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.

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BEARING STIFFENER

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

S1. If $N > 0.15 \cdot b_f$, and $t_f \le 0.4 \cdot \sqrt{\frac{P_{bf}}{F_{yc}}}$, 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 $(d - 2k) > \frac{4100 t_w^3 \cdot \sqrt{F_{yc}}}{P_{bf}}$, 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)

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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 $b_S + \frac{1}{2}\cdot t_w \geq \frac{1}{3}\cdot$ (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

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(K1-6) when $\frac{d_c/t_w}{l/b_f} < 2.3$, 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) when $\frac{d_c/t_w}{l/b_f} < 1.7$, 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

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

(J8-1) $\frac{R}{\sum b_S' \cdot t_S} \leq 0.9 \cdot F_y$ (AISC 1978 1.5.1.5.1, Text 675)

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[Spec K 1.8] $\dfrac{R}{\sum b_S \cdot t_S + m \cdot t_w} \le F_a$, with $k \cdot l = 0.75 \cdot h$ (Figure ASD05.emf)

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

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

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

$A_{st} = \sum b_S' \cdot t_S$ F_{yst} =Stiffener yielding stress

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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. $\frac{a}{h} \le \left[\frac{260}{h/t_w}\right]^2$ and $\frac{a}{h} < 3.0$ (F5-1)

2. $f_v \le F_v^*$ where $F_v^* = F_v \cdot \frac{a}{h}$

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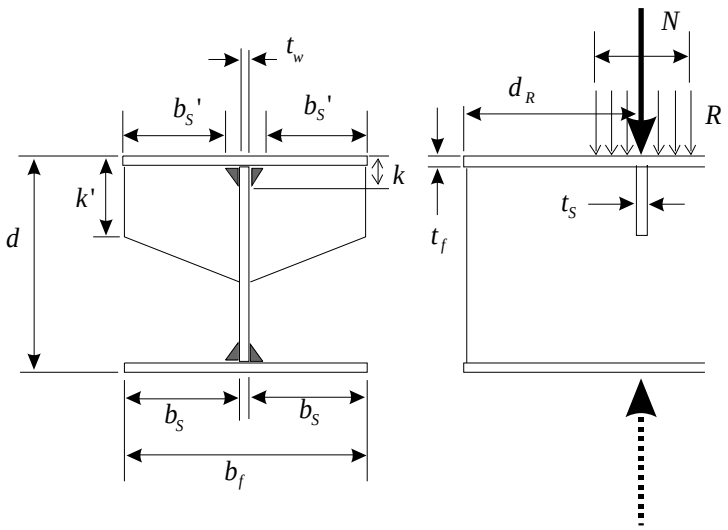
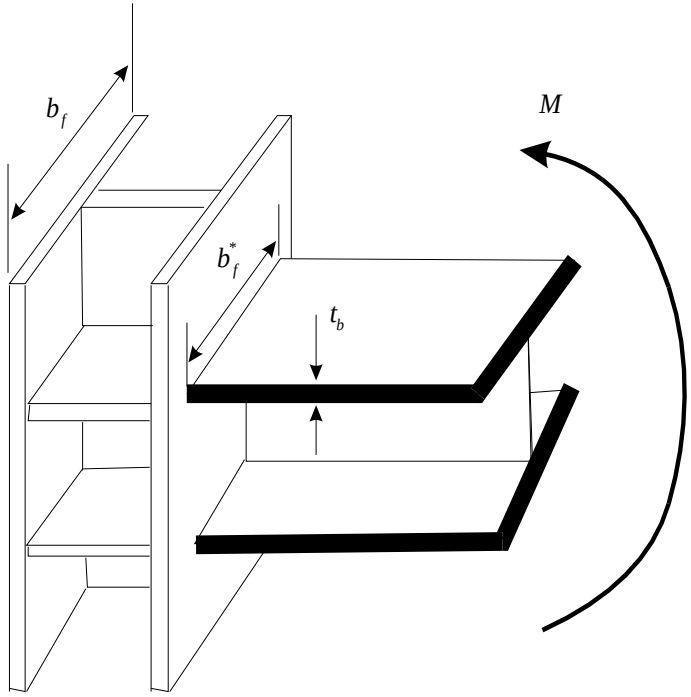


Bearing Stiffeners

Figure ASD01.emf



Outside of the flange connected to another beam for bearing moment

Figure ASD02.emf

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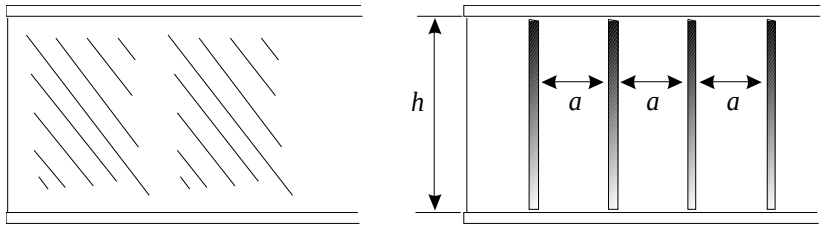
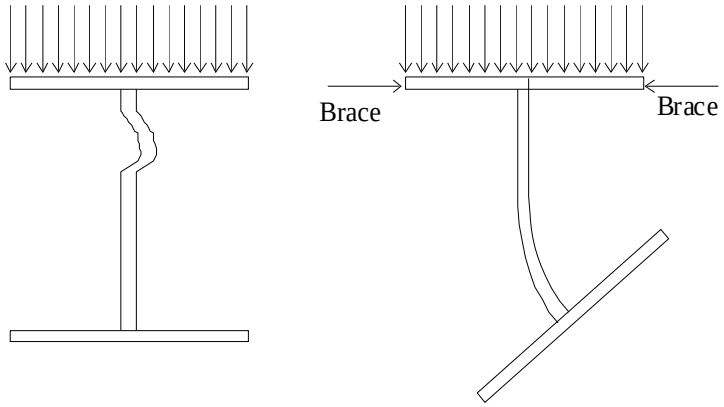


Web Shear Yielding

Transverse Stiffener

Figure ASD03.emf



Web Crippling

Sidesway Web Buckling

Figure ASD04.emf

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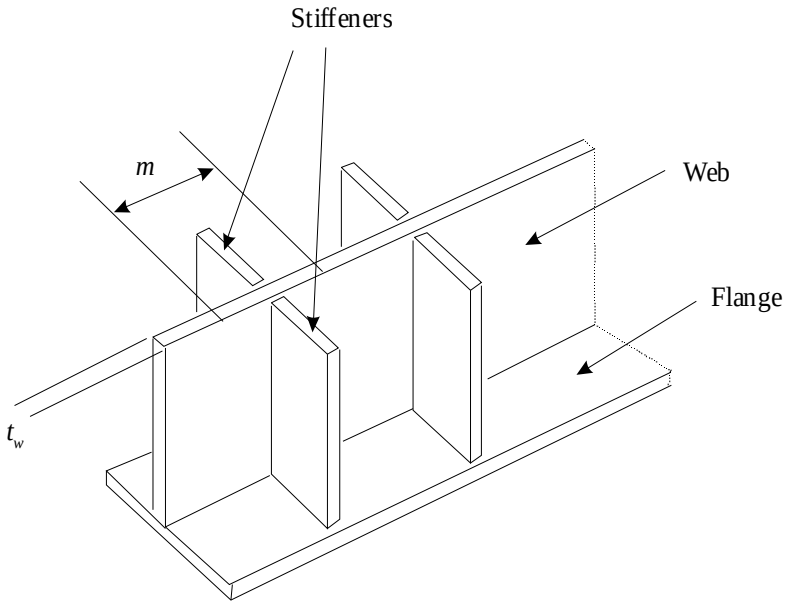

[Spec K1.8] Minimum Area Requirement for Bearing Stiffeners
Figure ASD05.emf

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