Transmitted Extension for
Washington and Washington
1907 April
Joist per ft.\(^2\) = 174 \text{ lb. per ft.}^2\) overall.

\(4/\text{beams} \times \text{ft.} = \text{effective span} = 29\) ft.

\(w = 13 \times 12 \times 29 = 85,320 \text{ lb.}

\(\text{Required} \quad Z = \frac{wL^2}{64} = \frac{13 \times 12 \times 29 \times 29}{2 \times 240 \times 64} = 113.4 \text{ in.}^3\) with units

\(\text{Select either} \quad 20'' \times 6\frac{1}{2}'' \times 6\frac{1}{2}''\)

or \(16'' \times 8'' \times 7\frac{1}{4}''\)

\(\text{Wt. beam} = \frac{75 \times 29}{2 \times 240} = 0.97 \text{ ton}\)

\(\text{Wt. load} = \frac{13 \times 12 \times 29}{240} = 20.86 \text{ ton}\)

\(\Sigma = 21.83 \text{ ton}\)

\(R_\Sigma = \frac{21.83}{2} = 10.92 \text{ ton}\)
Effective span = 36 ft

\[ w = 15' \times 124' \text{ per ft.} \text{ in.} \]

Required \( Z = \frac{wL^2}{64} = \frac{15' \times 124' \times 36'^2 \times 12}{64 \times 2240} \text{ inch in.}^2 \]

Select 2 in. x 7 1/2 x 90 # 5

\( 15' \times 6' \times 2 \)

Wh. beam = \( \frac{10.5 \times 36'}{2240} = 1.74 \text{ ton} \)

Wh. floor = \( \frac{15' \times 124' \times 36'}{2240} = 29.59'' \text{ ton} \)

\[ \Sigma = 31.63 \text{ ton} \]

and \( R = \frac{31.63}{1.2} = 26.35 \text{ ton} \)
\[ \begin{align*}
\text{Beam E.F.} & \quad \text{Effective span} = c' + 2h' \\
\omega & = 6 \times 12 + 4 \text{ " Left side.} \\
\theta & = 74.4^\circ \\
P & = 10.9 \\
R_1 & = 15.7 \\
& \quad R_2 = R_1 = 15.7 \\
R_1 & = R_2 = \frac{10.9}{2} + 10.9 = \frac{71.6 \times 39}{2 \times 22400} + 10.9 = 11.8 + 10.9 \\
& \quad = 15.7 \\
M_0 & = (15.7 \times 8) - \frac{(71.6 \times 6.4)}{22400} = 125.6 - 10.6 \\
& \quad = 115.0 \text{ tons ft} \\
\text{and } M_0 & = (15.7 \times 14.5) - \frac{(71.6 \times 14.5)}{22400} = 227.7 - (34.9 + 70.8) \\
& \quad = 122.0 \text{ tons ft} \\
\text{Required } I & = \frac{61}{8} \text{ in.}^3 \\
& \quad = 183 \text{ in.}^3 \text{ units}.
\end{align*} \]

... (a. 111) will suffice, but select 2 in. 112 to match adjacent beams. 195/4 x 10 x 108½".
10 x 1½" I 18 x 6
Beam D.E.

Effective span = 23'

\[ P = 15.6 \]

\[ w = 6 \times 12t = 74.4 \text{ kips} \]

\[ w/2 = 74.4 \times \frac{23}{2 \times 40} = 3.8 \text{ tons} \]

And

\[ 23 R_1' = 15.8 \times 5 \]

\[ R_1' = 15.8 \times \frac{5}{23} = 3.4 \text{ tons} \]

And

\[ R_2' = 15.8 - 3.4 = 12.4 \text{ tons} \]

\[ R_1 = 7.2 \text{ tons} \]

And

\[ R_2 = 16.2 \text{ tons} \]

\[ M_x = \left( 5 \times 16.2 \right) - \left( 74.4 \times 2.5 \right) = 81.0 - 185.1 = -76.9 \text{ ft-kips} \]

\[ M_x = R_1x - w \frac{2}{2} \text{ for a beam. } R_1 = 7.2 \text{ kips} \text{ and } w = \frac{R_2}{w} = \frac{74.4}{23} = 3.2 \text{ kips/ft} \]

\[ M_x = 2.27 \text{ kips-ft} \]

\[ Z = \frac{76.9 \times 2}{8.2} = 230.7 \text{ in}^3 = 115.4 \text{ with } 2 \text{ units} \]

Result: 20" x 6 3/8" x 6 5/8"
31, Beams B.C., effective span = 29'.

\[ \frac{wL}{64} = \frac{744 \times 29^2}{660 \times 2} \approx 7.4 \text{ ft} \text{ kips} \]

Required \[ I = \frac{wL^2}{64} = \frac{744 \times 29^2 \times 17}{660 \times 2} \approx 1,530 \text{ in}^4 \text{ kips} \]

A 14" x 3 1/2" x 40 ft beam would do just this, but when
the weight of the beam is added

Select a 15" x 6" x 45 ft. R. S. J.

\[ R_1 = R_2 = \frac{wL}{L} = \frac{744 \times 29}{140} \approx 11.8 \text{ tons} \]

Standards:

\[ \text{Take } H = 18 \text{ feet} \]

Let \( \alpha \) = least overall dimension.

Then \( H > 4 \alpha \)

\[ \frac{\alpha + \frac{H}{2}}{\alpha} = \frac{18 \times 12}{10} = 21.6 > 4 \alpha \]

\[ \frac{120 \alpha}{140} \approx 0.86 > 1 \]

\[ \alpha = \frac{16 \times 12}{140} = 1.14 \text{ inches} \]

The beam will deflect \( = 0.04 \text{ in} \)
Try Haunchen j.13

Load = 10^2

9 x 7' x 50 #

one end being used 0" " jacked.

Necctually on y-axis

\( R_y = \frac{15 \times 12}{\sqrt{3.65}} = 131 \) (Note: This is the moment of the force about the y-axis)

\( R = \frac{2.2 \times 10^2}{131} = 0.44 \) (Note: This is the vertical force component)

Weight Haunchen = 15 \times 50

\( \Sigma = 3.2 \) (Note: This is the sum of forces)

and safe load = 2.2 \times 14.7 = 32.6 tons

Equivalent concentric load = 2.2 \times 10 = 22.8 tons

Weight Haunchen = 15 \times 50

\( \Sigma = 3.2 \) (Note: This is the sum of forces)

and safe load = 2.2 \times 14.7 = 32.6 tons

Necctually on x-axis

\( R_x = \frac{15 \times 12}{\sqrt{3.76}} = 57.5 \) (Note: This is the moment of the force about the x-axis)

\( R = \frac{2.2 \times 10^2}{57.5} = 0.4 \) (Note: This is the horizontal force component)

Weight Haunchen = 2 \times 10^2

\( \Sigma = 23.2 \) (Note: This is the sum of forces)

and safe load = 2.2 \times 14.7 = 32.6 tons

\( \Sigma = 72.8 \) (Note: This is the sum of forces)

Load on foundation = 10.4 tons
Load = 32 tons

Try Trench 10.

One end hinged

9" x 10" x 71/2"

Trench Area = 3.11 tons in²

Equivalent eccentricity load = 1.99 x 32 = 64.0 tons

Wt. Trench = \( \frac{18 \times 71.5}{2240} \)

\( \Sigma = 64.6 \) tons

and safe load = 3.1x 20.2 = 62.6 tons. (Allowable).

Trench Area = 4.11 tons in²

Wt. Trench

\( \Sigma = 77.6 \) tons.

+ Safe Load = 4.1 x 20.2 = 82.6 tons

Load on foundations = 32.6 tons.