# CHAPTER 7

# 7. Comparisons With Light-Framed Construction

## 7.1 Introduction

This chapter compares the SIPS shear wall system with light-framed wood construction shear walls. Results obtained from this investigation are compared quantitatively with results obtained from past studies of monotonic and cyclic performance of light-framed wood shear walls. Overall SIPS wall behavior is also qualitatively compared with light-framed construction.

## 7.2 Light-Framed Construction Data

Several sources of information were used to compare the monotonic and cyclic performance of SIPS shear walls with light-framed wood shear walls. Tests performed by other researchers on light-framed wood shear walls, when compared with SIPS shear walls, will help indicate the level of performance that can be expected of SIPS shear walls.

Dolan (1989) performed shear wall tests on 8 ft by 8 ft walls under five different load combinations. Tests were performed on the walls under static monotonic, static cyclic, sine-wave, free vibration, and dynamic earthquake simulation loading. Static monotonic and static cyclic tests were similar to the monotonic and cyclic tests performed in this study. Dolan tested seven walls under monotonic loading and four walls were tested under cyclic loading. Both monotonic and cyclic tests yielded values for peak load and initial stiffness ($K_o$). These values are listed in Table 7.1 and will be used to draw comparisons with the SIPS tests of this study.

**Table 7.1 – Monotonic and Cyclic Results for Peak Load and Initial Stiffness from Dolan (1989).**

| Monotonic Test | Peak Load (lb) | Ko (lb/in) | Cyclic Test | Peak Load (lb) | Ko (lb/in) |
|---|---|---|---|---|---|
| WS-11 | 6430 | 11600 | WC-1 | 7426 | 11800 |
| WS-12* | 7598 | 11900 | WC-2 | 7337 | 11800 |
| WS-13 | 7014 | 6400 | Average | 7382 | 11800 |
| WS-14 | 7600 | 9800 | PC-1 | 6851 | 10100 |
| Average | 7160 | 9930 | PC-2 | 6941 | 10200 |
| PS-1 | 6835 | 6400 | Average | 6896 | 10150 |
| PS-2 | 7531 | 12000 | | | |
| PS-3 | 7206 | 6600 | | | |
| Average | 7524 | 8330 | | | |

Notes: W = waferboard wall, P = plywood wall, S = static monotonic, C = cyclic
* A dead load of 10,000 lb was used for this test

Dolan tested walls sheathed on one side with both plywood and waferboard sheathing. Framing lumber used for the walls was Spruce-Pine-Fir Standard and Better grade spaced at 2 ft centers. The plywood sheathing was 3/8 in. A-C Exterior CF BC 142 grade Canadian Softwood Plywood. The waferboard sheathing was 3/8 in. solid exterior grade waferboard. The sheathing was nailed to the framing members with 8d nails at 4 in. centers on the perimeter and 6 in. field. Steel hold-down anchors were also constructed and used on the walls tested.

Johnson (1997) investigated the effects of openings on long shear walls by testing 8 ft by 40 ft perforated shear walls. Of interest to this study is the 8 ft by 40 ft walls tested by Johnson with no openings. Johnson tested walls monotonically with the straight ramp loading and cyclically with the sequential phased displacement loading procedure, as was done in this study. Both studies took place at the same research facility, the Brooks Forest Products Center in Blacksburg, Virginia. Johnson used many of the same parameters used in this study. The results for the wall with no openings for both monotonic and cyclic loading are shown in Table 7.2. The values of HE and PE presented are the maximum values obtained through failure of the wall.

**Table 7.2 – Monotonic and Cyclic Results For Peak Load, Elastic Stiffness, Ductility, Hysteretic and Potential Energies, and Equivalent Viscous Elastic Damping Ratio From Johnson (1997).**

| Cyclic Data | Initial Values | Stabilized Values | Monotonic Data | Values |
|---|---|---|---|---|
| Fmax (lb) | 32000 | 27500 | Fmax | 38800 |
| Ke (lb/in) | 69700 | 69200 | Ke | 63700 |
| Ductility | 4.5 | 5.2 | Ductility | 7.4 |
| HE (lb-in) | 41400 | 32400 | | |
| PE (lb-in) | 56300 | 45600 | | |
| EVDR at yield | 0.127 | 0.106 | | |
| EVDR at max | 0.120 | 0.108 | | |

Johnson tested perforated shear walls sheathed with plywood on one side and gypsum wallboard (GWB) on the other side. The plywood was 15/32 in., 3 ply, Structural 1 grade plywood. The GWB was ½ in. thick and was installed vertically with taped joints. The framing members consisted of Standard and Better, Spruce-Pine-Fir 2x4's framed at 24 in. centers vertically. The plywood sheathing was attached to the framing with 8d common nails at 6 in. along the edge and 12 in. in the field. The GWB was attached to the framing with 13 ga x 1 ½ in. drywall nails with a 3/8 in head at 7 in. along the edge and 10 in. in the field. Simpson HTT 22 tie-down anchors were also used for the wall tested with no openings.

Heine (1997) performed monotonic and cyclic test on 8 ft by 40 ft shear walls with and without tie-down anchors in order to investigate the effectiveness of tie-down anchors. Heine also performed tests at the same testing facility as was done for this study using the straight ramp monotonic loading and Sequential Phased Displacement cyclic loading. Of interest to this study are the tests performed on the walls with no openings, with and without tie-down anchorage. Results obtained from the monotonic tests are presented in Table 7.3, and results from the cyclic tests are presented in Table 7.4. The values of equivalent viscous damping ratio are presented as the mode of the EVDR throughout the test instead of being presented at yield and maximum load resistance as was done by Johnson (1997).

**Table 7.3 – Monotonic Results of Peak Load, Elastic Stiffness, and Ductility for Walls With and Without Tie-down Anchors From Heine (1997).**

| Monotonic Parameter | No Tie-down Anchors | With Tie-down Anchors |
|---|---|---|
| Peak Load (lb) | 25100 | 34600 |
| Elastic Stiffness, ke (lb/in) | 54000 | 73300 |
| Ductility | 3.9 | 8.6 |

**Table 7.4 – Cyclic Results of Peak Load, Elastic Stiffness, Ductility, Hysteretic Energy, and Equivalent Viscous Damping Ratio for Initial and Stabilized Cycles from Heine (1997).**

| Cyclic Parameter | No Tie-down Initial | No Tie-down Stabilized | With Tie-down Initial | With Tie-down Stabilized |
|---|---|---|---|---|
| Peak Load (lb) | 26700 | 22500 | 27700 | 23700 |
| Ke (lb/in.) | 61600 | 61100 | 69000 | 67800 |
| Ductility | 2.7 | 4.1 | 5.1 | 5.9 |
| HE (lb-in.) | 27200 | 23400 | 34500 | 26800 |
| EVDR | 0.14 | 0.12 | 0.12 | 0.11 |

Walls with tie-down anchors are considered to be engineered construction. Walls without tie-down anchors represent conventional construction practices. Both types of walls were sheathed on both sides. One side was sheathed with 7/16 in. OSB rated sheathing and the other side with ½ in. GWB. The framing lumber was Stud or Better, Spruce-Pine-Fir, spaced at 24 in. centers vertically. The OSB sheathing was attached to the framing with 8d common nails at 6 in. along the perimeter and 12 in. in the field. The GWB sheathing was attached to the framing using 13 ga x 1 ½ in. drywall nails at 7 in. perimeter and 10 in. field.

Results obtained from other researchers also are compared with the research conducted in this study. Tissell (1990) summarized the ASTM E72 and ASTM E564 monotonic tests performed on different 8 ft by 8 ft wall configurations by the American Plywood Association. Patton-Mallory et al (1984) conducted tests on 22 in. tall shear walls sheathed on two sides with plywood and gypsum board. Values obtained for base shear at capacity are compared with the values obtained for base shear at capacity in this study.

## 7.3 Test Parameters

The following section compares the shear wall performance of SIPS with the data previously mentioned on a quantitative basis. Monotonic test parameters used to compare the SIPS shear walls with current light-framed construction are capacity, elastic stiffness, and ductility. In addition, cyclic test parameters of capacity, elastic stiffness, ductility, hysteretic energy, and equivalent viscous damping ratio are used to compare the cyclic performance of the shear walls.

For means of comparison, the values dealing with load resistance or stiffness of a wall is presented in terms of a one-foot length of wall. This would allow capacity to be compared in terms of a unit shear with the units lb/ft. This assumes that the force applied to the wall is distributed uniformly along the base of the wall as is done in shear wall design. White (1995) found through a parametric study of shear walls that strength and stiffness increased linearly with the aspect ratio of the wall, so stiffness is presented in terms of a unit stiffness. Because hysteretic energy and potential energy are functions of the stiffness of the wall, they are presented in this manner as well. Ductility and equivalent viscous damping ratio are non-dimensional and need not be presented as a function of wall length.

For discussion purposes, walls tested by Johnson (1997) are referred to as perforated shear walls because the walls are designed under the perforated shear wall method. Walls tested by Heine (1997) without tie-down anchors are referred to as conventional construction. Walls tested by Heine with tie-down anchors and Dolan (1989) represent engineered construction. Perforated shear walls have tie-down anchors only at wall ends. Engineered construction walls have tie-down anchors anywhere there is an opening, such as a door, in the wall. Conventional construction does not use tie-down anchors.

### 7.3.1 Capacity

Capacity of the walls is interesting to compare because capacity is what the design of shear walls is based on. Monotonic and cyclic values of capacity for the SIPS shear walls and for the systems of light-framed construction are presented in Table 7.5. Since Dolan did not use the sequential phased displacement method of loading, the results obtained from his work are presented as initial cyclic values.

**Table 7.5 – Values of Capacity per Foot of Length of Wall for SIPS Compared with Perforated, Conventional, and Engineered Construction.**

| Wall Description | Category | Monotonic Capacity (plf) | Initial Cyclic Capacity (plf) | Stabilized Cyc. Capacity (plf) |
|---|---|---|---|---|
| Wall A | SIPS | 340 | 319 | 258 |
| Wall B | SIPS | 329 | 318 | 252 |
| Wall C | SIPS w/ 2 bottom plates | 559 | 535 | 439 |
| Wall D | SIPS w/ tie-down | 884 | 833 | 690 |
| Johnson | Perforated | 970 | 800 | 688 |
| Heine w/out tie-downs | Conventional | 628 | 668 | 563 |
| Heine w/ tie-downs | Engineered | 865 | 693 | 593 |
| Dolan – Waferboard | Engineered | 895 | 862 | N/A |
| Dolan - Plywood | Engineered | 941 | 923 | N/A |

As shown in Figure 7.1, the only SIPS wall that has a capacity near the other types of walls discussed is Wall D, the wall with tie-down anchors. Data the SIPS are compared with in Figure 7.1 comes from Johnson and Heine. The capacity of Wall D is comparable to that of the engineered construction tested by Heine with nails spaced at 6/12 in. The engineered construction walls tested by Dolan have higher values of capacity than do any of the other systems due to a smaller (4/6 in.) nail spacing. Values of capacity for Wall D are greater than that of conventional and engineered construction by Heine for the monotonic tests. The values of capacity for Wall D are greater than that of conventional, engineered tested by Heine, and perforated walls under cyclic loads. Wall D would be a system that could reasonably compete with modern light-framed construction shear walls.

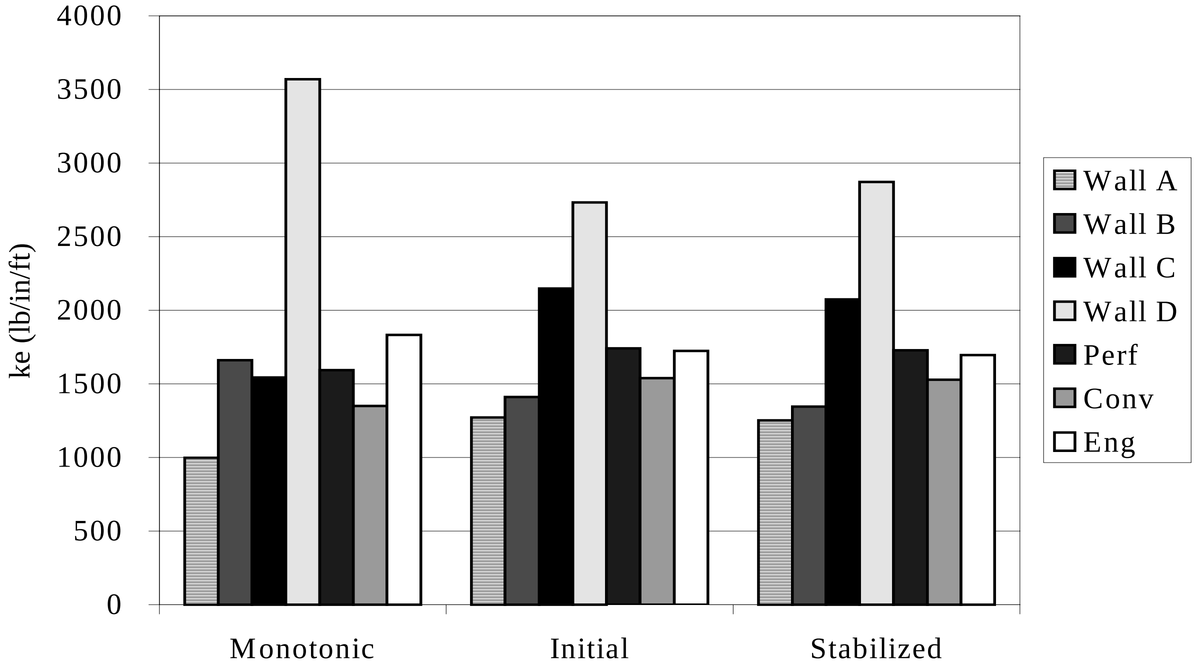

**Figure 7.1 – Values of Capacity Compared for the Four SIPS Walls and Perforated, Conventional, and Engineered Construction Values.**

Walls A, B, and C do not achieve capacities equal to those for conventional construction data discussed here for neither monotonic nor cyclic loading. The only data found in the literature, which had capacity values as low as Walls A and B, come from the study performed by Patton-Mallory et al (1984). Patton-Mallory et al found values of monotonic load per foot of wall at capacity for a wall sheathed with a single sheet ½ in. gypsum wall board with 1 ¼ in. drywall screws at 5 ¼ in. spacing to be between 280 and 330 plf. This is approximately the capacity achieved from the wall configurations A and B. This would probably not be acceptable for use as a shear wall where lateral loads of higher magnitude were expected.

Wall C showed a slightly larger value of capacity but are still not within the range of the conventional, perforated, or engineered construction being investigated. The only values of capacity in the literature which come close to the capacity of Wall C is found in the summary of ASTM E72 and E564 tests performed by the American Plywood Association by Tissell (1990). Some of the tests performed on panel siding with casing nails had capacities near the magnitude of Wall C. Monotonic capacity of Wall C was 559 plf. Tissell reports that a wall constructed of 5/8 in. plywood with a single row of 8d casing nails at 6 in. reached a capacity of 512 plf. A wall constructed of 3/8 in. plywood with a double row of 6d casing nails at 6 in. at panel edge reached a capacity of 553 plf. If a factor of safety of 3 is assumed, Wall C would have capacities on the order of plywood panel siding with either 6d or 8d casing nails in the UBC, Table 25-K-1. Wall C would probably also not be suggested for use in an area where loads of larger magnitude were expected.

### 7.3.2 Elastic Stiffness

Values of elastic stiffness are presented in Table 7.6. Values of elastic stiffness obtained from the monotonic tests as well as from the initial and stabilized envelope curves of the cyclic tests are presented. High values of stiffness are beneficial under loading such as wind loads. High values of stiffness for seismic loading may not necessarily be beneficial. Along with higher values of stiffness come lower values of energy dissipation, which is not beneficial for a structure under seismic loading.

**Table 7.6 – Values of Elastic Stiffness per Foot of Length of Wall for SIPS Compared with Perforated, Conventional, and Engineered Construction.**

| Wall Description | Category | Monotonic $k_e$ (lb/in/ft) | Initial Cyclic $k_e$ (lb/in/ft) | Stabilized Cyc. $k_e$ (lb/in/ft) |
|---|---|---|---|---|
| Wall A | SIPS | 999 | 1270 | 1250 |
| Wall B | SIPS | 1660 | 1410 | 1350 |
| Wall C | SIPS w/ 2 bottom plates | 1540 | 2150 | 2070 |
| Wall D | SIPS w/ tie-down | 3570 | 2730 | 2870 |
| Johnson | Perforated | 1590 | 1740 | 1730 |
| Heine w/out tie-downs | Conventional | 1350 | 1540 | 1530 |
| Heine w/ tie-downs | Engineered | 1830 | 1730 | 1690 |
| Dolan – Waferboard | Engineered | 1240 | 1270 | N/A |
| Dolan - Plywood | Engineered | 1040 | 1470 | N/A |

As shown in Figure 7.2, Walls A and B have, for the most part, lower values of elastic stiffness in both monotonic and cyclic tests than do perforated, conventional, and engineered construction. Values of elastic stiffness for Walls A and B are, however, close to the values of initial stiffness for both monotonic and cyclic loading for the walls tested by Dolan. Dolan used a different definition of stiffness than was used here, but the values should still be close since the walls are near elastic at the point where stiffness is defined using both definitions of stiffness. Monotonic values of stiffness of Wall B are higher than conventional or perforated values of stiffness, but this must be viewed with caution due to reasons discussed in Chapter 4. The cyclic stiffness values are lower than conventional and perforated shear walls for Walls A and B.

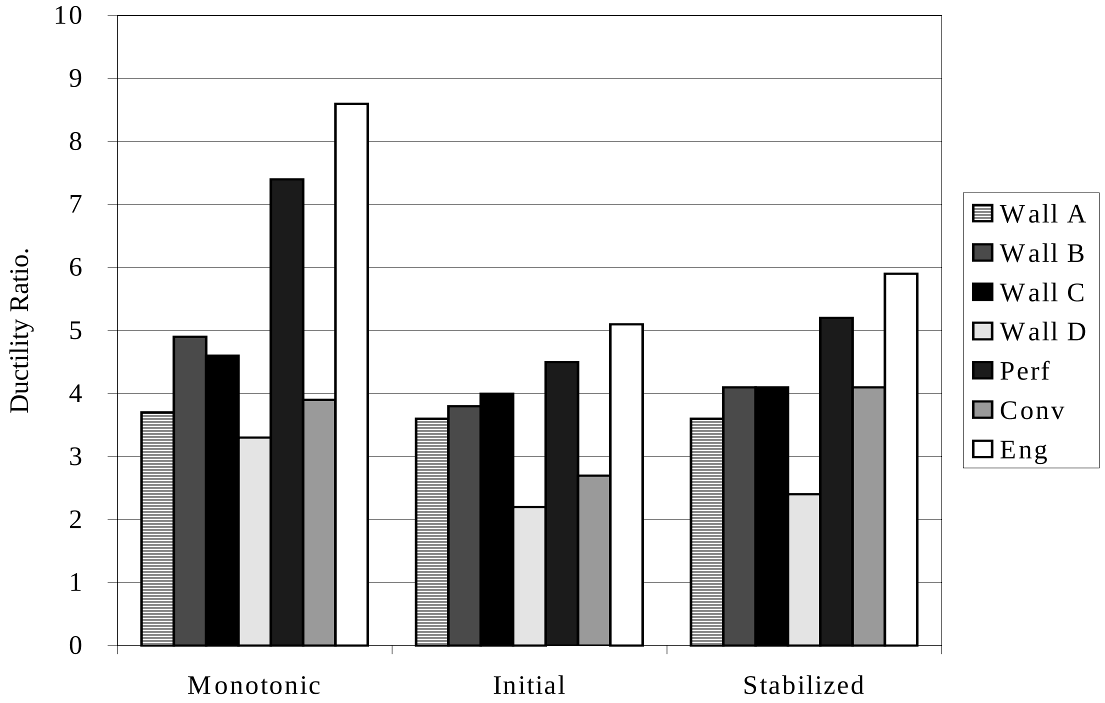

**Figure 7.2 – Values of Elastic Stiffness Compared for the Four SIPS Walls and Perforated, Conventional, and Engineered Construction Values.**

Addition of a second bottom plate to a SIPS wall, as was done for Wall C, increases stiffness to approximately equal or greater values than that of conventional and perforated construction for monotonic loading. Wall C had higher values of elastic stiffness for the cyclic tests than all three types of construction. The addition of tie-down anchors made the SIPS system much stiffer than any of the three types of construction it was being compared to, as shown for Wall D.

The SIPS shear walls were much stiffer than the perforated, conventional, and engineered construction shear walls when viewed on a basis of their relative stiffness. This higher stiffness is due to the fact that the SIPS walls have little “play” in them. The use of an adhesive combined with the use of brittle drywall screws results in a very stiff, brittle system.

### 7.3.3 Ductility

Values for ductility for the SIPS walls, as well as for the conventional, perforated, and engineered construction walls are presented in Table 7.6. Monotonic as well as initial and stabilized cyclic values are presented. Ductility is an important indicator of seismic performance of a structure when viewed in conjuncture with other parameters.

**Table 7.7 – Values of Ductility Ratio of Wall for SIPS Compared with Perforated, Conventional, and Engineered Construction.**

| Wall Description | Category | Monotonic Ductility | Initial Cyclic Ductility | Stabilized Cyc. Ductility |
|---|---|---|---|---|
| Wall A | SIPS | 3.7 | 3.6 | 3.6 |
| Wall B | SIPS | 4.9 | 3.8 | 4.1 |
| Wall C | SIPS w/ 2 bottom plates | 4.6 | 4.0 | 4.1 |
| Wall D | SIPS w/ tie-down | 3.3 | 2.2 | 2.4 |
| Johnson | Perforated | 7.4 | 4.5 | 5.2 |
| Heine w/out tie-downs | Conventional | 3.9 | 2.7 | 4.1 |
| Heine w/ tie-downs | Engineered | 8.6 | 5.1 | 5.9 |

As shown in Figure 7.3, values of ductility ratio for all of the SIPS walls are lower than for the engineered and perforated construction shear walls. Conventional construction walls had a lower ductility than Walls B and C for some of the loading cases. This would suggest that the SIPS walls fail with a more brittle mode of failure than did the other walls. The SIPS wall with tie-down anchors, Wall D, had significantly lower values of ductility ratio than any of the walls, including the conventional construction wall. This is important because this is the only wall configuration that is likely to be used where ductility is a factor due to the low values of capacity of the other SIPS wall configurations. A low value of ductility ratio is not desired for a wall in a high seismic region if other parameters are not great enough to overcome the lack of ductility in a wall.

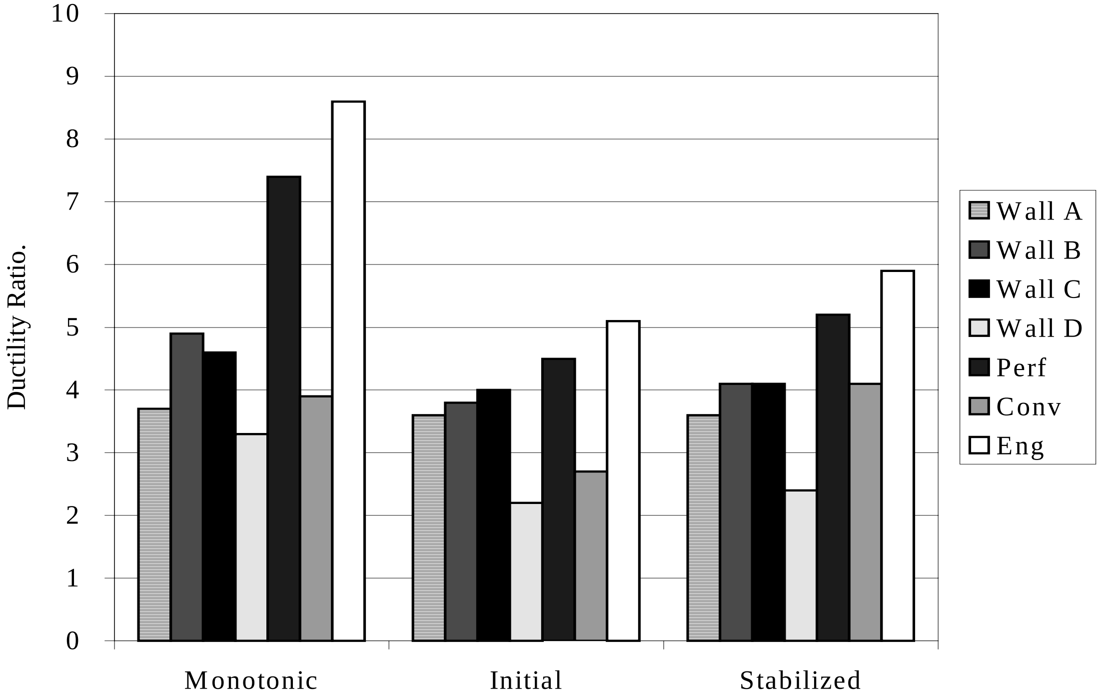

**Figure 7.3 – Values of Ductility Ratio Compared for the Four SIPS Walls and Perforated, Conventional, and Engineered Construction Values.**

### 7.3.4 Hysteretic Energy

Values of maximum hysteretic energy, through failure of the wall, based on a one-foot section of wall are presented in Table 7.7 for the SIPS, conventional, engineered, and perforated walls. Hysteretic energy is an important seismic parameter for shear walls because it gives a measure of how much energy is dissipated under cyclic loading.

**Table 7.8 – Values of Ductility Ratio of Wall for SIPS Compared with Perforated, Conventional, and Engineered Construction.**

| Wall Description | Category | Initial Cyclic HE (lb-in/ft) | Stabilized Cyc. HE (lb-in/ft) |
|---|---|---|---|
| Wall A | SIPS | 175 | 96 |
| Wall B | SIPS | 144 | 89 |
| Wall C | SIPS w/ 2 bottom plates | 236 | 110 |
| Wall D | SIPS w/ tie-down | 268 | 168 |
| Johnson | Perforated | 1035 | 810 |
| Heine w/out tie-downs | Conventional | 680 | 585 |
| Heine w/ tie-downs | Engineered | 862 | 671 |

As can be seen in Table 7.7, the values of hysteretic energy are much lower for the SIPS shear walls than for the light-framed wood shear walls. Brittle fasteners used to construct the SIPS shear walls do not experience enough inelastic deformation to allow appreciable energy dissipation. Wall D, with the tie-down anchors, dissipates the largest amount of energy among SIPS walls. Wall D still only has hysteretic energy values 39% of that found for initial and 29% of that found for stabilized cyclic values for conventional construction. Wall D dissipates approximately 25% the amount of energy dissipated by the perforated shear walls. This would suggest that the SIPS walls do not have the ability to dissipate energy nearly as well as light-frame wood construction shear walls. The same trends can be seen in the cyclic parameter of potential energy.

### 7.3.5 Equivalent Viscous Damping Ratio

Values of equivalent viscous damping ratio, EVDR, are presented in Table 7.8. Values of EVDR presented for the SIPS walls and perforated walls are for the initial and stabilized cycles near yield and maximum load resistance. Values of EVDR presented for the conventional and engineered construction walls are the mode, or most common value, for the initial and stabilized cycles throughout the entire test. These values correspond to approximately the EVDR at maximum load resistance since the values of EVDR level out with increased displacement in the tests Heine (1997) performed. For this reason, they are presented in Table 7.8 as values at maximum load resistance for comparison purposes.

**Table 7.9 – Values of Equivalent Viscous Damping Ratio of Wall for SIPS Compared with Perforated, Conventional, and Engineered Construction.**

| Wall Description | Category | Initial | | Stabilized | |
|---|---|---|---|---|---|
| | | EVDR at yield | EVDR at max | EVDR at yield | EVDR at max |
| Wall A | SIPS | 0.11 | 0.11 | 0.09 | 0.10 |
| Wall B | SIPS | 0.09 | 0.13 | 0.06 | 0.11 |
| Wall C | SIPS w/ 2 bottom plts | 0.11 | 0.09 | 0.07 | 0.08 |
| Wall D | SIPS w/ tie-down | 0.05 | 0.10 | 0.04 | 0.07 |
| Johnson | Perforated | 0.127 | 0.12 | 0.106 | 0.108 |
| Heine w/out tie-downs | Conventional | N/A | 0.14 | N/A | 0.12 |
| Heine w/ tie-downs | Engineered | N/A | 0.12 | N/A | 0.11 |

As shown in Table 7.8, EVDR values obtained for all of the SIPS walls are lower than the EVDR obtained for the conventional, perforated, and engineered construction walls. Wall D is the SIPS wall with the lowest values of EVDR. This is the system most likely to be accepted for use and is also the system that has the lowest damping ability of any other SIPS or other system from which comparisons are drawn. The damping ratio of a system is hard to predict by means other than testing so there is no real explanation as to why this occurs this way. This could be due to the low hysteretic energy values brought about by a more pinched hysteresis for SIPS walls when compared with light-framed construction walls.

## 7.4 Wall Behavior

As discussed in previous chapters, the SIPS shear walls tested appeared not to rack as light-frame shear walls are commonly assumed. Without tie-down anchors, the walls appeared to behave as rigid bodies. The SIPS shear walls did, however, appear to perform with more racking behavior when tie-down anchorage was used. It is important to note in the testing of the SIPS wall panels, no vertical gravity load was applied to the top of the wall to prevent the end studs from uplifting and help resist overturning moment. Walls without tie-down anchors may have behaved differently if they had been tested with a vertical load applied.

Heine (1997) noticed the same type of rigid body behavior while testing long (40 ft) shear walls without tie-down anchors as did Dolan (1989). This cannot be assumed to be a behavior characteristic of just this type of shear wall system. Usually failure of shear walls occurs with nail pull through and tear through of the sheathing. The failure observed with the SIPS shear walls was different in part due to the type of fasteners used. More research should be performed on systems such as these to see how they perform with more ductile fasteners such as nails.

## 7.5 Overall Comparison

An overall comparison can be made as to the performance of the SIPS shear walls when compared with the light-framed construction shear walls discussed previously. The only way that the SIPS shear walls tested in this study can reach the necessary capacities is by using tie-down anchors. For areas of low seismic activity, where only lateral forces from wind will control design, these walls may be acceptable. The SIPS walls exhibit a capacity equal to and stiffness greater than that of light-framed shear walls. Though this stiffness may attract more load, if the structure is expected to remain relatively elastic, the SIPS shear walls would be a good choice.

For areas of high seismic activity, use of the SIPS shear walls tested in this study are not recommended. Even though the capacity of the SIPS shear walls are equal to the light-framed construction shear walls, the ductility, energy dissipating properties, and damping properties are significantly lower than for light-framed construction shear walls. If a wall exhibits a lower ductility and energy dissipation ability, capacity should be much greater to make up for loss of seismic durability. The energy dissipating ability of wood structures is what partly makes them attractive for seismic areas. For this reason, wood structures have proven over time to be effective in resisting earthquake forces. This trend, however, may not hold true for the more brittle SIPS shear walls. Also, the much greater stiffness of the SIPS shear walls will attract more load, which would also have a negative impact on their use in high seismic regions. This conclusion is reinforced by an example in Appendix E of a typical residential house in a high-seismic region using SIPS panels. A factor of safety of only 1.5 was obtained in the example, which is not adequate.

Structurally insulated panel shear walls may be able to exhibit the ductility and energy dissipation properties of light-framed construction if more ductile fasteners were used. Further testing should be conducted on SIPS shear walls with fasteners such as nails to investigate whether or not they would be acceptable for high seismic areas.

## 7.6 Conclusions

The following conclusions can be drawn from the comparisons made between the SIPS shear walls and shear wall tests previously performed on conventional, perforated, and engineered construction light-framed wood shear walls.

- The SIPS wall configurations that do not use tie-down anchors have very low values of maximum load resistance when compared with light-framed construction.
- The SIPS wall that uses tie-down anchors had values of maximum load resistance that were comparable to light-framed construction under both monotonic and cyclic loading.
- Values of elastic stiffness for the SIPS wall with tie-down anchors were much higher than values of stiffness for light-framed construction.
- The SIPS walls exhibited lower ductility than light-framed construction walls.

- The SIPS walls do not dissipate energy nearly as effectively as light-framed construction walls. This is due to the brittle combination of adhesives and drywall screws being used as fasteners.
- The SIPS walls had lower values of equivalent viscous damping ratio when compared to light-framed construction. The SIPS wall with tie-down anchors had the lowest values of EVDR. The SIPS walls, therefore, have lower damping abilities than do light-framed construction walls.
- The SIPS walls tested would be more effective in areas controlled by wind loads and low seismic zones, where the wall is expected to remain elastic, and would be less effective in a high seismic zone than would light-framed construction walls.

## 7.7 Summary

The chapter compares the structurally insulated panel shear walls tested for this study with light-framed shear walls tested for other studies. Different numerical values were compared for the different types of walls. Overall behavior of the different types of walls was also discussed.