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Felt Tips

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EFFECTS OF INSULATION ON FIRE RATED ASSEMBLIES

Underwriters Laboratories fire resistance classifications are developed for complete assemblies, such as roofs, floors, beams, columns, walls, partitions, ceilings, and similar combinations of building components. These tests are conducted in accordance with the Standard for Fire Tests of Building Construction and Materials, UL263, also designated as ANSI A2.1 and ASTM E119. The classification period is expressed in minutes or hours and is applicable to the assembly tested in its entirety.

There are three general fire performance characteristics that should be considered in assessing the effects of adding insulation to building construction systems with respect to building fire situations. These criteria include: flammability or flame spread; combustibility; and the influence of insulation on the hourly fire resistance rating of building structures tested and classified without insulation.

Because of their widespread use, a greater emphasis has been placed on conducting physical characteristic tests on cellulose loose fill material and other insulations to determine density, thermal resistance, moisture absorption, odor emission, corrosiveness, and flame resistance permanency, as well as other characteristics that may be specified in various product safety standards.

In general, adding insulation materials to an assembly will reduce the overall heat transmission through the assembly under fire exposure conditions when the burning characteristics of the material do not add significantly to the severity of the fire environment. Reduction in heat transmission will result in lower unexposed surface temperatures but can also cause higher temperature development on components within the assembly in comparison to the same or similar assembly tested and rated without the added insulation. The magnitude of the temperature increase on components within an assembly and the overall effect on fire resistance performance depend upon several factors, including: basic construction and structural characteristics of the assembly; the type and thermal resistance of the insulating material; and the location of the insulating material within the assembly.

In some fire tests it has been shown that placing the insulating materials directly on top of the ceiling can cause higher temperatures on the ceiling materials resulting in premature fallout of the ceiling under fire exposure conditions. In other test situations, it has been learned that increasing the thickness of roof insulation in excess of that specified in a rated roof-ceiling design, or using materials of different compositions having greater insulating characteristics, can result in higher temperatures on structural members within the assembly, including the metal roof deck, leading to premature structural failure of the assembly.

The location of insulation within a design may also influence the fire resistance performance of an assembly under fire exposure conditions. In a recent investigation, two similar wood joist floor assemblies were tested, one with insulation placed directly on the ceiling and the other with the insulation stapled between the joists directly under the wood subfloor. The assembly insulation placed directly on top of the ceiling developed a fire resistance classification 25 percent less than the assembly with the insulation located directly under the floor.

These studies indicate that factors necessary to meaningful assessment of the performance of fire rated assemblies incorporating added insulation are: fuel contribution characteristic of the insulating material and the magnitude of temperature increases of the components within the assembly and the resulting effect on structural performance.

In most cases, the insulations specified for use in previously tested and rated designs have been evaluated with respect to their combustibility characteristics. As new types of insulation materials are encountered, fuel contribution, flammability, combustibility, flame spread, and similar characteristics must be evaluated.

For new assembly evaluation, full scale test assemblies are often designed to incorporate the maximum anticipated thickness of insulation, so that the assembly may be utilized with varying thicknesses of insulation without additional full scale testing. These test assemblies can be instrumented to evaluate the performance of designs with minimum and maximum thicknesses of insulation.

In specifying insulations, information should be determined relative to the flame spread and combustibility characteristics of the materials, with particular regard to applicable building code requirements and regulations.

Adding insulation to an existing fire resistive design can reduce the hourly fire resistance rating. Analyze and evaluate the factors influencing rated assemblies.

A new study released by Owens-Corning Corporation indicates that a well insulated house is no more hazardous than a poorly insulated house in the fully developed stages of a fire.

Scientists constructed three 8 ft. x 12 ft. x 8 ft. test structures to analyze the effect of insulation on fire performance. The thermal characteristics of the test room interiors were measured for structures with no insulation (the control structure) for those insulated to Federal Housing Administration Standards (R-19 ceiling, R-11 walls and floor) and Energy Efficient Homes recommendations (R-38 ceiling, R-19 walls, and R-22 floor.)

As a result of the tests, company scientists reported: No significant differences in the maximum mean surface temperatures inside the test structures. No significant differences in the maximum mean cavity temperatures (between the gypsum board and the outside sheathing) as measured for the room insulated to FHA and EEH levels.

The temperatures on the cavity side of the gypsum board was either the same or higher for the insulated rooms as compared to the room with no insulation. The temperature on the interior cavity surface of the sheathing was consistently lower for the insulated structures.

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