PROJECT Circulating Matters

YEAR
2022

LOCATION
Ithaca, NY, United States

USE
Other

CONSTRUCTION
New Construction

ARCHITECT
Circular Construction Lab, Cornell University College of Art, Architecture, and Planning

ENGINEER
schlaich bergermann partner

DEVELOPER
Cornell Council for the Arts

BUILDER
Circular Construction Lab, Trade Design Build

SUPPLIER
pcrents

SPECIALISTS
Finger Lakes Reuse

GROSS AREA
150 sq-ft

MEAN ROOF HEIGHT
N/A

STORIES ABOVE GRADE
1

STORIES BELOW GRADE
0

RISK CATEGORY
II

COST INFORMATION
Unavailable

LCA INFORMATION
Unavailable

Credit: Albert Vecerka Esto

PRINCIPLE	SCALE	SYSTEMS	MATERIALS
DESIGN FOR DISASSEMBLY	Elemental Subsystems **Whole-structure**	Non-structural Envelope Balconies **Stairs/ramps** Foundations **Beams** Bracing Walls Roof Floors **Columns**	Other Earthen **Wood** Steel Masonry Precast concrete Insitu concrete
STRUCTURAL COMPONENT REUSE	Whole-structure Subsystems **Elemental** **+Deconstruction**	**Columns** Floors Roof Walls Bracing **Beams** Foundations **Stairs/ramps** Balconies Envelope Non-structural	Insitu concrete Precast concrete Masonry Steel **Wood** Earthen Other

SUMMARY

Circulating Matters was a temporary installation completed as part of the 2022 Cornell Biennial on the Cornell University campus. It was constructed from salvaged lumber material from the nearby Catherine Commons Deconstruction Project. The installation was deconstructed and reconfigured for permanent assemby at Art Omi, NY.

SUSTAINABILITY GOALS

The project sustainability goals were explicitly focused on a Circular Economy strategy - to use only salvaged deconstructed material, and to design the structure for disassembly and future material reuse.

CIRCULAR ECONOMY STRATEGIES

Circulating Matters was a temporary art installation for the 2022 Cornell Biennial. As a stucture accessible by the public, and could be climbed and inhabited, it required a City Building Permit and the associated structural engineering analysis, design and justification. The project is constructed as a series of adjacent moment frames supported on a wood base founded on screw piles.

The wood used was old growth Eastern Hemlock and a hard pine extracted from a residential building constructed in Ithaca, NY in 1910. The wood was felled and milled before contemporary lumber industry size and grading rules were established. The design and material property justification process is described in detail in the linked Project Journal paper - 'Structural design using reclaimed wood–A case study and proposed design procedure'

The project was conceived as a holisitic implementation of Circular Economy principles. The design of the installation was based on the specific material stock retrieved from the Catherine Commons Deconstruction Project, a local 13-bedroom residential deconstruction project lead by the Circular Construction Lab in early 2022. The design was refined from a series of concepts developed as part of the Advanced Architectural Design Master of Science studio ‘Unbuild: Design’ taught at Cornell University in the Fall of 2021. The installation on the Cornell University campus was temporary, and the project was designed for disassembly with reservible screwed connections between all wood elements, and removable screw foundations.

KEY FINDINGS, RECOMMENDATIONS, AND LESSONS LEARNT

The primary challenges of the project were: designing with an atypical material source of limited and variable lumber lengths and non-contemporary cross-section dimensions, and determining suitable lumber mechanical properties to complete a structural design.

Due to the nature of the installation as a temporary art piece, the final design geometry (overall plan area and height) was adjusted to suit the available material. This flexibility on the overall brief is not typical, but lessons can be learnt for more constrained briefs such as maintaining flexibility on joist

spacing in the structure to allow for limited joist sizes, or to match different column and stud sizes. To meet geometric requirements for connections and the global structure, the installation at times used more lumber than necessary to allow for a global fit.

The non-contemporary cross-section dimensions made using conventional folded steel lumber connectors was impractical without reducing element widths and depths to match modern standards. This generated additional work in the forming the base frame of the installation. Custom steel connectors were fabricated to accomodate the traditional lumber widths to meet the heads of the screw pile foundations.

The project ran in parallel with a research project exploring feasible methods for establishing lumber mechanical properties for salvaged material. The research proposed three processes to determine the properties - one based on determining the species of the lumber and using tabulated data and custom reductions, one that was based on measurements of specific gravity taken from a sample of the salvaged material, and one which completed destructive bending tests of a sample of the salvaged material. It was suggested that a method based on the specific gravity measurements may be most suitable for future commercial engineering design work that does not have extensive access to Universal Testing Machine laboratory equipment and testing expertise. These key findings are discussed in the linked Project Journal paper - 'Structural design using reclaimed wood–A case study and proposed design procedure'.

FURTHER INFORMATION AND RESOURCES

Architect website: https://labs.aap.cornell.edu/ccl/circulatingmatters

Engineer website: https://www.sbp.de/en/project/cornell-folly-circulating-matters/

Project journal paper: https://www.sciencedirect.com/science/article/pii/S0959652623024745

Source-material deconstruction project: https://labs.aap.cornell.edu/ccl/decon

Reconstructed project location website: https://artomi.org/exhibition/felix-heisel-and-the-circular-construction-lab-circulating-matters-2/

AVAILABLE QUANTITATIVE DATA

3.16 cubic yards of wood, of that 1.69 cy of joist, 0.82 cy of columns, 0.50 cy of boards and 0.15 cy of connector elements.

ABOUT THE DATABASE

This case study has been prepared by the Structural Engineering Institute Sustainability Committee Circular Economy Work Group with the goal of sharing and promoting the excellent circular economy work that project teams are working on throughout North America and the world. Often it is hard to find information on how circular economy principles are implemented in practice; these circular economy case studies aim to better share information amongst the industry.

Some case studies have been prepared directly by a project team member, while others have been prepared based on available texts and publications. In the second case, the text descriptions are a summary of information available from other sources. These sources are referenced in the *Further information and* resources section.

While reasonable efforts have been made to ensure the information is representative and accurate, we cannot guarantee there are no errors. Please contact the case study team to provide additional information, suggest updates and amendments, or with any other questions. To submit a new case study to the database, please use this submission form. Thank you!