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CAPACITY OF SHEATHING-TO-WOOD JOINTS WITH OVERDRIVEN NAILS

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RESUMO: Este trabalho apresenta um estudo a respeito das ligações pregadas considerando os efeitos da pregação sob pressão excessiva, ou seja, da cravação da cabeça do prego além da superfície da chapa. Oito conjuntos de dez ligações foram montados e ensaiados utilizando os procedimentos de deslocamentos seqüencial (Sequential Phased Displacement, SPD). Quatro conjuntos utilizaram chapas de OSB com 11,1 mm de espessura e quatro utilizaram compensado de 11,9mm, pregados em peças de madeira Douglas Fir–Larch, de 38,1mm x 88,9mm, utilizando pregos de 2,87mm de diâmetro e 60,3mm de comprimento. A distância da borda da chapa para o centro do prego foi de 9,53mm. As ligações foram montadas sem cravação da cabeça do prego e com cravação de 1,58mm, 3,18mm e 4,76mm além da superfície. Dez corpos de prova de ligação foram montados para cada profundidade de cravação do prego. Considerando a resistência da ligação sem cravação como valor de referência, as cravações com 1,58, 3,18 e 4,76 mm apresentaram decréscimo da resistência de 7%, 11% e 20%, respectivamente para o OSB. Nas ligações com compensado, as ligações com 1,58 e 3,18mm de cravação não apresentam diminuição da resistência, enquanto com cravação de 4,76 apresentou diminuição de 12%. Com relação à dissipação de energia da ligação, a redução foi de 26%, 45% e 54% para ligações com OSB e de 26%, 44% e 74% para as ligações com compensado para as cravações de 1,58, 3,18 e 4,76mm, respectivamente.

Palavras chave: ligações, estruturas de madeira, pregação

ABSTRACT: The capacity of sheathing-to-wood joints assembled with overdriven nails is discussed in this paper. Eight sets of ten joints were assembled and tested using the Sequential Phased Displacement (SPD) loading protocol. Four sets used 11.1 mm Oriented Strand Board (OSB) and four sets used 11.9 mm plywood panels. Wood members were 38.1 by 88.9 mm Douglas Fir-Larch and nails were 2.87 mm diameter by 60.3 mm long. Edge nailing distance was 9.53 mm. Joints were assembled with flush-driven nails and with nails overdriven 1.58, 3.18, and 4.76 mm. Ten OSB and ten plywood joints were built for each nail depth. Using joints with flush-driven nails as a baseline, decrease in strength capacity for OSB joints with nails overdriven 1.58, 3.18, and 4.76 mm was 7, 11, and 20 percent, respectively. Plywood joints with nails overdriven 1.58 and 3.18 mm did not experienced any increase or decrease in strength capacity whereas joints with nails overdriven 4.76 mm experienced a decrease of 12 percent. For joints with nails overdriven 1.58, 3.18, and 4.76 mm, reduction in energy dissipation capacity was 26, 45, and 54 percent for OSB joints and 26, 44, and 74 percent for plywood joints, respectively.

Keywords: wood joints, overdriven nails, wood structures

1. INTRODUCTION

Overdriven sheathing nails are one of the major structural deficiencies in sheathing-to-wood connections. A properly driven nail should have the top of the nail head flush with the surface of the sheathing material. If a nail is driven deeper than this ideal depth, the nail is considered to be overdriven. Conversely, if a nail is driven more shallow than this ideal depth, the nail is considered to be underdriven. These conditions are depicted in Figure 1.

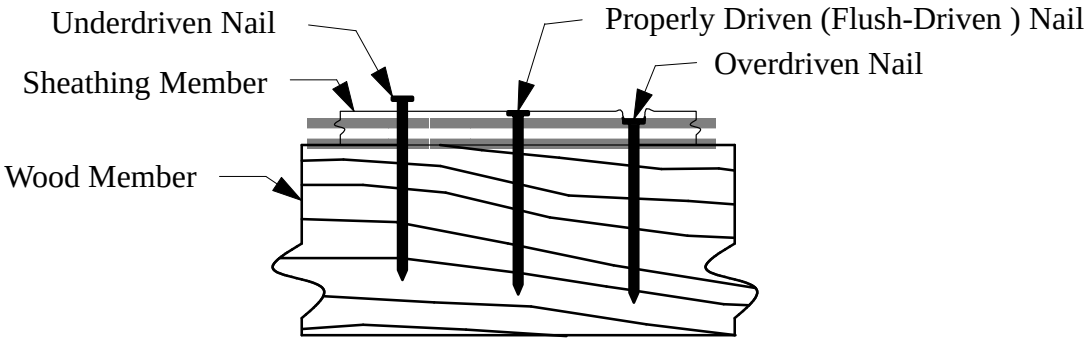

Figure 1 – Driven Nail Condition

The designer of a structure hopes that the structure will be built properly, i.e. sheathing nails will be driven flush with the outer surface of the sheathing. Nails, however, are not driven properly (Gray and Zacker 1995, Gray and Zacker 1888, Zacker and Gray 1989, Hall 1996, Jones and Fonseca 2000; Rabe and Fonseca 2000) because nail guns are usually used to drive the nails. In fact, overdriven nails in light-frame wood construction became a serious problem with the advent of pneumatic tools.

Until recently wood structures have fared well in earthquakes. During the Northridge earthquake, however, failure of many wood structures was attributed to the large number of systems constructed with overdriven nails (Hall 1996). Engineers must, therefore, question the effects that overdriven nails have on the capacity of wood joints. Unfortunately, only limited research has been conducted to investigate such a problem.

Research conducted to date on specimens with overdriven nails is incongruous. Zacher and Gray (1985, 1989) and Gray and Zacher (1988) concluded that performance of specimens with overdriven nails is not satisfactory; Andreason and Tissell (1994) concluded that overdriven nails will not significantly affect the strength of specimens with overdriven nails until at least 20 to 25 percent of the nails are overdriven; and Ficcadenti et al. (1996) concluded that overdriven nails may even increase the strength and displacement capacity of a specimen. Clearly, due to the many variables affecting the behavior of specimens with overdriven nails, investigations conducted to date are simply insufficient. Furthermore, testing has not been performed with a level of accuracy that allows bounds to be set on the capacity of systems with overdriven nails.

An experimental program has been set up to establish a database, determine capacity bounds, and evaluate the performance of sheathing-to-wood joints constructed with overdriven nails (Burns and Fonseca 2001, Jones and Fonseca 2000, Rabe and Fonseca 2000). This paper briefly discusses the findings of the initial phase of this experimental program.