Now you can choose

either one and get the same fire protection thickness.

Restrained or Unrestrained?

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HAVE YOU EVER been caught up in a debate about whether restrained conditions or unrestrained conditions should be used with fire resistance ratings in the Underwriters Laboratories (UL) Fire Resistance Directory?

If you have, we're happy to report that this tired old argument is now dead. Thanks to recent tests of unrestrained specimens at UL, we now know the answer is that it doesn't matter. The fire protection required will be the same—at least for the floor construction described in the new UL Design No. D982.

A Little History

The distinction between restrained and unrestrained ratings began several decades ago after many, many fire resistance ratings already had been published by UL without the distinction. A course correction began in the 1960s when the theory was advanced that the fire performance of floors and beams, in test specimens built tight to the test frame, benefitted from resistance to the specimen's thermal expansion provided by the test frame. Since all specimens were built tight, the course correction affected all ratings.

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The effect was extensive. All existing structural steel-framed deck/concrete floor ratings became restrained assembly ratings, and each listed design was modified to also include an unrestrained assembly rating that was determined using temperature criteria from the original testing (there are two criteria for structural steel beams: an average temperature of 1,100 °F at any cross section in the beam and a maximum temperature of 1,300 °F at any point in the beam). Initially, it was clear that typical structural steel construction was considered restrained, but that clarity gradually was obscured as standards and practices evolved in the ensuing decades.

It eventually became a matter for the building official, architect and/or engineer of record to decide. Yes, no and maybe all became answers to the question and the cost of defaulting to the conservative choice ensured arguments. The fire protection thickness using an unrestrained assembly rating is about twice that for a restrained assembly rating.

The Path not Chosen

Relatively unrecognized in the history of all this is that it is possible to perform tests in the unrestrained condition. This approach is more direct, based upon structural performance, and a contrast to the indirect approach of inferring an unrestrained assembly rating from a restrained test based upon the temperature criteria. Nonetheless, all tests since the distinction began have continued to be conducted in the restrained condition.

This happens as a simple matter of economics. A test performed in the restrained condition results in both a restrained assembly rating and an inferred unrestrained assembly rating. A test performed in the unrestrained condition results in only an unrestrained rating.

So, nobody chose to test their fire protection products with an unrestrained structural steel-framed floor specimen—that is, until now. AISC and AISI recently funded testing of unrestrained floor specimens at UL that resulted in UL Design No. D982 that is now available in the online UL Fire Resistance Directory at www.ul.com; the design will also be printed in the next edition of the book form of the UL *Fire Resistance Directory*.

An unrestrained steel-framed floor specimen, before and after the fire test.

Put your Money where your Mouth is

AISC and AISI have always maintained that typical structural steel construction should be rated as restrained. This position is based on extensive technical justification (see "Restrained Fire Resistance Ratings in Structural Steel Buildings" in the 2nd Quarter 2001 issue of *Engineering Journal* at **www.aisc.org/ej**). Nonetheless, in some segments of the marketplace, unrestrained ratings are still selected. Recognizing that no amount of ongoing education or debate would resolve the conflict, we decided to pursue a solution through UL testing.

The goal of the testing was to prove or disprove our hypothesis that an unrestrained structural steel framed floor test would produce a result comparable to the performance of a similar floor in a restrained test. Earlier tests by the National Institute for Standards and Technology conducted on floors framed with open-web steel joists indicated that floor fire performance in an unrestrained test was better than the performance of an identical floor specimen in a restrained test. However, AISC and AISI needed further experimental confirmation that such performance is repeatable, and also that such performance could be extended to floors framed with structural steel beams.

A New Design for Unrestrained Construction

Simply stated, these test results are great. They provide a solution that eliminates the need to argue about what fire protection thickness is required. Now, if you decide to use a restrained rating or one of these unrestrained ratings, you will get the same fire protection thickness.

The new UL Design No. D982 resulting from AISC/AISI (see Figure 1) provides for two-hour unrestrained assembly ratings with unprotected steel deck and SFRM protection on the steel beam with thickness sufficient to obtain a one-hour unrestrained beam (temperature-based) rating. The design can be used in both Canada and the United States, it works with a wide range of steel deck products and it is valid for any SFRM material bearing the UL Classification Mark. MSC

Design No. D982

July 01, 2013

Unrestrained Assembly Rating - 2 Hr.

Unrestrained Beam Rating - 1 Hr.

Loading Determined by Allowable Stress Design Method or Load and Resistance Factor Design Method published by the American Institute of Steel Construction, or in accordance with the relevant Limit State Design provisions of Part 4 of the National Building Code of Canada

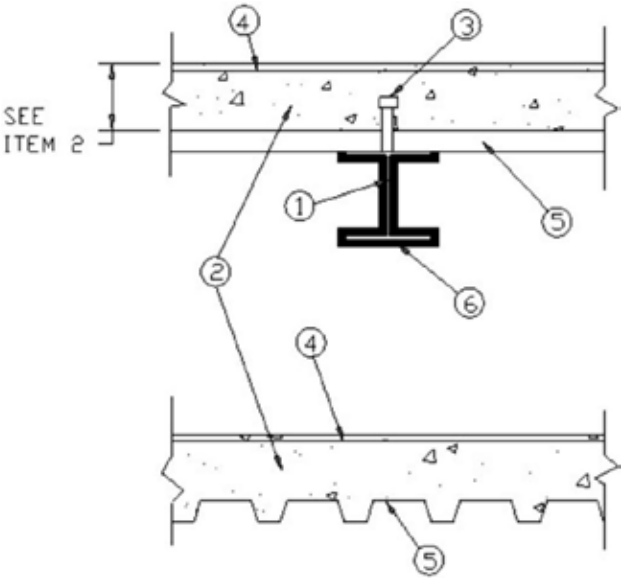

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Figure 1

1. **Beam —** W6X15 min. size.

2. **Normal Weight —** Compressive strength 3500 psi. Normal weight concrete, carbonate or siliceous aggregate, 150 ± 3 pcf unit weight. Min. thickness 4-1/2 inches.

3. **Shear Connectors —** Studs, max. 3/4 in. diam, headed type or equivalent, designed in accordance with the specification of the American Institute of Steel Construction. Welded to top flange of beam through steel floor or form units.

4. **Welded Wire Fabric —** 6 by 6 — W1.4 x W1.4, positioned at 1/2" bleow the top surface of the concrete slab.

5. **Steel Floor and Form Units* —** Composite or non-composite. Min. 1-1/2 in. deep, galv or phosphatized/painted fluted units. Min gauge 22 MSG. Welded to supports approx 12 in. OC. Total live and dead load shall not exceed 200 psf.

See CHWX or CHWX7 for list of Classified companies.

6. **Spray-Applied Fire Resistive Materials* —** Applied by mixing with water and spraying in one or more coats to steel beam surfaces which are free of dirt, loose scale and oil. Application shall be in accordance manufacturer's instructions and applicable UL Design. Coating thickness shall be sufficient to obtain 1 hr Unrestrained Beam Rating. See D900, N700 and N800 series designs for specific coatings and coating thickness requirements. When selecting a design, note the beam size and the design's capacity for heat dissipation as recommended in *Guide BXUV, IV Beams, 4. Beam Substitution*.

See CHPX or CHPX7 for list of Classified companies.

*Bearing the UL Classification Mark