

ALLOWABLE STRESS DESIGN FLOWCHART

FOR

AISC MANUAL OF STEEL CONSTRUCTION, NINTH EDITION

APPENDIX B

BEARING STIFFENERS AND TRANSVERSE STIFFENERS DESIGN

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S-Y. Chen, December 1997, *Using Genetic Algorithms for the Optimal Design of Structural Systems*, Dissertation for Doctor of Philosophy, Department of Civil Engineering, Arizona State University.

BEARING STIFFENER

Situations When Bearing Stiffeners Are Required (See Figure ASD01.emf)

- S1. If $N > 0.15 \cdot b_f$, and $t_f \leq 0.4 \cdot \sqrt{\frac{P_{bf}}{F_{yc}}}$, a pair of stiffeners should be provided opposite to tension flange, to prevent Local Flange Bending
- S2. If (K1-2) and (K1-3) are satisfied, and R is in compression, stiffeners must be provided to prevent Local Web Yielding
- S3. If (K1-4) and (K1-5) are satisfied, and R is in compression, stiffeners must be provided such that $k' > \frac{d}{2}$, to prevent Web Crippling (Figure ASD04.emf).
- S4. When R is on one Flange, and (K1-6) and (K1-7) are satisfied, and R is in compression, stiffeners must be provided such that $k' > \frac{d}{2}$ to prevent Sidesway Web Buckling (Figure ASD04.emf).
- S5. When R is on both flange, and $(d - 2k) > \frac{4100t_w^3 \cdot \sqrt{F_{yc}}}{P_{bf}}$, a stiffener or a pair of stiffener should be provided opposite to the compression flange, such that $k' > \frac{d}{2}$, to prevent compression Buckling of the Web
- S6. If the outside face of the flange is connected to another beam for bearing moment, (K1-9) must be satisfied, but it is NOT necessary to extend k' , such that $k' > \frac{d}{2}$. (See Figure ASD02.emf)

Special requirement for Designing Bearing Stiffeners (Figure ASD01.emf, ASD02.emf)

1. For conditions S2, S3, S4, S5, S6 above, [J8-1] must be satisfied
2. For conditions S3, S4, S5 above, [Spec K1.8] must be satisfied
3. For conditions S1, S5, S6, the following conditions must be satisfied
 - a. $b_s + \frac{1}{2} \cdot t_w \geq \frac{1}{3} \cdot b_f^*$ or $b_s + \frac{1}{2} \cdot t_w \geq \frac{1}{3}$. (Width of the Moment Connection Plate)
 - b. $t_s \geq 1 \frac{1}{2} \cdot t_f$
 - c. Stiffeners welded to web of the column should be sized to carry the force (in the stiffener) caused by unbalanced moments

Other Equations for Bearing Stiffeners (Mentioned Above)

(K1-2) when $d_R \geq d$, $\frac{R}{t_w \cdot (N + 5 \cdot k)} > 0.66 \cdot F_y$

(K1-3) when $d_R < d$, $\frac{R}{t_w \cdot (N + 2.5 \cdot k)} > 0.66 \cdot F_y$

(K1-4) when $d_R \geq d$, $R > 67.5 \cdot t_w^2 \cdot \left[1 + 3 \cdot \frac{N}{d} \cdot \left(\frac{t_w}{t_f} \right)^{1.5} \right] \cdot \sqrt{F_{yw} \cdot \frac{t_f}{t_w}}$

(K1-5) when $d_R < d$, $R > 34 \cdot t_w^2 \cdot \left[1 + 3 \cdot \frac{N}{d} \cdot \left(\frac{t_w}{t_f} \right)^{1.5} \right] \cdot \sqrt{F_{yw} \cdot \frac{t_f}{t_w}}$

where F_{yw} is yielding stress of beam web

$$(K1-6) \quad \text{when } \frac{d_c/t_w}{l/b_f} < 2.3, \text{ and the flange is against rotation and } R > \frac{6800 \cdot t_w^3}{h} \cdot \left[1 + 0.4 \cdot \left(\frac{d_c/t_w}{l/b_f} \right)^3 \right]$$

$$(K1-7) \quad \text{when } \frac{d_c/t_w}{l/b_f} < 1.7, \text{ and the flange is NOT against rotation and } R > \frac{6800 \cdot t_w^3}{h} \cdot \left[0.4 \cdot \left(\frac{d_c/t_w}{l/b_f} \right)^3 \right]$$

a. $d_c = d - 2 \cdot k$, l = unbraced length of flange

b. If the flange is against rotation and $\frac{d_c/t_w}{l/b_f} \geq 2.3$, or the flange is NOT against rotation and $\frac{d_c/t_w}{l/b_f} \geq 1.7$, then condition S4 need not be checked.

(K1-1) & (K1-8)

F_{yc} column yielding stress

If the force is due to dead and live load only $P_{bf} = \frac{5}{3} \cdot$ (force delivered by the flange or moment connection)

If the force is due to dead and live load in conjunction with wind or earthquake

$$P_{bf} = \frac{4}{3} \cdot \text{(force delivered by the flange or moment connection)}$$

$$(J8-1) \quad \frac{R}{\sum b_s' t_s} \leq 0.9 \cdot F_y \quad (\text{AISC 1978 1.5.1.5.1, Text 675})$$

[Spec K 1.8] $\frac{R}{\sum b_s \cdot t_s + m \cdot t_w} \leq F_a$, with $k \cdot l = 0.75 \cdot h$ (Figure ASD05.emf)

when $d_R < d$ $m = 12 \cdot t_w$

when $d_R \geq d$ $m = 25 \cdot t_w$

(K1-9) $A_{st} \geq \frac{P_{bf} - F_{yc} \cdot t_w \cdot (t_b + 5 \cdot k)}{F_{yst}}$

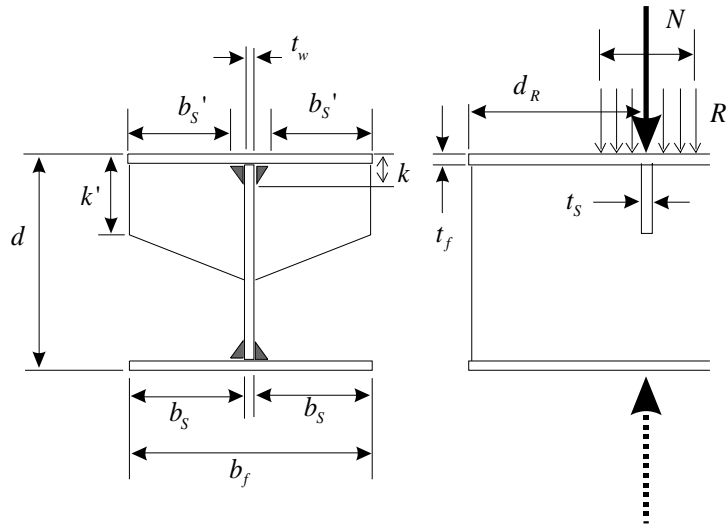
$A_{st} = \sum b_s \cdot t_s$ F_{yst} = Stiffener yielding stress

TRANSVERSE STIFFENER

Situations When Transverse Stiffeners Are Required (Figure ASD03.emf)

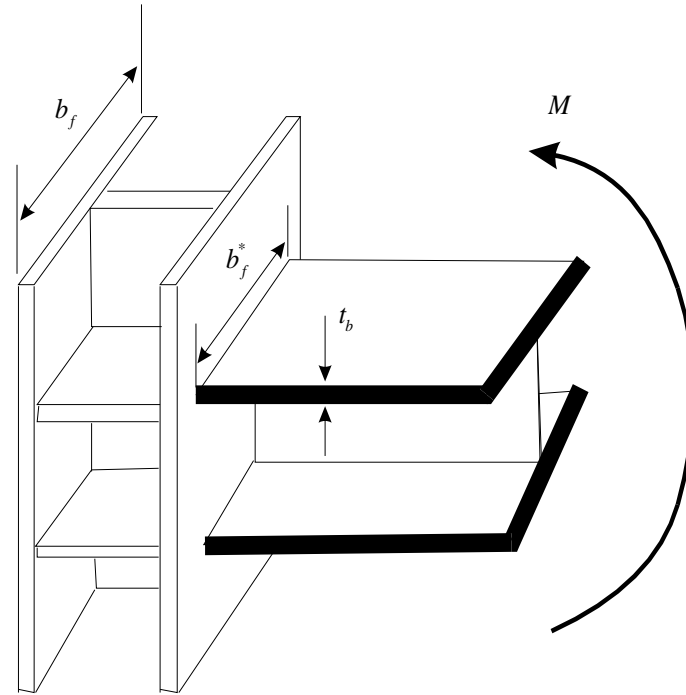
When $\frac{h}{t_w} > 260$ and $f_v > F_v$, stiffeners are required, such that

1. $\frac{a}{h} \leq \left[\frac{260}{h/t_w} \right]^2$ and $\frac{a}{h} < 3.0$ (F5-1)
2. $f_v \leq F_v^*$ where $F_v^* = F_v \cdot \frac{a}{h}$



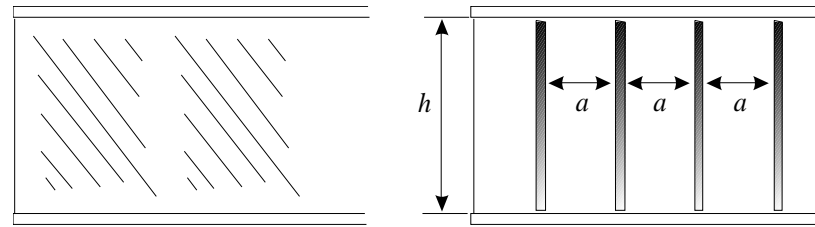
Bearing Stiffeners

Figure ASD01.emf



Outside of the flange connected to another beam for bearing moment

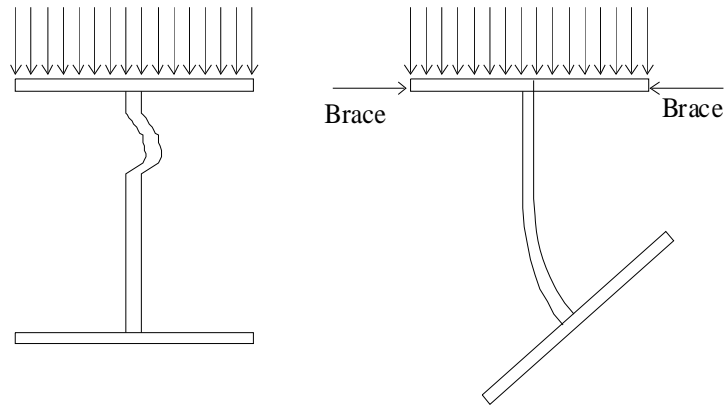
Figure ASD02.emf



Web Shear Yielding

Transverse Stiffener

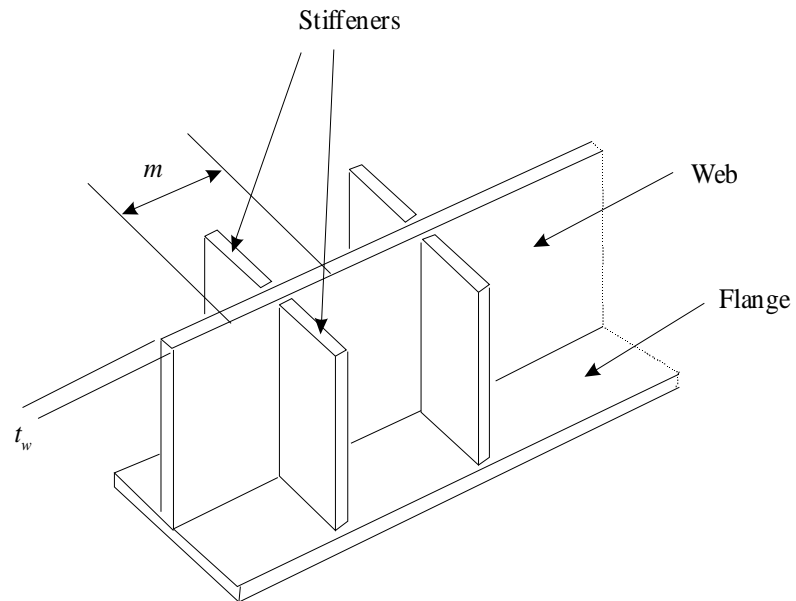
Figure ASD03.emf



Web Crippling

Sidesway Web Buckling

Figure ASD04.emf



[Spec K 1.8] Minimum Area Requirement for Bearing Stiffeners
Figure ASD05.emf