Wei-Wen Yu Center for Cold-Formed Steel Structures

CCFSS technical bulletin

UNIVERSITY OF MISSOURI-ROLLA

DIRECTOR: ROGER A. LABOUBE, PH.D., P.E.
FOUNDING DIRECTOR: WEI-WEN YU, PH.D., P.E.

VOLUME 14, NUMBER 2
FALL 2005

WALL STUD-TO-TRACK GAP EXPERIMENTAL INVESTIGATION

INTRODUCTION

The Standard for Cold-Formed Steel Framing - General Provisions (2004) specifies that the gap between the wall stud and track in a wall assembly must not exceed 1/8 in. This gap dimension is consistent with the gap specified by ASTM C1007 (Standard, 2004). The value of 1/8 inch is based on industry experience and practice but had not been experimentally verified. Thus, a test program was initiated at the University of Missouri-Rolla to explore both the axial strength concerns as well as the aesthetic concerns associated with a gap between the stud and track in a typical cold-formed steel wall assembly. The experimental study attempted to simulate conditions that would be seen in a typical wall stud assembly.

SCOPE OF INVESTIGATION

Two different test setups were employed in order to evaluate the performance of the stud to gap connection. One test setup simulated a typical sheathed wall. The intent was to check for aesthetic damage to the sheathing, this test setup can be seen in Figure 3. The other test was a stub column test with no sheathing applied. The intent of the stub column test was to evaluate the strength of the stud-to-track connection. The five variables considered in the test program were member thickness, gap distance between wall stud and track, gap distance between wall sheathing and floor, sheathing type and screw diameter. Both the stud-to-track gap and the sheathing to floor gap are depicted in Figure 1.

Material Properties. All cold-formed steel members tested had a nominal member depth of 3 5/8 inches and a nominal width of 1 5/8 inches. The test specimen thicknesses ranged from nominal thicknesses of 0.097 inches to 0.033 inches. In each test the studs were paired with their corresponding track sections, thus both stud and track had the same nominal thickness.

Testing Variables. For the wall assembly tests, the gap distance, depicted in Figure 1, between the stud and the track was varied from 1/8 in. to ¼ in. The gap distance on the stub column test was varied from 0.036 in. to 0.125 in.

The gap distance between the sheathing and the floor, depicted in Figure 1, was set at either ¼ inches, to match the largest stud to track gap or with no gap at all.

Two types of sheathing were investigated on the wall tests, either gypsum board, with a thickness of 3/8 in. or OSB with a thickness of ¼ in.

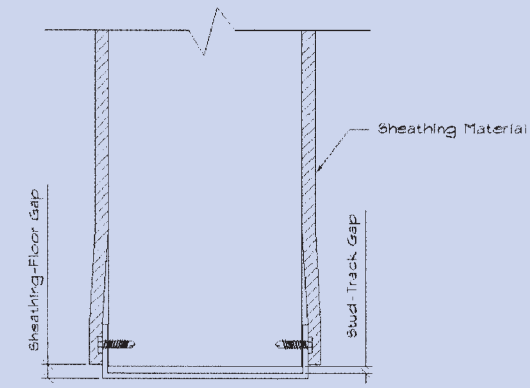

Figure 1: Stud-to-track gap and Sheathing-to-floor gap.

Both No. 8 and No. 10 self-drilling screws were included in the test program.

TEST SETUP

Two separate test setups were utilized in the test program. One test setup was directed at replicating a wall assembly having sheathing on both sides. These specimens were comprised of a 4'-0" stud connected to a 2'-0" long track section. The sheathing was connected to the stud and track sections as shown in Figure 2. The second test setup was comprised of a stub column connected to a short track section with no sheathing applied, shown in Figure 4. For details of the test setups see Findlay (2005).

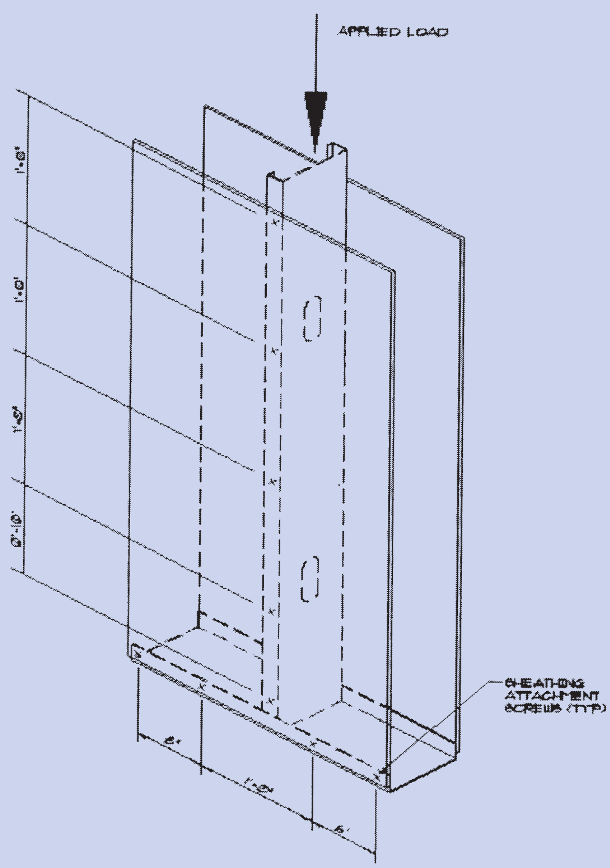

Figure 2: Sheathing attachment screw pattern.

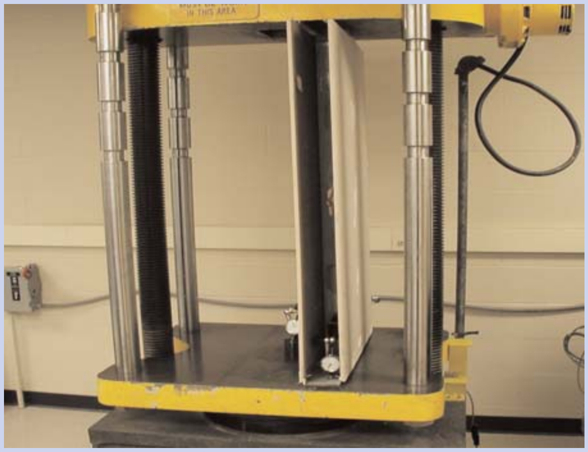

Figure 3: Typical specimen with sheathing.

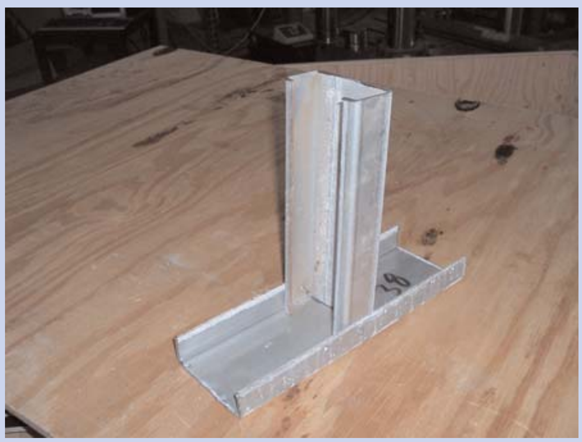

Figure 4: Typical stub column test specimen without sheathing.

Test Procedure for Wall Assemblies. The specimens were tested using a Tinius-Olsen test machine, seen in Figure 3; where they were loaded in compression. During the load application dial gauges were used to monitor the vertical movement of the stud in relation to the track section and also to monitor the vertical movement of the gypsum board. Any aesthetic damage or failures in the connections were noted.

Test Procedure for Stub Column Tests. The specimens were also tested in a Tinius-Olsen testing machine. The load was applied until failure of the connection.

CONCLUSIONS

At total of 54 wall assembly tests and stub column tests were performed in the UMR study. The test results indicated that the maximum allowable gap distance between the load bearing stud and the track section is dependent on the thickness of the members. Test results indicated that for thinner members (less than 0.054 inches), subject to a tilting failure mechanism of the self-drilling screw which was the predominant mode of failure, the maximum gap distance may be 1/8 inch to prevent substantial aesthetic damage to the gypsum sheathing. It was also determined experimentally that although the screw connection failed in the titling mechanism, it was still capable of resisting uplift forces.

The test data also revealed that a desirable gap distance between a load bearing stud and the track section should be 1/16 in. for thicker members (greater than 0.054 inches). The connection was subject to a shear failure of the screw as the predominant mode of failure. A stud-to-track gap of 0.065 inches still resulted in a shear failure of the connection screw. The test data indicated that a stud-to-track gap of 0.065 inches or less will close before both the connection screws fail. The smaller 1/16 in. gap prevented aesthetic damage of the sheathing from occurring.

TECHNOLOGY TRANSFER

Based on the findings of this research study the American Iron and Steel Institute's Committee on Framing Standards has adopted the following guidelines to be included in the next edition of the *Commentary of the Cold-Formed Steel Framing Standard - General Provisions:*

Axial loads in a wall stud in excess of the capacity of the screw connection may be transferred between the stud and track in bearing. Therefore, relative movement between the stud and track may occur to close any gap between end of the stud and the track. To determine the influence of this relative movement between the stud and track on the serviceability of sheathed wall assemblies, a testing program was conducted at the University of Missouri-Rolla (Findlay, 2005). The UMR test program only considered the stud and track having the same thickness. For thinner stud and track materials (0.054 inches (1.37 mm) or less), testing showed that relative movement between the stud and track was accommodated through a combination of track deformation and screw tilting. In these cases the connection remained intact and was capable of resisting uplift forces and providing resistance to rotation caused by the torsional component developed in the stud. For thicker materials (greater than 0.054 inches), testing showed that the relative movement between the stud and track could result in shear failure of the screws. In these cases, a smaller gap tolerance (e.g., 1/16 inch (1.6 mm)) would be desirable. A smaller gap tolerance may also be desirable in multi-story structures where the accumulation of these gap closures may become significant. Depending on track radius, it may be necessary to oversize the depth of the track to assure that the stud flanges do not prematurely engage the track radius and result in an excessive gap. For all thickness of materials, testing has shown that the gap between the sheathing and the floor should be equal to or greater than the gap between the stud and the track.

REFERENCES

American Iron and Steel Institute (2004), “Commentary on the Standard Cold-Formed Steel Framing -- General Provisions,” Washington, D.C.

American Society for Testing and Materials (2004), “Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories,” ASTM C1007, West Conshochocken, PA

Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories (2004), ASTM C1007, ASTM International, West Conshochocken, PA

Findlay, P.F. (2005), "Serviceability Issues Pertaining to Load Bearing and Non-Load Bearing Steel Framed Walls," thesis presented to the faculty of the University of Missouri-Rolla in partial fulfillment of the degree Master of Science, Rolla, MO