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SHEAR WALL STRENGTH REDUCTION FROM OVERDRIVEN NAILS

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ABSTRACT: Shear walls using nailed sheathing panels and wood framing form an important lateral force resisting system in wood structures. During construction of wood shear walls, however, it is common for nails to be overdriven. Overdriven driven nails may significantly reduce the shear wall strength. In fact, a recent study indicates that overdriven nails may reduce shear wall strength from 5% to 22%, depending on the depth that the nail is overdriven. The objective of this paper is to determine if the reduction in shear wall strength is proportional to the nail-head depth by (1) idealizing load-displacement curves for sheathing connections with overdriven nails, and (2) employing the idealized load-displacement curves in a analytical model to predict the strength of shear walls with various nail-head depths.

Keywords: wood shear walls, overdriven nails, analytical modeling, load-displacement curves

1. INTRODUCTION

Shear walls using nailed sheathing panels and wood framing form an important lateral force resisting system in wood structures. By nailing sheathing panels to the wood framing, a structural "rib" is formed that will transfer lateral forces into supports and foundations. Interestingly, the overall strength and behavior of a shear wall is governed by the strength and behavior of the nailed sheathing connections.

Figure 1 depicts sheathing connections with properly and improperly driven nails. A nail is underdriven when the nail head is above the sheathing panel (Figure 1*a*). Nails that are driven to the proper depth are considered flush driven, since the nail head is contacting the sheathing panel surface (Figure 1*b*). Nails are considered overdriven when the nail head penetrates the sheathing panel thickness (Figure 1*c*).

During construction of wood shear walls, it is common for nails to be driven improperly. In a survey of construction in the San Francisco, California area, for example, ZACHER and GRAY (1989) reported that approximately 80% of the nails were overdriven 3.18 mm or more in plywood shear walls. Incidentally, overdriven nails in gypsum board covered shear walls and roof or floor diaphragms were also observed. More recently, in a survey of construction in the Salt Lake City, Utah area, RABE (2000) reported that more than 80% of the nails were overdriven, and that one third of these overdriven nails were driven 3.18 mm or more beyond the sheathing surface.

Overdriven nails may significantly reduce strength in shear walls. ZACHER and GRAY (1985, 1989) tested shear walls with plywood sheathing and overdriven nails. The test results suggested that overdriven nails caused premature failure. JONES and FONSECA (2002) tested shear walls with oriented strand board sheathing. For the tests, 100% of the nails were driven to specified depths. The test results indicated that overdriven nails may reduce shear wall strength from 5% to 22%, depending on the depth that the nail-heads are overdriven. Moreover, the test results suggested that shear wall strength reduction is proportional to the nail-head depth.

2. OBJECTIVE

The objective of this paper is to determine if the reduction in shear wall strength is proportional to the nail-head depth. The objective is met by (1) idealizing load-displacement curves for sheathing connections with overdriven nails, and (2) employing the idealized load-displacement curves in a analytical model to predict the strength of shear walls with various nail-head depths.

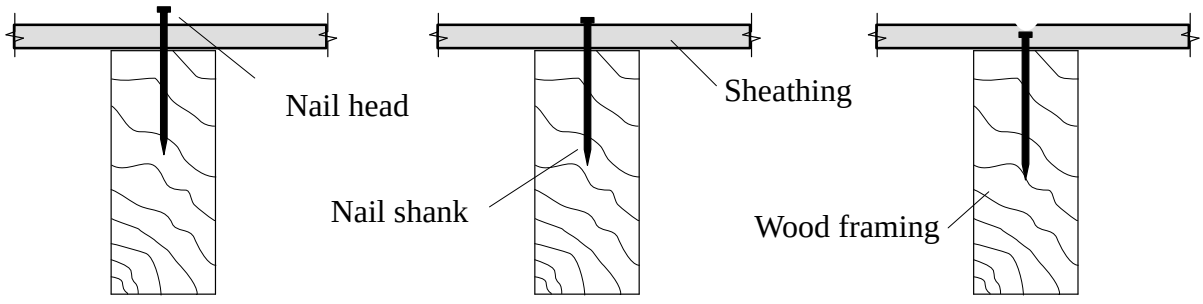

Figure 1 – Sheathing Connections with Properly and Improperly Driven Nails