CALDERWOOD ENGINEERING
222 RIVER ROAD
RICHMOND, ME 04357
PH. (207) 737-2007 FAX (207) 737-2008

Middlesex, Vermont
Erection Plan

Calcs by: TEPA
Checked by: GNM

Town of Middlesex, VT 12 (Rural Major Collector)
Project Number BRF 024-1(37)

References:
-Use AISC 9th ASD to check stresses in girders during erection
-AASHTO 7th Ed.

Section Properties of W30x90 Girders:

$S_b := 245\ in^3$ $\quad S_t := S_b = 245\ in^3$ $\quad w_{self} := 96.43\ plf$

$d := 26.3\ in$ $\quad b_f := 10.4\ in$ $\quad t_f := 0.61\ in$ $\quad A_f := b_f \cdot t_f = 6.344\ in^2$

$d_{web} := d - 2 \cdot t_f = 25.08\ in$ $\quad t_w := 0.47\ in$ $\quad F_y := 50\ ksi$ $\quad L := 46\ ft$

Check slenderness:

$$\frac{65}{\sqrt{\frac{F_y}{ksi}}} = 9.192 \qquad \frac{b_f}{t_f} = 17.049 \qquad \frac{95}{\sqrt{\frac{F_y}{ksi}}} = 13.435$$

Shape is noncompact

$$L_c := min\left(\frac{\frac{76 \cdot b_f}{in}}{\sqrt{\frac{F_y}{ksi}}}, \frac{20000}{\left(\frac{\frac{d}{in}}{\frac{A_f}{in^2}}\right) \cdot \frac{F_y}{ksi}}\right) \cdot in = 8.041\ ft$$

F1-2, ASD

$d_{compweb} := \frac{d_{web}}{2} \cdot \frac{1}{3} = 4.18\ in$ $\quad A_{compweb} := d_{compweb} \cdot t_w = 1.965\ in^2$

$A_t := A_{compweb} + A_f = 8.309\ in^2$ $\quad I_t := \frac{\left(t_f \cdot b_f^{\ 3}\right)}{12} + \frac{\left(d_{compweb} \cdot t_w^{\ 3}\right)}{12} = 57.217\ in^4$

$r_T := \sqrt{\frac{I_t}{A_t}} = 2.624\ in$

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Check stress on single, unsupported girder:

$w_{beam} := w_{self}$

$M_u := \frac{w_{self} \cdot L^2}{8} = 306.069\ kip \cdot in$ Moment induced by vertical loads (dead load)

$f_{bv} := \frac{M_u}{S_b} = 1.249\ ksi$ Stress induced by dead load, no curvature

$f_b := f_{bv} = 1.249\ ksi$

$L_b := L = 46\ ft$ conservative

$Check_{Fb} :=$ if $L_b < L_c$
"Fb=0.66Fy"
else
"Check Equation F1−6, F1−7, & F1−8"

$Check_{Fb} =$ "Check Equation F1−6, F1−7, & F1−8"

$l := L_b = 552\ in$ $\frac{l}{r_T} = 210.349$ Assume $C_b := 1.0$

$Limit_1 := \sqrt{\frac{\left(102 \cdot 10^3 \cdot C_b\right)}{\frac{F_y}{ksi}}} = 45.166$ $Limit_2 := \sqrt{\frac{\left(510 \cdot 10^3 \cdot C_b\right)}{\frac{F_y}{ksi}}} = 100.995$

$F_{b1} := \left(\frac{2}{3} - \frac{\left(\frac{F_y}{ksi} \cdot \left(\frac{l}{r_T}\right)^2\right)}{1530 \cdot 10^3 \cdot C_b}\right) \cdot F_y = -38.966\ ksi$ (F1-6)

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$$F_{b2} := \frac{\left(170 \cdot 10^3 \cdot C_b\right)}{\left(\frac{l}{r_T}\right)^2} \cdot ksi = 3.842\ ksi \qquad \text{(F1-7)}$$

$$F_{b3} := \frac{\left(12 \cdot 10^3 \cdot C_b\right)}{\left(l \cdot \frac{d}{A_f}\right)} \cdot ksi = 5.244\ ksi \qquad \text{(F1-8)}$$

$$F_b := \begin{cases} \max\left(F_{b1}, F_{b3}\right) & \text{if } \frac{l}{r_T} < Limit_2 \\ \max\left(F_{b2}, F_{b3}\right) & \text{else} \end{cases} \qquad F_b = 5.244\ ksi$$

$$f_b = 1.249\ ksi$$

$$Check_1 := \begin{cases} \text{“OK”} & \text{if } f_b < F_b \\ \text{“No Good”} & \text{else} \end{cases} = \text{“OK”}$$

<u>By inspection:</u>
Worst case bending occurs when beam sitting on abutments. Beam will be okay during lifting.

Crane will be setting on crawler pads and 10" of pavement on Rt 12. No need for crane mats.

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Check lateral force on G1 with 40MPH wind:

$q_z := 0.00256 \cdot \left(40^2\right)\ psf = 4.096\ psf$ $\qquad$ $d = 26.3\ in$

$w_{lat} := q_z \cdot d = 8.977\ plf$

$P_{lat} := \frac{w_{lat} \cdot L}{2} = 206.473\ lbf$ each end

Say: Ratchet straps at ends must resist a minimum of 250lbs