Funicular 1

$x_L := 0 \cdot ft$ $x_C := 550 \cdot ft$ $x_R := 1100 \cdot ft$

$y_L := 0 \cdot ft$ $y_C := -21 \cdot ft$ $y_R := 0 \cdot ft$

Points though which the funicular polygon must pass, which could be hinges in a 3 hinges (isostatic) arch

Uniform Loads

$q_D := 8 \cdot \frac{lbf}{ft}$ $q_L := 0 \cdot \frac{lbf}{ft}$

uniform dead and live load (on horizontal projection)

Point Loads

$P_D := kip \cdot \begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \end{pmatrix}$ $P_L := kip \cdot \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $A := ft \cdot \begin{pmatrix} \frac{1100}{3} \\ \frac{2200}{3} \\ 0 \\ 0 \end{pmatrix}$

This sheet builds the funicular polygon that passes through three points of

- 1 set of point dead + live loads
- 1 uniform dead + live load extended all over the span

Note that if central point is below extremes we find a cable sahpe, otherwise we get an arch shape
Procedure is find isostatic moment and scale to meet within span point ordinate, then chart

$l := x_R - x_L$ $n_p := \text{length}(P_L)$

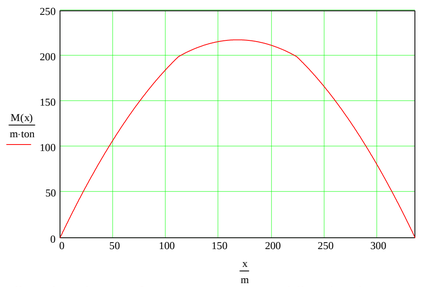
Moment of a point load P at abscissa ab

$$M_P(P, ab, x) := \begin{cases} P \cdot \frac{(l - ab)}{l} \cdot x & \text{if } x \le ab \\ P \cdot \frac{ab}{l} \cdot (l - x) & \text{otherwise} \end{cases}$$

Service Level Moment

$$M(x) := \frac{(q_D + q_L) \cdot x}{2} \cdot (l - x) + \sum_{i=1}^{n_p} M_P(P_{D_i} + P_{L_i}, A_i, x)$$

Service level Moment



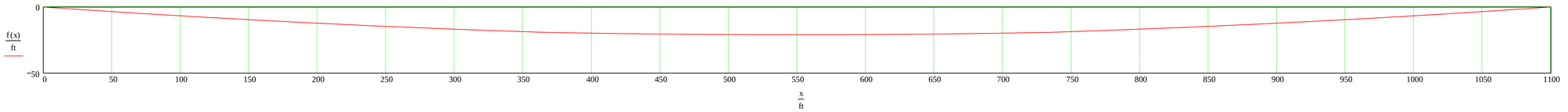
Scaling the shape of moment to meet obliged points

$f_{net} := y_C - \frac{y_R - y_L}{x_R - x_L} \cdot x_C$ $f_{net} = -21\,ft$ net sagitta at within span obliged point

$k := \frac{f_{net}}{M(x_C)}$

$f(x) := k \cdot M(x) + \frac{y_R - y_L}{x_R - x_L} \cdot x$

Funicular Polygon for these service level loads


0
−50
f(x)
ft
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
x
ft