6. CONCLUSION

After a thorough examination of the formulation of the allowable strength in the building code in design loads for wood shear walls, the following shortfalls in the methodology of determining and applying these design loads were found:

(1) Code allowable design loads are extrapolated from equations that model individual fasteners and are used for elements that have geometries and components that stress these elements in a way not accounted for in the model equations. Failure mechanisms that limit over-strength and energy dissipation are present and adversely affect the performance of the element in a way that is not understood by many designers and engineers.

(2) Code allowable design loads were verified with testing that is not representative of the loading that the elements would incur under seismic conditions. It is apparent from the most recent building code requirements and research that dynamic testing should replace the previously used static test procedures performed to verify shear wall element design loads. In addition, walls with higher aspect ratios than the specimens tested should not use design loads extrapolated from the lower aspect ratio walls.

(3) Individual shear wall components and the effect they have on the shear wall performance must be accounted for in design of the shear walls. This is especially true in higher aspect ratio walls (2:1 & greater) with large

uplift loads. Current allowable load factors assumed to be present in published code strength loads may not be large enough to account for the lack of ductility and energy dissipation in higher aspect ratio walls.

(4) Test data are limited on stapled shear walls sheathed with OSB. The majority of test data and research published is on hand-driven fasteners, not pneumatic fasteners. Pneumatic fasteners are more commonly used in the construction of shear walls.

(5) Simple framing modifications that will reinforce highly stressed components of the shear wall should be developed to improve the inelastic performance and design loads of the shear wall.

The results of this research demonstrate that the following conclusions may be made:

(1) The tabulated loads in NER 272 for 16 gauge staples and 7/16″ sheathing are reasonable for standard panels with aspect ratios of two or less. The designer should know that significant damage occurs at ASD level forces and the performance of the element at this level of force and beyond could only be described as a life safety level.

(2) The affects of eccentric hold-downs caused the sheathing to fail in the lower corners of the shear walls. This could be overcome with minor strapping and framing modifications. The results of the hold-down modifications are a shear-panel element with a design strength increase of 40% and nearly twice the energy dissipation capabilities of standard construction procedures. This improves seismic performance over a wide

range of seismic loads and will result in less structural and less cosmetic damage in seismic events that are less than design earthquakes. The modifications made during the test are simple, affordable, and easily verifiable in the field. Double studs in lieutenant of 3x-boundary members are more affordable and most wood-framed walls already have double top plates and double studs adjacent to openings. When building a wall directly on the foundation wall, the only increase in material from doubling all boundary studs is a double sill that some framers use anyway; this allows the wall to be framed on the ground and lifted in place on top of the green plate. The biggest expense is the $7.00 strap, longer anchor bolts, 2″ square washers, and labor for installation of the strap and additional staples. The additional strength and ductility achieved from the minor additional cost are easily justified.

(3) There are still simple improvements that could be made to the end-wall stud strap developed from this research. By beveling the edge of the sill plate and using a wider strap, additional reductions in top-of-wall displacement would be achieved.

(4) So that the sections of element remain intact through the elastic and inelastic range, walls greater than 4′ in length should have the sheathing panels installed horizontally and blocked along the horizontal edge, or the adjoining studs at the vertical panel edge must be nailed to account for the inelastic loads that will occur on the panel.