

# ETH Zurich Pavilion

IDEAS CITY Festival 2015 / First Street Garden

33 East 1st Street and Houston Street / 2nd Avenue



Assistant Professorship of Architecture and Construction  
Assistant Professor Dirk E. Hebel

Block Research Group - BRG  
Professor Philippe Block

**ETH** zürich



**BRG**

**DARCH**

Waste is a result of human actions and interactions, bringing raw natural materials from one stage of being into another by applying various forms of skills and energy. In this sense, waste was seen for centuries as something specific, belonging neither to the family of natural resources nor to the one of finished products. Waste has been a by-product, an (ideally) invisible result of making and living in cities, but waste could also be understood as an integral part of what we define as a resource. We would thereby acknowledge its capacity to function as the required substance or matter from which to construct or configure new cities. This metabolic thinking understands our built environment as an interim stage of material storage.

The ETH Zurich Pavilion at the IDEAS City Festival 2015 in New York City is an example of this approach using discarded beverage cartons as its resource. Produced from paper, polyethylene and aluminum, over 180 billion such units were consumed in the past year alone. To recycle the product, the laminated layers need to be separated through high water and energy use. In the United States, only about 40% of households have access to such a recycling process, sending 430,000 tons of highly valuable material to landfills. The US company ReWall uses a process that activates this potential by pressing boards out of 100% reused, shredded beverage cartons. Although they are intended for interior wall cladding, the ETH Zurich Pavilion uses these panels as its only structural building material.

The expressive pavilion is designed to appear to float in the narrow slot between the buildings of the First Street Garden. Designed by the ETH Department of Architecture's Assistant Professorship for Architecture and Construction Dirk E. Hebel and the Block Research Group, the structure allows the use of a non-standard, weak material in construction. To keep the stresses in the material low, the shape follows the flow of forces, resulting in a vaulted structure in compression. Thanks to its overall double curvature and the triangular sections of the arches, which give the structure a deeper section for the same thickness and weight, the shell is stable and safe.

Additionally, due to their original use as beverage cartons, the boards are waterproof. The layout of the structural tiles of the shell's top surface are aligned with the direction of rain flow to function as water-shedding shingles.

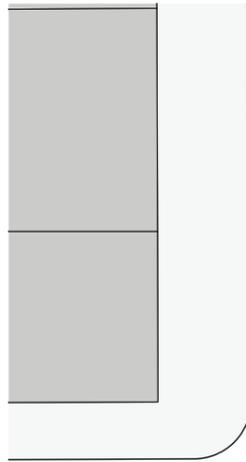
The separate, parametrically varying arches, which allow building up the pavilion in stable sections, are shaped to respond to the structural requirements, forming a dramatic spatial experience that accentuates the structure's flow of forces. The dry-assembled pavilion utilizes industrial packaging straps to keep the thin, CNC-cut sheets together in triangular blocks. Being extremely lightweight, the arches are then tied down using tie-down straps. This strap-only construction process also enables efficient disassembly. Without the need to remove or dispose of metal fixings, glue or non-recyclable materials, the structure's components can subsequently be returned to the recycling process in a straightforward manner.

The pavilion's arches touch down on temporary support structures made of industrial pallets. The weight of these modules additionally anchors the shell to the ground without leaving invasive marks or structures on the site after the pavilion's removal. Finally, these support structures are elements of the spatial layout, forming the bar and exhibition areas, providing seating, and creating divisions or wall spaces.

Underneath and within this structure, ETH Zurich will curate a program following the theme of the pavilion. The exhibition 'Building from Waste' displays over 25 construction materials derived from waste, activating resources within our cities that have remained invisible until now. A covered area for about 30-40 people will provide space for invited guests from ETH Zurich and its partners to organize lectures and seminars for the general public. A bar will offer a variety of catering services throughout the duration of the festival.



The Site First Street Garden New York

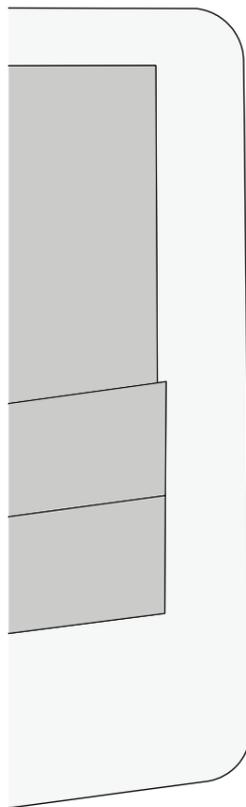


2<sup>nd</sup> Avenue

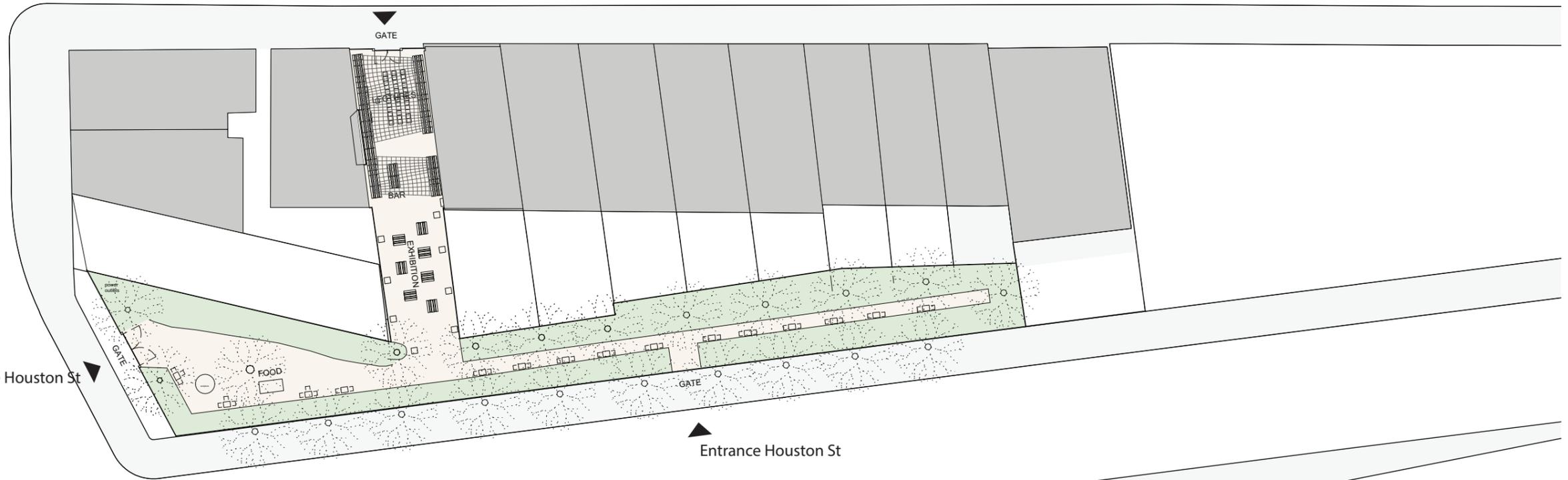


ETH  
Pop-Up  
Workshop

E 1<sup>st</sup> Street



Entrance 1st Street

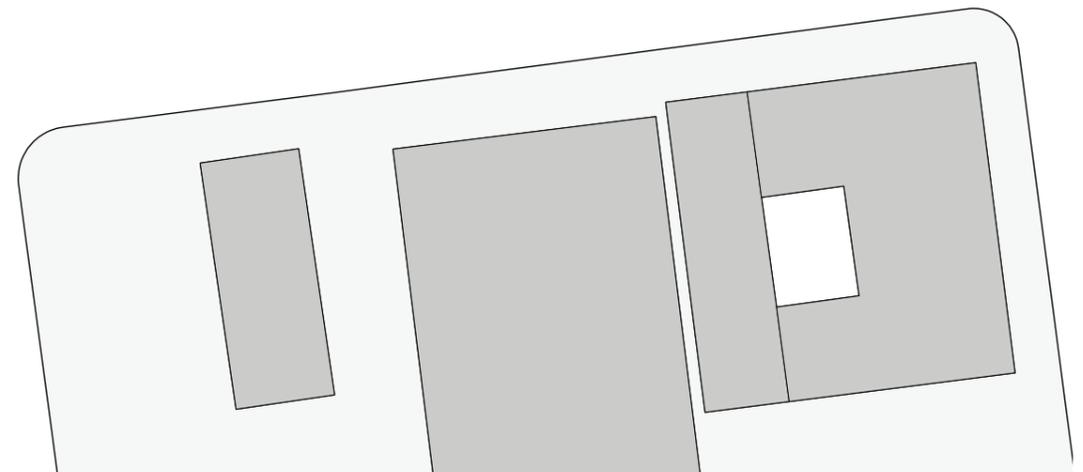
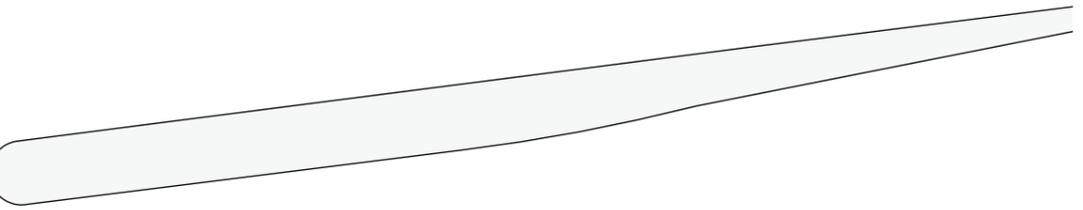
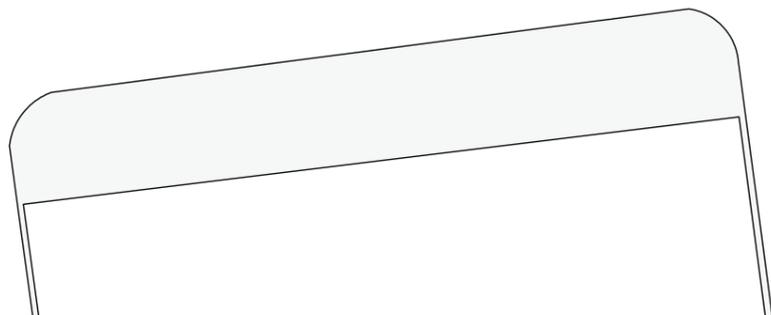
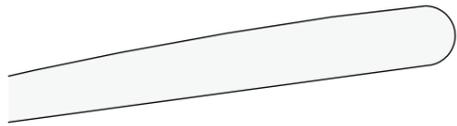


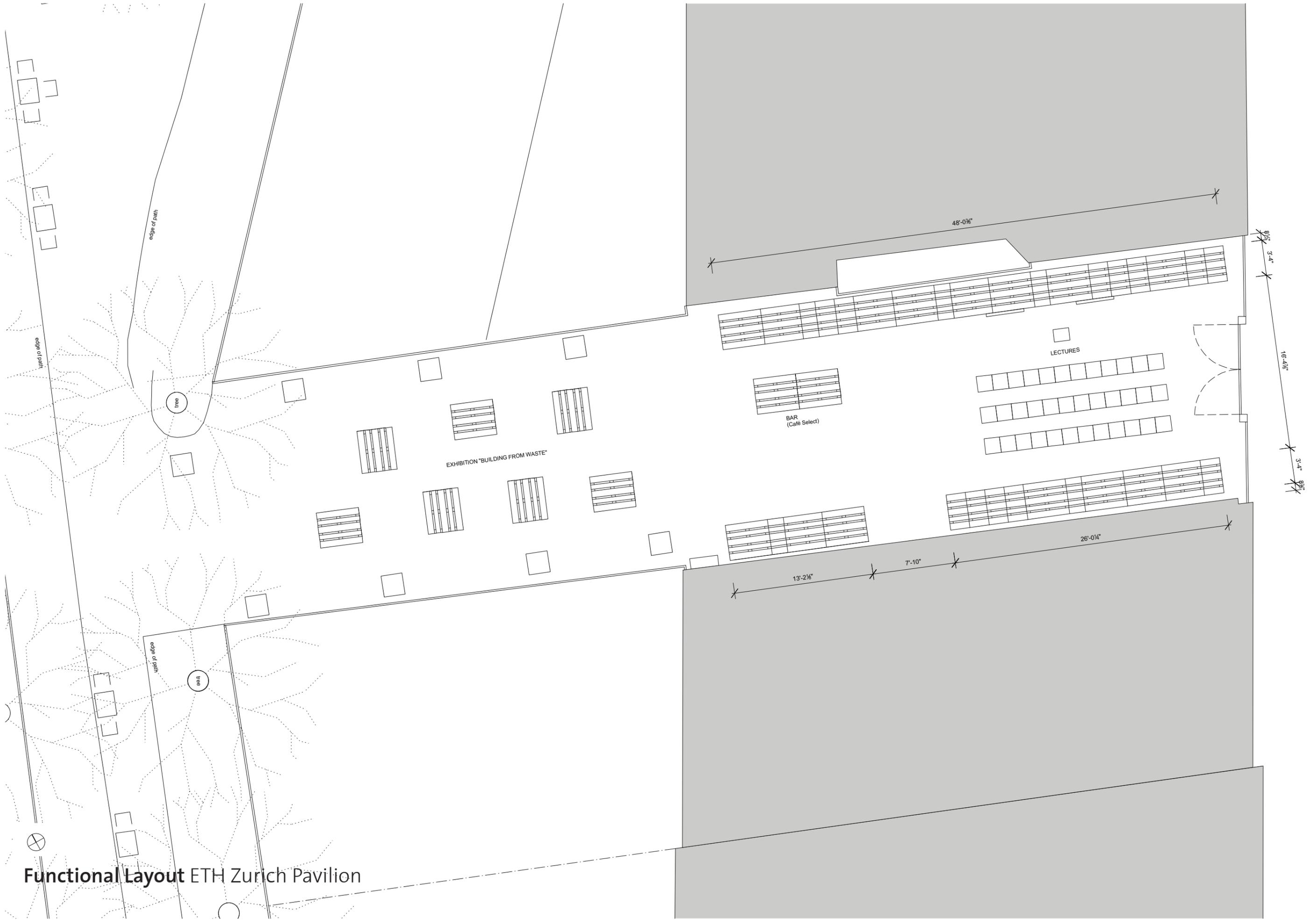
Entrance Houston St

Entrance Houston St

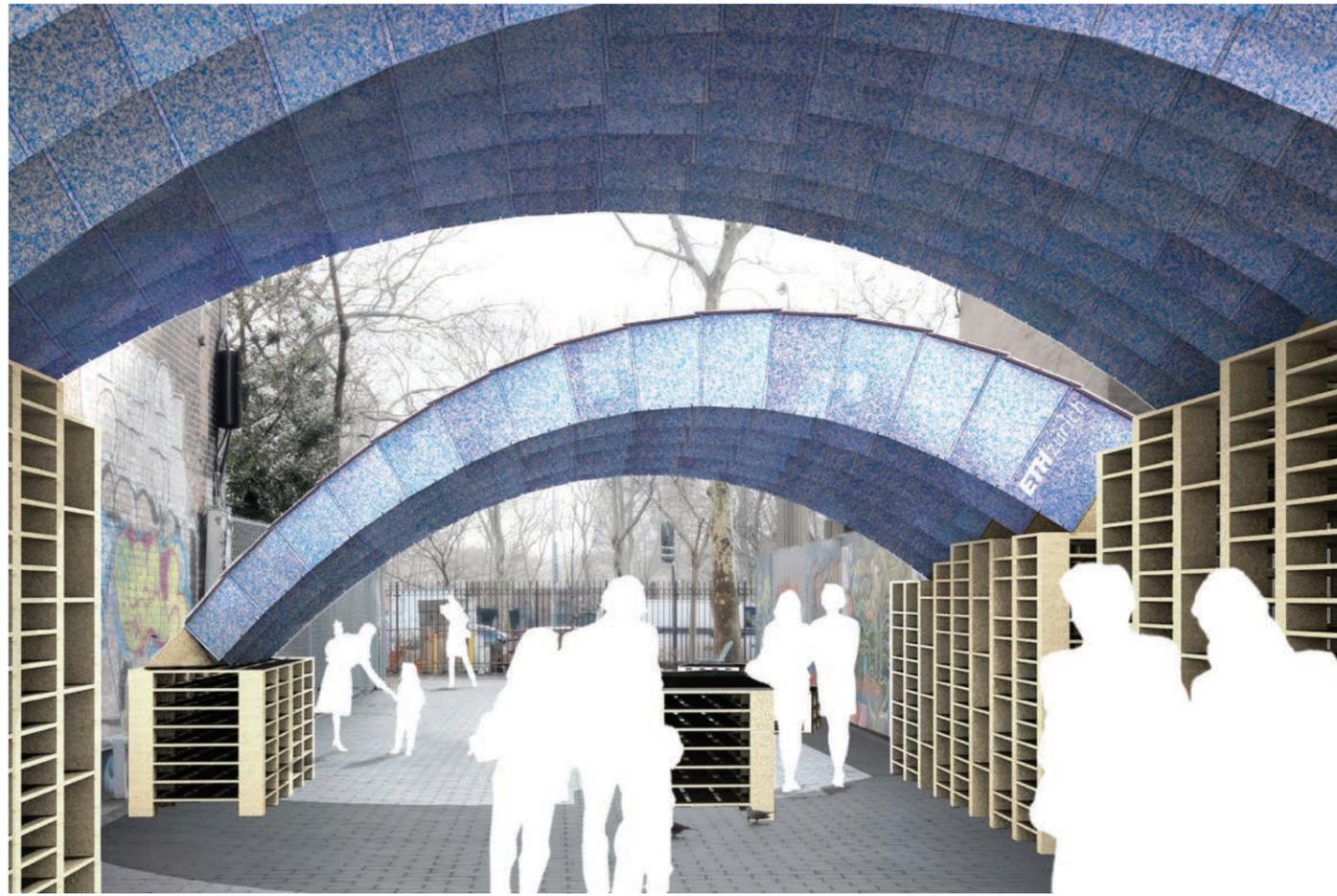
E Houston Street

⊕  
Site Plan ETH Zurich Pavilion





Functional Layout ETH Zurich Pavilion



View of Seminar Space and Bar from underneath

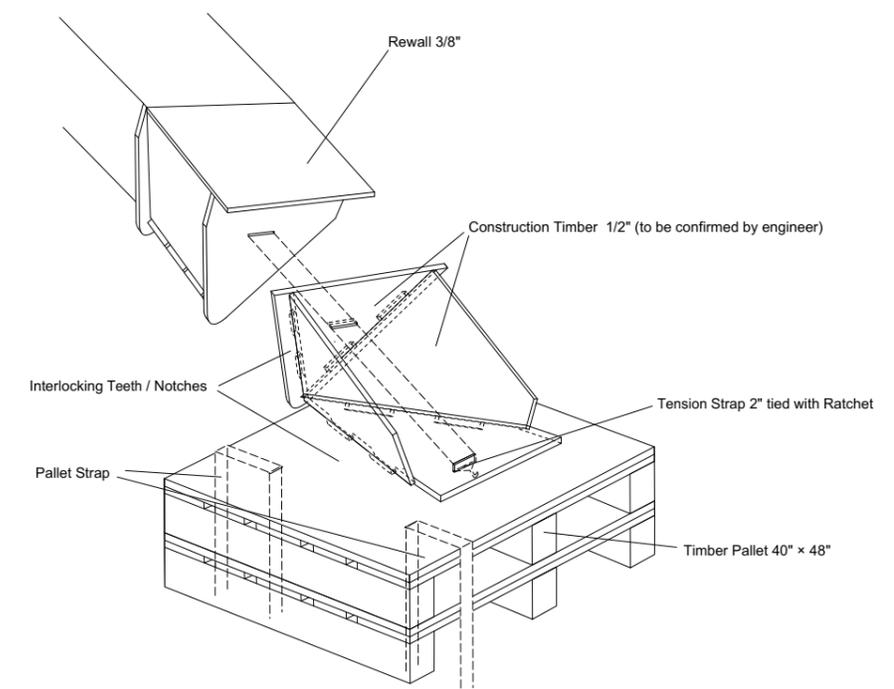
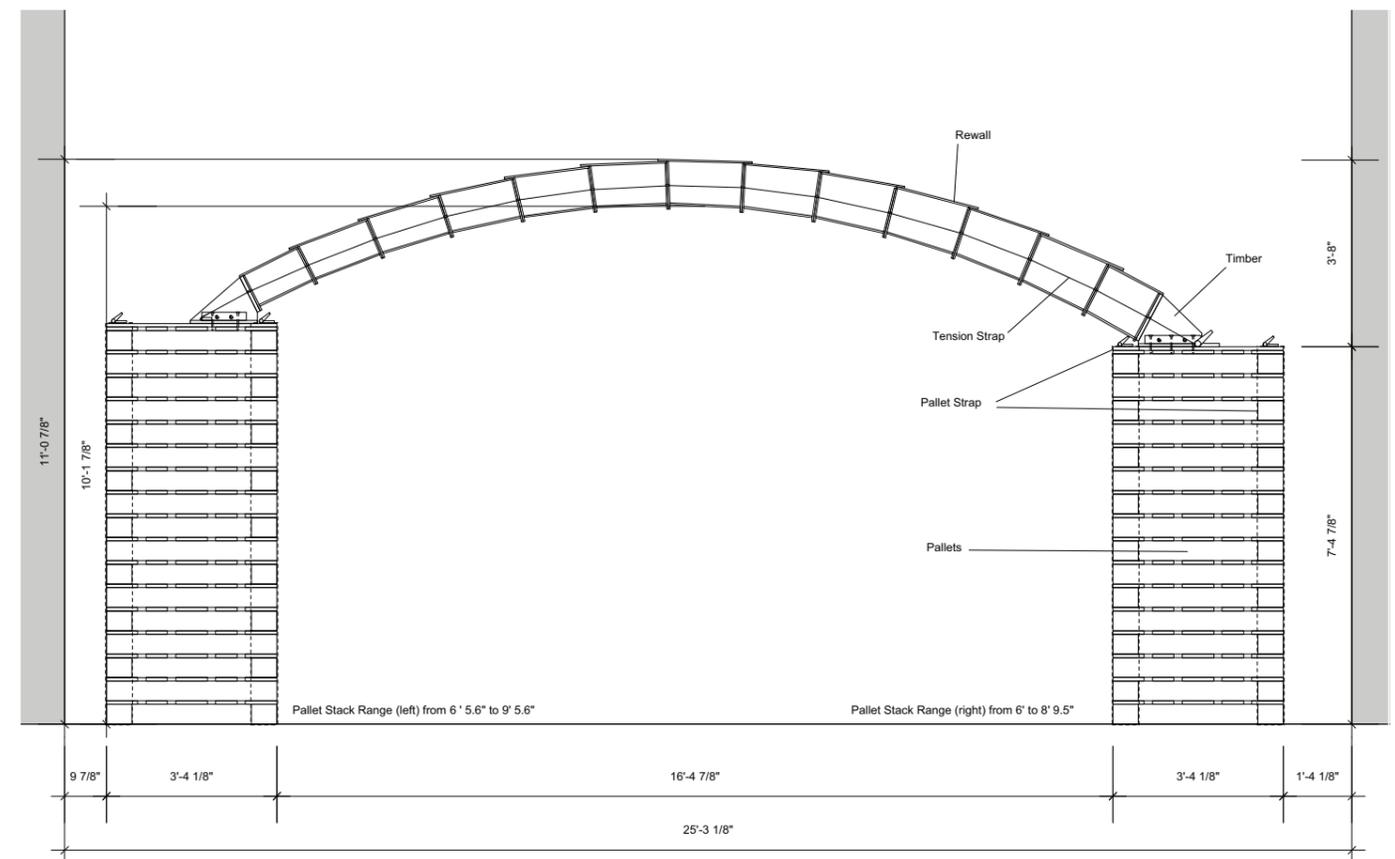


View of Pavilion and Exhibition from Houston Street

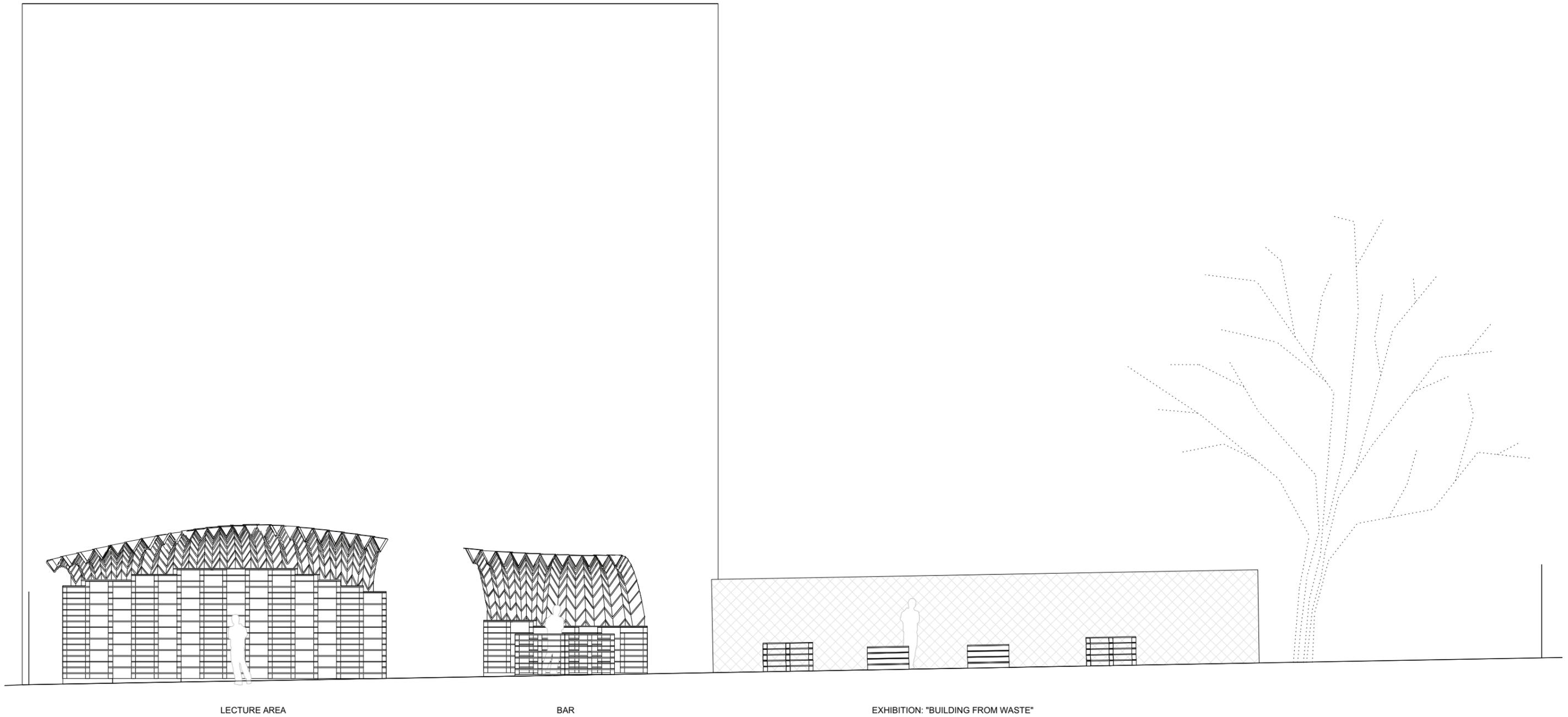
The structure is composed of a series of catenary arches assembled from discrete blocks. The blocks are triangular in section and assembled from Re-Wall panels. The panels are machined in such a way as to guarantee a continuous connection between the blocks, and a uniform transfer of stresses between them. To ensure an adequate connection of the discrete blocks, a pre-stressed cable, running inside the blocks all through the length of the arch, is employed. The arches are also structurally connected with each other at each block. Lateral forces in any direction outside the plane of the arch can be resisted by the ensemble of arches.

The arches are supported at the ends by means of wooden landings that are in perfect contact with the arches. The vertical loads are then directly transmitted to the ground, while the horizontal thrust is handled by the weight of the pallets in the landings.

The catenary shape of the arches is used so that the forces inside the structure under self-weight will always be compression forces. Live loads and wind loads are also taken into account by the use of the pre-stressed cable running inside the blocks, all through the length of the arch.



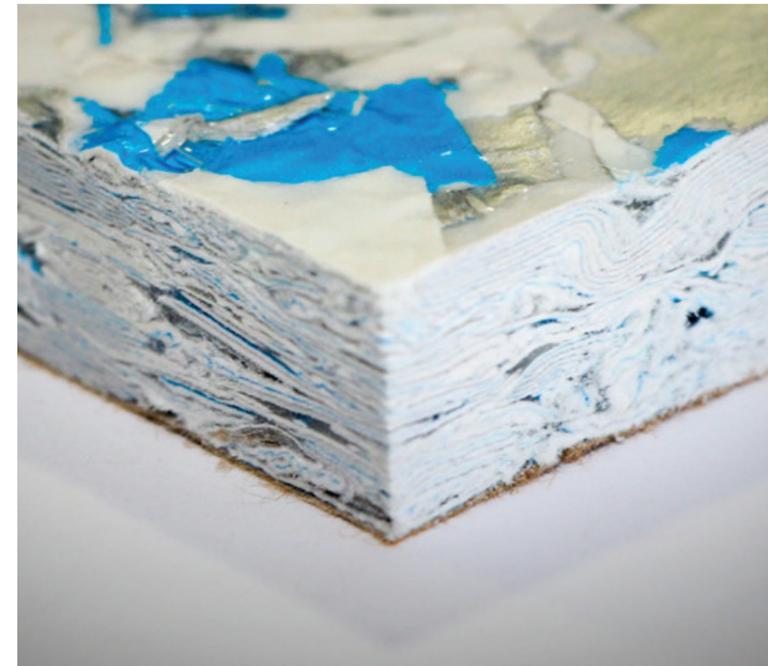
**The Structure** ETH Zurich Pavilion



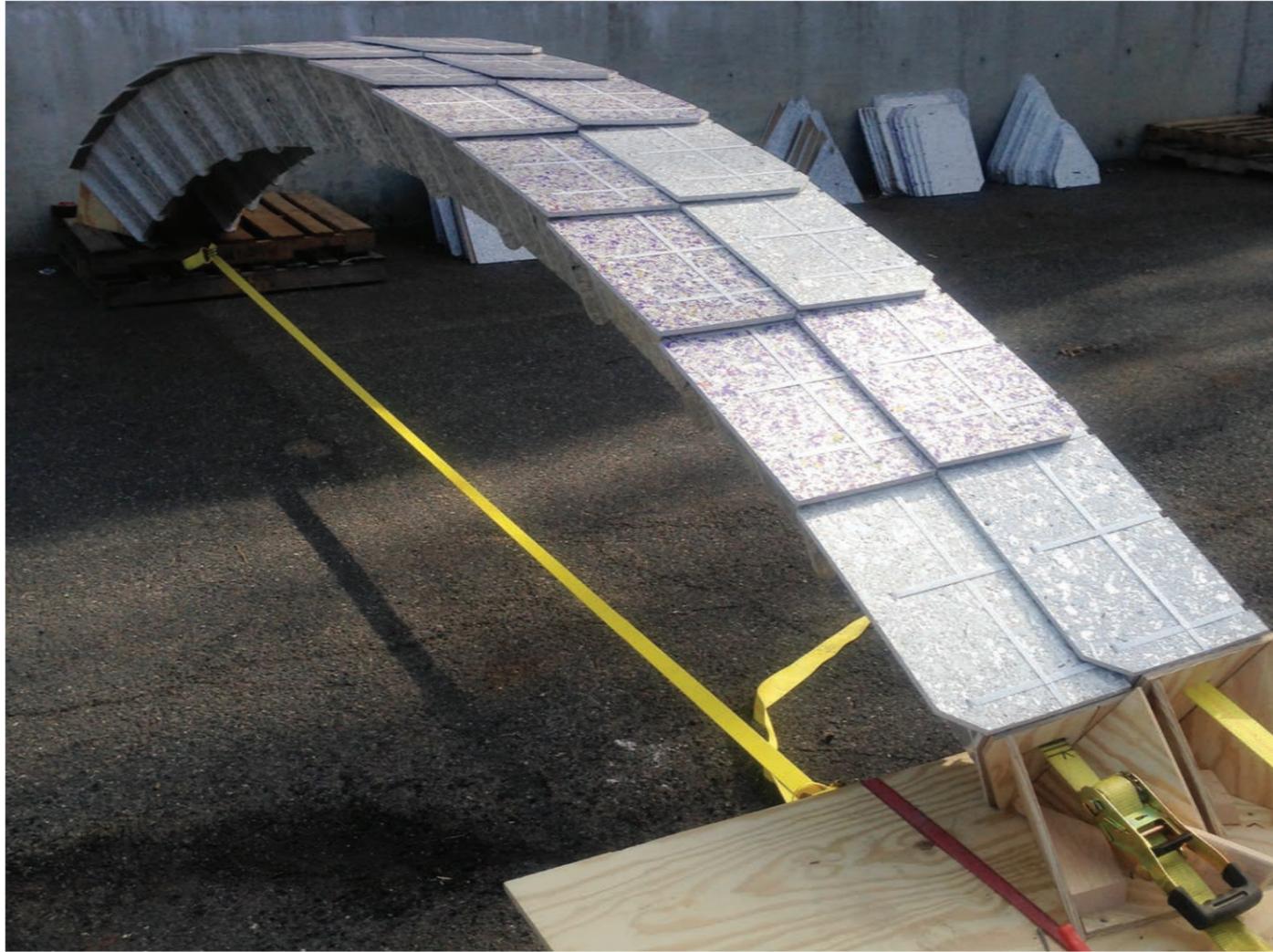
Longitudinal Section ETH Zurich Pavilion

For the production of the Pavilion, ETH Zurich has teamed up with the US manufacturer ReWall, who produces building products from 100% recycled beverage cartons, cups and their components. ReWall's zero waste zero water process with a miniature carbon footprint differs vastly from manufacturing of the traditional materials they replace. They use no formaldehyde glues, water or hazardous chemicals. They take a typically very hard to recycle composite material - cartons, and upcycle them into very durable, moisture and mold resistant composite panels.

Re-Wall is made from 100% recycled packaging that is designed to hold liquids for years, shedding and preventing water absorption it is also highly mold resistant. Made from FDA approved food packaging, it is using no glues and no chemicals in the production process to create a product that emits zero VOCs. The produced boards can be reintroduced into the production cycle to once again create boards in different compositions after their first use.



**The Material** ReWall Naked Board



Full Scale Testing in New Jersey

## Popup Workshop + Gallery

34 E 1st Street

During the month of May, ETH Zurich's Assistant Professorship of Architecture and Construction Dirk E. Hebel and the Block Research Group together with miLES will transform the storefront at 34 E. 1st Street into a pop-up workshop and gallery for the prefabrication of the ETH Zurich Pavilion across the street at First Street Green Park. The storefront will become a workshop, showcase, and resting stop to visualize the working process behind the construction of a temporary structure by the ETH Department of Architecture. Peek into it, you may find surprises!



The Construction ETH Zurich Pop-Up Workshop



“Reduce, Reuse, Recycle, and Recover” is the sustainable guideline that has replaced the “Take, Make, Waste” attitude of the industrial age. Based on their backgrounds at the ETH Zurich and the Future Cities Laboratory in Singapore, the authors provide both a conceptual and practical look into the materials and products that use waste as a renewable resource.

This book introduces an inventory of current projects and building elements, ranging from marketed products (among them façade panels made of straw and self-healing concrete) to advanced research and development of ideas like using newspaper, wood, or denim jeans as isolating fibres. Going beyond the mere recycling aspect of reused materials, it looks into innovative concepts for how materials usually regarded as waste can be processed into new construction elements. The products are organized according to their manufacturing processes: densified, reconfigured, transformed, designed, and cultivated materials.

A product directory presents all materials and projects in this book according to their functional uses in construction: load-bearing, self-supporting, insulating, waterproofing, and finishing products. In the external space of the park, the ‘Building from Waste’ exhibition will display 25 construction materials produced from refuse materials.



**Building from Waste** Exhibition and Book

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Concept, Design and Construction:

Assistant Professorship of Architecture and Construction  
Assistant Professor Dirk E. Hebel

Block Research Group - BRG  
Professor Philippe Block

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In collaboration with:

Lukas Fitze / Featurezoo  
ETH Department of Architecture

ETH Zurich would like to thank the following partners:

New Museum / IDEAS City  
NYC PARKS  
First Street Green

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Center for Architecture New York Chapter

Café Select  
pareup  
madeinLES  
W.I.R.E - Web for interdisciplinary Reseach & Expertise

Timbur llc

**ETH** zürich



**BRG**

**DARCH**



**IDEAS  
CITY**



NYC Parks



**CAFÉ SELECT**

**pareup**



**W.I.R.E. timbur llc**