Weld Calculations Made Simple: Checking HSS Welds Using STI's Effective Weld Length Calculator

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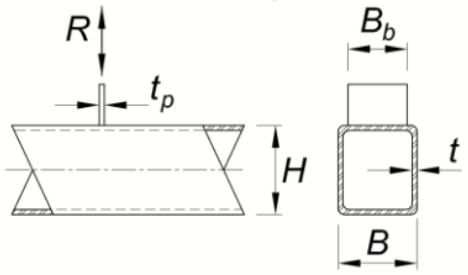
The Steel Tube Institute offers a convenient online tool to assist in determining the effective weld lengths for elements connected to HSS members. The effective weld length can then be multiplied by the weld size to quickly determine weld capacity. The tool is especially helpful for connection types where calculations can otherwise become complex and time-consuming. Let's look at two examples to demonstrate the Effective Weld Length Calculator capabilities.

Connection Type 1: Transverse Plate to Rectangular HSS

- HSS material: ASTM A500 Gr. C ($F_y = 50\ ksi,\ F_u = 62\ ksi$)
- Column: HSS12x8x1/2
- Plate Material: ASTM A572 ($F_y = 50\ ksi,\ F_u = 65\ ksi$)
- Plate: PL 3/8 x 6 1/2 in
- Plate is attached to narrow face of HSS

Effective Weld Lengths - AISC 360-22 Table K5.1

Connection Type: Transverse Plate - Rectangular



HSS Chord

Shape =	Rectangular
Steel Grade =	ASTM 500 Gr C
Yield Strength F_y =	50 ksi
Section =	HSS12x8x1/2
- Plate attached to narrow chord face	

Transverse Plate T- and Cross-Connections

Steel Grade =	ASTM A572
Yield Strength F_y =	50 ksi
Plate Width, B_b =	6 1/ 2 in
Plate Thickness t_p =	3/ 8 in

Chord Geometry		Plate Geometry	
Width: B =	8 in	Width: B_b =	6 1/ 2 in
Height: H =	12 in	Thickness: t_p =	0.375 in
Design Thickness: t =	0.465 in		

Figure 1.1
STI Effective Weld Length Calculator: User Input Summary for Transverse Plate-to-HSS Connection

We will calculate the effective weld length for the transverse plate per AISC 360-22 Specification Chapter K, Table K5.1:

$$B_e = \left(\frac{10}{B/t}\right)\left(\frac{F_y t}{F_{yb} t_b}\right) B_b \le B_b = \left(\frac{10}{8\ in/0.465\ in}\right)\left(\frac{50\ ksi \times 0.465\ in}{50\ ksi \times 0.375\ in}\right) 6.5\ in = 4.68\ in \qquad \textit{AISC 360-22 Spec Eq. (K1-1)}$$

$$l_e = 2B_e = 2 \times 4.68\ in = 9.37\ in \qquad \textit{AISC 360-22 Spec Eq. (K5-4)}$$

Compare these values with the output from the STI Effective Weld Length Calculator shown below:

Effective Weld Properties

Eq. K1-1	$B_e = \left(\frac{10}{B/t}\right)\left(\frac{F_y t}{F_{yb} t_b}\right) B_b \le B_b$	B_e = 4.68 in Effective Branch Width
Eq. K5-4	$l_e = 2B_e$	l_e = 9.37 in Effective Weld Width

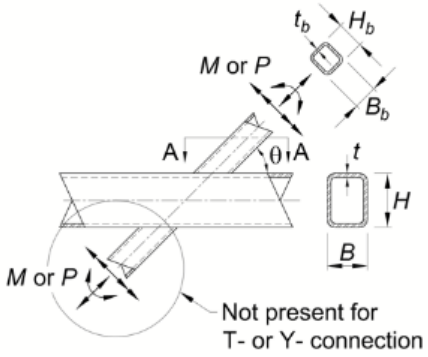
Figure 1.2
STI Effective Weld Length Calculator: Calculation Results for Transverse Plate-to-HSS Connection

Connection Type 2: Rectangular HSS-to-Rectangular HSS, Y-Connection, Under Branch Axial Load or Bending

- HSS material: ASTM A500 Gr. C ($F_y = 50\ ksi,\ F_u = 62\ ksi$)
- HSS chord shape: HSS12x8x1/2
- HSS branch shape: HSS6x6x3/8
- HSS branch angle $\theta = 45°$
- Branch is attached to narrow face of chord
- Check a 1/4" weld throat thickness

Effective Weld Lengths - AISC 360-22 Table K5.1

Connection Type: T-, Y-, or X- Rectangular

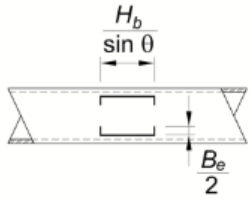


HSS Chord

Shape =	Rectangular
Steel Grade =	ASTM 500 Gr C
Yield Strength F_y =	50 ksi
Section =	HSS12x8x1/2
- Branch attached to narrow chord face	

HSS Branch

Shape =	Square
Steel Grade =	ASTM 500 Gr C
Yield Strength F_y =	50 ksi
Section =	HSS6x6x3/8
Branch Angle θ =	45.0 °
Weld Throat t_w =	1/ 4 in



Section A-A: Effective weld

Chord Geometry

Width: B =	8 in
Height: H =	12 in
Design Thickness: t =	0.465 in

Branch Geometry

Width: B_b =	6 in
Height: H_b =	6 in
Design Thickness: t_b =	0.349 in
Branch to Chord Width Ratio: β =	0.75

Figure 2.1
STI Effective Weld Length Calculator: User Input Summary for Rectangular HSS-to-HSS, Y-Connection

Calculate the effective weld length and moments of inertia for the weld group per AISC 360-22 Specification Chapter K, Table K5.1, Equations (K5-5) through (K5-7):

$$B_e = \left(\frac{10}{B/t}\right)\left(\frac{F_y t}{F_{yb} t_b}\right) B_b \le B_b = \left(\frac{10}{8\ in/0.465\ in}\right)\left(\frac{50\ ksi \times 0.465\ in}{50\ ksi \times 0.349\ in}\right) 6\ in = 4.65\ in$$

AISC 360-22 Spec Eq. (K1-1)

$$l_e = \frac{2H_b}{\sin\theta} + 2B_e = \frac{2\times 6\ in}{\sin 45} + 2 \times 4.65\ in = 26.26\ in$$

AISC 360-22 Spec Eq. (K5-5)

$$S_{ip} = \frac{t_w}{3}\left(\frac{H_b}{\sin\theta}\right)^2 + t_w B_e \left(\frac{H_b}{\sin\theta}\right) = \frac{0.25\ in}{3}\left(\frac{6\ in}{\sin 45}\right)^2 + 0.25\ in \times 4.65\ in \left(\frac{6}{\sin 45}\right) = 15.86\ in^3$$

AISC 360-22 Spec Eq. (K5-6)

$$S_{op} = t_w \left(\frac{H_b}{\sin\theta}\right) B_b + \frac{t_w}{3} {B_b}^2 - \frac{(t_w/3)(B_b - B_e)^3}{B_b}$$

$$= 0.25\ in \left(\frac{6\ in}{\sin 45}\right) 6\ in + \frac{0.25\ in}{3}(6\ in)^2 - \frac{(0.25\ in/3)(6\ in - 4.65\ in)^3}{6\ in} = 15.69\ in^3$$

AISC 360-22 Spec Eq. (K5-7)

Again, these values can be compared to output from the STI Effective Weld Length Calculator:

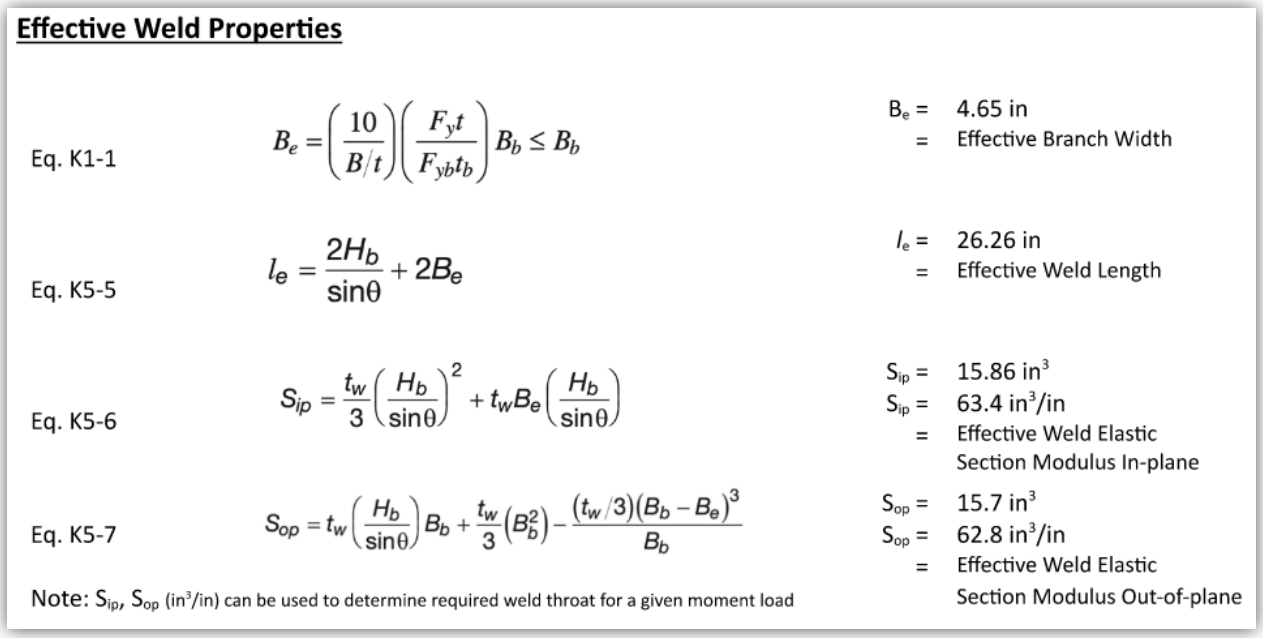


Figure 2.2
STI Effective Weld Length Calculator: Calculation Results for Rectangular HSS-to-HSS, Y-Connection