Truss-ting History

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Abstract

Building performance in this case being evaluated by traditional means, such as energy use over time, in addition to qualitative questions of space, history, pedagogy etc. Another term explicit in this project is that of "future use" by which we build on typical modes of site analysis in addition to the growing body of research developed through building scientists, we ask how building systems can be used to accommodate a variety of program while simultaneously maintaining a strong connection to place. Through the use of a hybrid system of glulam trusses and CLT panels to repurpose an existing historic pumphouse on the UMass Boston campus, an annex is created in dialogue with said structure.

The use of long span trusses serves the long-term needs of the project, ensuring the building's resiliency into the future. In the short term, the raising of trusses from the ground plane enables a landscape program to be developed that deals with rainwater management and flooding. Sculpting of topography channels water beneath the structure, collecting it within a depression and eventually filtering it prior to discharge into nearby Boston Harbor.[1] In the long term, spaces have inherent programmatic flexibility; long spaces enabled by the trusses enable a large variety of programs to occupy the spaces. CLT floor panels might also be removed, the trusses serving as the main structural support members, allowing for sectional flexibility.

A final aspect of the project's adaptability is its programmatic functions. As designed in the current day, the structure is enmeshed in UMass Boston as a piece of critical infrastructure, serving much needed campus functions such as power generation, lab spaces, and rainwater management. The pump house in its current stage exists as a biomass power plant, serving increased power consumption needs stipulated in local master plans. The spans enabled by the structure, however, enable various types of machinery to be switched in and out, allowing conversions from one power source to another. The annex, as designed, serves laboratory functions. The overdesign, in terms of HVAC and a flexible raised floor system, enables expansion of this lab program or later conversion to other uses as classrooms, offices, etc.

In short, a model for adaptable design is offered, both in terms of program and in application. The system is applicable to both free standing and existing structures, as well as offering a multitude of spatial configurations as time progresses.

Keywords: Pedagogy, Material + Construction Techniques, Structure, Energy + Systems

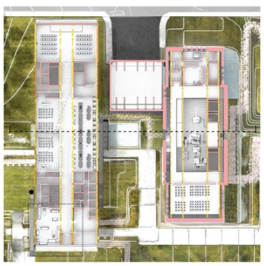
Acknowledgements

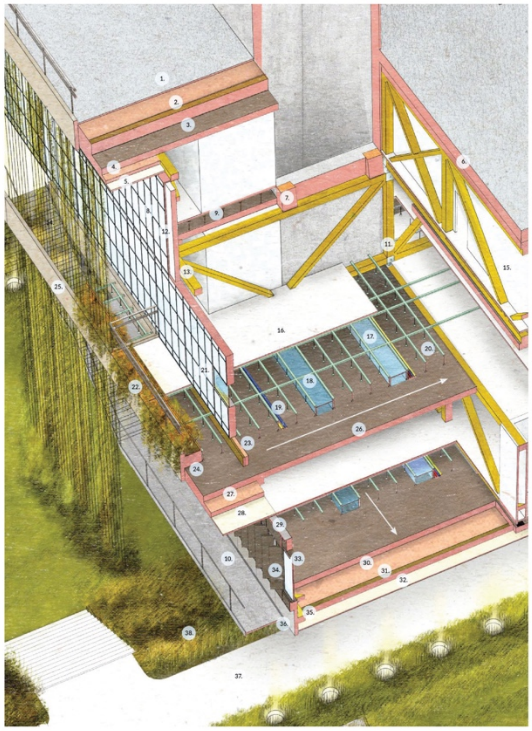
Project completed as an academic project for Associate Professor David Fannon's Comprehensive Design Studio to fulfill the requirements for Northeastern University's BS Architecture degree program

Notes or References:

1 "3D Data & Maps." Boston Planning & Development Agency. Accessed May 15, 2019. http://www.bostonplans.org/3d-data-maps/gis-maps/citywide-maps. (GIS Information for Site)

2 Several projects, including the Environmental Sciences Building at the University of British Columbia (Perkins and Will), the John W. Olver Design Building at UMass Amherst (Leers Weinzapfel), and the Wood Innovation Design Center in Prince George, BC (Michael Green Architecture) were analyzed as precedents and drawn on for inspiration in the design of this project

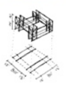




1. ROOF MEMBRANE AND INSULATION
2. ROOF BEAM
3. CLT COUCHED ON CORE
4. OVERHANG INSULATION
5. OVERHANG SHEATHING
6. ADDITIONAL SPACE FOR GREEN ROOF
7. TRUSS COUCHED TO CORE
8. HORIZONTAL AND VERTICAL PANEL SUBDIVISIONS
9. CLT RESTING ON TRUSS
10. EXTERIOR CATWALK STAIRWAY
11. TRUSS SADDLED TO TRUSS ABOVE AND BELOW
12. TRANSLUCENT PLASTIC WINDOW INSULATION
13. PANELS FIXED TO TOP TRUSS CHORD
14. VERTICAL TRELLIS WIRES ATTACHED TO WOOD PANELS
15. INTERIOR WALLS ATTACHED TO TRUSS
16. SUBFLOORING
17. SPACE FOR RETURN AIR
18. SPACE FOR SUPPLY AIR OR CHILLED BEAM
19. ACCOMMODATED CONDUITS AND PIPPING
20. RAISED FLOOR SYSTEM
21. INSULATED GLASS WALL PANELS WITH INSET WINDOWS
22. EXTERIOR HANDRAIL FIXED TO WOOD PANELS
23. INSULATION AND BLOCKING AT PANEL TO FLOOR CONNECTION
24. EXTERIOR PLANTER AND INSULATION IN RAISED FLOOR DEPTH
25. 3.75' x 6' EXTERIOR WOOD PANEL FIXED TO CLT
26. CLT RUNNING PERPENDICULAR TO BEAMS
27. CONTINUOUS INSULATION ALONG UNDERSIDE OF CLT
28. EXTERIOR SHEATHING ON UNDERSIDE OF CLT OVERHANG
29. CORK INSULATION BETWEEN UNITIZED PANELS
30. CORK INSULATION BETWEEN BEAMS
31. BEAM FIXED TO BOTTOM CHORD OF TRUSS TO HOLD CLT
32. EXTERIOR SHEATHING ALONG UNDERSIDE OF TRUSS
33. INSET PREFAB PANEL WINDOW
34. INSULATED PREFAB WOOD PANEL FIXED TO TRUSS
35. BOTTOM CHORD OF 15' TALL GLULAM TRUSS
36. 3.75' x 6' EXTERIOR WOOD PANEL FIXED TO TRUSS CHORDS
37. PERMEABLE PAVING.
38. PHYTOREMEDIATION AND WATER RETENTION STRATEGY
39. HYBRID WATER RETENTION AND PLAYSCAPE
40. LANDSCAPE/UNDER BUILDING LIGHTING

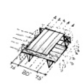
Alternating Truss Directions

By stacking 15' tall prefabricated wooden glulam trusses in alternating directions on a tartan grid, the primary structural system creates the possibility for long spans in perpendicular directions.



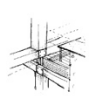
Cross Laminated Timber

The 15' x 30' tartan grid of the primary structural system of trusses allows for 45' CLT panels to span between truss chords giving rise to a number of opportunities for tertiary structural systems, and spatial variation



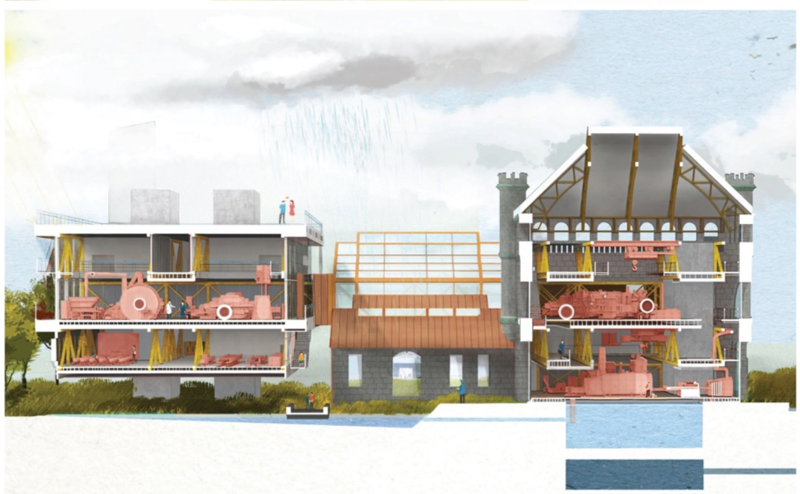
Raised Access Flooring

Saddling the trusses together at intersections along the tartan grid allows for flexibility in the distance from top to bottom chord. Using a RAF attached to the CLT panels allows for an easy and seamless distribution of mechanical systems, insulation, and planting strategies



Modular Facade System

Use of prefabricated structural elements lends itself naturally to prefabricated facade panels, especially when considering the buildings potential to change over time. A combination SIPS, insulated PVC, and typical glass curtain wall systems allow our highly adaptable structure to respond effectively to a variety of programmatic or climatic conditions.



Truss-ting History

Building Systems as a Temporal Dialogue

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ARCH 5120

Exploring the future use adaptability of wood construction techniques, our proposal utilizes a hybrid system of glulam trusses and CLT panels to repurpose an existing historic pumphouse on the UMass Boston campus and create an annex in dialogue with said structure. The radically different applications of the system, one as an internal frame to repurpose the pumphouse, the other as a free-standing laboratory, are a testament to the flexibility of prefabricated timber systems

A prefabricated structural system consists of long span glulam trusses, coupled with panelized CLT floors to span between trusses. The trusses offer their spanning capabilities to the building, allowing long span spaces within the design, uninterrupted by columns. At the same time, the CLT flooring system, due to CLT's inherent load-bearing capacities and spanning capabilities, offers uninterrupted spans perpendicular to trusses.

Trusses rotate 90 degrees to one another on every floor, allowing the system to "lock" around concrete cores, and thus gain lateral stability. This also allows the system to hang from cores to distribute loads to the ground. In the case of the historic pumphouse, this prevents further strain from being placed on already weather-worn walls, whilst in the new annex it allows for a completely free ground floor plan.

The use of long span trusses additionally serves long term needs functions in the project, ensuring the building's resiliency into the future. In the short term, the raising of trusses from the ground plane enables a landscape program to be developed that deals with rainwater management and flooding. Sculpting of topography channels water beneath the structure, collecting it within a depression and eventually filtering it prior to discharge into nearby Boston Harbor. In the long term, spaces have inherent programmatic flexibility; long spaces enabled by the trusses enable a large variety of programs to occupy the spaces. CLT floor panels might also be removed, the trusses serving as the main structural support members, allowing for sectional flexibility.

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In short, by truss-ting history, we offer a model for adaptable design the consolidates, past present and future use. The system is applicable both free standing and as support for existing structures, as well as allowing a large array of programs to exist within its confines

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