steel quiz

This month's Steel Quiz is based on the guidance and equations on transfer forces provided in Appendix D of AISC Design Guide 29: *Vertical Bracing Connections—Analysis and Design* (available at www.aisc.org/dg). The question and answer were contributed by Hamza Sekkak, a PhD student at the Illinois Institute of Technology. Thank you, Hamza!

Given the frame shown in Figure 1, calculate the transfer force (TF) at the highlighted connection in the center using the configuration shown in Figure 2. Treat end connections as pinned. The 1.5 k/ft force shown is being delivered by the attachment of a diaphragm to beams B3 and B4. The 10-kip and 20-kip forces shown are being delivered by the attachment of horizontal bracing to the beam ends.

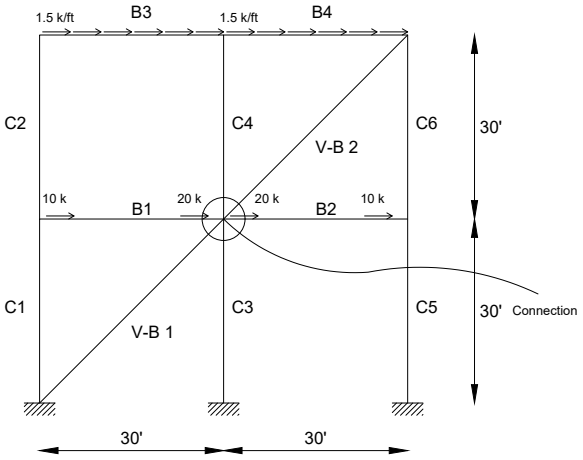

Figure 1

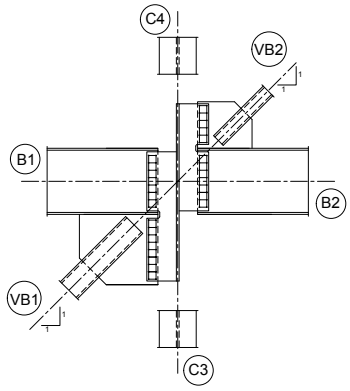

Figure 2

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steel quiz ANSWERS

Tension values are shown as positive and compression values as negative.

The transfer force can be determined by summing the forces on the left-hand side or right-hand side of the column and determining what force is required to achieve equilibrium. Using the configuration shown in Figure 2, the TF can be defined using the x-direction components of the forces as follows:

$$\begin{cases} TF = VB1_x + B1_x - (20 \text{ kips}) \\ \text{or} \\ TF = VB2_x + B2_x + (20 \text{ kips}) \end{cases}$$

The structural analysis of the frame has led to the following summary of results of internal forces (note that these values can be computed using hand calculations):

Member Label	Axial (kips)
C1	0
C2	0
C3	-60
C4	0
C5	-90
C6	-90
B1	-10
B2	10
B3	Linear: 0 to -45
B4	Linear: -45 to -90
VB1	212
VB2	127

Therefore:

$$\begin{cases} TF = (212 \times \cos 45) + (-10) - (20) = 120 \text{ kips} \\ \text{or} \\ TF = (127 \times \cos 45) + 10 + (20) = 120 \text{kips} \end{cases}$$

The TF of 120 kips represents the force that is transferred from the braced frame on the right-hand side of the column to the braced frame on the left-hand side of the column. Keep in mind that the AISC *Code of Standard Practice* states that when the fabricator is required to design connection details, the structural design drawings shall provide, among other things, "data concerning the loads, including shears, moment, axial forces and transfer forces, that are to be resisted by the individual members and their connections, sufficient to allow the fabricator to selet or complete connection details…" The approach demonstrated in this quiz is one way to determine the transfer force.

STEEL SOLUTIONS CENTER

If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or **solutions@aisc.org**.