

Estimating the Response of Cold-Formed Steel Frame Shear Walls

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PREFACE

This report was developed by Dr. Reynaud Serrette for the Lateral Design Task Group of the AISI Committee on Framing Standards. The objective of this project was to develop elastic shear stiffness coefficients and general (piece-wise linear or continuous) deflection expressions for the shear wall configurations to be included in the *AISI Standard for Cold-Formed Steel Framing - Lateral Design*.

This project developed a method to estimate the drift deflection of cold-formed steel frame shear walls recognized in the 2003 ICC *International Building Code* (IBC) and 2003 NFPA *Building Construction and Safety Code* (NFPA 5000). The method was based on a simple model for the behavior of shear walls and incorporated empirical factors to account for nonlinear behavior. The empirical factors were based on regression and interpolation analyses of the reversed cyclic test data used in development of the IBC and NFPA 5000 cold-formed steel shear wall design values. The findings provided a basis for the AISI Committee on Framing Standards to include an expression for the deflection of a blocked wood structural panel or sheet steel shear wall in the *AISI Standard for Cold-Formed Steel Framing - Lateral Design*.

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Estimating the Response of Cold-Formed Steel Frame Shear Walls

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INTRODUCTION

This paper describes a method that was recently developed to estimate the drift deflection of cold-formed steel (CFS) frame shear walls recognized in the 2003 International Building Code (IBC) and 2003 National Fire Protection Association (NFPA) Building Construction and Safety Code (NFPA 5000). The method is based on a simple model (illustrated in Figure 1) for the behavior of shear walls and incorporates empirical factors to account for nonlinear behavior. The empirical factors are based on regression and interpolation analyses of the reversed cyclic test data used in development of the IBC and NFPA CFS shear wall design values. Specifically, the peak response envelope data illustrated in Figure 2 was used.

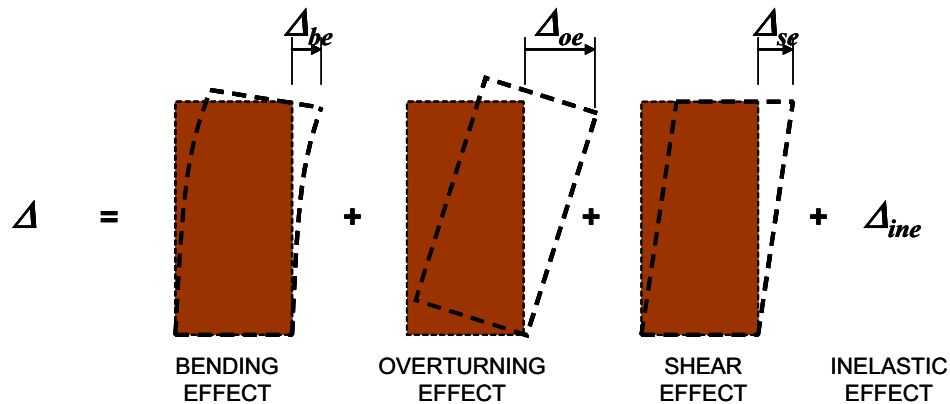


Figure 1. Modeling of drift deflection, Δ

In reviewing the accuracy and applicability of the formulation/method presented, it is important to keep in mind that the response of light frame shear walls is relatively complex and the proposed semi-empirical method is intended to provide an estimate, not an exact prediction, of drift deflection. To the extent feasible, the method was developed to be as general as possible. However, the specific application of the method is geared toward the CFS shear wall configurations referenced in the IBC and NFPA building codes. The method should not be used to estimate capacities nor should it be used to estimate drift deflection beyond the nominal strengths tabulated in the referenced building codes.

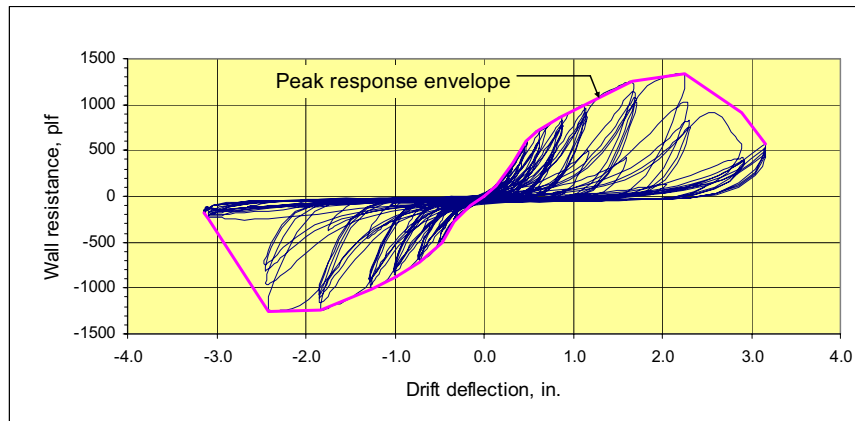


Figure 2. Example of a peak response envelope from a reversed cyclic test

DRIFT DEFLECTION FORMULATION

The formulation described below approximates the drift deflection (lateral displacement), Δ , of cold-formed steel frame shear walls sheathed with plywood, OSB or sheet steel. This formulation does not apply to gypsum-sheathed walls and is similar to the method used in wood-frame construction. The total deflection (Δ) of a uniformly fastened, blocked wood structural panel or sheet steel panel shear wall is permitted to be calculated using the following formula:

$$\Delta = \Delta_{be} + \Delta_{oe} + \Delta_{se} + \Delta_{ine} \quad (\text{Equation 1})$$

where Δ = total wall deflection, Δ_{be} = deflection due to cantilever bending, Δ_{oe} = deflection due to overturning anchor deformation, Δ_{se} = deflection due to shear deformation in the plane of the sheathing and Δ_{ine} = empirical inelastic deflection component (derived from regression analysis of reversed cyclic test data). These four components of deflection are defined in the following sections.