

WALL BRACING WITH A 4:1 ASPECT RATIO USING SHEATHING CUT AROUND OPENINGS

INTRODUCTION

Testing has been conducted on a 25- x 37-foot three dimensional house comparing different construction variables with continuous wood structural panel braced walls using 24-inch-wide (4:1 aspect ratio) bracing segments. This report examines the performance between rectangular sheathing (2 x 8-foot) versus sheathing cut around openings so that a full-size (4 x 8-foot) panel is a “C” shape cut to fit around the openings. Figures 1 and 2 depict the difference between sheathing cut around the opening and not. Builders in some areas, such as the Pacific Northwest, often sheath over openings during construction and cut around the openings later.

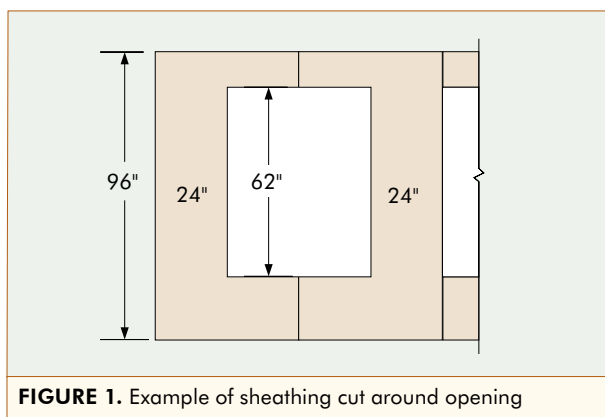


FIGURE 1. Example of sheathing cut around opening

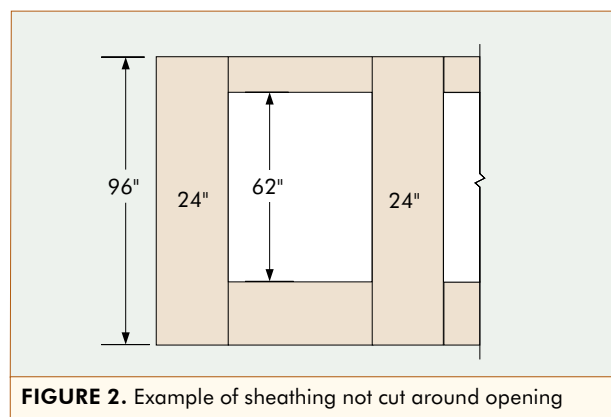


FIGURE 2. Example of sheathing not cut around opening

TEST METHODS

Figure 3 illustrates the five different house plans examined in this report. Each braced wall line was built with 32 percent bracing, which equals 12 feet of total bracing in the 37-foot-long walls and 8 feet of total bracing in the 25-foot-long walls. Tests 5b(C) and Test 5d(8C) had sheathing cut around the opening, and all other tests described in this report did not. Note that the 2-foot returns on the north and south wall for Test 5b and Test 5b(C) are not counted as bracing since they are next to a full-height opening and do not qualify as such per the 2006 International Residential Code (IRC). All wood structural panels used were 7/16-inch OSB APA Rated Sheathing 24/16 Exposure 1. Nails used to attach the OSB to the framing were 8d cooler nails (0.113 x 2-3/8 inches) at 6 inches o.c. at panel edges and 12 inches o.c. at intermediate supports. Figures 4 through 8 show the bracing panel layout for each wall. Test 5d and 5d(8C) had an 800-lbf capacity hold-down device in each corner. Additional construction details can be found in *Progress Report 3D-001*. Load was applied to the structure as described in reports *3D-001* and *3D-002*.

No attempt was made to analyze the impact of the size of the cantilevered portion of the sheathing that was cut around openings. In addition, panel edge nailing into framing at cut out areas was spaced as described above.

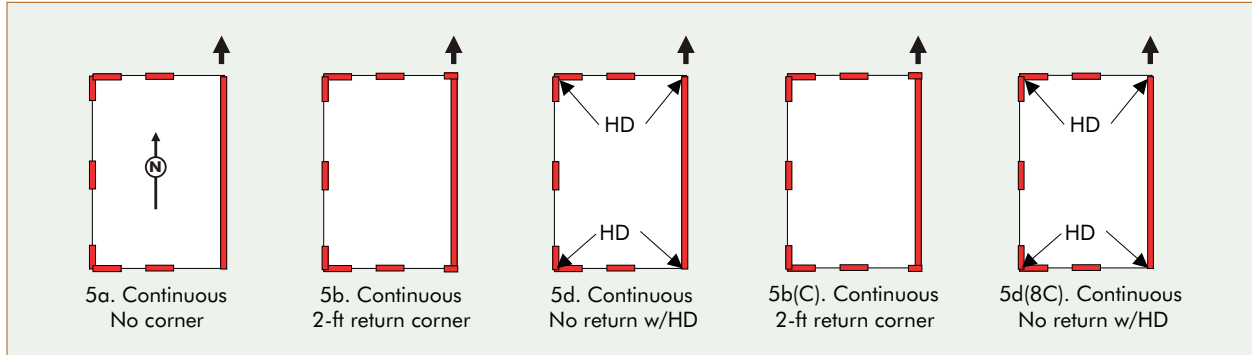


FIGURE 3. Five house plans examined in this progress report. Note the north direction, shown on Test 5a, is typical for each test. The “C” used within the test designation, e.g., 5b(C) and 5d(8C), indicates that sheathing was “Cut” around the openings for those tests on the east wall.

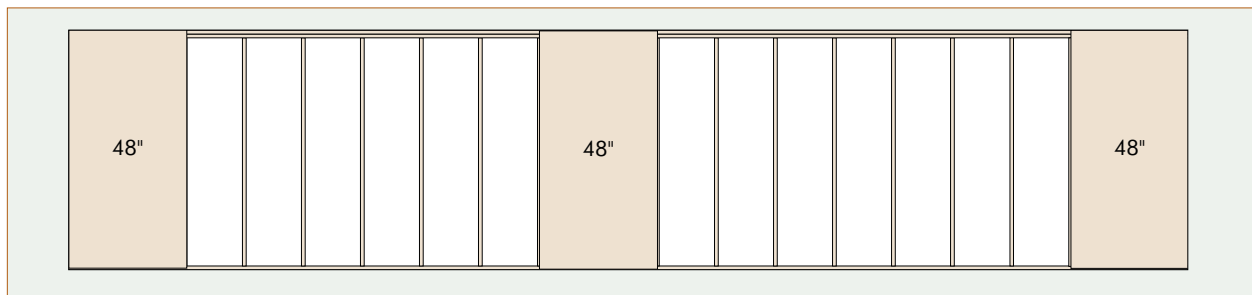


FIGURE 4. Panel layout detail of west wall used for all tests described in this report.

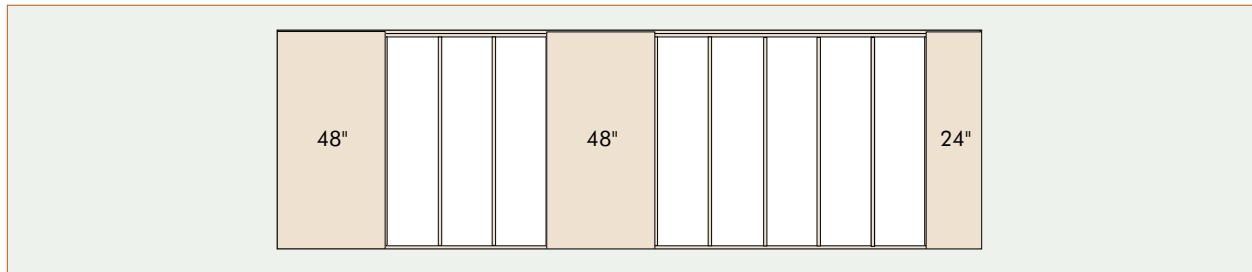


FIGURE 5. Panel layout detail of north and south wall for Tests 5b and 5b(C). The 24-inch segment served as the corner return for the east wall.

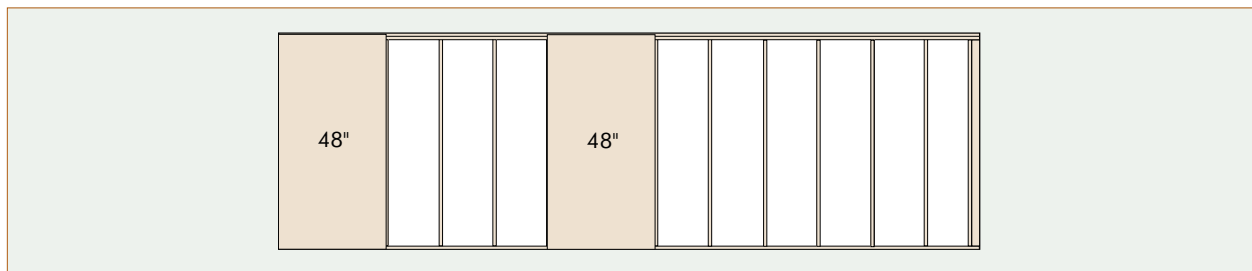


FIGURE 6. Panel layout detail of north and south wall for Tests 5a, 5d and 5d(8C). The end with no bracing panels served as the corner return for the east wall.

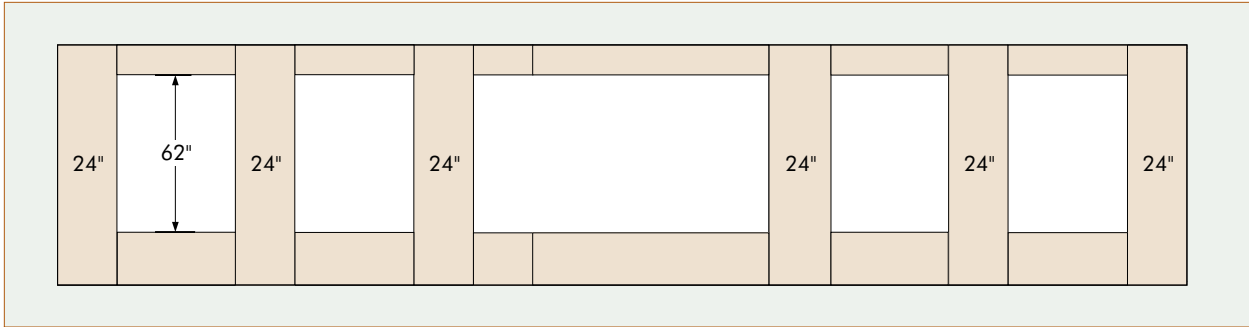


FIGURE 7. Panel layout detail of east wall for Tests 5a, 5b and 5d. Test 5d had an 800-lbf hold-down device at the corners of the house.

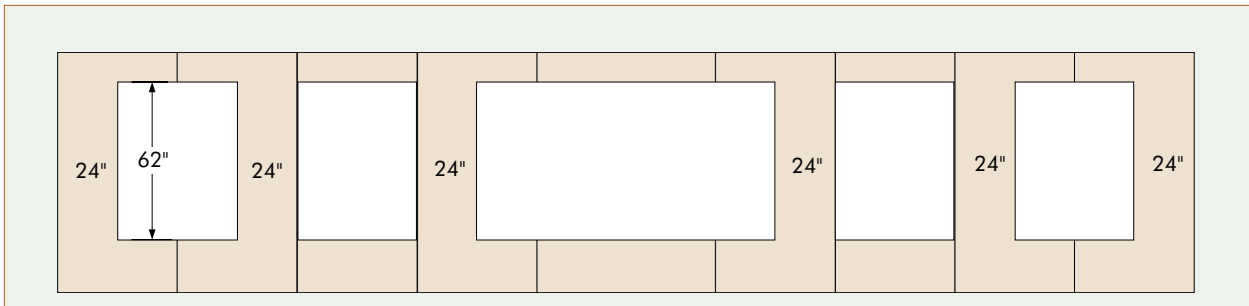


FIGURE 8. Panel layout detail of east wall for Tests 5b(C) and 5d(8C). Test 5d(8C) had an 800-lbf hold-down device at the corners of the house.

RESULTS

Figure 9 shows the applied load and the displacement recorded at the NE corner of the structure, where the load was applied, as shown by the arrow in Figure 3. Table 1 presents the test results. Table 2 shows the ratios between various tests.

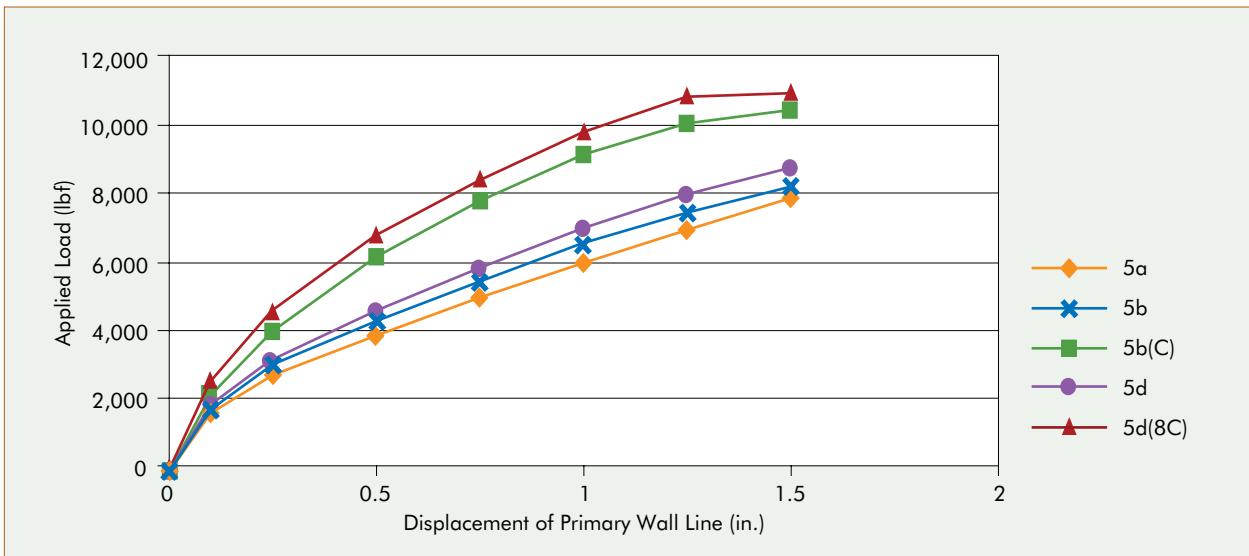


FIGURE 9. The load-displacement response recorded at the NE corner of the building where the load was applied.

TABLE 1.

TEST RESULTS WITH LOADS RECORDED AT NE CORNER OF THE BUILDING WHERE THE LOAD WAS APPLIED

House Test	Load (lbf) at following displacements						
	0.1 in.	0.25 in.	0.5 in.	0.75 in.	1.0 in.	1.25 in.	1.5 in.
5a	1,703	2,773	3,908	4,997	6,007	6,984	7,861
5b	1,737	2,933	4,293	5,463	6,510	7,447	8,186
5b(c)	2,149	4,067	6,185	7,809	9,143	10,005	10,442
5d	1,944	3,130	4,561	5,791	6,953	7,907	8,689
5d(8c)	2,543	4,528	6,743	8,352	9,721	10,745	10,870

TABLE 2.

RATIOS OF LOADS AT NOTED DISPLACEMENTS BETWEEN THE REFERENCED TESTS

Result ratio	Result ratio at following displacements						
	0.1 in.	0.25 in.	0.5 in.	0.75 in.	1.0 in.	1.25 in.	1.5 in.
5b/5a	1.02	1.06	1.10	1.09	1.08	1.07	1.04
5d/5a	1.14	1.13	1.17	1.16	1.16	1.13	1.11
5b(C)/5b	1.24	1.39	1.44	1.43	1.40	1.34	1.28
5d(8C)/5d	1.31	1.45	1.48	1.44	1.40	1.36	1.25

The ratios in Table 2 compare the tabulated performances given in Table 1. For example, at 0.25-inch displacement, the load that Test 5b resisted divided by the load that Test 5a resisted was 1.06 ($2,933/2,773 = 1.06$). This means that Test 5b resisted a 6 percent higher load than Test 5a at 0.25-inch displacement.

CONCLUSIONS

Each three-dimensional house test was conducted with equal amounts of bracing, 32 percent, with 12 feet of total bracing in the 37-foot-long wall and 8 feet of total bracing in the 25-foot-long wall. The test results support the following conclusions:

1. Test 5b with a 2-foot return corner improved performance by up to 10 percent over Test 5a that had no return corner (Test 5a).
2. The 800-lbf hold-down device in corners (Test 5d) improved performance 10 to 15 percent over Test 5a that had no hold downs.
3. Sheathing cut around the opening (Test 5b(C)) improved performance 25 to 45 percent over Test 5b that had no sheathing cut around openings.
4. Sheathing cut around the opening with hold downs (Test 5d(8C)) improved performance 25 to 50 percent over Test 5d with hold downs that had no sheathing cut around openings.

DISCUSSION

The presence of the 2-foot return corner on the continuously sheathed wall contributed very little to the lateral load performance of the three dimensional house. The 800-lbf hold-down device was slightly (about 5 percent) more effective than the corner return for improving lateral load performance. Most noticeably, cutting the sheathing around the opening provided significantly greater performance (about 25 to 50 percent) than a corner return or a hold down at the corner.

The findings presented in this report are part of a larger research project. Additional testing and data analysis are ongoing. When the project is complete, further details, results, and findings will be presented. The findings presented in this report may be updated as new and more data is collected and/or analyzed.

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