Ad Hoc Committee – Tall Wood Buildings
IDENTIFICATION OF ISSUES
(Updated June 22, 2016)

The following is a list of issues identified by the committee as of the date noted. These comments are reported as received, as such there may be redundancies. This list is not intended to be an exhaustive list of all issues but rather a work-in-progress.

SCOPE AND OBJECTIVES

1. Use consistent terms: Mass timber? Heavy timber? CLT? Where does glue laminated, structural composites, laminated veneer, cross laminated timber fit in?
2. Where does FRTW and Preservative treated wood fit in?
3. We need to define all of these wood technologies, and make sure there is a standard that validates each technology to heavy timber or mass timber, whatever the term may be.
4. What performance do we want? That is, what are the acceptable losses, in comparison to what we assume are the acceptable losses in current height/area tables. I listened to a webinar put on by the wood folks, and the (Canadian) fire protection engineer implied that the tables are mostly predicated on not allowing a conflagration—which would say the building can eventually collapse as long as it doesn't let the fire go anywhere else. So how long is "eventually?" When do the fire fighters give up trying to save the building and "surround and drown?"
5. Presumably, they're doing some sort of performance-based design for the buildings being designed and built in New York and Portland. What performance criteria are they using?
6. How do we deal with or justify the combustible/non-combustible and equivalence issue? In my mind, if we're going to make changes to the tables in the code, this is the biggest hurdle and can't just be waved off. What fire testing has been done to date to demonstrate equivalence? The tests I've heard of or seen don't let the burn continue after the desired rating is reached (mostly 2 hours).
7. The group may want to consider this in steps with a strong consideration for a Hybrid type of construction with concrete core structures.
8. What exactly is CLT, in terms of construction of the product, dimensions, etc? Is there a standard that products will be listed to, in order to help an enforcer know that we are looking at CLT?

FIRE TESTING

9. Concerns with reliability of modeling from small scale testing rather than having full-scale testing. Has there been any validation between small scale testing and modeling, comparing what the model says the fire will look like versus the results of a full scale test? Did the model prediction prove accurate? If not, how can we rely on small scale testing and modeling in the future?
10. Concern about the use of E-119 and the temperatures in that test, versus the actual temperatures experienced in a fire. The E-119 test reports rating in terms of hours, this is misleading if the temperatures produced are less than fire temperatures. Is there another test we can use for wood that produces higher temperatures, or should we have longer ratings for wood in order to get the E-119 test to the temperature growth that can reach fire temperatures?
11. Request a compilation of all fire testing that has occurred, especially those tests that are large-scale and have used real fire? Looking for any testing that shows the failure modes of mass timber, i.e. show us the failures, what was the cause of failure, etc. Have these products been tested to their limits?
12. Have any fire tests been conducted with building services, i.e. HVAC, electrical penetrations, shafts, etc, incorporated in the wall and floor/ceiling assemblies? What is the method of through penetration protection?
13. What is the extent of fire testing with encapsulation? Does the encapsulation fall away or break off during the test? Is the use of encapsulation valid, should we require that fire testing and fire ratings be established solely on exposed wood members?
14. What fire testing has been done in Europe? Do they have the same fire tests? If not, are their fire tests more or less challenging than our fire tests?
15. Do we have fire testing for all components of construction, walls, floors, columns, beams, connections, etc.? What is missing?
16. Have all tests follow the E-119 time/temperature curve, or have there been any with real fire? Can we develop a full-scale fire test with a live fire? Replicate a typical high-rise floor, replicate weight bearing loading through the structural frame, and allow free burn to structural failure to determine where the failure points lie?
17. Have any of the fire tests combined a scenario of seismic event and a subsequent fire event (unsprinklered due to damage to fire sprinkler systems)?
18. Testing to advance prescriptive code and/or preapproved performance based methods:
19. Wall and ceiling assembly tests of exposed mass timber. Also Floor tests with gypsum/concrete toppings (i.e. CLT is the formwork for a concrete floor)
20. Full room fire tests to better understand contribution of mass timber to a room fire – develop design fire curves for realistic fire exposure for fire engineering practitioners.
21. Use of pressure-impregnated wood as the laminates for manufacturing mass timber – are there adhesives that are appropriate with FRT wood? Compatibility with metal connectors?
22. Full scale fire tests of a CLT structure (see Cardington Fire Tests undertaken by the Steel Industry)
23. Floor-ceiling connections and use of intumescent or similar fire resistive material at joints to address fire/smoke spread at assembly joints.
24. Testing of connections and develop provisions on embedment of steel connections
25. Testing of penetrations through mass timber and current proprietary systems for fire-rated penetration details. Do we need to develop specific details for penetrations through exposed mass timber?
26. NFPA test plan still doesn't have a door into the hallway so we can measure the potential transition into the hallway where fire fighters will be operating;

27. Canadian test facility is limited to 10 mw in measurement capabilities. This will once again force the effort into modeling which I do not have a high degree of confidence in. This will lead to skepticism from people reviewing the results.
28. Factor in real world ventilation. Of course adding air will increase heat release rates but we are trying to understand the impact in a real world setting. The test plan as it currently is set up opens up all results for criticism and second guessing potentially keeping us where we are at.
29. What criteria is being used in the modeling? The recent tests at SP Test Research measured char rates at an average of 1.1 mm/min. This is far above the standard calculation of 0.7 mm/min. If we are not using an accurate rate it will compromise the results.
30. The tests at SP also demonstrated that the fire overcame the sprinkler in the hallway, the test realized collapse at the 1 hour 36-minute mark and manual suppression was required.
31. I also have a concern for the consistency of the adhesives and how do we regulate this through the codes or standards. I think this is a fundamental issue as different adhesives perform to various levels and are the current tests relevant to long term performance?
32. What are the glues used in CLT and what are their properties when exposed to heat from fire?

GENERAL FIRE

33. What are the impacts of through-penetrations? What percentage of an assembly can be subject to penetrations? Same 100 sq in per 100 sf?
34. Is CLT (or the other wood technologies) as safe as traditional sawn heavy timber? Concern that there is structural collapse faster with engineered lumber than with traditional sawn lumber http://www.ul.com/global/documents/offerings/industries/buildingmaterials/fireservice/NC9140-20090512-Report-Independent.pdf .
35. Due to contribution of fuel from wood structure are upgraded sprinkler systems required?
36. Are there additional safeguards required for building under construction? What kind of fire load will a HT building under construction produce, and what harm may come to neighboring buildings? There is a balance between forcing greater setbacks that are permanent through the life of a building, versus temporary additional protection to mitigate hazards during the construction period.
37. Are there any fire sprinkler exceptions (i.e. concealed volumes not protected) that should be reconsidered with the possibility of taller and taller wood structures?
38. Encapsulation
    a. Consideration of prescriptive height/area limits for unprotected timber buildings. Buildings with exposed timber over such prescriptive heights/areas are required to undergo fire engineering assessment (with Performance based design guidelines established).
    b. Consideration of fire retardant treatments (non-pressure treated) which could be simple Flame spread/smoke development to achieve Class A, to complete multi-application intumescent applications to achieve extended duration 30-minute fire performance. Some clear coat systems exist. Although inspection and maintenance/serviceability of such treatments may be an issue.
    c. Provide a guideline for extent of encapsulation of exposed mass timber by gypsum (or similar) based upon testing to achieve required fire-resistance.
39. Fire Management in Mass Buildings
    a. Guidance on management procedures and methods to reduce the risk of fires during construction in mass timber buildings.
    b. Increased level of sprinkler protection, monitoring and reliability criteria for mass timber buildings with exposed timber.
    c. Improved means of early detection, fire service facilities for firefighting, improved exiting and fire Department access provisions.
40. Impact on sprinkler system load (water supply) vs combustible construction fuel load
41. Impact on first responders due to combustible high rise construction
42. Ensuring fire stop assemblies in place and inspected
43. 18-story building in Vienna. When the designers were conducting research on the char rate they also realized a rate of 1.1 mm/min. They were also concerned on the building performance so they are actually designing a concrete core structure with CLT facades and a hybrid concrete CLT floor. It will be fully sprinklered with the piping imbedded within the concrete.

GENERAL BUILDING

44. Impact on Height and Area of Chapter 5 of the IBC?
45. Impact on IBC Section 403 High Rises?
46. How are we verifying the inspections of these panels as they are installed and connected, are there special inspections we need to add?
47. Should there be a reversion to egress factors for CLT high-rises?
48. Addition of a section within Chapter 7 of IBC for acceptable methods of protection of connections for mass timber. Metal connectors and adequate means of embedment/encasement/proprietary protection to achieve specific ratings.
49. Details for protection at penetrations and assembly connections, methods of installation.
50. Connections/ Penetrations/Barrier Junctions
51. How amenable are CLT and other engineered panels to being modified during building alterations? If one cuts a hole through a panel (open up two spaces, add HVAC, add electrical, add a door, etc.) what kinds of effects can we expect?
52. Necessary safeguards during construction.
53. Aspects that may require special inspection? Coatings, connection details, etc?
54. Periodic inspections?
55. We also need to look at toxicity of the adhesives, are we creating an unintentional health issue?
56. Construction of shafts?
57. Post construction maintenance requirements?
58. Exterior wall opening protection?

STRUCTURAL

59. Structural issues, post tension uses, lateral load unknowns.
60. Do structural issues arise over time as wood ages?
61. Do structural issues arise during a fire event that may expose responders to building collapse?
62. Structural concerns, are there issues with all-wood buildings, or do we need to focus on composite construction? Issues with lateral strength, lots of unknowns.
63. How does a charred building assembly act in terms of continued operation? If a fire occurs that visibly chars a structural assembly, does that assembly need to be repaired prior to occupancy of the building? What is the char depth that is permitted before calling a building unsafe?
64. Current status of using mass timber walls as vertical lateral force resisting systems?
65. Current status of using mass timber walls as horizontal lateral force resisting systems (eg diaphragm load values?)
66. How are all the lateral design factors established? (Note that there are more than just “R.”) This may be dependent on establishing a system that includes standardized connections.
67. Connections – How do they get designed for structural capacity, structural ductility (related to lateral load design factors), and fire protection?

MATERIAL KNOWLEDGE AND STANDARDS

68. CLT and wood technologies, is there are weak direction, i.e. any difference in performance perpendicular versus parallel to grain?
69. How are we verifying the quality of construction of the panels from the manufacturing plants?
70. Encapsulation, what is the role of gypsum, is Type X or Type C better.
71. How is CLT constructed, what are the weak components? When CLT fails during fire/load tests, what are the failure points of the product?
72. Are additives/coatings such as intumescent paint useful to CLT?
73. Not all species of wood are the same, if there a list of acceptable wood species? Differences between hard and soft woods? Are there minimum characteristics such as shear strength, density, hygroscopy, potential heat content, flame spread, char formation and resulting insulation, any others, that can differentiate an optimum wood versus a poor wood choice?
74. Impact of wood aging on fire/structural considerations?
75. What are the standards that are used internationally where tall wood buildings are being constructed?

MISC

76. Environmental issues, such as mold, moisture issues, climatic differences, age of wood, is there a loss of mass over time, etc.
77. Improved Education of AHJ's to Mass Timber
78. Relative risk assessment studies to comparable non-combustible construction
79. Involvement of the Insurance Industry to understand insurable risk
80. Development of a standard for Mass Timber buildings (i.e. SFPE 29 for Steel Structures) parts of which are now adopted within Chapter 7 of IBC.
81. Should we develop a guide for the performance based analysis of the taller projects that are presented to AHJ's? Even if we expand the height and area to new upper limits, should we guide code officials on any projects that may be even higher and larger?
82. Need for Fire/Structural Peer Review?
83. Energy considerations…..IECC mass wall considerations?