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Understanding Proper Application for Head-of-Wall Joints in Metal Building Systems

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The Galesburg Fremont Fire Station in Galesburg, Illinois, is constructed with a metal building system that incorporates a brick façade. It has a standing seam metal roof. *Photo courtesy of MBMA-member firm.*

end uses.

Code Compliance

Because most metal building systems are low-rise buildings classified by the International Building Code (IBC) as Type IIB, a metal building roof often is not required to be built using passive fire protection designs.

The IBC Type IIB designation describes non-combustible framing materials. Since a metal building system uses primary and secondary steel members that are non-combustible, they conform to this classification. Metal building systems utilize non-combustible metal roof panels, which often are not required to be protected for fire resistance. Because of the building layout, use, proximity to other buildings and other factors, building codes may require fire-resistive walls in certain locations but not fire-resistive roofs for Type IIB buildings.

Requirements Are Not Always Clear

For the Type IIB construction prevalently applicable to metal building systems, local codes can require certain types or locations of walls to be fire-resistance rated, but at the same time, those same codes permit an unrated roof. This

You may be most familiar with metal building systems when used for warehouses, maintenance facilities or agricultural buildings. However, today metal building systems are just as often used in a range of low-rise, non-residential applications, such as offices, sports facilities, retail stores, community and public buildings and strip shopping centers. Their functional versatility, advanced custom designs, cost-effectiveness and energy efficiency have propelled the growth and popularity of metal building systems to all sorts of

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dichotomy raises questions as to how to classify the head-of-wall (HOW) joint between these two types of assemblies. Section 714.1 of the 2009 IBC states: "Joints installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies shall be protected by an approved fire-resistant joint system." This section has also been commonly interpreted to include joints between fire-rated walls and non-fire-resistance-rated steel roofs that frequently occur in metal building systems.

2009 IBC Section 714.3 requires fire-resistive joint testing in accordance with ASTM E 1966 or ANSI/UL 2079, which specifically states that the wall and roof assemblies shall each be fire-resistance rated. There is no standard for testing joints between a rated assembly and a non-rated assembly. The [Metal Building Manufacturers Association \(MBMA\)](#) recently set out to answer specific questions about the fire resistance of HOW joints in metal building systems, particularly between a rated wall assembly and an unrated roof assembly.



The fire resistant wall and Head-of-Joint assembly being tested at Underwriters Laboratories. *Photo courtesy of MBMA.*

The HOW Joint Fire Tests

MBMA and an industry partner, the [American Iron and Steel Institute \(AISI\)](#), designed and sponsored standard head-of-wall fire tests, while [Hughes Associates Inc.](#) provided program technical assistance. [Underwriters Laboratories \(UL\)](#) performed the tests in July 2007. The tests evaluated three specific instances when there is a fire-rated wall assembly and non-rated roof assembly – where the roof purlin is (1) located inside the wall, (2) parallel to the wall and (3) perpendicular to the wall.

After UL assembled the HOW joints and attached instrumentation the assembly underwent two tests each: a one-hour fire exposure test of the HOW joint followed by a hose stream test afterwards. There are three specific layouts that are commonly used for HOW joints in metal building systems (noted above). UL tested two of the three joint layouts, after which it was determined that the third layout did not need to be tested and would fall within the existing results.



The wall and HOW assembly undergoing the hose stream test. *Photo courtesy of MBMA.*

The results of the tests led to three new UL certifications, one for each of the specific purlin/wall layouts: HW-D-0488, HW-D-0489, and HW-D-0490. Because ANSI/UL 2079 requires tests to have both a wall and ceiling fire-rated assembly, no UL ratings could be granted for HOW joints between fire-rated walls and non-rated ceilings. However, the tests addressed these cases and UL offered a follow-up letter that helps to clarify the situation for the non-rated ceiling case.

The HOW joint assemblies that were used and tested at UL were representative of those commonly used by the industry for metal building systems construction and

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followed ASTM E 1966 and ANSI/UL 2079. The [complete UL report](#) details the joint assemblies and their results and is available by [clicking here](#).

Note some important features of the assemblies and tests listed below:

- The roof assemblies that were tested did not include the fire-resistive, roof-ceiling membrane to which the UL P200 or P500 series refers.
- The roof insulation was continuously draped over the top of the wall. The roof insulation did not have to be cut and re-attached to each side of the wall, as has sometimes been required.
- UL-rated firestop caulking was used, and is vital to the fire-resistive performance of this HOW intersection.
- The HOW joints that were tested were designed for vertical joint movement of up to 2 inches, up or down, from the installed neutral position. The wall construction allowed for this movement.
- The tests subjected the joints to movement cycling, with a minimum of 10 cycles per minute and a total of 500 cycles. The tests began and ended with the joint at its maximum width of 4 inches.

Results and Follow-Up

The two joint assemblies UL tested--one with the roof purlin inside the wall and one with the purlin perpendicular to the wall--passed both the standard fire exposure test and the hose stream test. As mentioned previously, ANSI/UL 2079 states that the tests must be between adjacent fire-resistive assemblies, so UL cannot issue ratings between a fire-resistive rated assembly and an unrated roof assembly. But UL's follow-up letter to the report highlights the results of the MBMA tests. The UL letter, dated February 5, 2008 states:

"Because Standard ANSI/UL 2079 is not applicable to joint systems installed between fire-resistive and non-fire-resistive structures, it was determined that, by testing the joint systems beneath the same roof structure described in Roof-Ceiling Design Nos. P265, P268 and P516 but without the ceiling membrane, the results of the tests could be applied to those P200 or P500 Series Roof-Ceiling Designs in the Fire-Resistance Directory which specify the use of the basic roof structure."

"The nominal 2-inch-wide dynamic joint systems in the two head-of-wall joint system fire tests conducted for MBMA at UL on July 19, 2007, met the conditions of acceptance in Standard ANSI/UL 2079 for a one-hour fire assembly rating following Class II movement cycling of 100 percent in compression and extension. At the conclusion of each fire test, the temperatures on the unexposed (non-fire) side of the joint system were below the ANSI/UL limits, the fire did not penetrate the wall or joint system and the hose-stream test was determined to have been met."



The wall and HOW assembly successfully passed the fire test. *Photo courtesy of MBMA.*

The UL letter and test results provide guidance for code enforcers and contractors on projects where local codes and occupancy conditions allow fire-resistance-rated walls to be built beneath unrated roofs. For buildings that do require a fire-resistive roof-ceiling membrane, the joint designs can also directly follow the existing UL listings (HW-D-0488, HW-D-0489, and HW-D-0490).



Once this issue was brought to the forefront, MBMA requested an ICC Committee Interpretation on the issue of whether or not a fire-resistance rated joint was required where a fire-resistance-rated wall intersects a non-fire-resistance rated roof. The ICC Committee Interpretation, 34-08, was issued (also available on the MBMA Website) that confirmed that a fire-resistance-rated joint is not required. Rather than a fire-resistance-rated joint test requirement, the ICC Committee Interpretation pointed to the continuity requirements already in the IBC.

Once the committee confirmed the ICC interpretation, Hughes Associates, representing MBMA, submitted an IBC code change proposal for the 2012 edition of the IBC. The proposal was ultimately successfully adopted at the IBC Final Action Hearings in Dallas, Texas in May 2010. The revised 2012 IBC will clarify that the requirement is indeed intended to maintain continuity between non-fire-resistance-rated ceilings and fire-resistance-rated walls, rather than to require a fire-resistance-rated joint. This important code change clarifies the application of the IBC in these instances, and greatly enhances the authority having jurisdiction's ability to interpret and enforce the code.

The important new 2012 IBC code provisions in this regard will state the following:

The voids created at the intersection of a fire barrier and a non-fire-resistance-rated roof assembly shall be filled. An approved material or system shall be used to fill the void, shall be securely installed in or on the intersection for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to retard the passage of fire and hot gases.

It is hoped that these new IBC provisions, past fire tests, and the detailed UL report available on the MBMA website will make it easier for all interested parties when evaluating HOW joints in metal building systems.

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