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HYSTERESIS MODEL PARAMETERS FOR NAILED SHEATHING CONNECTIONS IN WOOD SHEAR WALLS

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ABSTRACT: Wood shear walls provide the primary lateral resistance in many residential and commercial structures. The overall strength and behavior of a shear wall is determined by the individual behavior of the nailed sheathing connections. The objective of this paper is to quantify the effects of loading, unloading, pinching, and strength and stiffness degradation parameters on the connection hysteresis model. The results indicate that strength and stiffness degradation, and pinching behavior parameters are essential for hysteresis model accuracy.

Keywords: wood shear walls, hysteresis models, analytical modeling, dynamic analysis

1. INTRODUCTION

Wood shear walls provide the primary lateral resistance in many residential and commercial structures. Nailed wood framing and sheathing panels allow the wall to transfer in-plane lateral forces through diaphragm action into supports and foundations. Interestingly, the overall strength and behavior of the wall is determined by the individual behavior of the nailed sheathing connections.

In Figure 1*a* the lateral deformation of a nailed sheathing connection is depicted. The lateral force transferred from the sheathing through the nail displaces the nail head relative to the nail shank. Initially, the wood fibers, sheathing, and nail remain elastic. The load–displacement relationship is linear. As loading progresses and the deformation of the connection increases, wood fibers crush and the nail may begin to yield. If the loading is reversed, the nail moves through the gap formed by the crushed wood fibers. Connection stiffness and strength is regained as the nail bears with the wood fibers on the opposite side of the gap. As a result, the hysteretic behavior shown in Figure 1*b* is typical of nailed sheathing connections. FOSCHI (2000) and HE et al. (2001) have demonstrated that the hysteretic behavior of the connection may be idealized by modeling the nail as an elastic-plastic pile embedded into a nonlinear layered medium consisting of wood framing and sheathing.

Alternatively, the hysteretic behavior may be idealized using a hysteresis model determined through experimental testing of individual nailed sheathing connection assemblies, or coupon tests. A hysteresis model determined in this way consists of a predefined set of load-paths that describe unloading, load reversal, and reloading within a response envelope.

2. OBJECTIVES

The objective of this paper is to quantify the effects of loading, unloading, pinching, and strength and stiffness degradation parameters on the accuracy of the hysteresis model. For comparison, the dynamic response of a 2.44×2.44 m oriented strand board shear wall will be predicted using the Clough, Q-hyst and modified Stewart hysteresis models.

3. HYSTERESIS MODELS

The Clough, Q-hyst, and modified Stewart models are three well-known hysteresis models. In this paper, the envelope (bilinear or trilinear backbone) curves in the original hysteresis models are replaced with an exponential envelope curve proposed by FOSCHI (1977).

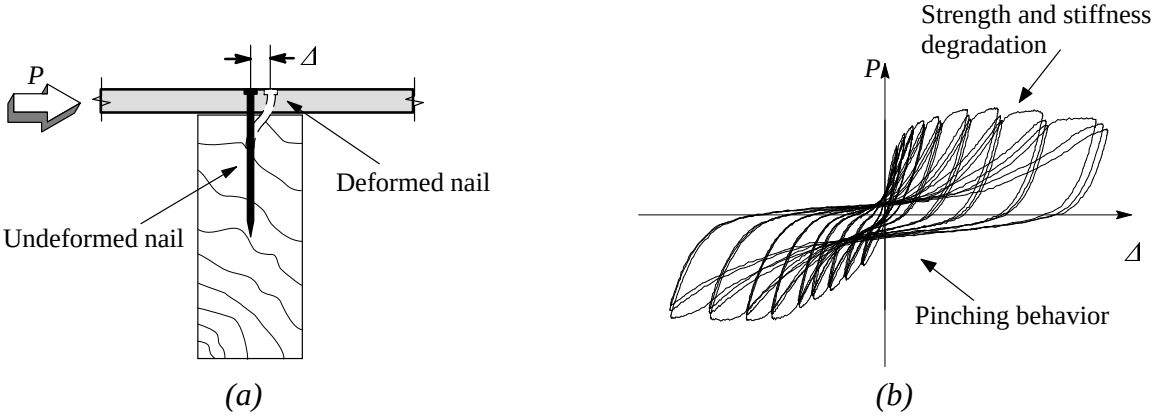

Figure 1 – Nailed Sheathing Connection: (a) Lateral deformation; (b) Hysteresis.