# INNOVATIVE RESIDENTIAL FLOOR CONSTRUCTION:
## HORIZONTAL DIAPHRAGM VALUES FOR COLD-FORMED STEEL FRAMING

Prepared for

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**Table 1**
**Design Unit Shear Values for Unblocked Horizontal Diaphragms Using Structural Wood Panels and Douglas-Fir Framing [8]**

| Plywood Grade | Common Nail Size or Screw Size | Fastener Spacing[1] | Minimum Panel Thickness (in.) | Maximum Joist Spacing (in.) | Minimum Nominal Size of Framing Member (in.) | Design Unit Shear Value (plf) | Load Factor[2] |
|---|---|---|---|---|---|---|---|
| Structural I | 10d | 6/12 | 15/32 | 24 | 2x | 285 | 3.90 |
| C-D, C-C, and other grades | 10d | 6/12 | 15/32 | 24 | 2x | 255 | 4.57 |
| | | | 19/32 | 24 | 2x | 285 | 3.89 |
| APA Rated STURD-I-FLOOR | 10d | 6/12 | 19/32 | 24 | 2x | 285 | 4.68 |
| | | | 15/32 | 24 | 2x | 255 | 5.12 |
| APA Rated STURD-I-FLOOR | 8d | 6/12 | 15/32 | 24 | 2x | 240 | 4.66 |
| Structural I C-D 32/16 | 8d | 6/12 | 1/2 | 24 | 2x10 | 240 | 5.83 |
| Structural I C-D 48/24 | 10d | 6/6 | 3/4 | 48 | 3x12 | 320 | 3.94 |
| 2-4-1 T&G | 8d | 6/6 | 3/4 | 48 | Double 2x8 | 320 | 3.55 |
| Structural I C-D 48/24 | #10 Screw | 6/12 | 3/4 | 48 | Steel Truss | 190 | 3.79 |

For SI: 1 inch = 25.4 mm, 1 plf = 1.488 Kg/m
[1] The first number in the schedule refers to panel edge fastener spacing (inches) along panel edges supported by joists, and the second number refers to fastener spacing (inches) along framing members not at panel edges.
[2] The load factor is determined by dividing the ultimate tested shear value by the design shear value [8].

As can be seen in Table 1, the design shear values for wood diaphragms have somewhat inconsistent and conservative load factors (i.e., safety factor).

## Review of Design Procedures

The use of diaphragm action to resist seismic and wind loads is common practice in the design of residential construction. A typical residential floor diaphragm comprises of a number of component elements including floor sheathing, primary supporting members (joists), secondary supporting members (braces), shear connectors, and a variety of fasteners (nails, pneumatic fasteners, screws, etc.). The shear capacity of diaphragms depends mostly on the strength and spacing of the individual fasteners that connect the sheathing to the floor or roof framing.

Design professionals typically model floor diaphragms as deep horizontal beams that carry in-plane forces to stiffened points in the structure (i.e. shear walls). Plywood or oriented-strand-board (OSB) sheathing acts as the web of the beam and the edge framing acts as the flanges of the beam. This diaphragm action provides lateral stability to the structure. To simplify design, the web is assumed to resist only shear forces and the flanges are assumed to resist only flexural forces. The stiffness and ultimate strength of a floor diaphragm must be established by a designer. Prediction of these quantities can be accomplished using any of the following three approaches: