PROJECT Boulder Community Hospital

YEAR
2023

LOCATION
Boulder, CO, United States

USE
Healthcare

CONSTRUCTION
Deconstruction of Existing Structure for Reuse, New Construction

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ARCHITECT
City of Boulder, Michele Crane, Facilities Chief Architect

ENGINEER
KL&A Engineers and Builders

DEVELOPER
City of Boulder's Alpine-Balsam Redevelopment Plan

BUILDER
Ameresco - General Contractor, Colorado Cleanup Corporation - Deconstruction Contractor

SUPPLIER
n/a

SPECIALISTS
KL&A Team Carbon, Embodied Carbon Specialists

GROSS AREA
250,000 sq-ft

MEAN ROOF HEIGHT
N/A

STORIES ABOVE GRADE
5

STORIES BELOW GRADE
0

RISK CATEGORY
IV

COST INFORMATION
Unavailable

LCA INFORMATION
Partially available

Credit: KL&A Engineers & Builders

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
PRINCIPLE	SCALE	SYSTEMS	MATERIALS
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

A 250,000 sf hospital was sustainably deconstructed by the City of Boulder, and 93.5% of all materials were diverted from landfill, via recycling or reuse. 584 wide flange and HSS members were stockpiled for structural reuse.

SUSTAINABILITY GOALS

Boulder passed Deconstruction Ordinance 8366, effective July 2020, requiring all residential and commercial demolition / deconstruction projects to divert a minimum of 75% of waste by weight from landfills, via recycling or reuse. For this building, the goals were to achieve 90% waste diversion, prioritize reuse, and illustrate the potential for a circular economy and long-term material stockpile within the city.

CIRCULAR ECONOMY STRATEGIES

After a community hospital was left unused, the City of Boulder purchased the building and began redevelopment. After several iterations, a new housing plan was established, requiring the removal of the hospital.

The circular approach for the project needed to be robust to divert 75% of a 65 million pound building from landfill. The deconstruction started with interiors, focusing on doors, light fixtures, sinks, mechanical and electric equipment, and other indoor items. These items were auctioned off for reuse. The next phase of deconstruction was centered around the core and shell: exterior materials and structural elements. This phase had a particular emphasis on structural steel. One percent of the building weight was structural steel memebers.

The structural steel members were deconstructed, recovered, and physcially and digitially inventoried, including material testing. Over 580 pieces were recovered and stockpiled. To date, 89 pieces (25% of the stockpile's weight) have been installed as structural members in nearby Boulder Fire Station 3, at the aparatus bay and mechanical screen. Many other pieces have been claimed for reuse in other new construction projects. And the remaining pieces are resting at the site's stockpile, available for procurement and reuse.

The concrete and brick in the building were downcycled to site fill - crushed, processed, and used to regrade the old hospital site after deconstruction.

One portion of the building, the Pavillion, was not demolished and instead will be renovated for use as city offices. Renovations include the exterior enclosure and interior fittings.

KEY FINDINGS, RECOMMENDATIONS, AND LESSONS LEARNT

In total, 93.5% of the hospital's construction materials were diverted from landfill, equal to around 60.8 million pounds. This includes 98% of the core and shell with 584 structural steel wide flange and tube steel pieces salvaged, totaling over 160 short tons.

The BCH stockpile is estimated to have saved 167,338 kgCO2eq in embodied carbon emissions, 36,344 kgCO2eq specific to FS3. This saving is equivalent to 37 gasoline-powered passenger vehicles driven for 1 year (United States Environmental Protection Agency, 2023). Compared to the embodied carbon emissions of typical new construction (500 kgCO2eq/m2), this saving is equivalent to 3,605 square feet (335 m2) of constructed floor area.

The contractor on the deconstruction project, Ameresco, has said publically that, due to additional labor and time costs, the BCH project deconstruction cost was roughly 20% higher than traditional demolition.

The BCH deconstruction, component process and stockpile, and reuse in FS3 illustrate that structural component reuse at-scale is possible and financially feasible. The necessary change in behavior, priorities, and incentives is more challenging than the technical aspects. Deconstruction and recovery costs will likely be the most prohibitive challenge. The enthusiasm and commitment of the design and construction team were instrumental in hitting the ambitious diversion requirements. However, the lasting impact of the project is still unclear. The city is interested in carrying out other deconstruction projects and material stockpiling, but has not yet said it is the new normal and won't require it. Currently, the city's enforcement of their deconstruction ordinance has resulted in 76% landfill diversion of all projects since implementation.

FURTHER INFORMATION AND RESOURCES

https://coloradosun.com/2023/10/29/boulder-community-hospital-deconstruction-recycled/

https://bouldercolorado.gov/news/city-models-sustainable-deconstruction-alpine-balsam-project

https://bouldercolorado.gov/projects/alpine-balsam-implementation

https://bouldercolorado.gov/news/city-models-sustainable-deconstruction-alpine-balsam-project

https://www.youtube.com/watch?v=cviJHKwGhm0&t=281s

Further contact: Emily Freedman, Sustainability and Policy Advisor and Alexis Feitel, Structural Engineer, KL&A

AVAILABLE QUANTITATIVE DATA

584 pieces of structural steel were salvaged from the deconstruction project. This steel will be used in many future construction project. One project, Fire Station 3, has successfully installed 89 wide flange pieces as strcutrual components, equivalent t

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!