



# Behavior of cold-formed steel wall panels under monotonic horizontal loading

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## ABSTRACT

This paper summarizes the findings of an experimental study on cold-formed steel (CFS) wall panels with oriented strand board (OSB) sheathing. Static lateral load tests were conducted on a total of thirteen full-scale wall panel specimens to investigate the performance of CFS walls utilizing primarily the construction details used in Turkey. Experimental results revealed that the geometry of hold-down attachment used at the base of CFS wall panels to transfer tensile forces has a major effect on the overall behavior of the panels. Extensive damage was observed to occur in the hold-down attachment and in part of the bottom track adjacent to the hold-down, which prevented the wall panels to exhibit the stiffness associated with the main load resisting mechanisms. Tilting of the screws connecting the OSB sheathing to the CFS boundary framing members, as well as the separation of sheathing from the framing members were other commonly observed deformation modes. Existence of diagonal struts inside CFS frame was determined to cause a slight increase in load capacity and initial stiffness of the panels. It is also shown that the measured load capacity of wall panels can be predicted with an acceptable accuracy using design equations available in the literature.

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## 1. Introduction

Cold-formed steel (CFS) construction is a practical alternative to concrete or conventional steel structures mainly due to higher strength/weight ratio and faster construction. Because of their lighter weight, CFS residential and commercial buildings are becoming more efficient alternative in regions involving seismic risk compared to concrete and conventional steel counterparts. Wall panels made of CFS framing sheathed on one side or on both sides with steel or some type of wood boards have been widely used as the lateral load resisting elements in cold-formed steel structures constructed especially in low and medium seismic risk regions. The framing in these wall panels include top and bottom tracks fastened to vertical studs with either screws or rivets. The tracks and studs are usually made from C-shaped CFS sections.

American Iron and Steel Institute provides design rules for CFS framed buildings in AISI S100, S200, and S213 manuals [1–3]. In Europe, Eurocode 3 [4] specifies the design provisions for CFS members. Because of the need for understanding the behavior of these structures, especially under the effect of seismic loads, lateral resistance of CFS shear wall panels has recently been studied both experimentally [5–17] and analytically [17–19]. Serrette et al. investigated the performance of different sheathing materials through both small scale tests on sheathed CFS studs and full scale tests on wall panels [6]. Pan and Shan also performed monotonic tests on CFS wall panels and investigated the effect of

sheathing material, sheathing thickness, and wall aspect ratio [14]. Lange and Naujoks studied the behavior of CFS wall panels under combined lateral and vertical loads [19]. Fiorino et al. studied the typical screw connections used to attach sheathing boards on CFS framing members [10]. Use of flat-strap X-bracing in CFS wall panels has also been the subject of several studies [5,8,9,12]. Serrette et al. and Tian et al. performed monotonic load tests on CFS wall panels utilizing flat-strap X-bracing [5,8]. Kim et al. performed shake table tests on a CFS structure with flat-strap X-bracing, and reported that the structure exhibited a ductile behavior [9]. Tests done by Al-Kharat and Rogers on CFS walls with flat-strap X-bracing revealed that the behavior of wall panels was mostly determined by hold-down details [12]. Use of steel sheet as sheathing on CFS wall panels was investigated by Yu [13], and the failure of wall panels was determined to be primarily due to buckling of steel sheet sheathing and pullout of screws.

In a typical CFS construction, in addition to being responsible for resisting lateral loads, CFS wall panels also form the gravity load resisting system of the structure. For this reason, the axial compression behavior of CFS studs and wall panels has also been investigated by several researchers [7,11,15,16]. These studies indicated that the existence of sheathing improved the axial compression behavior of CFS studs with the level of increase in load capacity being affected by sheathing material and screw spacing.

The main objective of this study was to evaluate the performance of CFS wall panels utilizing primarily the construction details used in Turkey. The focus was limited to CFS wall panels using oriented strand board (OSB) as sheathing material and are subjected to monotonic lateral loading.

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