Groundbreaking: Tall Mass Timber Construction Types Included in 2021 IBC

Historic Action by ICC Follows Ad Hoc Committee Recommendations By Kenneth Bland, P.E.

he 2021 International Building Code (IBC) will introduce three new types of construction for fire-resistance-rated mass timber structures, the first significant addition to the types of construction in many years. Although still considered combustible construction, the structural frames of these buildings are designed for integrity in the unlikely event of fire exposure.

The Governmental Members of the International Code Council (ICC) approved a package of 14 proposals to recognize these new types of construction and related provisions. ICC's rigorous code development process has led to the recognition of a strong, low-carbon alternative to traditional materials in the building and construction industry. These changes expand the use of mass timber for larger and taller wood buildings up to 18 stories - a move welcomed by architects, engineers, and building developers.

The new construction types are designated as:

- Type IV-A Maximum 18 stories, with non-combustible protection such as gypsum wallboard on all mass timber elements and providing 2- and 3-hour fire resistance.
- Type IV-B Maximum 12 stories, limited exposed mass timber is permitted and providing 2-hour fire resistance.
- Type IV-C Maximum 9 stories, mass timber designed for 2-hour fire resistance. The approval concludes several years of scientific research and testing, verifying that mass timber meets the performance standards called for by the most widely adopted U.S. building code.

ICC Code Development Process

In late 2015, at the request of the American Wood Council, the ICC Board of Directors formed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. The AHC-TWB was appointed in early 2016 and was led by Stephen DiGiovanni, P.E., a fire department protection engineer for Clark County, Nevada. Committee members consisted of code officials, fire officials, stakeholders, and other interested parties. If deemed appropriate after studying mass timber, the committee would act to develop and submit

code-change proposals in the ICC process for the 2021 edition of the International codes.

The AHC-TWB determined fire testing was necessary to validate and verify that the performance level of passive fire protection intended by the IBC was retained. Five large-scale fire tests were developed to simulate characteristics of the three new construction types proposed. Using cross-laminated timber (CLT) and glued laminated timber, a two-story building was constructed to resemble a fully furnished, onebedroom apartment on each level. Additionally, various configurations of exposed mass timber walls and ceilings, in addition to automatic sprinkler system effectiveness, were evaluated. Corridors and an interior stairwell were instrumented to assess tenability conditions.

- Test 1: a mass timber structure with all interior surfaces fully protected with 2-layers of gypsum wallboard was subjected to a large furnishings-and-contents fire. The test was terminated after three hours without significant charring on the protected wood surfaces of the structure.
- Test 2: approximately 30 percent of the CLT ceiling area in the living room and bedroom were left exposed. The test was terminated after four hours, providing additional time to determine if there would be continued burning from the exposed CLT without intervention to extinguish the fire. Notably, once the fire consumed the furnishings and contents, the exposed CLT essentially self-extinguished due to the formation of char that protected the underlying wood and a gradual reduction in the room temperature.
- Test 3: parallel CLT walls were left exposed, one in the living room and one in the bedroom. Similar to Test 2, once the fire consumed the furnishings and contents, the exposed mass timber surfaces essentially self-extinguished.
- Tests 4 and 5: examined the effects of sprinkler protection. For both tests, all mass timber surfaces in the living room and bedroom were left exposed. Test 4 demonstrated that, under normal operating conditions, a single sprinkler easily controlled the fire. For Test 5, the

fire was allowed to grow in the compartment for 23 minutes before water was supplied to the sprinklers, which quickly controlled the fire.

The fires in Tests 1 - 3 were left to free-burn and reached a maximum peak heat release rate of 23 megawatts. The tests demonstrated that, if the required sprinkler system failed to operate, the resulting fire would eventually decay to a size easily controlled with limited intervention and without propagating to the next compartment.

After two years of study, the AHC-TWB submitted their proposals for consideration during the ICC 2018 Group A code development cycle. ICC's code development process involves several public opportunities for new code proposals to be deliberated. First, proposals are considered by an ICC Code Development Committee. All 14 of the AHC-TWB proposals were recommended for approval or approval as modified, after considerable testimony. The proposals were deliberated a second time at the Public Comment Hearings where, once again, they received overwhelming support. Final approval occurred during ICC's online voting process, cdpACCESS. Official voting results were announced in February 2019, and each of the 14 tall mass timber proposals was approved.

Moving Forward

ICC's 2021 model code development cycle continues throughout 2019 with the consideration of three additional proposals which address inspection and structural code requirements. The 2021 IBC, containing the complete package of tall wood proposals, is expected to be released in late 2020, along with the full set of 2021 I-codes.

The International Code Council develops and publishes a family of model codes suitable for local, regional, or statewide adoption. Once a governmental entity takes action to enact the code as law, all construction must be designed, constructed, and inspected for compliance.

For more information on the mass timber code changes, visit www.awc.org/tallmasstimber..



Kenneth Bland is the Vice President of Codes & Regulations for the American Wood Council.