Silpakorn University Campus Visit

The Hong Kong Polytechnic University
School of Design

Environment and Interior Design Cluster

Design and Construction Technology

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Introduction and Overview

This presentation will describe work from The Hong Kong Polytechnic University School of Design in the Environment and Interior Design Cluster (E+I) focused on the theme of “design and construction technology.”

Section 1 details E+I faculty research using digital surveying technology for site documentation, digital cultural conservation, and digital ethnography.

Since 2020, faculty conducting research in E+I have used digital 3D scanning technology in three research cases. Each documents housing conditions in:

1. Stilt Housing in Tai O Village (GRF 15600621)
2. Tong Lau Buildings in Kowloon City
3. Public Housing throughout Hong Kong

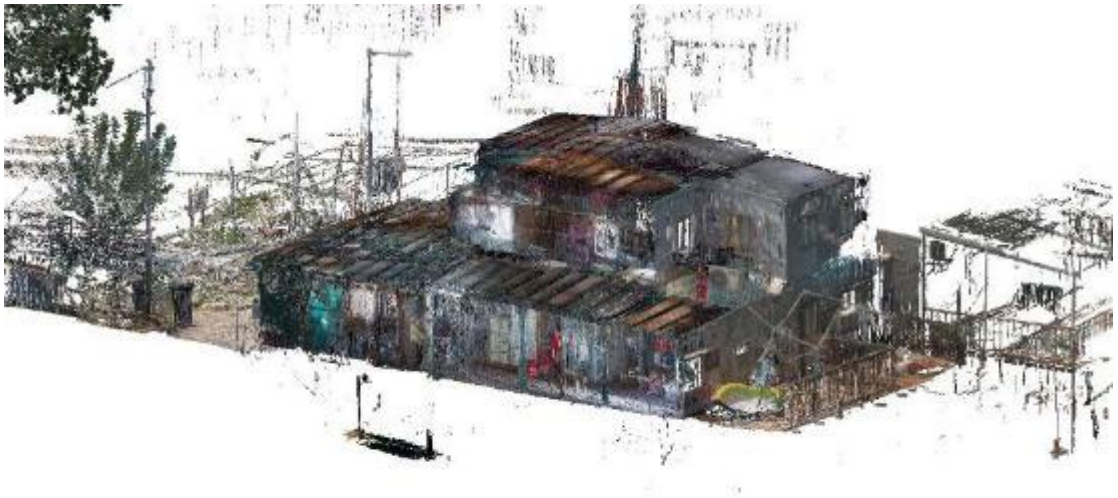


Image: Property of Assoc. Prof. Elkin

Technologies and Capabilities

Technologies involved in this design research include two categories of digital surveying equipment for 3D environment scanning. These include:

1. The Leica BLK2GO portable LiDAR and photogrammetry 3D scanner.
2. The Matterport 3 Pro3 Tripod-mounted LiDAR and photogrammetry 3D scanner

Uses and advantages of these technologies include:

1. Cost-effective, detailed, non-invasive site documentation.
2. “Digital twin” model production for digital heritage conservation, design analysis, and design development.

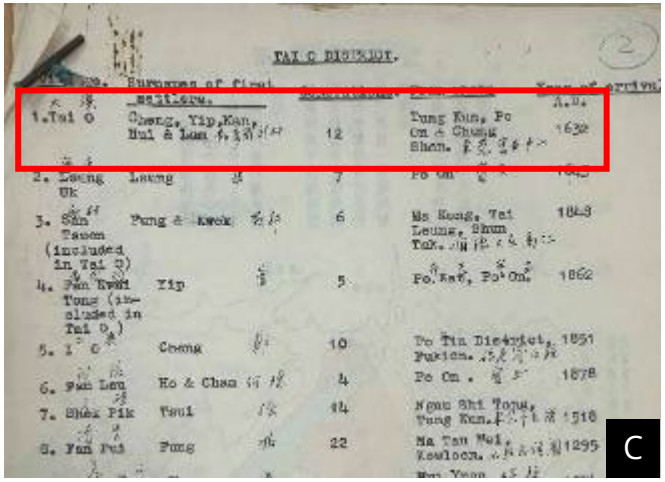
Image: The Leica BLK2GO Scanner.

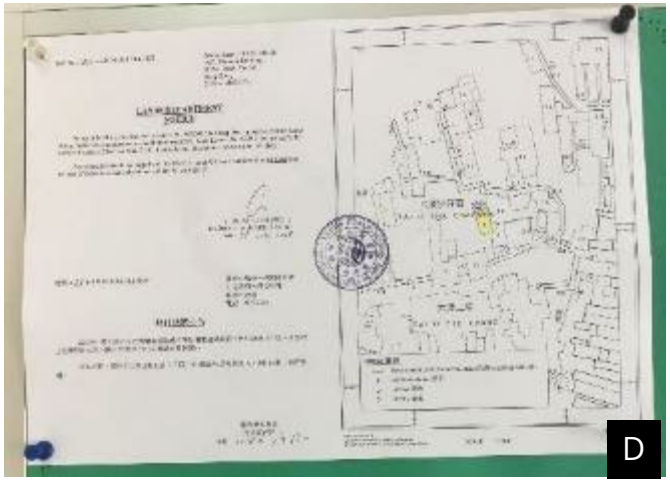
Leica Geosystems. (n.d.). *Leica BLK2GO Handheld Imaging Laser Scanner Leica Geosystems*. Retrieved November 14, 2024, from https://leica-geosystems.com/products/laser-scanners/autonomous-reality-capture/leica-blk2go-handheld-imaging-laser-scanner

Image: The Matterport 3 Scanner

Pro3 3D Camera – 3D digital twin capture reimagined. (n.d.). Matterport. Retrieved November 14, 2024, from https://matterport.com/pro3

Use Case 1: Stilt Housing in Tai O Village (GRF 15600621)





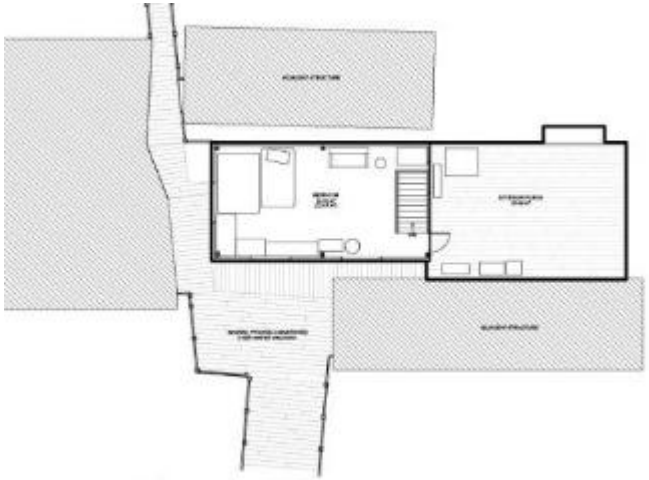
A. Tai O Village (Orange dot) is a fishing village where about 350 “stilt houses” remain. (Image: Location map. PolyU is located near the green dot. Google Maps).

B. Stilt housing (棚屋, *pang uk*) is a type of light wood framing housing built near shore edges and over water (Image: Daniel Elkin).

C. Stilt housing is culturally significant as a long-standing practice. Government records record *Tanka* ethnicity migrant fishing families settling in Tai O from at least 1632 (Image: Hong Kong Police Force).

D. Stilt housing is also threatened cultural heritage. Colonial-era policies constrain stilt house dwellers’ tenure security and ability to maintain stilt housing, including strenuous requirements for permitting and renovation (Image: Daniel Elkin).

Use Case 1: Stilt Housing in Tai O Village (GRF 15600621)



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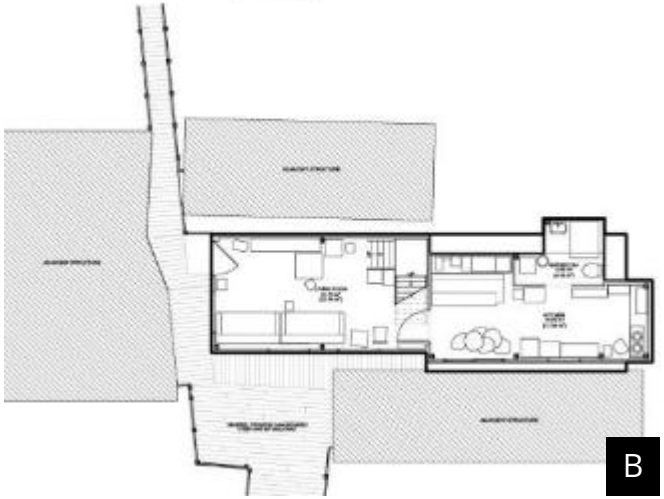
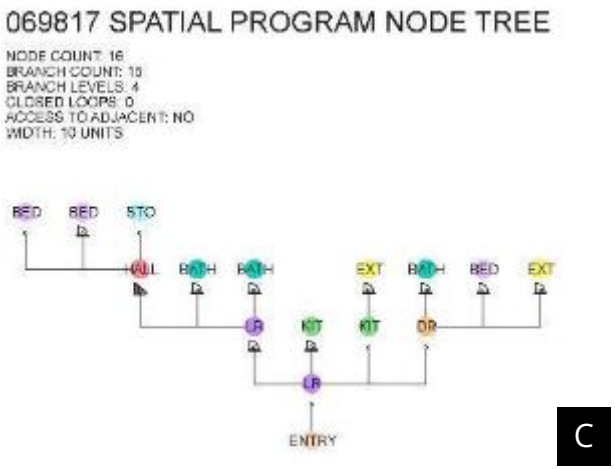


B



C

A. The Leica BLK2GO scanner allowed researchers to effectively document a sample (n=20) of stilt housing in Tai O Village for digital conservation and further scholarship (Image: Daniel Elkin).

B. Information capture using the BLK2GO is convenient for field work and very detailed, allowing researchers to develop floor plans, sections, and other documentation of stilt housing residents' distinct spatial and social practices (Image: Daniel Elkin).

C. This documentation also supports other types of spatial analysis, for comparison between stilt housing conditions and other vernacular housing practices (Image: Daniel Elkin).

Use Case 2: Tong Lau Housing in Kowloon City

A. Kowloon City (orange dot) is an urban district about 30 minutes north of PolyU's campus (Image: Location map. PolyU is located near the green dot. Google Maps).

B. Hong Kong *Tong Lau* shop houses developed on many parcels in Kowloon City from the 1950's to the 1990's, instances of a housing architecture typology distinct to Hong Kong (Image: Daniel Elkin).

C. Large areas of Kowloon City, including streets where Tong Lau buildings are concentrated, are slated for demolition and redevelopment under the Urban Renewal Authority's (URA's) KC-017 Redevelopment Scheme (Image: URA).

D. Since these Tong Lau housing conditions will be removed, researchers implemented a pilot ethnography and digital cultural heritage project to document a sample of them (n=6. Image: Daniel Elkin).

Use Case 2: Tong Lau Housing in Kowloon City

A

B

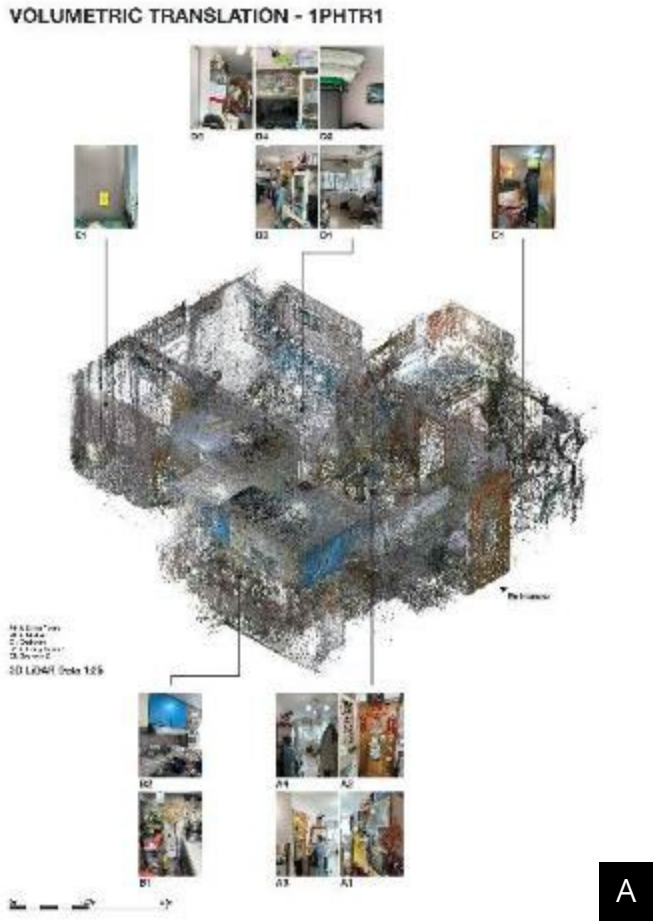
C

A. Though the pilot project's sample size was small, researchers were able to document housing conditions distinct to Hong Kong, including reoccupation of former factory buildings and housing in Tong Lau buildings built prior to World War II (Image: Daniel Elkin).

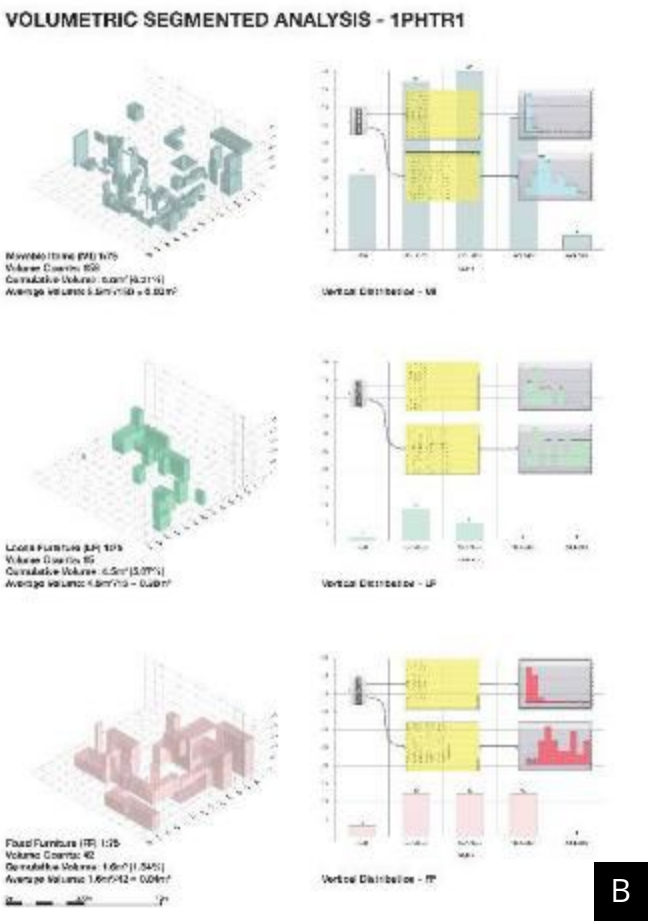
B. The Leica BLK2GO scanner allowed researchers to digitally conserve part of the exterior streetscape, which can supplement publicly-available 3D GIS data with more detail (Image: Daniel Elkin).

C. The interiors of the 6 housing conditions documented are also digitally conserved for analysis and further research, along with transcripts from ethnographic interviews with residents.

Use Case 3: Public Housing Throughout Hong Kong



A



B

A. Public housing housed over 2.6 million people in Hong Kong in 2023 (Hong Kong Housing Authority). Researchers in the School of Design have employed digital surveying technology in a post-occupancy survey project studying occupation of public housing flats.

B. Of primary concern in this study is the phenomenon of volumetric dwelling, which characterizes residents' dwelling patterns through comparison of total spatial volume versus usable spatial volume. Digital surveying and analysis algorithms allow researchers to monitor for spatial locations where dwellers' use habits may cause ergonomic challenges or hazards.

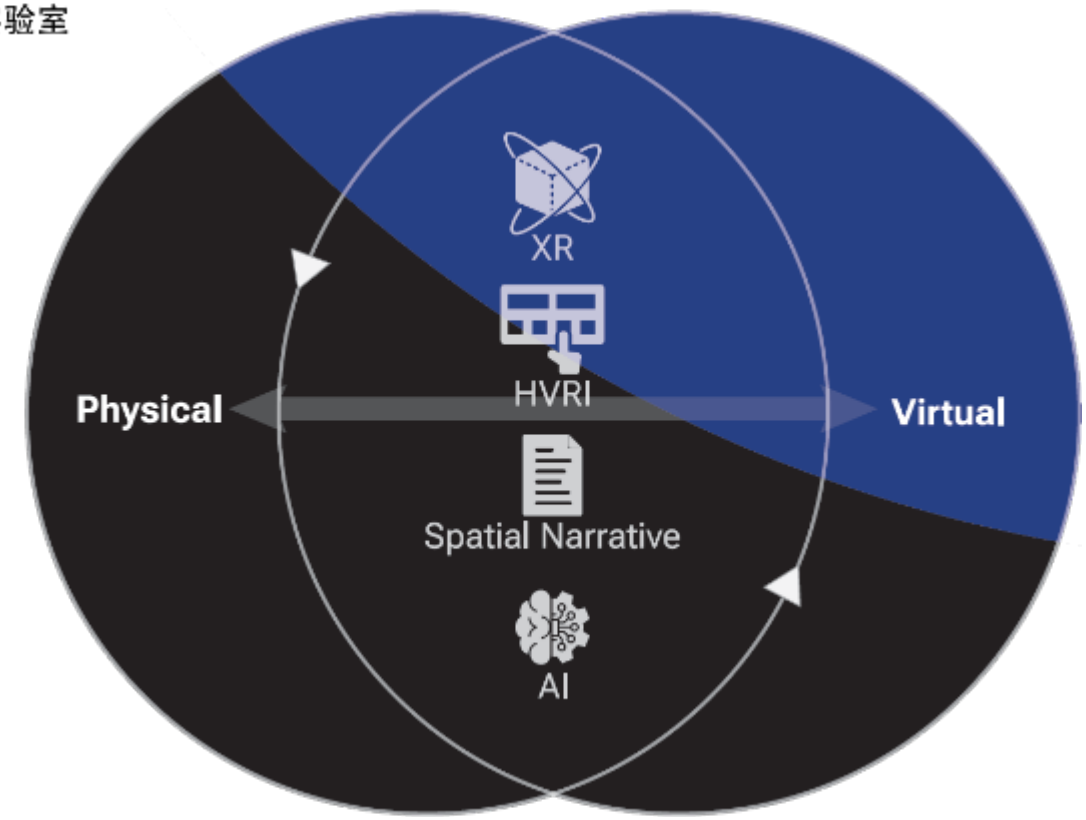
From Design Research to Pedagogy

A. Since E+I student projects almost always entail site survey, E+I faculty have introduced students to digital surveying technology to support their studio design projects (Image: Daniel Elkin).

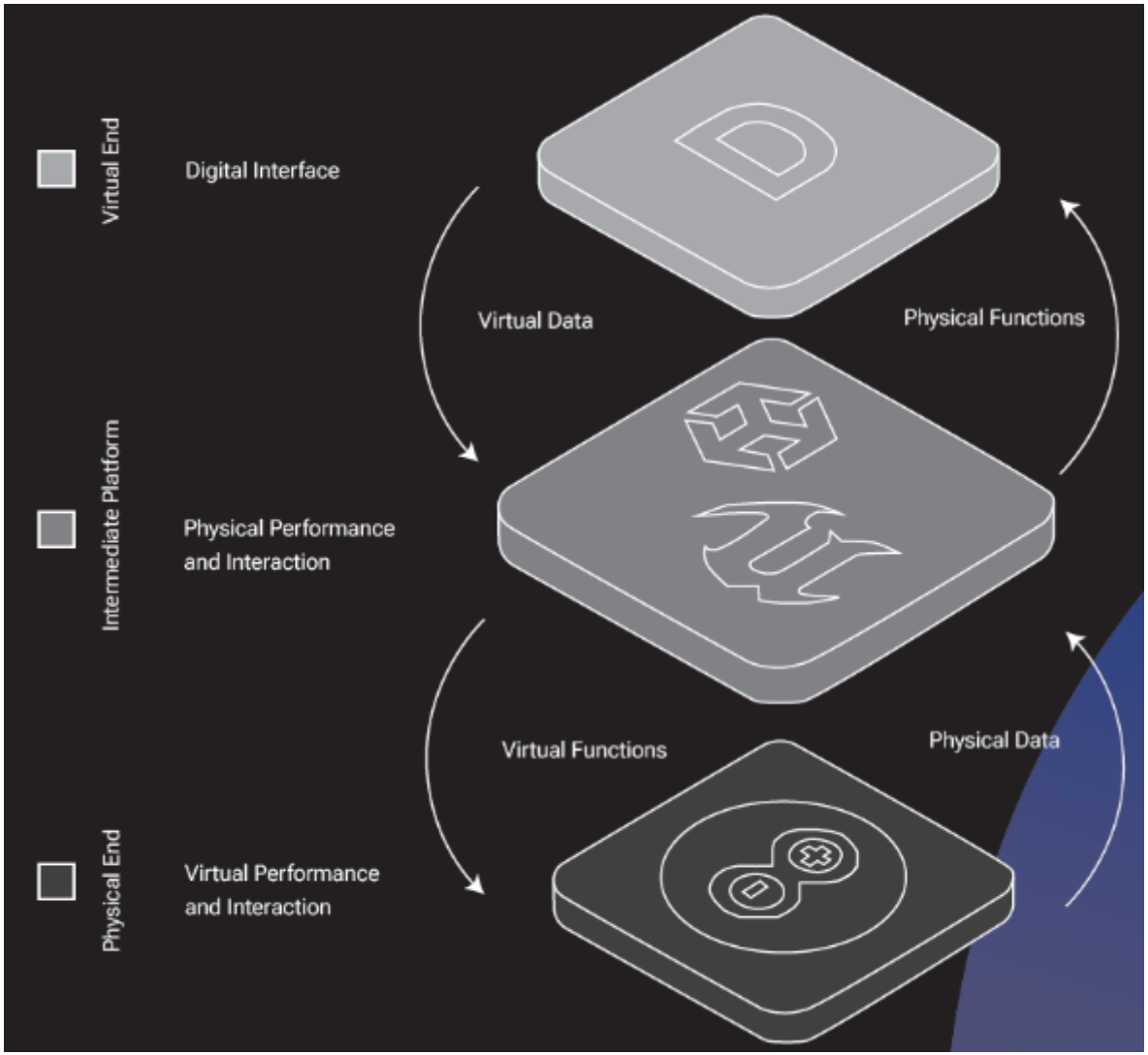
B. Digital 3D scanning point cloud geometry can help students understand site survey and construction documentation and develop their design work with better site documentation (Image: Daniel Elkin).

Introduction and Overview

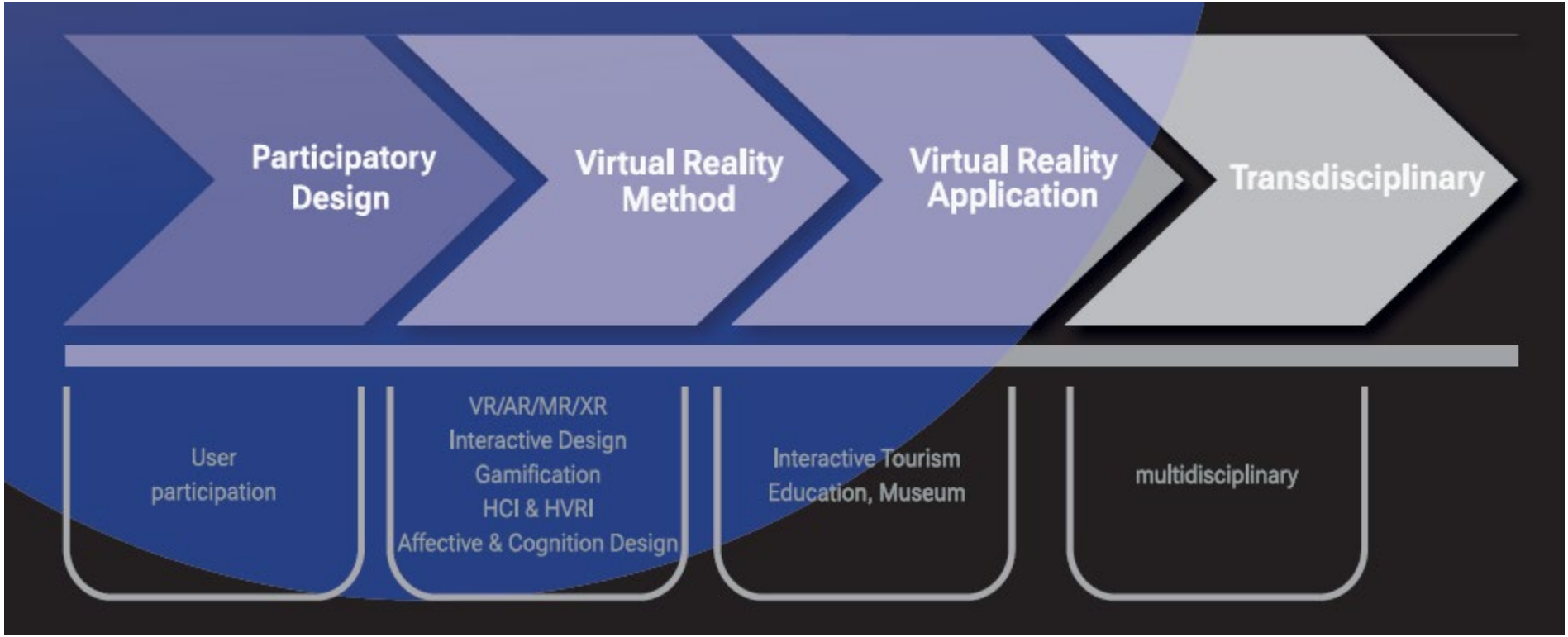
AI for
Creative Innovation
Design Joint Lab
人工智能 (AI) 创新设计联合实验室



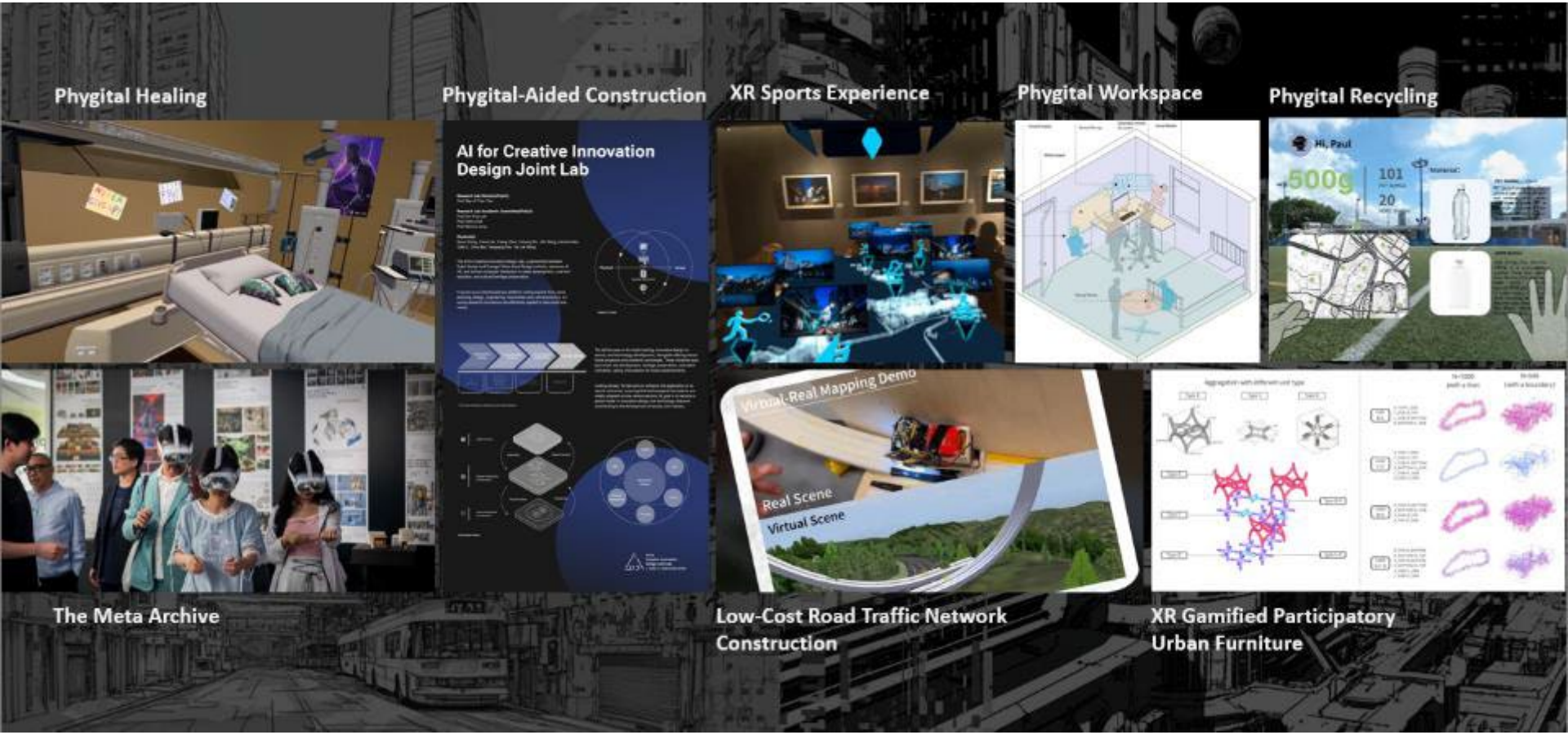
Technologies and Capabilities



Applications



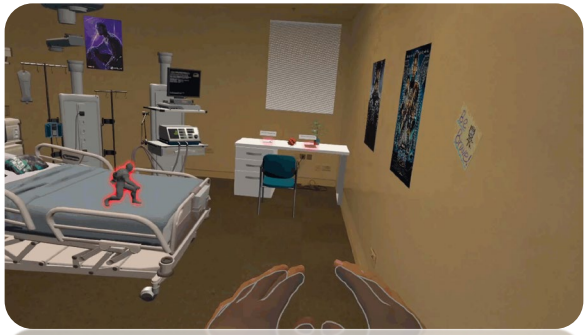
Project Catalogue



Project 1: Degree of Immersive towards EEN

This project proposes the use of Mixed Reality (MR) technology to enhance the healing process by integrating physical and digital content in a "physical-digital fusion" environment. The goal is to leverage real environments and interactive content to address the limitations of fully virtual settings. Currently, the impact of combining real and virtual elements on human perception remains unclear. Thus, this study will explore how the design of MR scenes affects perceptions of psychological healing by comparing the effects of virtual, real, and mixed scenarios on attention restoration and stress reduction. The research aims to provide insightful approaches and implementation strategies for creating MR therapeutic environments based on human perceptual experiences using MR technology.

100% Immersive



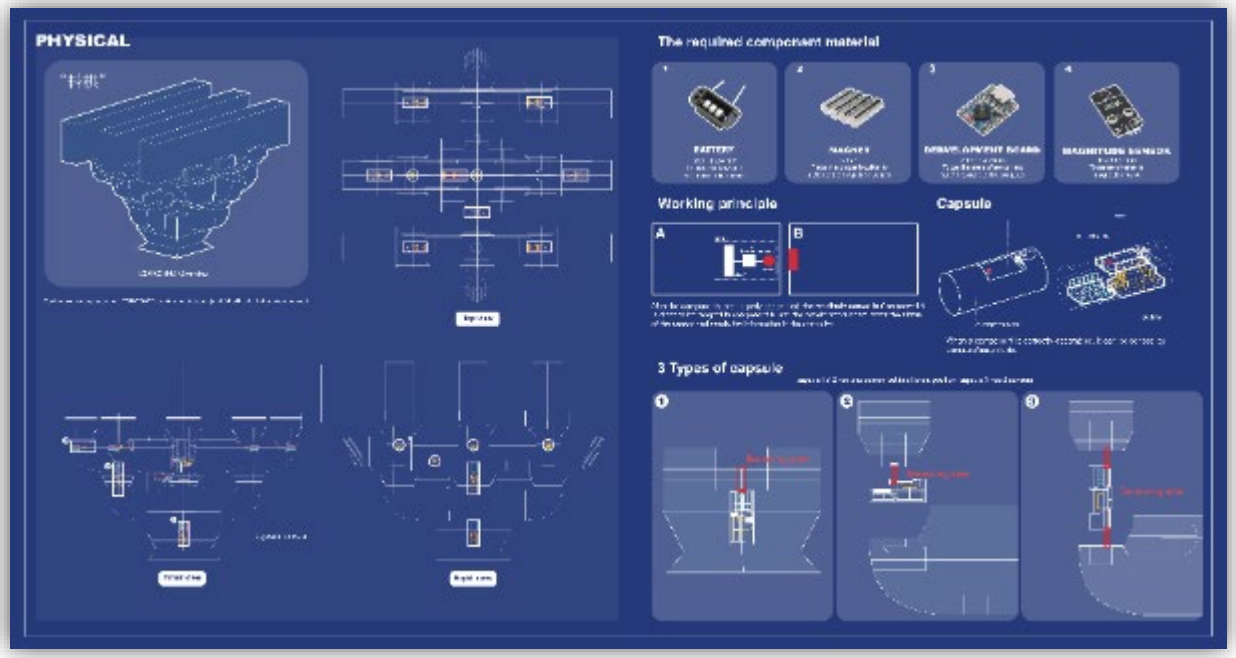
60% Immersive

30% Immersive

Project 2: The Meta Archive

This project transforms EID students' 3D works into immersive experiential spatial archives. Through the imaginative perspectives of students, it reexamines the narrative trajectories of Hong Kong across different time periods, entering a surreal realm that blends the physical and digital. By integrating virtual and physical models, VR content, and interactive experiences, it reinterprets Hong Kong's past, present, and future. The exhibition draws inspiration from cinema, mythology, and literature, as students reimagine the city's landscape. Through speculative narratives and visual storytelling, visitors are transported into various parallel realities. With the students' imaginative viewpoints, we aim to reassess the trajectories of different timelines, presenting a fresh narrative of Hong Kong that steps into the realm of the surreal.

Project 3: tPAC: Phygital-Aided Construction System



While a good component system may follow similar principles to the flat-pack furniture introduced by IKEA, the complexity of the construction industry is significantly higher. Workers responsible for assembling intricate building components are likely unfamiliar with the parts, need to use unfamiliar hardware, and must adhere to less obvious assembly sequences. To address this challenge, our proposed solution leverages virtual/digital twins, pre-programmed assembly sequences, extended reality (XR) glasses, and physical feedback and verification. This approach provides workers with real-time guidance and feedback during the assembly process, enhancing both efficiency and accuracy.

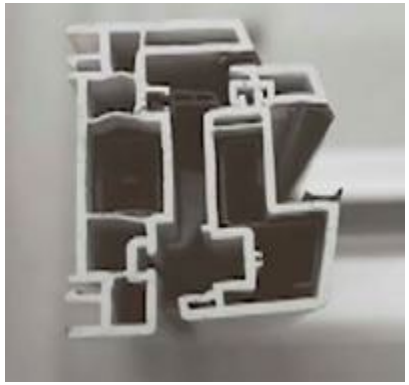
Project 4: Mind in Motion XR Sports Experience

As one of the world's most dynamic cities, Hong Kong thrives at the intersection of culture, technology, and sports. In this spirit, the AiCID Laboratory is proud to present an immersive experience that utilizes Mixed Reality (MR) technology to reveal the inspiring stories behind athletic success. This exhibition not only showcases the physical excellence of Hong Kong athletes and sports enthusiasts but also highlights their mental resilience. Through interactive experiences, audiences will immerse themselves in narratives of perseverance, passion, and mental well-being.

Project 4: Mind in Motion XR Sports Experience

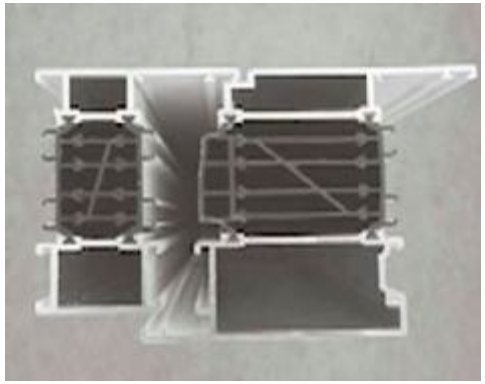
Context: Complexity

1950s



1970s

1990s



2010s

Window profile evolution. Source: Elements of Architecture, Rem Koolhaas, 2014.

Context: Complexity

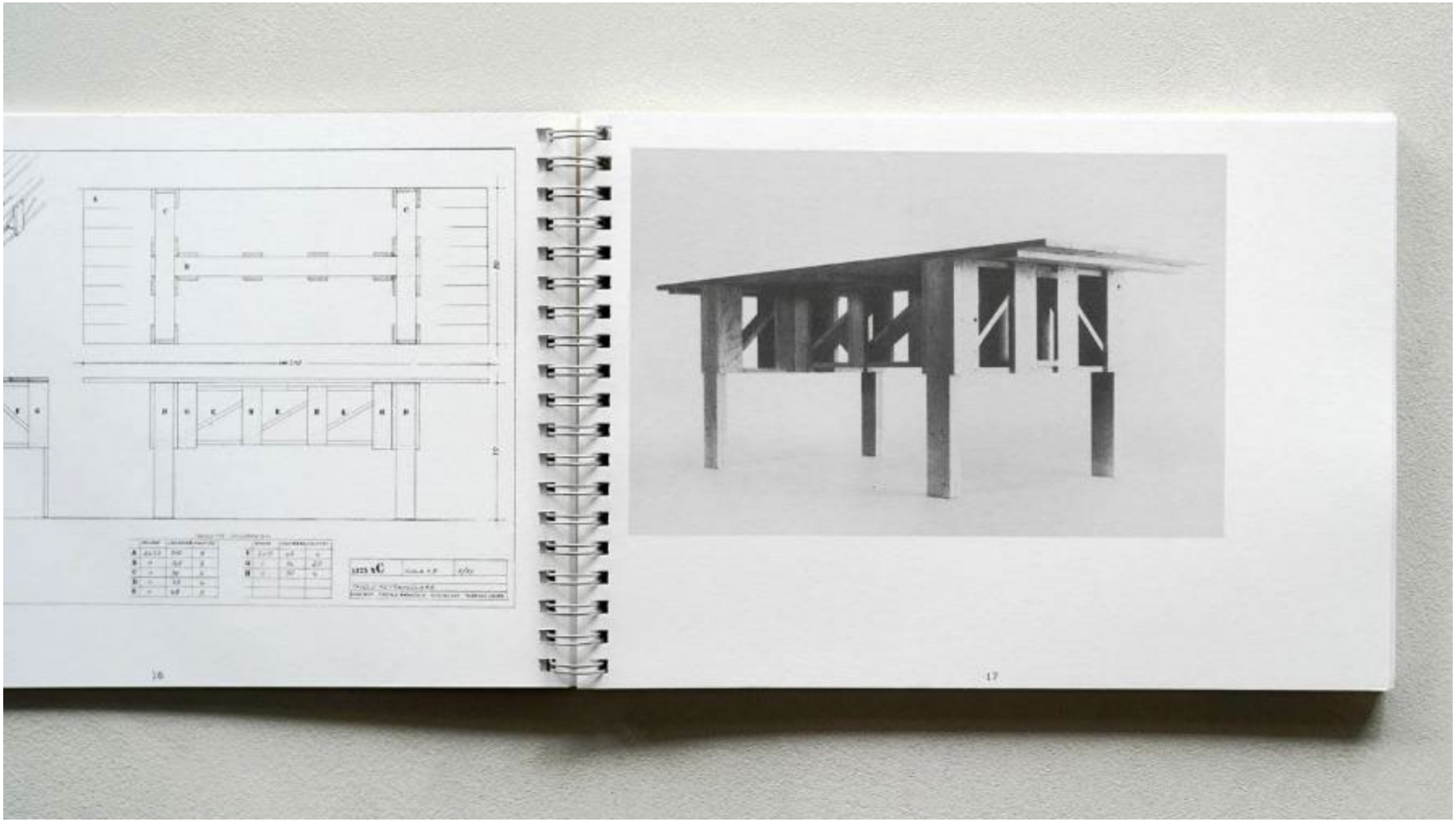
660 Fifth Avenue, New York City, 2020 & 2024. Image: KPF

REJUVENATION

Ethos: Simplicity

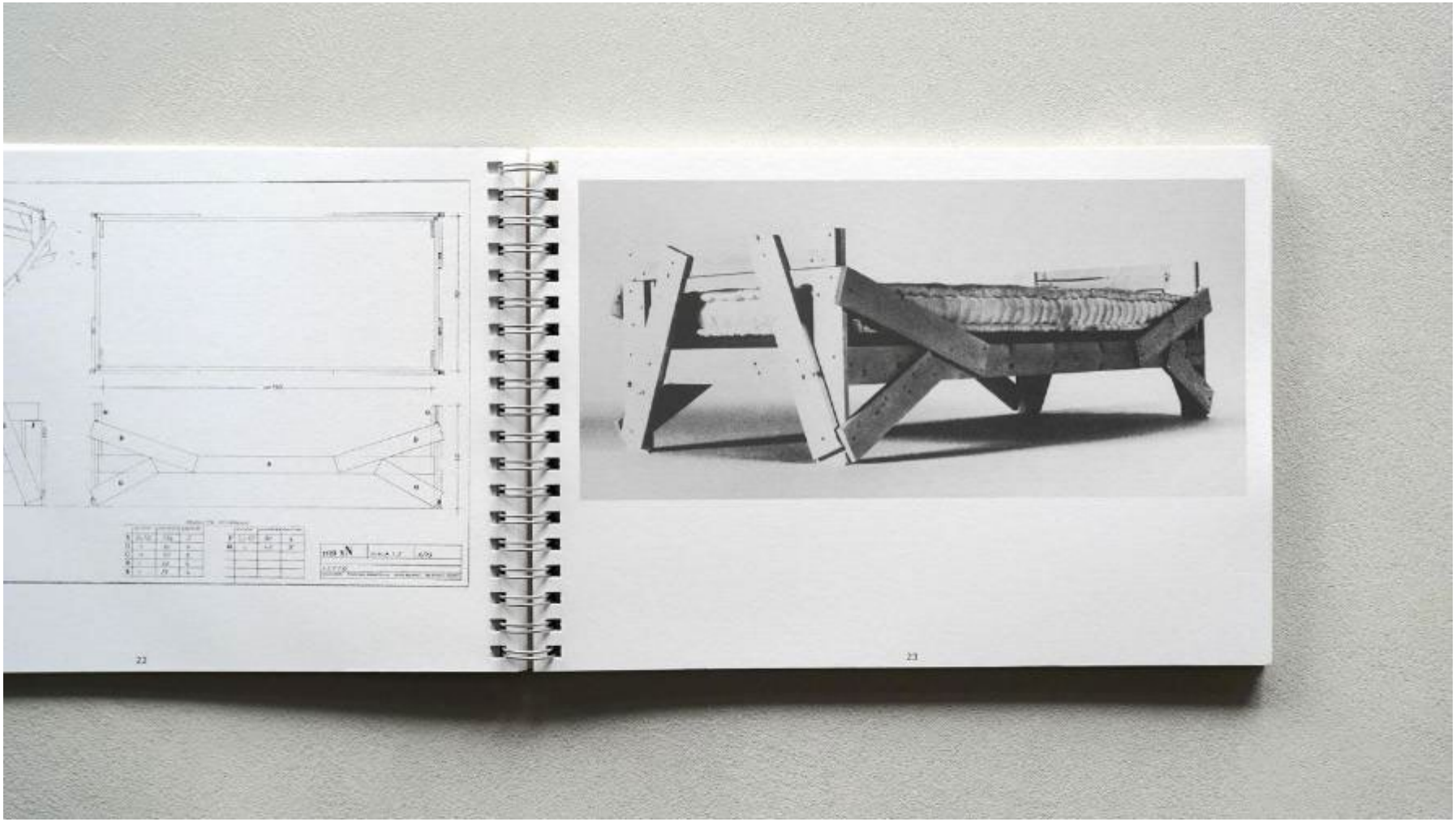
Autoprogettazione, Enzo Mari, 1974. Image: Zelt Bookstore

Ethos: Simplicity



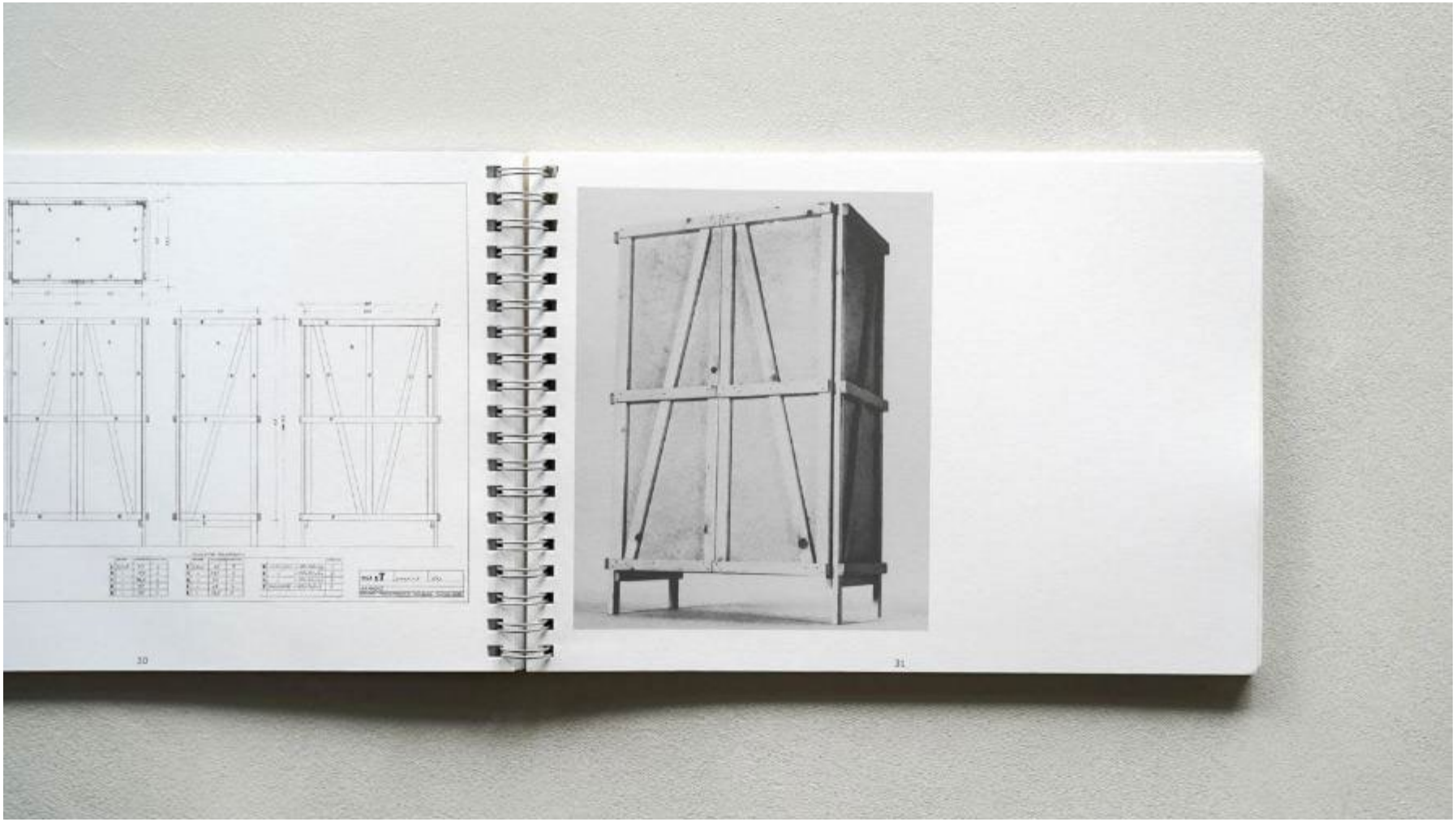
Autoprogettazione, Enzo Mari, 1974. Image: Zelt Bookstore

Ethos: Simplicity



Autoprogettazione, Enzo Mari, 1974. Image: Zelt Bookstore

Ethos: Simplicity



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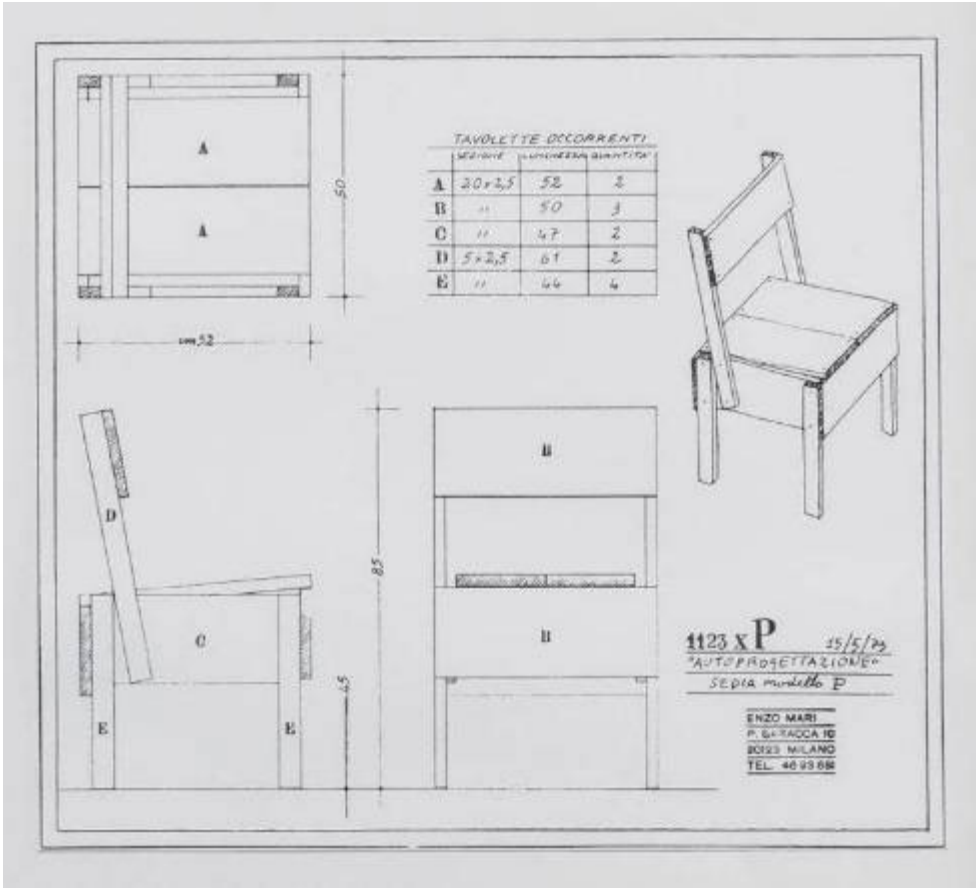
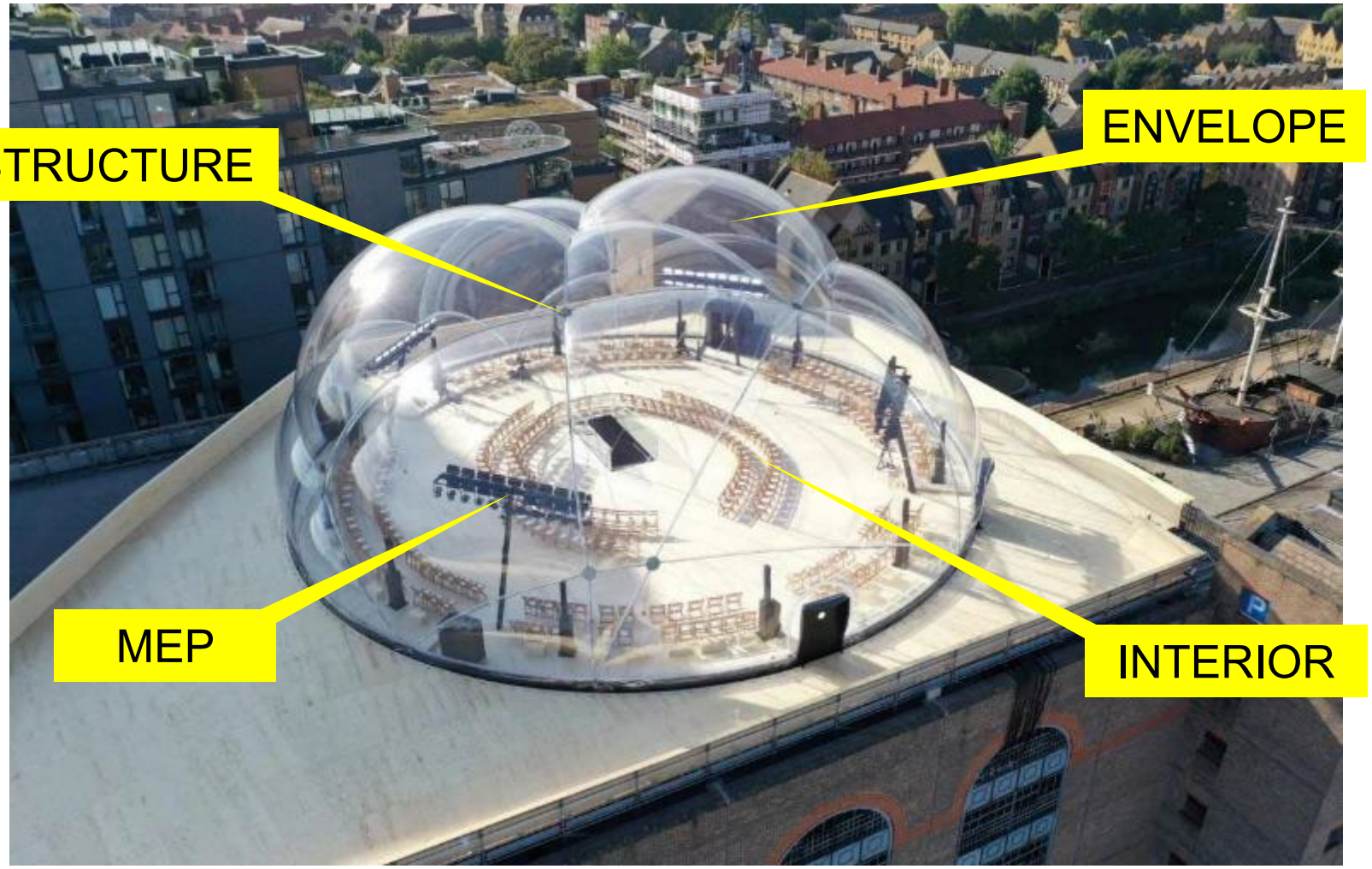


Autoprogettazione, Enzo Mari, 1974. Image: Braun's Good Design

Knowledge Transfer: Systems

MCQ Pavilion, Smijan Radic, 2022. Image: Smiljan Radic.

Knowledge Transfer: Systems



MCQ Pavilion, Smijan Radic, 2022. Image: Smiljan Radic.

Knowledge Transfer: Systems

HSBC Hong Kong HQ, Foster & Partners, 1985. Source: Dezeen.

Knowledge Transfer: Systems

HSBC Hong Kong HQ, Foster & Partners, 1985. Source: Dezeen.

Knowledge Transfer: Materials

St Gallen Cathedral, Caruso St John, 2013. Image: Caruso St John

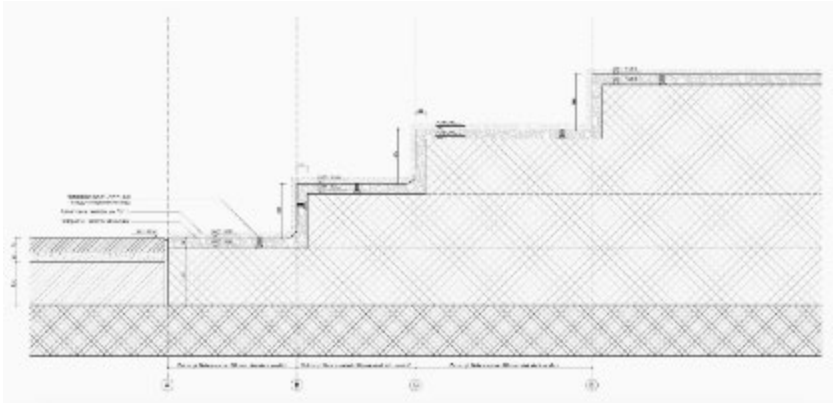
Knowledge Transfer: Fabrication

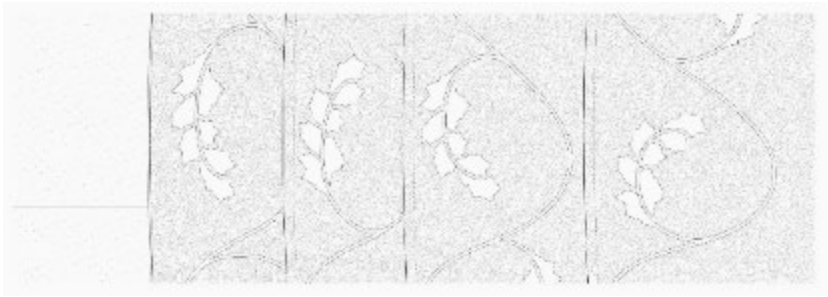
St Gallen Cathedral, Caruso St John, 2013. Image: Caruso St John

Knowledge Transfer: Assemblies

St Gallen Cathedral, Caruso St John, 2013. Image: Caruso St John

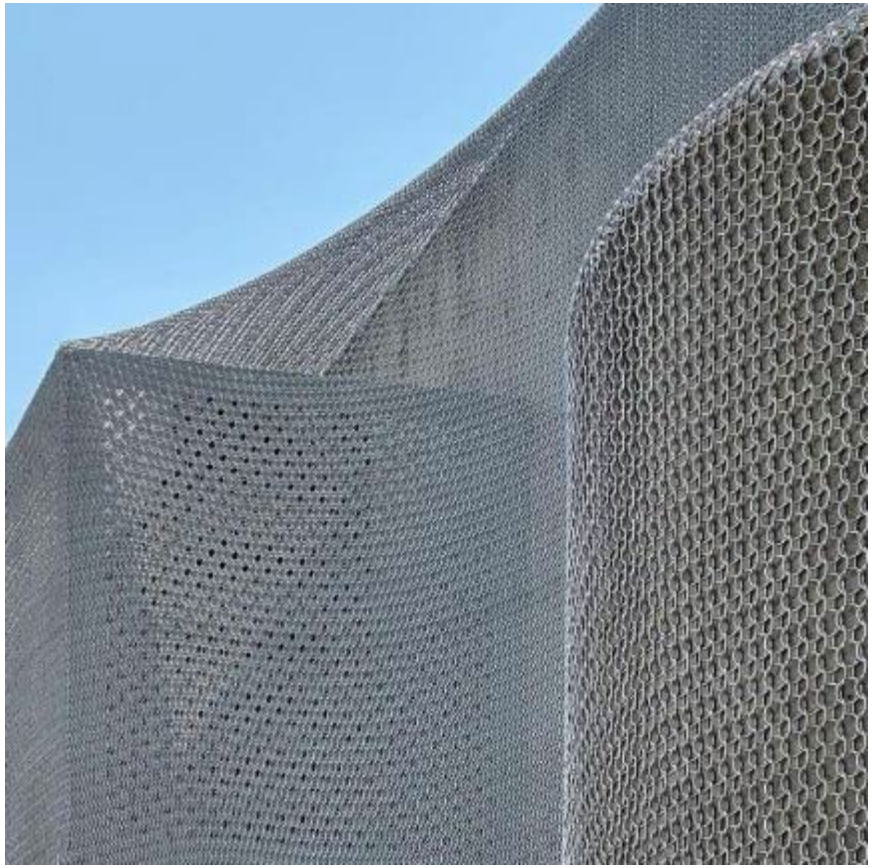
Knowledge Transfer: Documentation





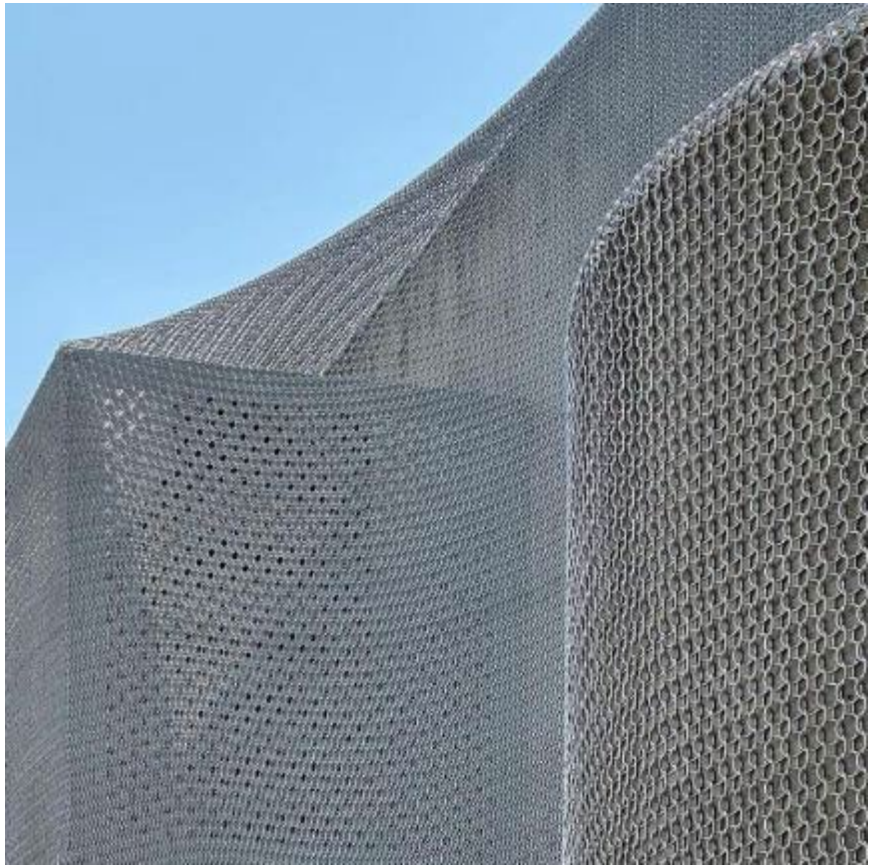
St Gallen Cathedral, Caruso St John, 2013. Image: Caruso St John

Knowledge Transfer: Materials



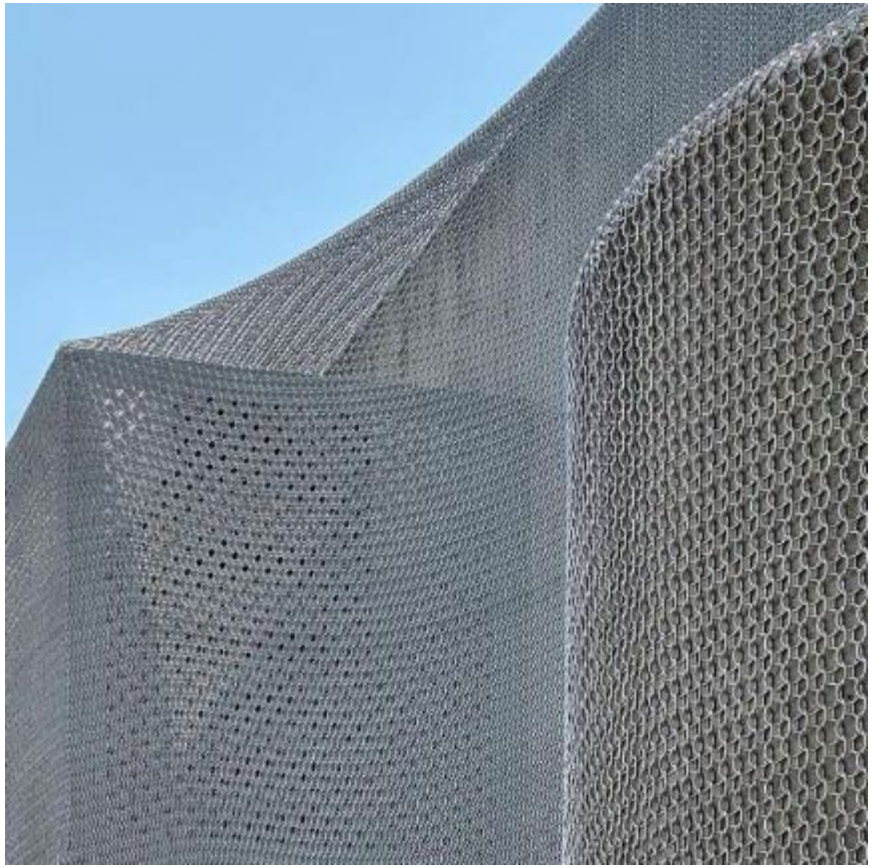
Kukje Gallery, SO-IL Studio, 2012. Image: SO-IL Studio

Knowledge Transfer: Fabrication



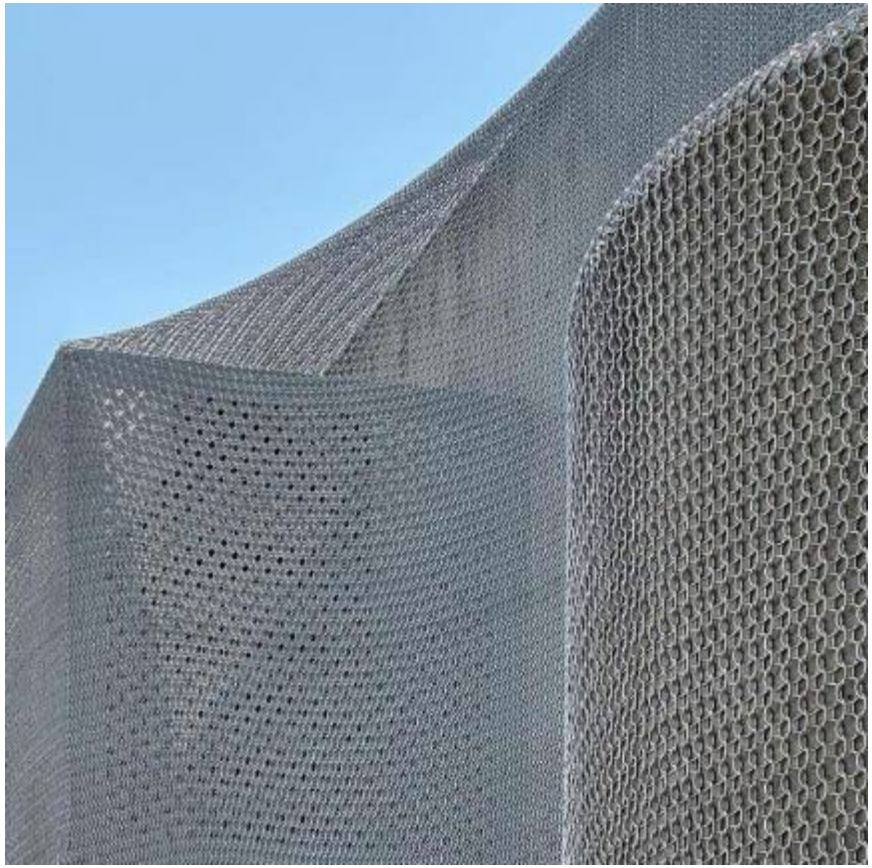
Kukje Gallery, SO-IL Studio, 2012. Image: SO-IL Studio

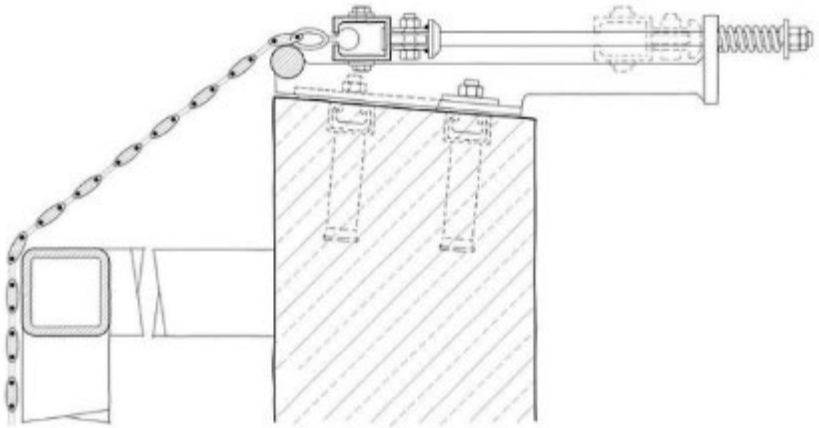
Knowledge Transfer: Assemblies



Kukje Gallery, SO-IL Studio, 2012. Image: SO-IL Studio

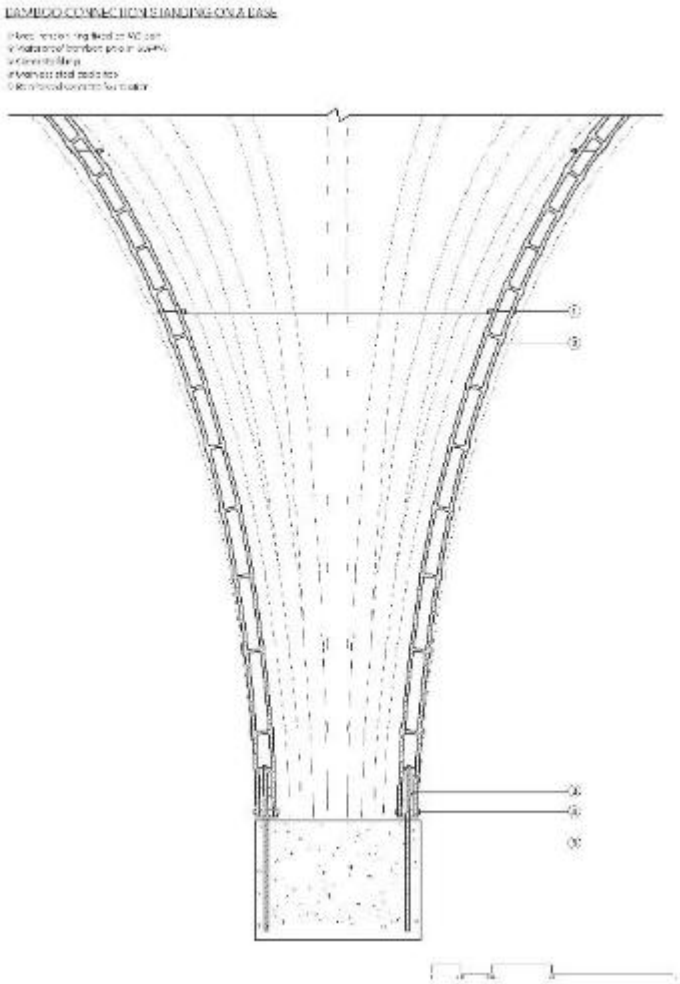
Knowledge Transfer: Documentation

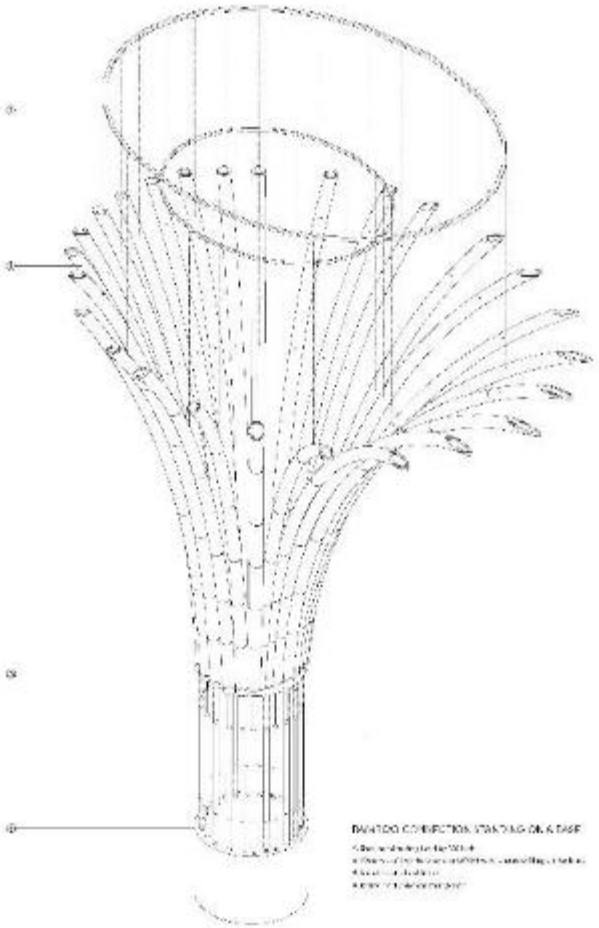




Kukje Gallery, SO-IL Studio, 2012. Image: SO-IL Studio

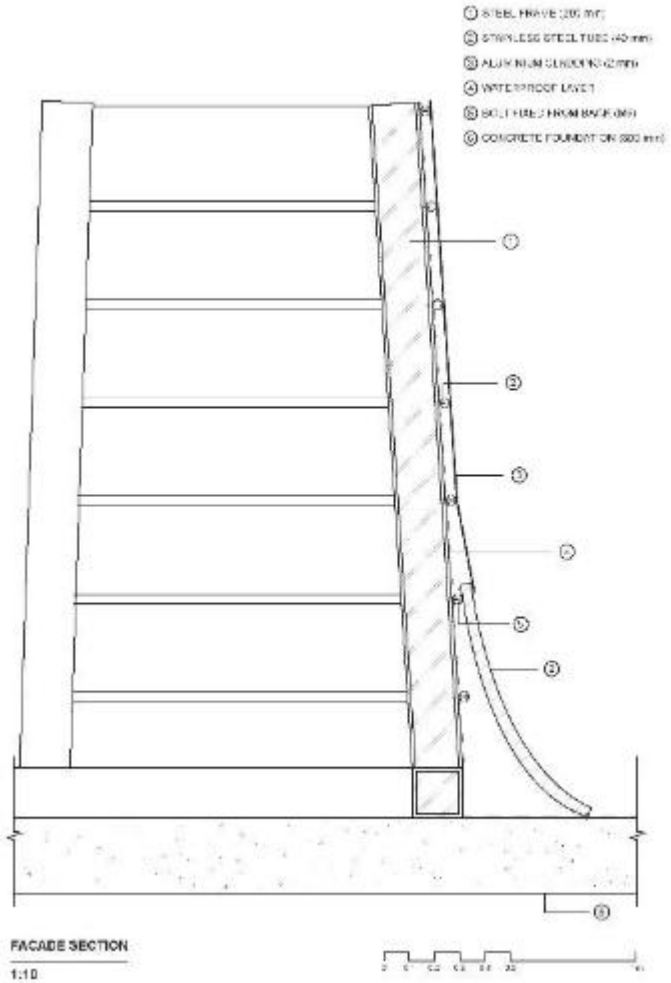
Invention: Student Work

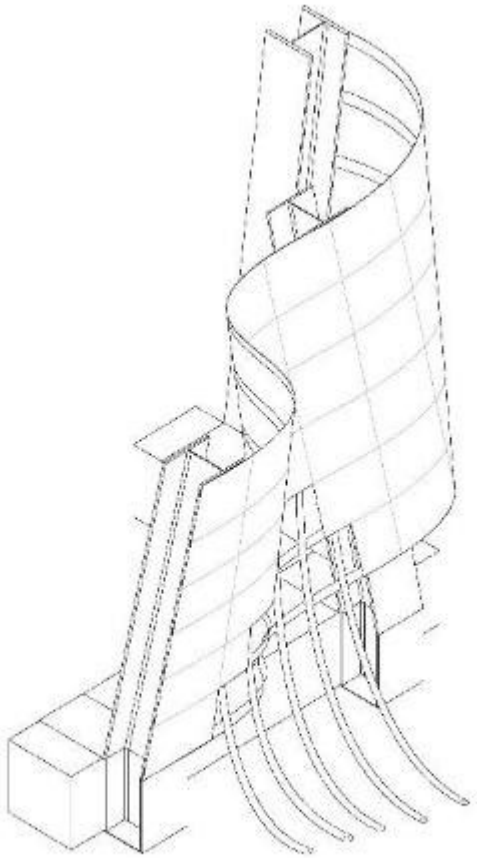




Images: Charlene Leung, 2024.

• INVENTION: STUDENT WORK





Images: Chung Heitung, 2024.

Image and Reference Sources

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