Designing for Relative Stiffness with the iLevel® Shear Brace (iSB)

Pre-fabricated shear wall products such as the iSB have varying stiffness depending on the brace height and width. As a result, special attention must be taken to ensure that the lateral loads are properly distributed to the lateral load resisting elements based on the relative stiffness of each element. Where multiple iSB's are placed in a wall line and/or combined with other shear resisting elements, the lateral load must be proportioned based on the lateral stiffness of the shear wall elements by assuming that deflection for each wall will be equal.

The following section is a design example that illustrates how lateral loads should be distributed to multiple iSB's in a wall line.

Sample Calculation

Given:
Design Seismic Shear Load = 5000 lbs.
Design Wind Shear Load = 6000 lbs.
Plate Height = 9 ft

Solution:
Try iSB 24x9 and 18x9

Allowable Design Loads for Brace on Concrete Foundation

Brace[1]	Width	Height	Total Vertical Load[2] (lbs)	Seismic Design			Wind Design		
				Allowable Shear[3] (lbs)	Drift at Allowable Shear[3] (in.)	Holdown Uplift at Allowable Shear[4][5] (lbs)	Allowable Shear[3] (lbs)	Drift at Allowable Shear[3] (in.)	Holdown Uplift at Allowable Shear[4][5] (lbs)
iSB 18x9	18"	10 5/16"	8,000	1,905	0.43	13,770	2,090	0.51	15,105
iSB 24x9	24"	10 5/16"	8,000	3,905	0.42	21,280	4,295	0.47	23,405

Develop stiffness for each panel by dividing the allowable shear by the drift at allowable shear.

Brace	$k_{seismic}$ (lbs/in)	k_{wind} (lbs/in)
iSB 18x9	4430	4098
iSB 24x9	9298	9138
Total	13728	13236

$$F = k\Delta$$
$$k = \frac{F}{\Delta}$$
$$\sum F = \sum \Delta_1 x_1 + \ldots + \Delta_n x_n$$
$$\Delta = \Delta_1 = \Delta_2 = \ldots = \Delta_n$$
$$F_{tot} = (k_1 + \ldots + k_n)\Delta$$
$$\Delta = \frac{F_{tot}}{k_1 + \ldots + k_n}$$
$$F_n = k_n \Delta$$

Divide the design load by the total stiffness of the wall line to find the total deflection of the wall line.

Total Seismic Deflection (in.)	5000/ 13728	=	0.364223
Total Wind Deflection (in.)	6000/ 13236	=	0.453298

This deflection is then multiplied by the stiffness of each panel to determine the load to each panel.

Brace	Distributed Seismic Shear (lbs)	Allowable Seismic Shear (lbs)	Distributed Wind Shear (lbs)	Allowable Wind Shear (lbs)	Status
iSB 18x9	1614	1905	1858	2090	OK
iSB 24x9	3386	3905	3328	4295	OK