Technical Bulletin #22c

Created: 4-26-99, Revised: 6-15-11

DIAPHRAGM CAPACITY OF PREMIER SIPs

Premier SIPs has completed a series of full-scale diaphragm tests to determine design values for Premier SIPs Structural Insulated Panels. These full-scale tests were conducted following the protocols of ASTM E455 "Standard Method for Static Load Testing of Framed Floor or Roof Diaphragm Constructions for Buildings" and ASTM E1803 "Standard Test Methods for Structural Capacities of Insulated Panels".

Three separate assemblies using variations of fasteners were tested in sets of two, as is required in the ASTM protocols. Each diaphragm was made up of 6-4'x12'x6" panels creating a diaphragm of 8' x 36' for an aspect ratio of 4.5 to1. The panels were supported on 4x6's at each 8' edge and at the third points along the 36' length of the diaphragm. Along the 36' lengths of the diaphragm were 4x6's that were spliced together to act as the chord members of the diaphragm. The two 8' ends of the diaphragm were the support locations, which simulated shear walls supporting the diaphragm.

The lateral loads were applied to the diaphragm at the third points via a hydraulic ram. The 4x6 frame had reaction points at the end of each of the 8' sides. By applying loads through the panel diaphragm in this manner and having the reaction points on the 4x6 frame, we were assured that the load was applied to the panel diaphragm; therefore, the screw fasteners had to transfer the shear forces to the supporting 4x6's.

Each set of the three panel assemblies varied the number of screws and nails that were used to connect the panels to each other and to the supporting 4x6's. In two of the tests the fastening pattern within the diaphragm varied according to the expected shear forces in the diaphragm. These two diaphragms were sectioned into thirds. The center third of the diaphragm had less fasteners than the outside thirds as the loads in this area are minimal. Fastener number and placement corresponded to the shear diagram of the tested diaphragm, i.e. more fasteners at a closer spacing were used in the outside thirds of the diaphragms as compared to the center third of the diaphragm. Shear is always the greatest at the supported edges. This was done as a means to economize labor as well as the number of fasteners used in the diaphragm. All fasteners installed in these tests were applied on the topside of the diaphragm only. Premier SIPs typical details call for 8d nails at the splines on both faces of the panel. When top spline only methods are used the fastening frequency is doubled.

The first assembly used 8d nails @ 3" on center throughout the diaphragm to fasten the 7/16" OSB splines. The 3" on center spacing was used because the diaphragm was only nailed on the topside. The typical nail spacing is 6" on center for fastening splines on both faces of the panels. The panel screw fasteners were spaced at 12" on center into all of the 4x6's. This diaphragm achieved 450-plf design shear capacity. This value reflects a safety factor of three. The deflection of the diaphragm across the 36' at 435-plf was 0.41".

The second assembly used 8d nails @ 3" on center to fasten the OSB splines in the center third of the diaphragm and 2" on center in the outside thirds. The panel fastener spacing in the outside thirds of the diaphragm was decreased to 3" on center. The screw spacing was changed for the end of the diaphragm as well as along the top and bottom chords of the diaphragm. This diaphragm achieved 550-plf design shear capacity. Again this value has a safety factor of three. The deflection of the diaphragm across the 36' at 538-plf was 0.37".

Technical Bulletin #22c

Created: 4-26-99, Revised: 6-15-11

The third assembly used 8d nails @ 3" on center to fasten the OSB splines in the center third of the diaphragm and 1 ½" on center in the outside thirds. The panel fastener spacing in the outside thirds of the diaphragm was decreased to 2" on center. The screw spacing was changed for the end of the diaphragm as well as along the top and bottom chords of the diaphragm. This diaphragm had a design value of 750-plf. This value represents a safety factor of three. The deflection of the diaphragm across the 36' at 750-plf was 0.37".

Subsequent to the diaphragm testing just described, Premier SIPs conducted an additional two diaphragm tests. In these tests the same nail and panel fastener spacing was maintained throughout the diaphragm, which consisted of 6-4'x8'x6" panels configured to make an 8'x24' diaphragm.

The first diaphragm utilized 7/16" splines connecting the panels with a nailing pattern of two rows of 0.113" x 2-3/8" nails at 3" on center. Only the top OSB skin was nailed. The perimeter panel fastener screws attaching the diaphragm to the chord members were spaced at 4" on center. This diaphragm had a capacity of 917 plf. The deflection of the diaphragm across the 24' at 917-plf was 0.18".

The second diaphragm utilized 23/32" splines connecting the panels with a nailing pattern of two rows of 0.113" x 2-3/8" nails at 3" on center. Only the top OSB skin was nailed. The perimeter panel fastener screws attaching the diaphragm to the chord members were spaced at 4" on center. This diaphragm had a capacity of 1136 plf. The deflection of the diaphragm across the 24' at 1136-plf was 0.19".

Each of the values reported for the capacity of the diaphragm is a design value. It has a factor of safety of three associated with it.

In any designs using the diaphragm capacity of the panels, it is up to the designer or engineer to determine the required diaphragm capacities and then apply the values described in this technical bulletin appropriately.