LOADING DATA

design_load = HL93

Strength_limit := 1

wearing_surface := 6in

DECK GEOMETRY

Taken as the (clear span + 1/2 width of stringer) but not to exceed (clear span +deck thickness)

design_span := 4.5ft

WHEEL LOADS & DISTRIBUTIONS:

Axle load of 32,000 lbs controls w/ Multiple Presence Factor (1.2)

$WL := 16kip \cdot 1.2 = 19.2 \cdot kip$

DECK PROPERTIES & DESIGN VALUES:

Glulam COMB. 2, Species DF (AASHTO Table 8.4.1.2.3-2)

$F_{bo} := 1800psi$ $F_{cpo} := 560psi$ $F_{vo} := .72 \cdot 230psi$ $E_o := 1600000psi$

Deck Thickness $t := 5.125in$

Assumed Panel Width $W_p := 48in$

Tire Contact Area LRFD 3.6.1.2.5

$Tire_{width} := 20in$ $Tire_{lgth} := 10in$

Equivalent Strip Width LRFD Table 4.6.2.1.3-1

* Direction of Primary strip relative to traffic = perpendicular
* Interconnected design

$W_d := 4t + 30in$

$W_d = 50.5 \cdot in$

$A := W_d \cdot t$ $S_x := \frac{W_d \cdot t^2}{6}$ $I_x := \frac{W_d \cdot t^3}{12}$

$A = 258.81 \cdot in^2$ $S_x = 221.07 \cdot in^3$ $I_x = 566.49 \cdot in^4$

WOOD ADJUSTMENT FACTORS - LRFD 8.4.4.1

Moisture Content Factor : LRFD Table 8.4.4.3-2

$C_{m\_b} := .8$ $C_{m\_v} := .875$ $C_{m\_E} := .833$

WOOD ADJUSTMENT FACTORS cont.

Flat Use Factor : LRFD 8.4.4.6-2 $C_{fu} := 1.1$

Time Effect Factor : LRFD 8.4.4.9 $C_{\lambda} := 0.8$

Bearing Factor ; LRFD Table 8.8.3-1 $C_b := 1$

ADJUSTED DESIGN VALUES - LRFD 8.4.4.1

Resistance factors - LRFD Table 8.5.2.2 $\phi_m := 0.85$ $\phi_v := 0.75$ $\phi_{cp} := 0.9$

Conversion Factors : LRFD Table 8.4.4.2 $C_{KFb} := \frac{2.5}{\phi_m}$ $C_{KFv} := \frac{2.5}{\phi_v}$ $C_{KF\_CP} := \frac{2.1}{\phi_{cp}}$

$Fb := F_{bo} \cdot C_{KFb} \cdot C_{m\_b} \cdot C_{fu} \cdot C_{\lambda}$ $Fb = 3727.06 \cdot psi$

$Fv := F_{vo} \cdot C_{KFv} \cdot C_{m\_v} \cdot C_{\lambda}$ $Fv = 386.4 \cdot psi$

$E := E_o \cdot C_{m\_E}$ $E = 1332800 \cdot psi$

FACTORED RESISTANCE

Flexure

$M_n := Fb \cdot S_x$ $M_n = 823.94 \cdot in{\cdot}kip$

$M_r := \phi_m \cdot M_n$ $M_r = 700.35 \cdot in \cdot kip$

Shear

$V_n := \frac{Fv \cdot A}{1.5}$ $V_n = 66.67 \cdot kip$

$V_r := \phi_v \cdot V_n$ $V_r = 50 \cdot kip$

DECK DESIGN :

LRFD Table 3.5.1-1 $WT_{wood} := 50pcf$ $WT_{asphalt} := 140pcf$

Dead load and Moments for Components (deck, rail & misc DL)

$Deck_{dl} := A \cdot WT_{wood}$ $\quad Deck_{dl} = 0.09 \cdot klf$

$Misc_{dl} := .2klf$

$DC := Deck_{dl} + Misc_{dl}$ $\quad DC = 0.29 \cdot klf$

$M_{DC} := \frac{DC \cdot design\_span^2}{8}$ $\quad M_{DC} = 0.73 \cdot ft \cdot kip$

$V_{DC} := \frac{DC \cdot design\_span}{2}$ $\quad V_{DC} = 0.65 \cdot kip$

Dead load and Moments for Asphalt Wearing Surface

$DW := W_d \cdot wearing\_surface \cdot WT_{asphalt}$ $\quad DW = 0.29 \cdot klf$

$M_{DW} := \frac{DW \cdot design\_span^2}{8}$ $\quad M_{DW} = 0.75 \cdot ft \cdot kip$

$V_{DW} := \frac{DW \cdot design\_span}{2}$ $\quad V_{DW} = 0.66 \cdot kip$

Maximim HL93 Vehicle Moment : Truck load condition only LRFD 3.6.1.3.3 (multiply by 80% for multi span credit)

$M\_HL93 := \frac{WL \cdot design\_span}{4} \cdot .8$ $\quad M\_HL93 = 17.28 \cdot ft \cdot kip$

Strength Limit States LRFD Table 3.4.1-1 $\quad \gamma_{DC} := 1.25 \quad \gamma_{DW} := 1.5 \quad \gamma_{LL} := 1.75$

LRFD 1.3.3 Ductility $\quad \eta_D := 1.0$

LRFD 1.3.4 Redundancy $\quad \eta_R := 1.0$

LRFD 1.3.5 Operational Importance $\quad \eta_I := 1.0$

LRFD 1.3.2.1-2 $\quad \eta_i := \begin{cases} (\eta_D \cdot \eta_R \cdot \eta_I) & \text{if } \eta_D \cdot \eta_R \cdot \eta_I \geq 0.95 \\ 0.95 & \text{otherwise} \end{cases}$ $\quad \eta_i = 1$

FLEXURE CHECK

$Q_{flexure} := \eta_i(\gamma_{DC} \cdot M_{DC} + \gamma_{DW} \cdot M_{DW} + \gamma_{LL} \cdot M\_HL93)$

$Q_{flexure} = 32.28 \cdot ft \cdot kip$

Flexure_check := "OK" if $M_r \geq Q_{flexure}$ "RE-RUN" otherwise

Flexure_check = "OK"

SHEAR CHECK

$a := design\_span - t - 72in = -23.12 \cdot in$

$$V\_HL93 := \begin{cases} \left(\frac{WL}{design\_span}\right) \cdot (design\_span - t + a) & \text{if } design\_span \geq (t + 72in) \\ \frac{WL \cdot (design\_span - t)}{design\_span} & \text{otherwise} \end{cases}$$

$V\_HL93 = 17.38 \cdot kip$

$Q_{shear} := \eta_i(\gamma_{DC} \cdot V_{DC} + \gamma_{DW} \cdot V_{DW} + \gamma_{LL} \cdot V\_HL93)$

$Q_{shear} = 32.22 \cdot kip$

Shear_Check := "OK" if $V_r \geq Q_{shear}$ "no good Re-run" otherwise

Shear_Check = "OK"

DECK DEFLECTION :

Live Load Deflection limited to L/425 LRFD 2.5.2.6.2

$$\Delta_{LL} := \frac{WL \cdot design\_span^3}{48 \cdot E \cdot I_x}$$

$\Delta_{LL} = 0.0834 \cdot in$

Deflection_Limit_Check := "deflection is good" if $\Delta_{LL} \leq .1in$ "excessive deflection, re-run" otherwise

Deflection_Limit_Check = "deflection is good"

$$\Delta_{LL\_allow} := \frac{design\_span}{425}$$

$\Delta_{LL\_allow} = 0.13 \cdot in$

$$\Delta_{ratio} := \frac{design\_span}{\Delta_{LL}}$$

$\Delta_{ratio} = 647.31$

Deflection_Ratio_Check := "Deflection is good" if $\Delta_{ratio} \geq 425$ "excessive deflction re-run" otherwise

Deflection_Ratio_Check = "Deflection is good"