>
</tr>
<tr>
<td>30.0 ft</td>
<td>0.70</td>
<td>1.00</td>
<td>22.0</td>
<td>39.1</td>
<td>35.8</td>
</tr>
<tr>
<td>50.0 ft</td>
<td>0.81</td>
<td>1.00</td>
<td>25.4</td>
<td>42.2</td>
<td>38.4</td>
</tr>
<tr>
<td>80.0 ft</td>
<td>0.93</td>
<td>1.00</td>
<td>29.1</td>
<td>45.5</td>
<td>41.2</td>
</tr>
<tr>
<td>120.0 ft</td>
<td>1.04</td>
<td>1.00</td>
<td>32.6</td>
<td>48.7</td>
<td>43.8</td>
</tr>
<tr>
<td>h = 157.0 ft</td>
<td>1.12</td>
<td>1.00</td>
<td>35.2</td>
<td>51.1</td>
<td>45.8</td>
</tr>
</tbody>
</table>
Location of Wind Pressure Zones

- Roofs w/ $\theta \leq 10^\circ$
- and all walls $h > 60'$

- Walls $h \leq 60'$
- & alt design $h<90'$

- Gable, Sawtooth and
- Multispan Gable $\theta \leq 7$ degrees &
- Monoslope $\leq 3$ degrees
- $h \leq 60'$ & alt design $h<90'$

- Monoslope roofs
- $3^\circ < \theta \leq 10^\circ$
- $h \leq 60'$ & alt design $h<90'$

- Monoslope roofs
- $10^\circ < \theta \leq 30^\circ$
- $h \leq 60'$ & alt design $h<90'$

- Multispan Gable &
- Gable $7^\circ < \theta \leq 45^\circ$

- Hip $7^\circ < \theta \leq 27^\circ$

- Sawtooth $10^\circ < \theta \leq 45^\circ$
- $h \leq 60'$ & alt design $h<90'$

- Stepped roofs $\theta \leq 3^\circ$
- $h \leq 60'$ & alt design $h<90'$
# Roof Design Loads

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
<th>Multiple</th>
<th>psf (max)</th>
<th>psf (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing</td>
<td>3 ply felt &amp; gravel</td>
<td>5.5</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Decking</td>
<td>Metal Roof deck, 1.5, 22 ga.</td>
<td>1.7</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Framing</td>
<td>Steel roof joists &amp; girders</td>
<td>3.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Insulation</td>
<td>Rigid insulation, per 1&quot; x 2.0</td>
<td>3.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Ceiling</td>
<td>Suspended acoustical tile</td>
<td>1.8</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Sprinklers</td>
<td>Sprinklers</td>
<td>2.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Mech &amp; Elec</td>
<td>Mech. &amp; Elec.</td>
<td>2.0</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

|                     | Actual Dead Load                       |          |           |           |
|                     | Use this DL instead                    | 19.0     | 10.7      |           |
|                     | Live Load                              | 20.0     | 9.0       |           |
|                     | Snow Load                              | 20.0     | 0.0       |           |
|                     | Wind (zone 2 - 100sf)                  | 10.0     | -83.0     |           |

## ASD Loading

- Dead + Live Load: 42.5 psf
- Dead + 0.75(Wind + Live) Load: -77.6 psf
- 0.6*Dead + Wind Load: -124.7 psf

## LRFD Loading

- 1.2D + 1.6Lr + 0.8W: 64.0 psf
- 1.2D + 1.6W + 0.5Lr: -124.7 psf
- 0.9D + 1.6W: -124.7 psf

### Roof Live Load Reduction

- 0 to 200 sf: 20.0 psf
- 200 to 600 sf: 24 - 0.02(Area, but not less than 12 psf)
- over 600 sf: 12.0 psf

<table>
<thead>
<tr>
<th>Area</th>
<th>psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 sf</td>
<td>18.00</td>
</tr>
<tr>
<td>400 sf</td>
<td>16.00</td>
</tr>
<tr>
<td>500 sf</td>
<td>14.00</td>
</tr>
</tbody>
</table>

User Input: 450 psf 15.00 psf
## Floor Design Loads

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
<th>Multiple</th>
<th>psf (max)</th>
<th>psf (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooring</td>
<td>Carpet &amp; pad</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Topping</td>
<td>Concrete regular per 1&quot;</td>
<td>x 4.3</td>
<td>53.1</td>
<td>51.0</td>
</tr>
<tr>
<td>Decking</td>
<td>Metal Floor deck - 2&quot;, 20ga</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Framing</td>
<td>Steel floor bms/joists &amp; girders</td>
<td>8.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Topping</td>
<td>Deflection Concrete</td>
<td>x 0.8</td>
<td>9.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Ceiling</td>
<td>Suspended acoustical tile</td>
<td>1.8</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Sprinklers</td>
<td>Sprinklers</td>
<td>2.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Mech &amp; Elec</td>
<td>Mech. &amp; Elec.</td>
<td>2.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Misc.</td>
<td>Misc.</td>
<td>0.5</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

### Calculated Loads

- **Unreduced design live load:** 50 psf
- **Reduced live load:** 43.1 psf
- **Total live load:** 79.8 psf
- **Total load:** 149.8 psf

### Unreduced Dead Load

- **Total Dead Load:** 61.0 psf
- **Use this DL instead:** 100.0 psf

### IBC alternate procedure

- **Smallest of:**
  - $L = L_0(0.25 + 15/\sqrt{K_{LL}A_T})$
  - $R = 0.08(SF - 150)$
  - $R = 23.1(1+D/L) = 60.0\%$

For **Floor member** with $K_{LL} = 2$ and $A_T = 300\text{ sf}$:

- Reduced live load: $L = 43.1\text{ psf}$
- Reduced live load: $L = 44.0\text{ psf}$

For **Columns (2 or more floors)** with $K_{LL} = 4$ and $A_T = 500\text{ sf}$:

- Reduced live load: $L = 29.3\text{ psf}$
- Reduced live load: $L = 36.0\text{ psf}$

---

**FLOOR LIVE LOAD REDUCTION** (not including partitions)

NOTE: Not allowed for assembly occupancy or LL>100psf or passenger car garages, except may reduce columns 20% if 2 or more floors & non-assembly

### IBC alternate procedure

Smallest of:
- $R = 0.08(SF - 150)$
- $R = 23.1(1+D/L) = 60.0\%$
- $R = 40\%$ beams; $60\%$ columns

For **Floor member** with $K_{LL} = 2$ and $A_T = 300\text{ sf}$:

- Reduced live load: $L = 43.1\text{ psf}$

For **Columns (2 or more floors)** with $K_{LL} = 4$ and $A_T = 500\text{ sf}$:

- Reduced live load: $L = 29.3\text{ psf}$
CODE SUMMARY

**Code:**
ASCE 7 - 02

**Live Loads:**
- **Roof:**
  - 0 to 200 sf: 20 psf
  - 200 to 600 sf: 24 - 0.02Area, but not less than 12 psf
  - over 600 sf: 12 psf

Typical Floor: 50 psf
Lobbies & first floor corridors: 100 psf
Corridors above first floor: 80 psf

Mechanical: 100 psf
Stairs & Exitways: 100 psf
Balcony / Deck: 50 psf
Partitions: 20 psf

**Dead Loads:**
- **Floor:** 79.8 psf
- **Roof:** 20.0 psf

**Wind Design Data:**
- **Basic Wind speed:** 120 mph
- **Mean Roof Ht (h):** 157.0 ft
- **Occupancy Category:** II
- **Importance Factor:** 1.00
- **Exposure Category:** B
- **Enclosure Classif.:** Partially Enclosed
- **Internal pressure Coef.:** +/-0.55
- **Directionality (Kd):** 0.85

**Roof Snow Loads:**
- **Design Roof Snow load:** $0.0$ psf
- **Flat Roof Snow Load:** $P_f = 33.6$ psf
- **Ground Snow Load:** $P_g = 40.0$ psf
- **Rain on Snow Surcharge:** $= 0.0$ psf
- **Importance Factor:** $I = 1.00$
- **Snow Exposure Factor:** $C_e = 1.00$
- **Thermal Factor:** $C_t = 1.20$
- **Sloped-roof Factor:** $C_s = 1.00$

**Earthquake Design Data:**
- **Seismic Use Group:** $= II$
- **Importance Factor:** $I = 1.00$
- **Mapped spectral response accelerations:**
  - $S_s = 60.00 \, %g$
  - $S_1 = 10.00 \, %g$
- **Site Class:** $= D$
- **Spectral Response Coef.:**
  - $S_d = 0.528$
  - $S_d1 = 0.160$
- **Seismic Design Category:** $= D$
- **Basic Structural System:** $= $ Bearing Wall Systems
- **Seismic Resisting System:** $= $ Special reinforced concrete shear walls
- **Design Base Shear:** $V = 0.036W$
- **Seismic Response Coef.:** $C_s = 0.036$
- **Response Modification Factor:** $R = 5$
- **Analysis Procedure:** $= $ Equivalent Lateral-Force Analysis
## Component and Cladding Wind Pressures

### Roof

<table>
<thead>
<tr>
<th>Area</th>
<th>Surface Pressure (psf)</th>
<th>10 sf</th>
<th>100 sf</th>
<th>500 sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Zone 1</td>
<td>-65.8</td>
<td>-55.5</td>
<td>-48.2</td>
<td></td>
</tr>
<tr>
<td>Negative Zone 2</td>
<td>-97.5</td>
<td>-83.0</td>
<td>-72.9</td>
<td></td>
</tr>
<tr>
<td>Negative Zone 3</td>
<td>-97.5</td>
<td>-83.0</td>
<td>-72.9</td>
<td></td>
</tr>
<tr>
<td>Positive Zones 1-3</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td></td>
</tr>
</tbody>
</table>

### Parapet

<table>
<thead>
<tr>
<th>Area</th>
<th>Solid Parapet Pressure (psf)</th>
<th>10 sf</th>
<th>100 sf</th>
<th>500 sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASE A: Interior Zone</td>
<td>113.3</td>
<td>93.4</td>
<td>77.9</td>
<td></td>
</tr>
<tr>
<td>Corner Zone</td>
<td>113.3</td>
<td>93.4</td>
<td>77.9</td>
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</tr>
<tr>
<td>CASE B: Interior Zone</td>
<td>-63.7</td>
<td>-54.9</td>
<td>-46.0</td>
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</tr>
<tr>
<td>Corner Zone</td>
<td>-95.6</td>
<td>-76.1</td>
<td>-56.7</td>
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</tbody>
</table>

### Wall

<table>
<thead>
<tr>
<th>Area</th>
<th>Surface Pressure (psf)</th>
<th>20 sf</th>
<th>100 sf</th>
<th>500 sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Zone 4</td>
<td>-48.2</td>
<td>-44.7</td>
<td>-41.2</td>
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</tr>
<tr>
<td>Negative Zone 5</td>
<td>-79.9</td>
<td>-65.8</td>
<td>-51.8</td>
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</tr>
<tr>
<td>Positive Zone 4 &amp; 5</td>
<td>0 to 15'</td>
<td>39.1</td>
<td>35.8</td>
<td>32.5</td>
</tr>
<tr>
<td>30 ft</td>
<td>39.1</td>
<td>35.8</td>
<td>32.5</td>
<td></td>
</tr>
<tr>
<td>50 ft</td>
<td>42.2</td>
<td>38.4</td>
<td>34.6</td>
<td></td>
</tr>
<tr>
<td>80 ft</td>
<td>45.5</td>
<td>41.2</td>
<td>36.8</td>
<td></td>
</tr>
<tr>
<td>120 ft</td>
<td>48.7</td>
<td>43.8</td>
<td>38.9</td>
<td></td>
</tr>
<tr>
<td>h = 157 ft</td>
<td>51.1</td>
<td>45.8</td>
<td>40.5</td>
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</tbody>
</table>