

Analysis of Sure-Board Series 200W Double-Sided 4 ft. x 9 ft. and Series MDF Single-Sided 8 ft. x 8 ft. Shear Wall Test Data

GENERAL

This report presents the results of an analysis of four reversed cyclic wood frame shear wall tests recently conducted using Sure-Board’s Series 200W and MDF panels. The four tests comprised three 4 ft. x 9 ft. (1.22 m x 2.74 m) double-sided Series 200W and one 8 ft. x 8 ft. (2.44 m x 2.44 m) single-sided Series MDF walls. In each test the panels were applied parallel to framing. General descriptions of the four Sure-Board walls are given in Table 1 (based in data provided by Specialized Testing). In addition to the Sure-Board analysis, the results of three 8 ft. x 8 ft. shear wall tests (*15/32-in. STR. 1 plywood panels attached to wood framing with 10d handdriven common nails at 2 in. on panel edges and 12 in. at intermediate supports*) conducted under the CoLA-UCI test program are compared with the results from the 8 ft. x 8 ft. Sure-Board test.

Table 1. Shear wall tests

| Specimen | Description |
|----------|---|
| SB_1-3 | 4 ft. x 9 ft. Series 200W Wall, Wood Framed with 4x6 Posts, Series 200W (Double Sided), Simpson HD15 at Exterior of Post, 10d Nails @ 2/6, With Compression Posts and TimberStrand 2x4 Sill Plate |
| SB_2-3 | Same as SB_1-3 |
| SB_3-3 | Same as SB_1-3 |
| SB_8x8 | 8 ft. x 8 ft. Sure-Board (MDF) Panel with Ring Shank Nails @ 2-in./6-in. Single Sill Plate - 4 -5/8-in. Diameter Sill Anchors |

TEST DATA

The response curves for the four Sure-Board test specimens are shown in Figures 1 through 4. The “backbone” curves (peak strength envelope curves) are also illustrated in the figures. The backbone curve was developed using the peak resistance values for the first cycle of each target displacement, as illustrated in Figure 5.

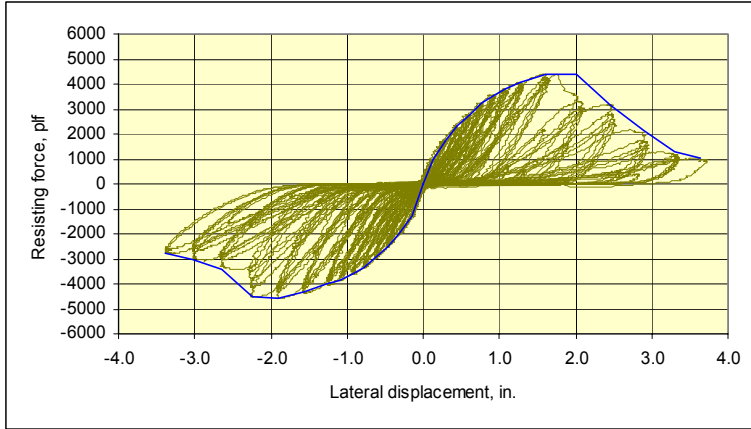


Figure 1. Specimen SB_1-3 response

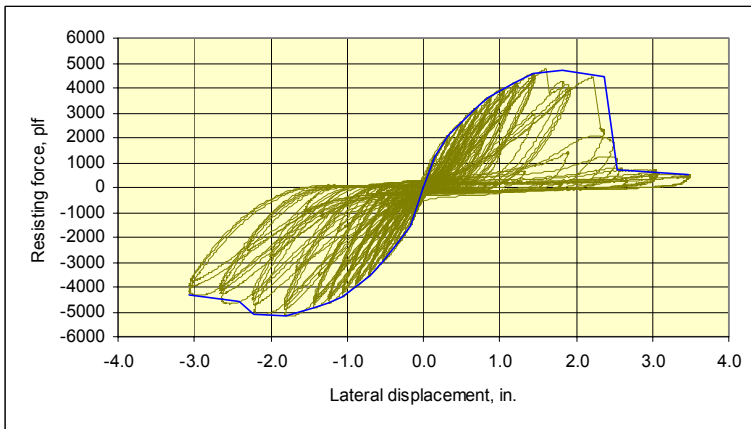


Figure 2. Specimen SB_2-3 response

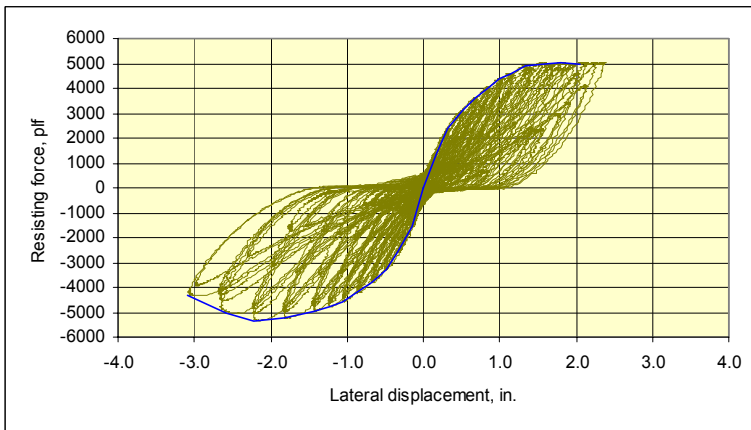


Figure 3. Specimen SB_3-3 response

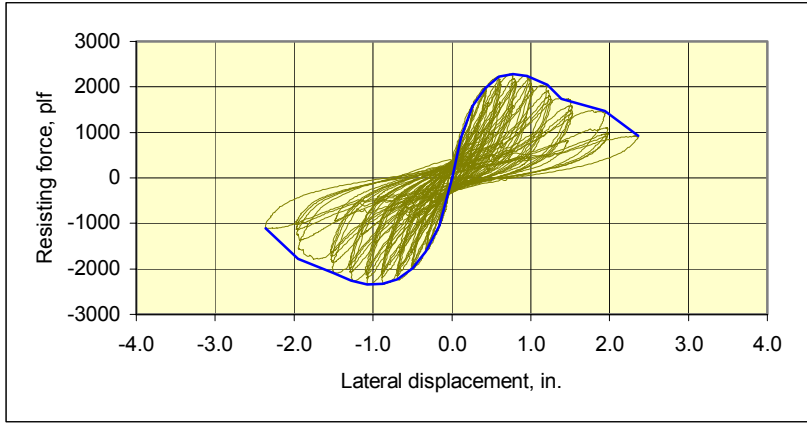


Figure 4. Specimen SB_8x8 response

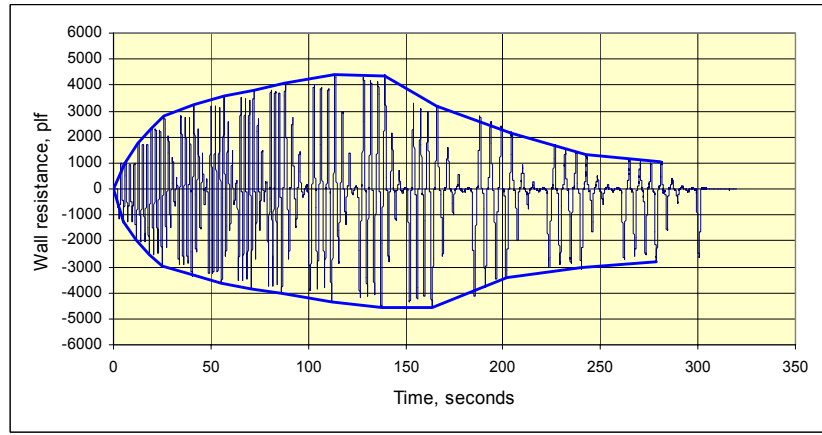


Figure 5. Wall resistance values used to develop the backbone curves in Figures 1 through 4

ANALYSIS OF TEST DATA

Using the backbone curves shown in Figures 1 through 4, the nominal strength level resistance and the corresponding lateral displacement were derived as illustrated in Figure 6. For a given test, the positive (pull) and negative (push) LRFD and ASD level resistances were then determined from the corresponding positive and negative nominal values as follows:

- $\pm F_{LRFD} = 0.55(\pm) F_{nominal}$ and $\pm \Delta_{LRFD}$ was derived from the backbone curve

$$- \pm F_{allowable} = \frac{\pm F_{LRFD}}{1.4} \left(\frac{2.5}{3.0} \right) = \frac{\pm F_{LRFD}}{1.68} \text{ and } \pm \Delta_{allowable} = \frac{\pm \Delta_{LRFD}}{1.68}$$

The $\left(\frac{2.5}{3.0} \right)$ ratio is an adjustment to account for the ICC-ES imposed safety factor (Ω) of 3.0 in Sure-Board's ER-6151. The adjustment was necessary because the Ω value used in design has traditionally been computed as $1.4/\phi$, where ϕ is the resistance factor for the wall. It is noteworthy that the CoLA-UCI shear wall report (*Report of a Testing Program of Light-Framed Walls with Wood-Sheathed Shear Panels, December 2001—produced by SEAOSC and University of California, Irvine*) recommends ϕ of 0.65 for wood structural panels when the wall strength is limited by the connection (sheathing to framing) strength. ϕ of 0.65 gives an implied Ω of 2.15 ($1.4/0.65$). Thus, design using $\phi = 0.55$ and $\Omega = 3.0$ appears to be relatively conservative.

As indicated earlier, data from three 8 ft. x 8 ft. CoLA-UCI wall tests was also analyzed for comparison with the Sure-Board 8 ft. x 8 ft. wall test. Figure 7 compares the results these three identical CoLA-UCI shear walls with the results from SB_8x8. The basic configuration of the CoLA-UCI test is summarized in the figure. Although only a single 8 ft. x 8 ft. test was conducted using the Sure-Board MDF panel, when compared to the CoLA-UCI test results, it is apparent that the Sure-Board MDF panel provides a higher strength and roughly twice the stiffness of the conventional wood structural panel shear wall.

Finally, based on the interpretation of test data described above, the design values for the Sure-Board tests, and the CoLA-UCI tests, are summarized in Table 2. Note that the resistance and deflection values given in Table 2 for a particular test are averages of the push and pull (negative and positive) interpreted values (for example, $F_{LRFD} = (|+F_{LRFD}| + |-F_{LRFD}|)/2$ and $\Delta_{LRFD} = (|+\Delta_{LRFD}| + |-\Delta_{LRFD}|)/2$). In Table 3, rather than interpret all resistance values as averages, only the nominal resistances are computed using the average of the push and pull curves. The LRFD and ASD resistance values are

computed directly from the averaged nominal strength values as $F_{LRFD} = 0.55F_{nominal}$ and $F_{ASD} = F_{LRFD}/1.68$.

It is of interest to note that at a lateral displacement equal to twice the nominal displacement value (Table 2), the MDF wall had a residual level resistance that exceeded (by more than twice) the allowable resistance.

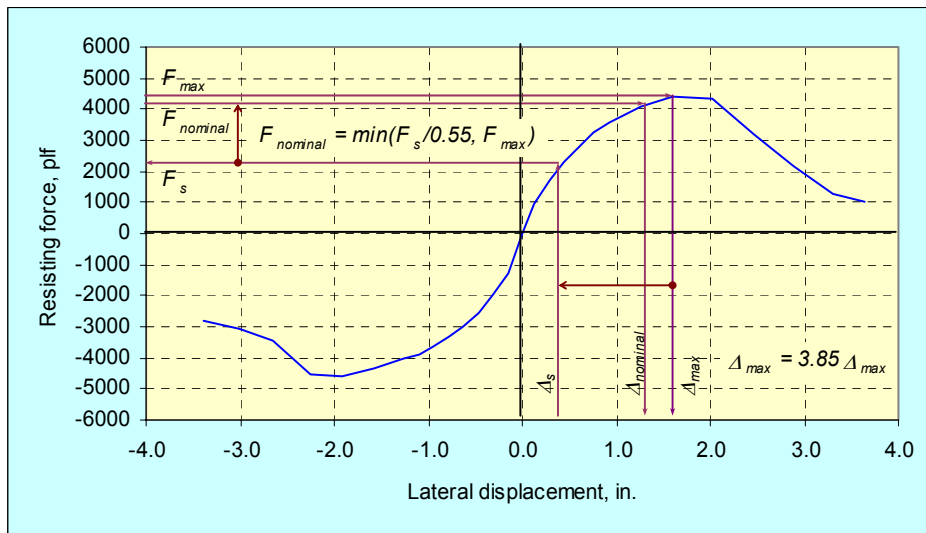


Figure 6. Interpretation of nominal wall strength

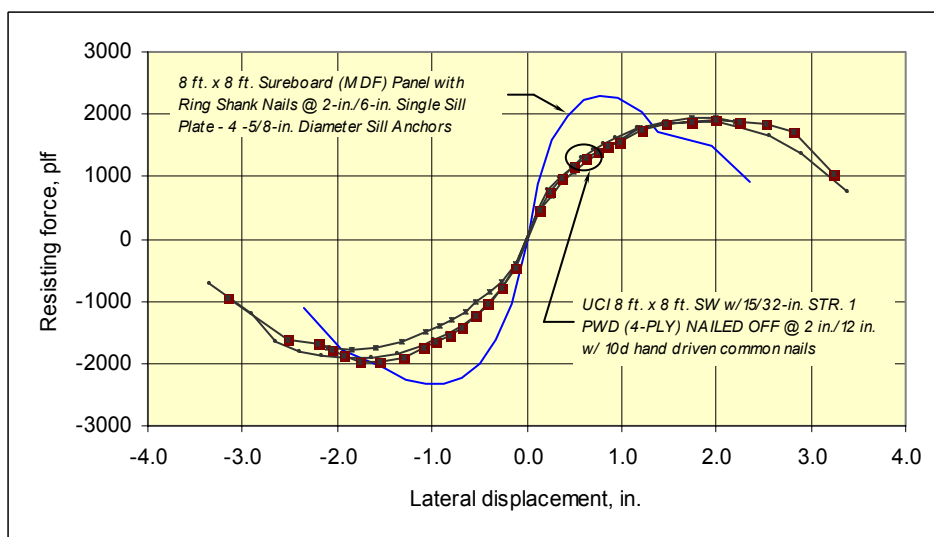


Figure 7. Comparison of CoLA-UCI shear wall tests with SB_8x8

Table 2. Interpretation of test results ¹

| Test No. | F _{max} , plf | Δ at F _{max} , in. | F _{nominal} , plf | Δ at F _{nominal} , in. | F _{LRFD} , plf | Δ at F _{LRFD} , in. | F _{allowable} , plf | Δ at F _{allowable} , in. |
|--------------------|---------------------------|--------------------------------|-------------------------------|------------------------------------|----------------------------|---------------------------------|---------------------------------|--------------------------------------|
| SB_1-3 | 4482 | 1.755 | 4299 | 1.576 | 2408 | 0.441 | 1433 | 0.262 |
| SB_2-3 | 4957 | 1.816 | 4851 | 1.667 | 2668 | 0.472 | 1588 | 0.281 |
| SB_3-3 | 5174 | 2.008 | 5174 | 2.008 | 2846 | 0.414 | 1725 | 0.203 |
| SB_8x8 | 2308 | 0.923 | 2308 | 0.923 | 1270 | 0.176 | 769 | 0.109 |
| <i>9A CoLA_UCI</i> | <i>1893</i> | <i>1.822</i> | <i>1893</i> | <i>1.822</i> | <i>1041</i> | <i>0.313</i> | <i>631</i> | <i>0.189</i> |
| <i>9B CoLA-UCI</i> | <i>1862</i> | <i>1.926</i> | <i>1852</i> | <i>1.843</i> | <i>1032</i> | <i>0.490</i> | <i>621</i> | <i>0.221</i> |
| <i>9C CoLA-UCI</i> | <i>1937</i> | <i>1.889</i> | <i>1937</i> | <i>1.889</i> | <i>1065</i> | <i>0.323</i> | <i>646</i> | <i>0.197</i> |

¹ All values computed as the average of the "push" and "pull" data

Table 3. Recommended design values

| Test No. | F _{nominal} ¹ , plf | Δ ¹ at F _{nominal} , in. | F _{LRFD} , plf | Δ at F _{LRFD} , in. | F _{allowable} , plf | Δ at F _{allowable} , in. |
|-----------------------|---|---|-------------------------|------------------------------|------------------------------|--------------------------------------|
| SB_1-3 | 4299 | 1.576 | 2364 | 0.441 | 1407 | 0.262 |
| SB_2-3 | 4851 | 1.667 | 2668 | 0.472 | 1588 | 0.281 |
| SB_3-3 | 5174 | 2.008 | 2846 | 0.414 | 1694 | 0.203 |
| 3-test average | 4775 | 1.750 | 2626 | 0.442 | 1563 | 0.249 |
| SB_8x8 | 2308 | 0.923 | 1269 | 0.176 | 756 | 0.109 |
| <i>9A CoLA_UCI</i> | <i>1893</i> | <i>1.822</i> | <i>1041</i> | <i>0.313</i> | <i>620</i> | <i>0.189</i> |
| <i>9B CoLA-UCI</i> | <i>1852</i> | <i>1.843</i> | <i>1019</i> | <i>0.490</i> | <i>606</i> | <i>0.221</i> |
| <i>9B CoLA-UCI</i> | <i>1937</i> | <i>1.889</i> | <i>1065</i> | <i>0.323</i> | <i>634</i> | <i>0.197</i> |
| 3-test average | 1894 | 1.851 | 1042 | 0.375 | 620 | 0.202 |

¹ Computed as the average of the "push" and "pull" data