

Seismic Equivalence Parameters for Engineered Woodframe Wood Structural Panel Shear Walls

Philip Line, P.E., Ned Waltz, P.E., and Tom Skaggs, P.E.

Abstract

Seismic equivalency parameters for drift capacity, component overstrength, and ductility for woodframe wood structural panel shear walls have previously been defined using a collection of 48 different walls tested with the CUREE cyclic load protocol (Waltz et al. 2008). When establishing minimum seismic performance parameters for new lateral force resisting systems to prove equivalence to woodframe wood structural panel shear walls, this initial reference database was viewed as being representative and sufficient. In the work summarized by this paper, 32 additional shear walls were tested to compare with and supplement the reference database. The new wall tests cover the practical extremes in nail diameter, panel thickness, and nail spacing for woodframe wood structural panel shear wall construction as defined by 2005 *Special Design Provisions for Wind and Seismic* (2005 *Wind and Seismic*) (AF&PA 2005) and the 2006 *International Building Code* (2006 *IBC*) (ICC 2006). The seismic equivalency parameters developed using the new 32 wall test set aligned very well with the distributions observed in the original 48 wall database. When data from the current study and the reference database are combined, the new database consists of 80 cyclic wall tests from four different laboratories that encompass a broad range of woodframe shear wall configurations. The average drift capacity, component overstrength, and ductility performance parameters for the combined data set were within 3 percent of the original estimates. The seismic equivalency criteria that would be derived using the combined database were also within 3 percent of those originally developed.

Introduction

Woodframe shear wall drift capacity, component overstrength, and ductility have previously been summarized for 48 walls tested using the CUREE cyclic load protocol (Waltz et al. 2008). The purpose of the original analysis was to provide criteria that could be used to establish seismic equivalency parameters that define performance of wood structural panel shear walls framed with wood studs. The original 48 wall tests were collected by an independent Task

Group working to provide a means for the International Code Council Evaluation Service (ICC-ES) to evaluate seismic performance of new products. When coupled with a specific allowable load derivation procedure and qualitative assessment of degradation in the wall's ability to carry gravity load, non-listed products and systems (e.g., those not defined in *Minimum Design Loads for Buildings and Other Structures*, ASCE 7) capable of meeting the target parameter performance levels established by the Task Group would be judged to be seismically equivalent. As seismically "equivalent" products, they would be assigned the same seismic design coefficients as woodframe wall systems sheathed with wood structural panels.

The original database of 48 walls covered a variety of shear wall aspect ratios, design capacities, sheathing panel thicknesses, nail sizes, and nail spacings. The database was a collection of wall tests conducted at three different labs for a variety of purposes using the CUREE cyclic test protocol (ASTM 2007) with realistic anchorage and boundary conditions. But, it did not cover the extremes of nail size, sheathing thickness, and nail spacings in shear wall design tables provided in references such as the 2005 *Wind and Seismic* standard and the 2006 *IBC*. In the work summarized by this paper, cyclic in-plane shear testing of two replicates of 16 different engineered shear wall configurations were completed to bracket the practical extremes of the shear wall design tables based on nail size, spacing, and sheathing thickness. The broader range of configurations in this study is compared to the 48 wall database used to develop the original equivalency targets.

The shear wall testing summarized in this paper was undertaken as part of a collaborative effort between American Forest & Paper Association, Weyerhaeuser, and APA-The Engineered Wood Association in the Spring of 2008.

Test Method

The 16 wood-frame wood structural panel shear wall configurations detailed in **Table 1** were tested to determine their in-plane shear performance in general accordance

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Homebuilder's Guide to Earthquake-Resistant Design and Construction, 2008 [Quantification of Building Seismic Performance Factors](#), 2009 This report describes a recommended methodology for reliably quantifying building system performance and response parameters for use in seismic design The recommended methodology referred to herein as the Methodology provides a rational basis for establishing global seismic performance factors SPF's including the response modification coefficient R factor the system overstrength factor and deflection amplification factor Cd of new seismic force resisting systems proposed for inclusion in model building codes The purpose of this Methodology is to provide a rational basis for determining building seismic performance factors that when properly implemented in the seismic design process will result in equivalent safety against collapse in an earthquake comparable to the inherent safety against collapse intended by current seismic codes for buildings with different seismic force resisting systems

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