POINT TORSIONAL STABILITY BRACING OF A BEAM.

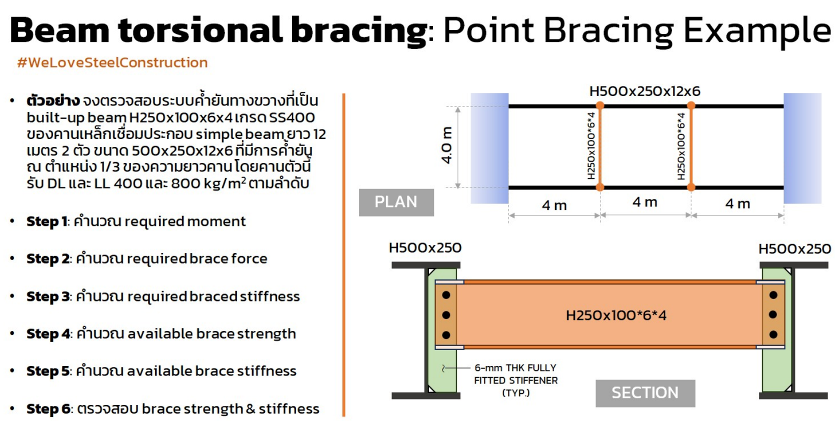

Figure 1: image

Load

Dead Load: $DL = 800\frac{kg}{m^2}$

$DL_{line} = 1600\frac{kg}{m}$

Live Load: $LL = 400\frac{kg}{m^2}$

$LL_{line} = 800\frac{kg}{m}$

$W_{factor} = 1.2 * (1600) + 1.6 * (800) = 3200\frac{kg}{m}$

Material Property

Yield Strength: $A_s = 245MPa$

Section Property of H-250x100x6x4

Section Area: $A_s = 21.52cm^2$

Weight: $w = 16.9\frac{kg}{m}$

Moment of inertia about x: $I_y = 100cm^4$

Moment of inertia about y: $I_x = 2256cm^4$

Section Property of H-500x250x12x6

Section Area: $A_s = 88.56\frac{kg}{m}$

Weight: $w = 69.52\frac{kg}{m}$

Moment of inertia about x: $I_x = 41121cm^4$

Moment of inertia about y: $I_y = 3126cm^4$

1. Required Moment.

ASD	LRFD
$M = \frac{W_u * l^2}{8} = \frac{2400*12^2}{8}$ $M_r = 43200kg.m$	$M = \frac{W_u * l^2}{8} = \frac{3200*12^2}{8}$ $M_r = 57600kg.m$

2. Required Brace Force (The required flexural strength for a point torsional brace).

ASD	LRFD
$M_{br} = 0.02M_a$	$M_{br} = 0.02M_u$
$M_{br} = 864kg.m$	$M_{br} = 1152kg.m$

3. Required Braced Stiffness.

ASD	LRFD
$\beta_T = \Omega\frac{2.4*L}{nEI_{yeff}}(\frac{M_r}{C_b})^2$ $\beta_T =$ $3 * \frac{2.4*12*10^3}{3*2*10^6*41121*10^4}(\frac{864*10^{-3}*9.81}{1})^2$ $\beta_T = 2.52 * 10^{-9}\frac{N}{rad.}$	$\beta_T = \frac{1}{\phi}\frac{2.4*L}{nEI_{yeff}}(\frac{M_r}{C_b})^2$ $\beta_T = \frac{1}{0.75} *$ $\frac{2.4*12*10^3}{3*2*10^6*41121*10^4}(\frac{1152*10^{-3}*9.81}{1})^2$ $\beta_T = 1.99 * 10^{-9}\frac{N}{rad.}$

4. Avilable Braced Strength.

From:

$M_n = M_p = F_yZ \leq 1.6 * F_yS_x$

$Z = 203.04cm^3$

$S_x = 178.87cm^3$

$1.6 * F_yS_x = 1.6 * 245 * 178.87 * 10^3 = 70.12 * 10^6$

$M_n = F_yZ = 245 * 203.04 * 10^3 = 49.74 * 10^6 \leq 70.12 * 10^6$ is true;

5. Avilable Braced Stiffness and Design thinkness of stiffeners.

$\beta_{Tb} = \frac{6EI}{L} = \frac{6*2*10^6*2256*10^4}{12*10^3} \frac{N}{rad.}$

$\beta_{Tb} = 2.26 * 10^{10} \frac{N}{rad.}$

From:

$\frac{1}{\beta_T} = \frac{1}{\beta_{TB}} + \frac{1}{\beta_{sec}}$

ASD	LRFD
$\frac{1}{2.52*10^{-9}} = \frac{1}{2.26*10^{10}} + \frac{1}{\beta_{sec}}$ $\beta_{sec} = 2.52 * 10^{-9} \frac{N}{rad.}$	$\frac{1}{1.99*10^{-9}} = \frac{1}{2.26*10^{10}} + \frac{1}{\beta_{sec}}$ $\beta_{sec} = 1.99 * 10^{-9} \frac{N}{rad.}$

Determine the required width, bs, of 4 mm.-thick of stiffeners.

From:

$\beta_{sec} = \frac{3.3*E}{h_o} * [\frac{1.5*h_o*t_w^3}{12} + \frac{t_{st}*b_s^3}{12}]$

ASD	LRFD
$2.52 * 10^{-9} =$ $\frac{3.3*2*10^6}{488} * [\frac{1.5*488*6^3}{12} + \frac{4*b_s^3}{12}]$ $b_s^3 = -34mm. < 0$	$1.99 * 10^{-9} = \frac{3.3*E}{488} * [\frac{1.5*488*6^3}{12} + \frac{4*b_s^3}{12}]$ $b_s^3 = -34mm. < 0$

6. Brace Strength & Stiffness Check.

ASD	LRFD
$\frac{M_n}{\Omega} = \frac{49.74*10^6}{3} = 16.58 * 10^6 kN.m$	$\phi M = 0.75 * 49.74 * 10^6 =$ $37.31 * 10^6 kN.m$
16.58*10ˆ6kN.m > 8.64kN.m (ok)	37.31*10ˆ6kN.m > 11.52kN.m (ok)