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Wood Industry Fire Research Program

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Introduction

Five years ago a lumber industry committee concluded that the industry was terribly behind its competitors in terms of fire research. Structural fire models developed by the steel and concrete industries were already then becoming a reality. Fire growth models, potentially effecting lumber products, were being developed without significant input from the industry.

Looking toward the future, changes in wood design and engineering will also demand new analytical techniques in terms of fire performance. Existing fire ratings

will not apply to nontraditional products and assemblies. Methods for accurately evaluating these new items will be required.

In response, the wood industry was developed a dynamic program of fire research to respond to the challenges raised by our competitors. These challenges are not **only** in the research itself, but in the effect such research will have on markets. The program is expected to yield cost savings on fire testing, expanded market opportunities as a result of more accurate characterization of the fire properties of wood products, and protection of existing markets as the true fire performance of wood materials is revealed.

Fire modeling

Historically, products have been evaluated for their fire performance by use of standard fire tests that subject these materials to a known fire and then measure their response. These fire tests have been accused of being cumbersome, expensive, and unrealistic in their ability to predict performance under real fire conditions. However, recent advances in technology have opened up numerous possibilities for simulating all such fire tests on the computer.

By using computers to simulate how a fire grows, spreads, and effects structural elements, evaluation of products can be conducted inexpensively and accurately. Computer programs, or mathematical fire models, will allow material and product fire performance evaluations to be conducted on the computer. It is anticipated that in the future, regulation of products and assemblies will be based upon their performance in fire models.

Fire growth models

Room or compartment fire growth models, collectively referred to as fire growth models, are sets of mathematical expressions that describe the physical and chemical reactions occurring in a room as a fire develops. Such models take into account room geometry and available openings for ventilation, and then predict the resulting room temperature profile, rate of heat release, and smoke production.

These fire growth models impact lumber products in three ways that require industry investigation: 1) their use in comparing room lining materials such as paneling for contribution, if any, to fire build-up and spread; 2) the contribution of other ***room*** items such as contents and furnishings to fire development; and 3) the provision of a more realistic fire exposure for determining the structural response of the building. Within the context of this third use, standard fire exposures such as the ASTM E 119 temperature-time exposure curve will be replaced by a number of computer-generated fire growth curves, each depicting the particular room, occupancy, or exposure being evaluated.

In response, the lumber industry fire research program is endeavoring to provide answers that will facilitate further development of fire growth models. Most notable is the collection and testing of a wide range of wood materials at the Forest Products Laboratory (FPL) and at Forintek Canada Corp. to determine their fundamental fire properties, critical as inputs to the models. A supply of these accurately characterized materials is stored at FPL for use by all industry fire researchers so that research results are predicated upon similar materials. Additional industry-supported research to further develop fire growth models themselves is underway at FPL, Ohio State University, the Center for Fire Research at the National Bureau of Standards, and Michigan State University.

Fire endurance models

Buildings and their component assemblies are evaluated for their structural fire performance by means of fire endurance tests that subject the various assemblies to a fire exposure under full design loads expected in use. Assemblies tested must retain their structural integrity for specified periods of time. Industry fire research to predict this fire endurance time has periodically been conducted for some time, but has increased under the fire research program, particularly in development of predictive fire models to calculate the fire endurance of an assembly. These fire endurance models generally evaluate the primary governing load-bearing element and calculate its residual ability support a load as it is reduced in size by charring and reduced in strength from elevated temperatures.

The lumber industry fire research program is engaged in projects to develop fire endurance models for wood framed assemblies such as trusses, floors, and walls. Mathematical models for heavy timber members have been completed and are being refined. Fundamental fire property data, developed under the fire growth model program outlined above, are also needed as inputs to fire endurance models. For protected assemblies, or those meeting minimum 1-hour fire endurance ratings, mathematical subroutines to characterize the heat transfer through protective membranes are also being generated.

Toxicity

Outside the mathematical fire modeling area, the lumber industry is also conducting fire research on the combustion toxicity of its products. In response to legislation arising in the United States as well as abroad, the industry is undertaking a program to characterize its materials in terms of smoke toxicity. While traditionally not regulated on the basis of smoke toxicity, lumber products have nonetheless been caught in regulation aimed at the influx of synthetic products. Testing of a wide range of wood-based materials under a number of smoke toxicity tests proposed for standardization will provide the lumber industry with the product and material information regulators **are** requesting.

Other industry fire research

Through the extensive industry fire research program, the lumber industry also supports research on fire risk assessment, standardization of fire test methods in both the United States (ASTM and National Fire Protection Association) and abroad (International Standards Organization, and fundamental fire property test development.

Summary

The extensive lumber industry fire research program has been outlined detailing a comprehensive effort in fire modeling, smoke toxicity, and other significant fire areas. The program supports a widely cooperative effort comprised of researchers from industry, government, and universities. Ongoing meetings between researchers insures a continued dialogue and sharing of research information and results.

As a result of these efforts, the lumber industry is poised to take advantage of changes that are occurring in wood design as well as regulation. Rapid, accurate, and inexpensive evaluation of lumber product fire performance will be the result.