FIRE INSIGHTS
Fire Topics Related to the Structural Building Components Industry

Equivalent Performance Through Testing of Unprotected Floor Assemblies

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Introduction:

The Structural Building Components Association (SBCA) and its members strongly believe in a key engineering and building code principle – to provide structural building component solutions that safeguard the public health, safety and general welfare of building occupants, while serving the general public's desire to have buildings constructed that are affordable and environmentally responsible. As the building code states, this also includes providing "safety to fire fighters and emergency responders during emergency operations."

Issue:

There has been testing of various floor assemblies used in the marketplace, but most testing has not been performed so that one can make valid comparisons on an apples-to-apples basis.

While some non-standardized ad hoc testing conducted is beneficial and provides considerable insight, it cannot be relied upon to compare differing floor assembly performances and to draw conclusions about the ability of an assembly to maintain fire fighter safety.

The only viable way to compare floor assemblies accurately is to test to a standard under specific equivalent requirements.

Analysis, Evaluation and Interpretation:

The tests shown in **Table 1** were all done in accordance with the *ASTM E119* Assembly Fire Endurance Testing standards. This standard states:

> Scope
> 1.1 The test methods described in this fire-test-response standard are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including bearing and other walls and partitions, columns, girders, beams, slabs, and composite slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building…
>
> 1.4 These test methods prescribe a standard fire exposure for comparing the test results of building construction assemblies. The results of these tests are one factor in assessing predicted fire performance of building construction and assemblies. Application of these test results to predict the performance of actual building construction requires the evaluation of test conditions.

Table 1 shows the results of the only testing that SBCA is aware of that was conducted in accordance with *ASTM E119* on unprotected assemblies. Using 100 percent design load capacity, this testing was conducted in a manner intended to provide an assessment of "equivalent performance" as defined in the following language that was passed at the International Code Council Hearings. This language will be added and implemented into the *2012 IRC/IBC* code.

R501.3 Fire protection of floors. Floor assemblies, not required elsewhere in this code to be fire resistance rated, shall be provided with a ½ inch gypsum wallboard membrane, 5/8 inch wood structural panel membrane, or equivalent on the underside of the floor framing member.

Exceptions:
1. Floor assemblies located directly over a space protected by an automatic sprinkler system in accordance with Section P2904, NFPA13D, or other approved equivalent sprinkler system.
2. Floor assemblies located directly over a crawl space not intended for storage or fuel-fired appliances.
3. Portions of floor assemblies can be unprotected when complying with the following:
3.1 The aggregate area of the unprotected portions shall not exceed 80 square feet per story
3.2 Fire blocking in accordance with Section R302.11.1 shall be installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.

4. Wood floor assemblies using dimension lumber or structural composite lumber equal to or greater than 2-inch by 10-inch nominal dimension, or other approved floor assemblies demonstrating equivalent fire performance. (emphasis added)

ASTM E119 Assembly Tests at Full Design Load[2]

Test	Structural Member	Spacing (inches o.c.)	Structural Failure (min:sec)	Average Deflection at Floor (inches)	Loading (psf) - Percent Design Stress
FM FC 209	2x10	24	13:34	2.83	62.1 - 100%
FM FC 212	2x10	24	12:06	3.58	62.4 - 100%
NBS 421346 (2)	2x10	16	11:38	2.7	63.7 - 100%
NBS 421346 (4)	2x10	16	11:38	3.3	63.7 - 100%
FPL	2x10	16	6:30	4.0	79.2* - 100%
FM FC	12" Truss**	24	10:12	11.5	60.0 - 100%
FM FC 208	7¼ Steel C-joist	24	7:30	7.0	69.8 - 100%

*This load may be greater than 100% of design load. **Refers to a Metal Plate Connected Wood Truss.

Table 1: *ASTM E119* Assembly Tests at Full Design Load

Conclusion:

The performance of 2x10's, in terms of "time to structural failure," range from 6 minutes 30 seconds to 13 minutes 34 seconds. The 10-minute-12-second time to structural failure of the metal plate connected wood trusses strongly suggests that unprotected truss performance is essentially equivalent to a 2x10 floor joist system. The Steel C-joist test didn't have as high of a time to structural failure, but its performance of 7 minutes 30 seconds still falls within the range of the *ASTM E119* results for 2x10s.

The National Association of Home Builders (NAHB) and the American Wood Council (AWC) have promulgated this code change proposal which:

1. Contains language that is confusing at best.
2. Cannot be easily applied.
3. Allows the use of 2" by 10" or greater depth engineered wood products made from nominal dimension lumber ***without*** the application of a ½" gypsum wallboard membrane or $^5/_8$" wood structural panel membrane.
4. Seeks to promote exclusions that make a structure that is on fire less safe rather than safer.
5. Allows other approved floor assemblies that demonstrate equivalent fire performance using 2" by 10" or greater in depth engineered wood products that are made from nominal dimension lumber.

SBCA's policy is to foster the concept of fire ground safety that is fair and rational. Where increased fire resistance is desired, beyond what has traditionally been allowed by the *IRC* and *IBC*, a minimum of ½" gypsum wallboard or other materials that increase the fire resistance of the floor assembly should be applied to unprotected floor applications, regardless of the structural framing materials that make up the floor assembly.