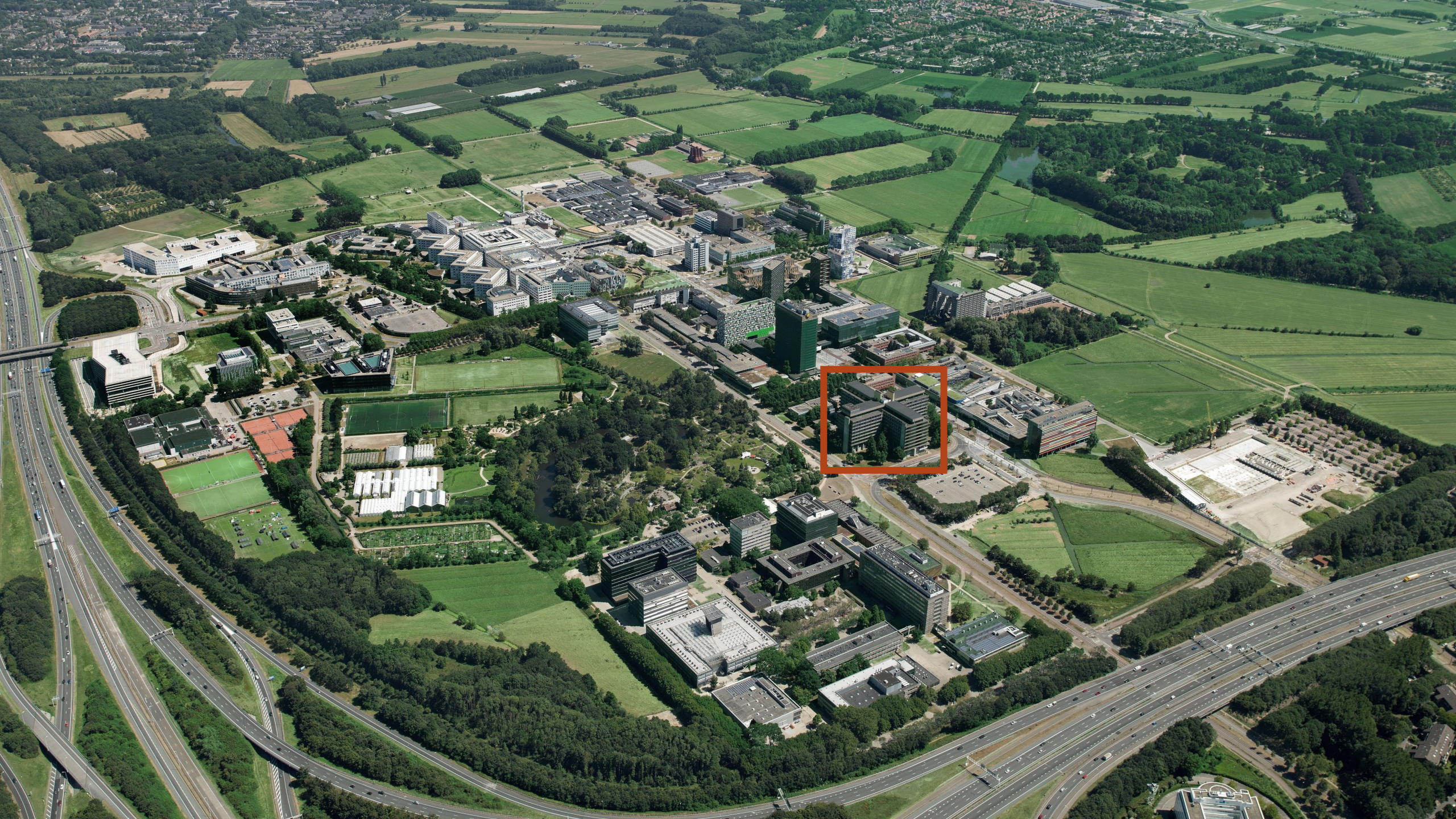
The Bricoleur — Architect :

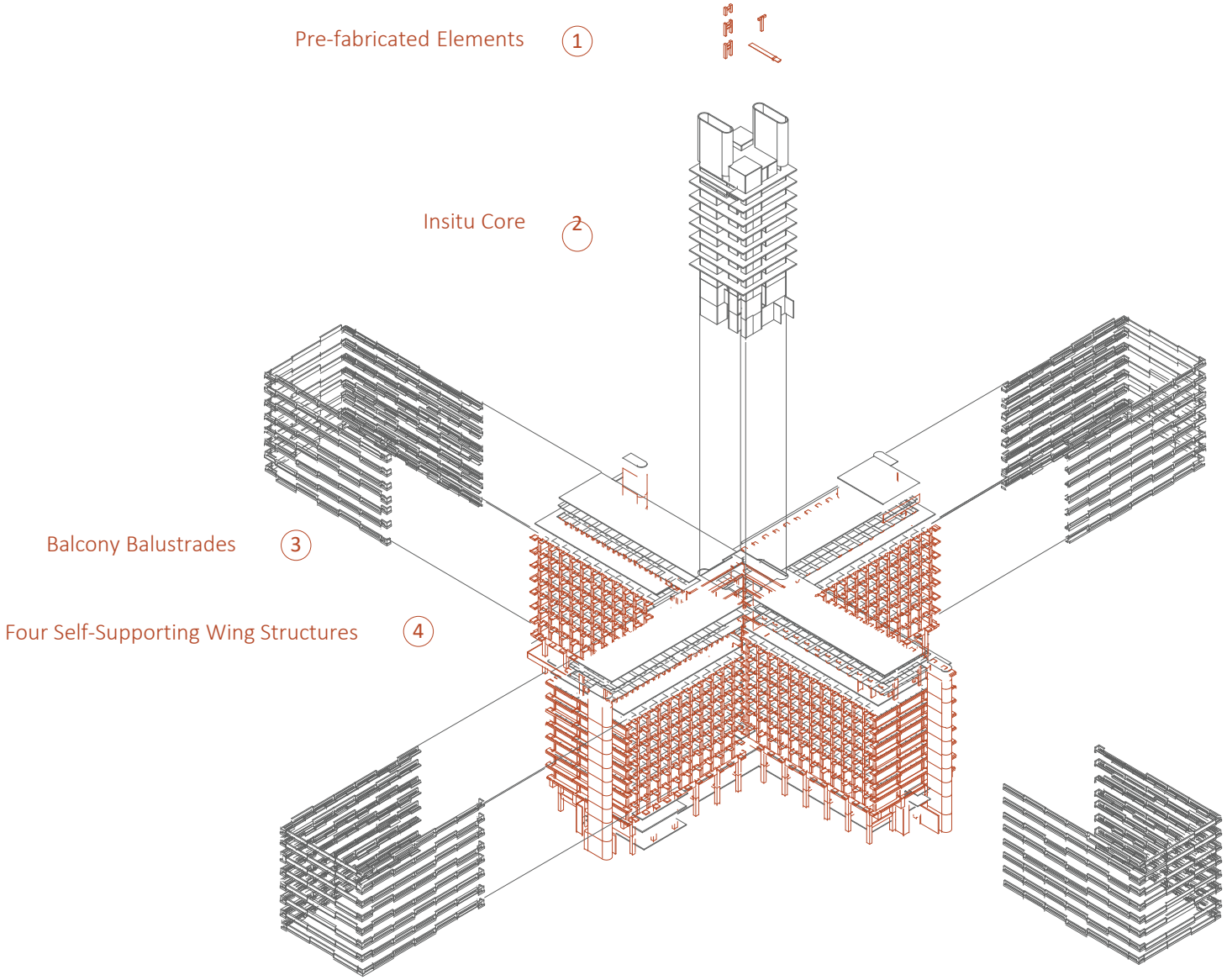
Healing 1960s and 70s Concrete Buildings

Laura Wiedenhöver | 5084431 | aE Graduation Studio | P5 | 20.12.22

Built Year: 1969 – 1973 Height: 45 m Length: 120 m Width of Wing: 27,60 m Gross Floor Area: 53,720 m²

The Hugo R. Kruytgebouw





Existing structural build-up of the brutalist Kruytgebouw

A CRAFTED KIT-OF-PARTS

HEALING THE HUGO R. KRUYTGEBOUW WITH TIMBER FRAMING AND BIOPHILIC DESIGN STRATEGIES

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ABSTRACT

This paper conducts a material assessment of timber and concrete, analyzes historic and modern wood-to-concrete joinery techniques and proposes a healthy and circular building approach using timber framing and biophilic design strategies to revitalize existing 1960s and 70s Dutch concrete structures. It argues for the re-nurturing of natural and local ways of making in existing structures in order to challenge the contemporary building practices in the Netherlands, enhance the sensory relationship humans have with the built environment, and advance people's health, fitness, and well-being. This is specifically applied through a research-by-design approach to the Hugo R. Kruytgebouw located in Utrecht University Campus.

KEYWORDS: *TIMBER, WOOD-TO-CONCRETE, BIOPHILIC DESIGN, HUMAN WELL-BEING, HEALTHY BUILDINGS*

I. INTRODUCTION

Close to a hundred-thousand dwellings built during the 1960s and 70s have reached a building life-cycle of fifty years, making more than 50% of the total Dutch building stock in need of a revision to prepare them for a second-life (de Rouw, 2018; Manifesto, n.d.). Many urgently need a new facade, yet one must remember that within the facades of these buildings often lie toxic materials, such as asbestos (Pijpers, 2021). Having to face challenges of refurbishment (such as toxic materials), questions of material awareness and future construction methods arise. With the building sector accounting for 25-30% of the total waste world-wide, showing how the circular economy can be applied in architecture could help spread awareness about the benefits of material reuse, and material embodied energy in order to avoid the pollution and depletion of natural resources (Beim et al., 2019; Uddin, 2020).

To meet the 2050 climate neutral goal set by the Dutch government and European Union, the existing building stock of the Central Dutch Government Real Estate Agency is facing major renovation challenges that have a big effect on the building industry, building technology, and building material choices (Snijders, 2020). The building industry currently accounts for 36% of the world's final energy use and 39% of energy and process related emissions (IEA, 2019). Concrete remains as the most used material for construction in the Netherlands since directly after the Second World War (Dzhibov, n.d.; White, n.d.). Concrete continues to be a universal environmental problem due to the production of cement. It is estimated that 600 kg $C0_2$ is emitted into the atmosphere per 1 ton of cement (Leschs Kosmos, 2022). Fifteen million cubic meters of concrete is used every year in the Netherlands, resulting in 3.7 Mt of $C0_2$ per year (MVO Nederland, 2021).

Before industrialization, timber construction was all over Europe and Asia. Timber was considered to be the most important material for building (Hudert & Pfeiffer, 2019, p. 101). Due to the vast local availability, ease of use, and good structural properties of timber, skilled craftsman relied on press-fit timber joints for centuries without the use of metal (p. 101). This changed when metal fasteners became cheaper, extinguishing a local tradition from many European and Asian countries (p. 101). Even today, the 'new' construction materials such as cast iron, steel, and concrete remain sold at lower prices because their demand in the global building and construction industry remain high (p. 101). Although the environmental cost also remains high, these costs are left out of the pricing

Table 7. Modern wood-to-concrete connections

Advantages	**Disadvantages or Shortcomings**
It is more cost-effective to join a wooden beam to a concrete wall with a metal fastener (Blass et al., 2017, p. 549) This however, is only due to the current demand in the building and construction industry (Hudert & Pfeiffer, 2019, p. 101).	Steel is a raw material that is costly, difficult to produce and energy intensive during its production phase (Hillebrandt et al., 2019, p. 68)
Metal fasteners are protected with fire-protective coatings or additional fire-resistant materials (i.e., wood cladding or wood-based materials of a certain minimum thickness) when joining wood-to-concrete (Hillebrandt et al., 2019, p. 69; Blass et al., 2017, p. 558).	The loadbearing capacity of metal fasteners is quickly lost when heat is applied (p. 549) For example, since metal has a higher thermal conductivity than wood, it transmits heat to the surrounding wooden elements, weaking the overall performance of the structural elements (Blass et al., 2017, p. 556).
-	Metal fasteners tend to be hidden or kept out of sight, therefore, it may be assumed that they are not as aesthetically pleasing as traditionally crafted wooden joints (personal remark).
When designed properly, a wood-to-concrete connection may result in a structurally successful and pleasing aesthetic detail (personal remark).	Concrete is sensitive to changes in temperature while timber is affected by changes in moisture content (p. 315). This is only problematic however, if the wood-to-concrete connection is too rigid and if elements are excessively long (Blass et al., 2017, p. 315).

Appendix M : Advantages and disadvantages of modern wood-to-concrete connections

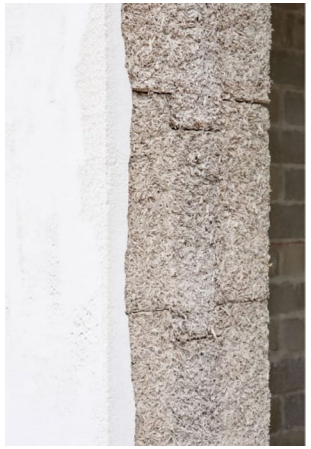
Appendix D : Brackets enabled cantilevers at various heights in fortification walls (Zwerger, 2015, p. 134).

Researched advantages and disadvantages of wood-to-concrete connections

Reflecting on a historic building approach : joining wood-to-concrete with press-fit connections

reclaimed timber

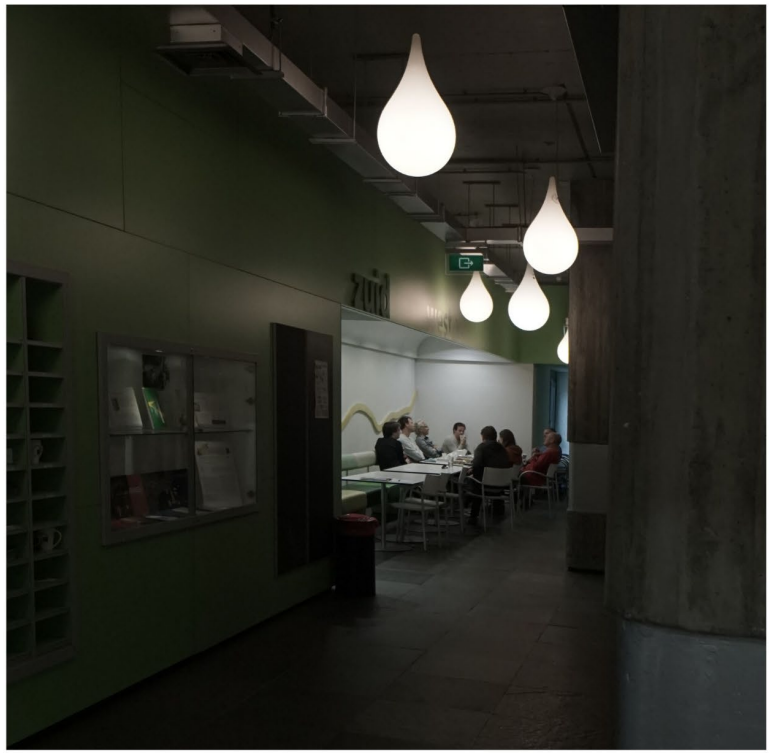
hempcrete



clay

recycled zinc

Sustainable materials used in the re-design

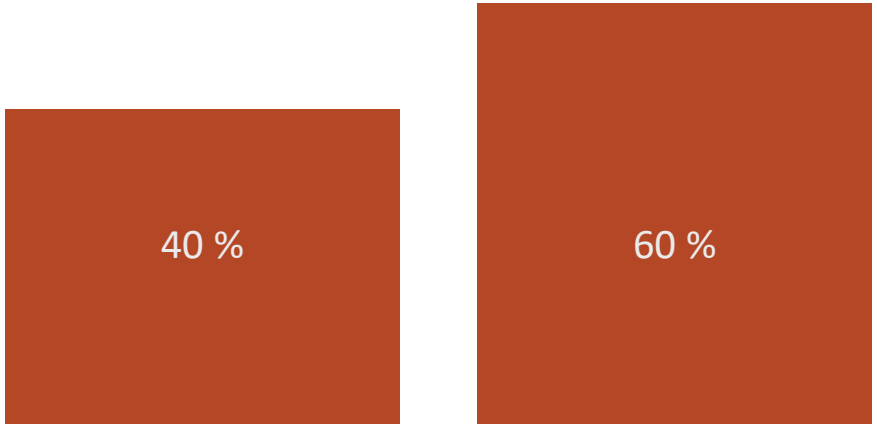


Poor daylighting

Poor building health

The Faculty of Science expects considerable growth, and an important part of the faculty strategy is [the ability] to meet and [have] multidisciplinary collaborations

— Pijpers, *2021*



Office Space

Collaborative Working Space

Lecture / Event Space

Laboratories

Existing building function

Office Space

Collaborative Working Space

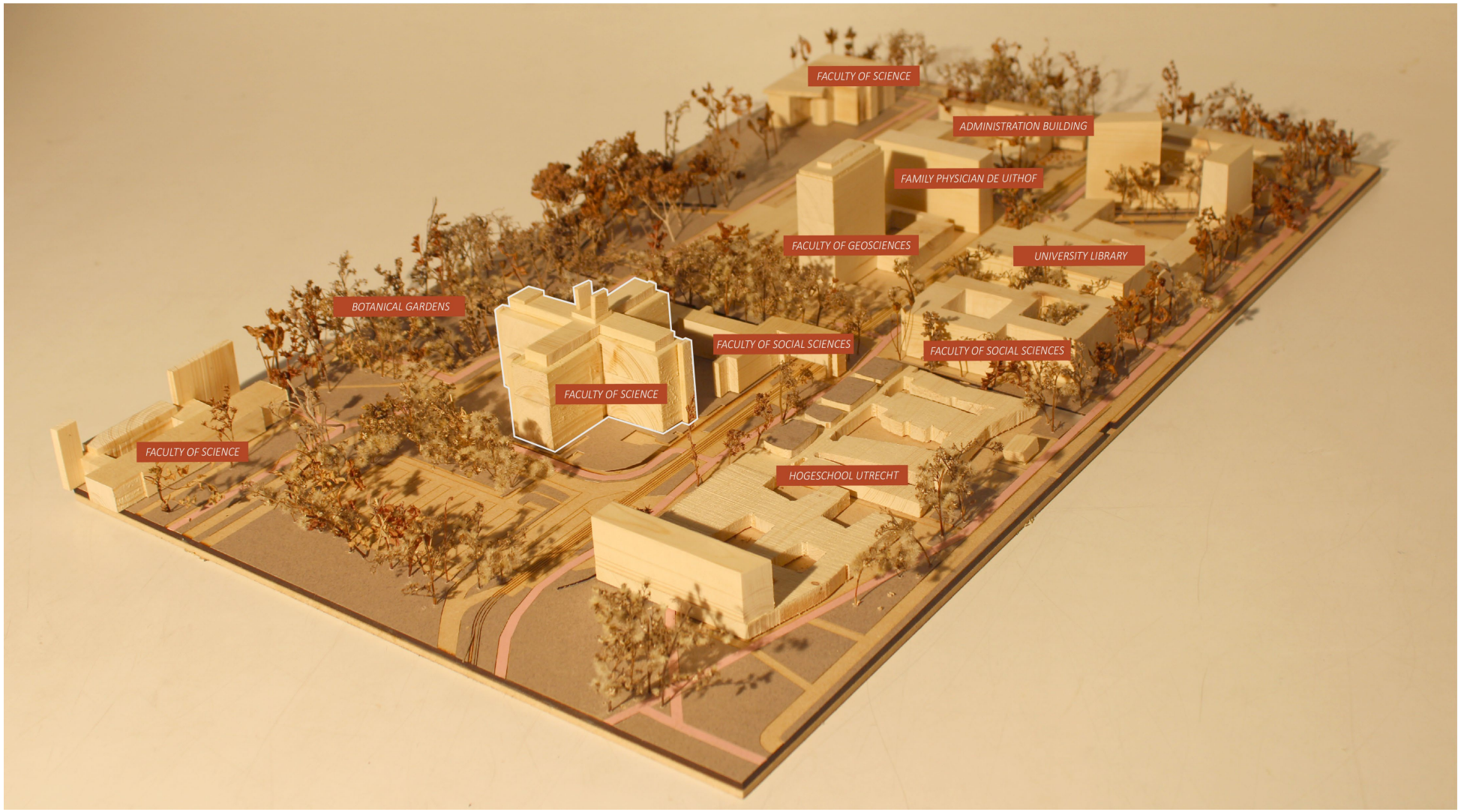
Lecture / Event Space

Laboratories

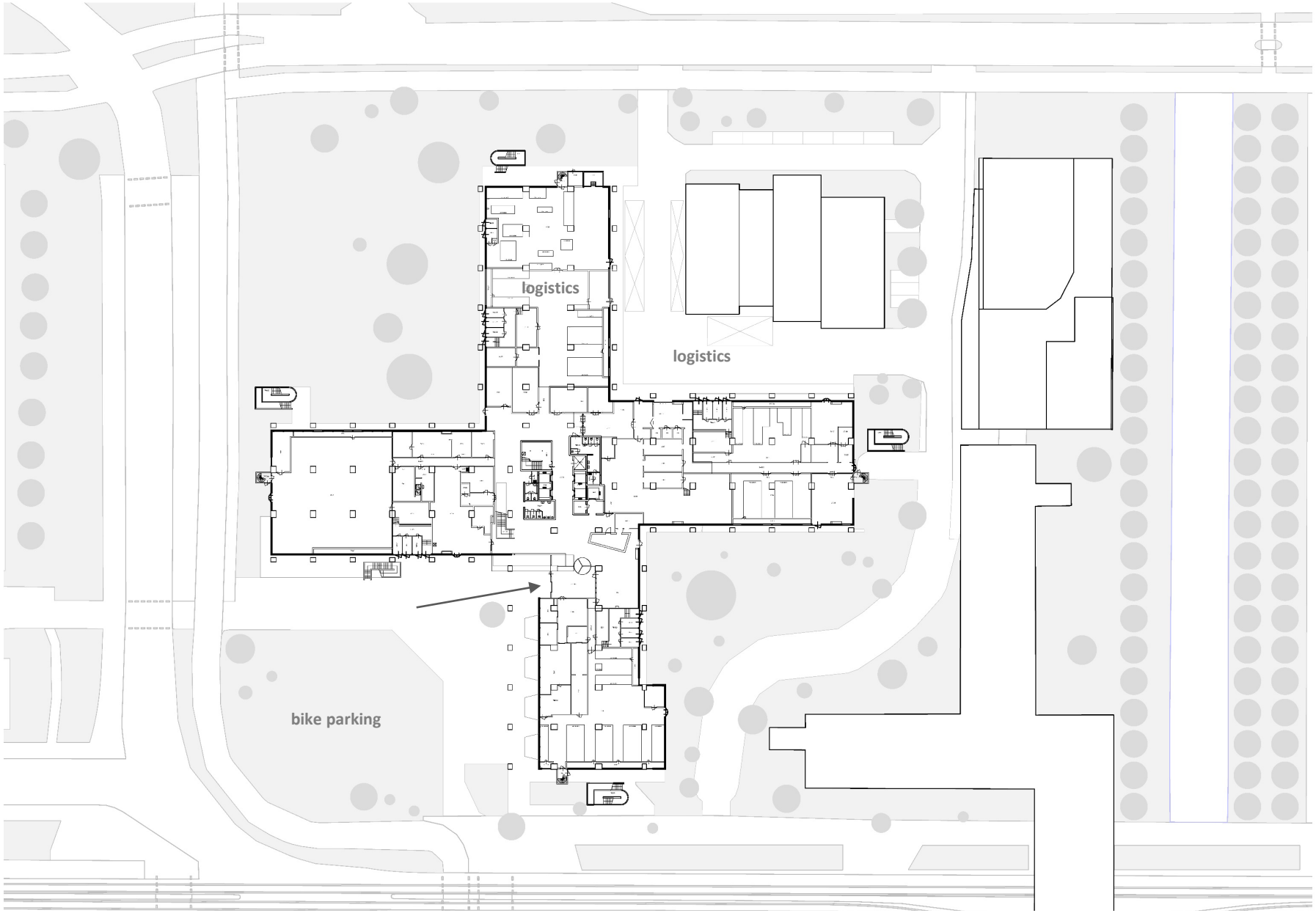
New building function

improve the building climate, integrate natural and local materials
+ increase the social interaction within the building

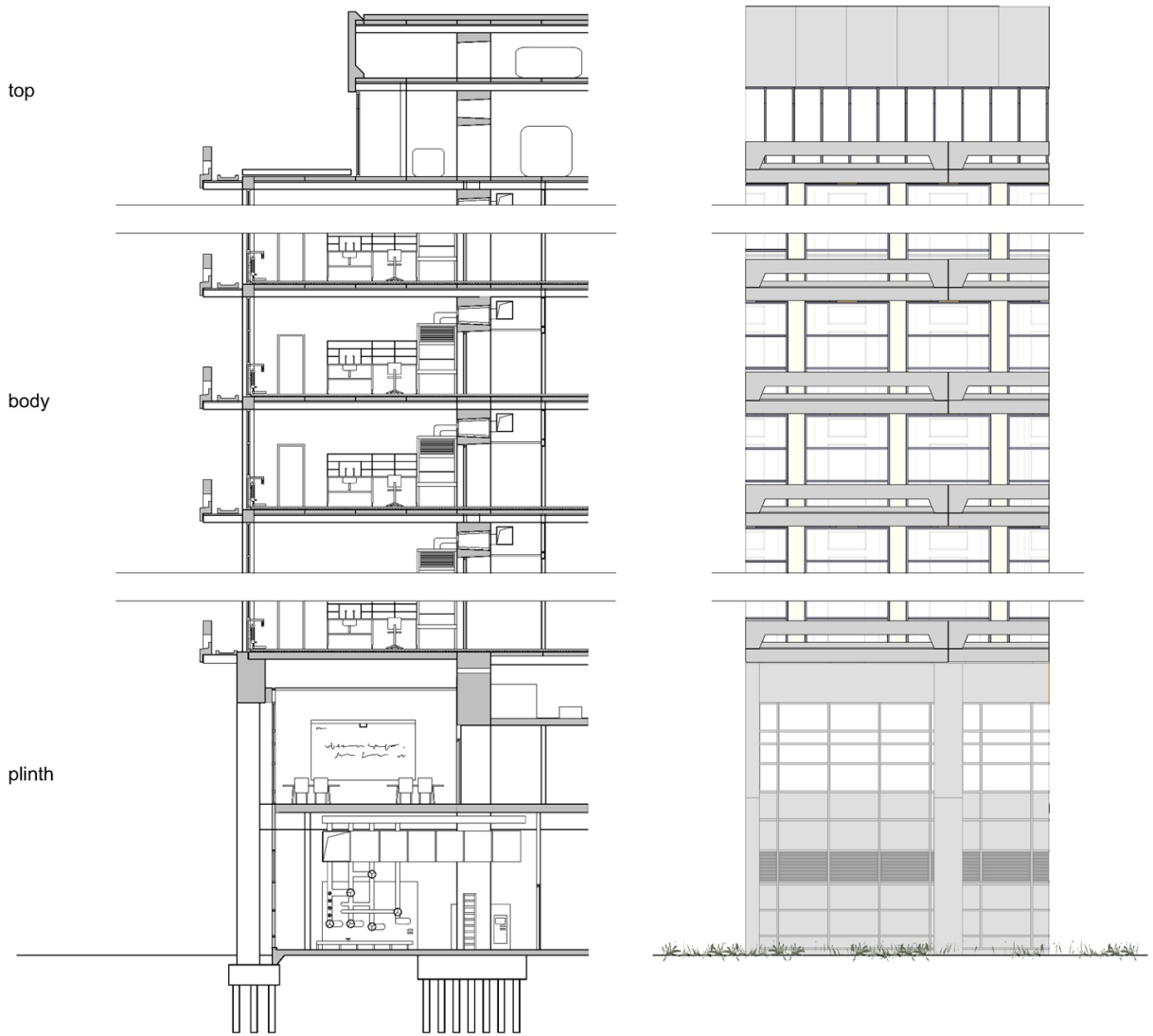
Design Goals



Existing Faculties and Building Functions



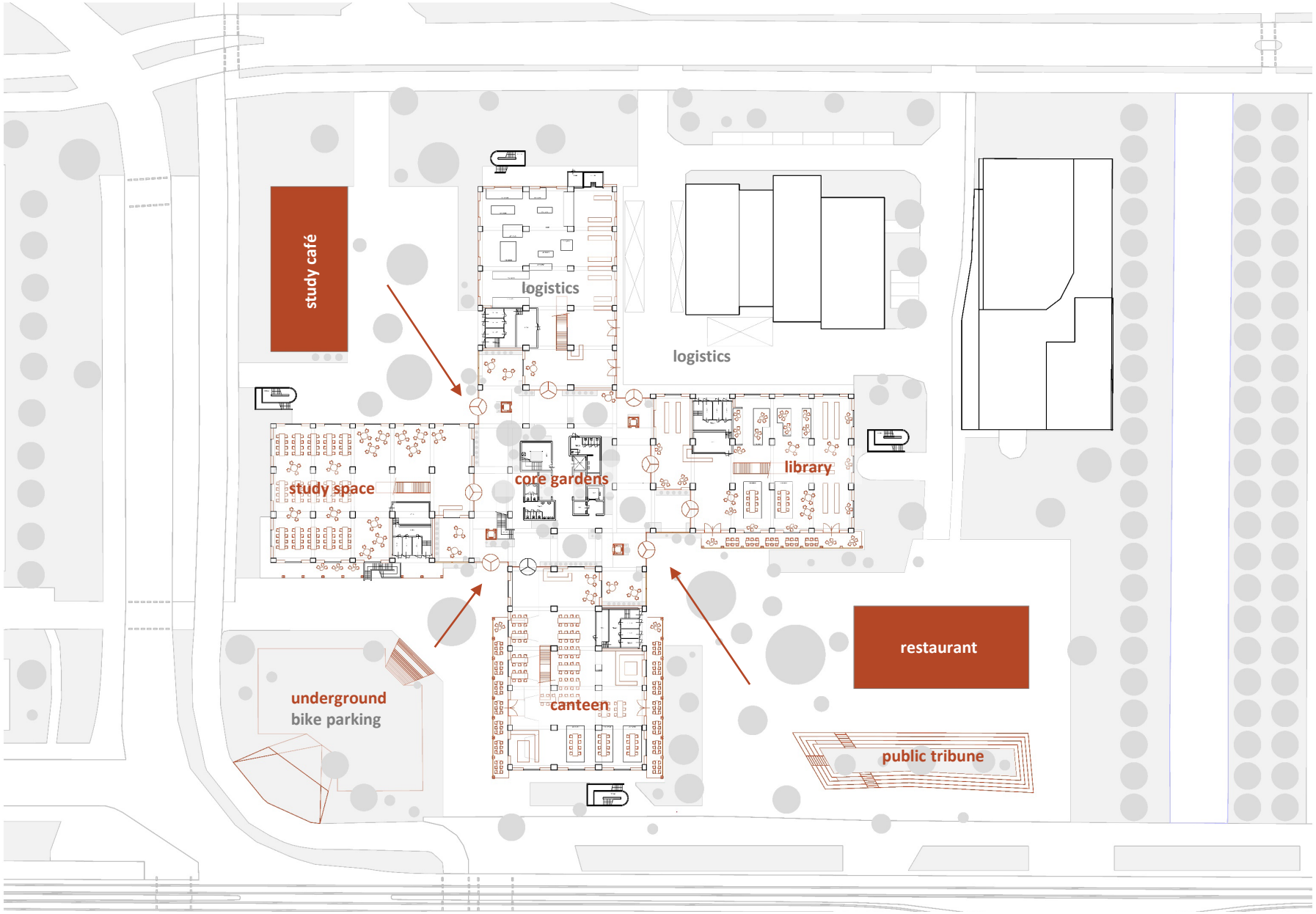
Existing plinth



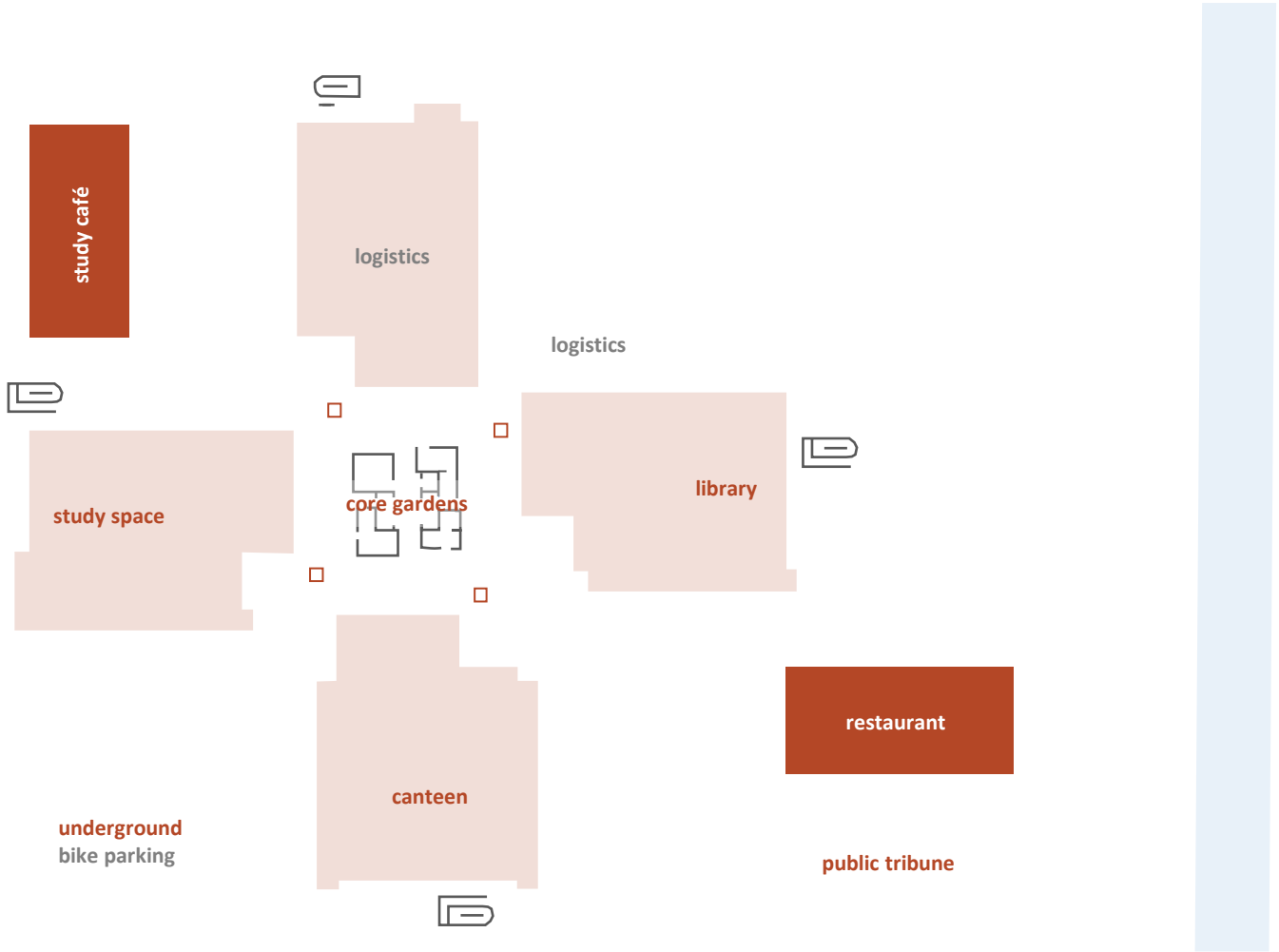
Existing Section/Facade of Kruytgebouw

Existing Plinth of the Kruytgebouw

New Section/Facade of Kruytgebouw


study café
logistics
logistics
study space
core gardens
library
restaurant
underground
bike parking
canteen
public tribune

New plinth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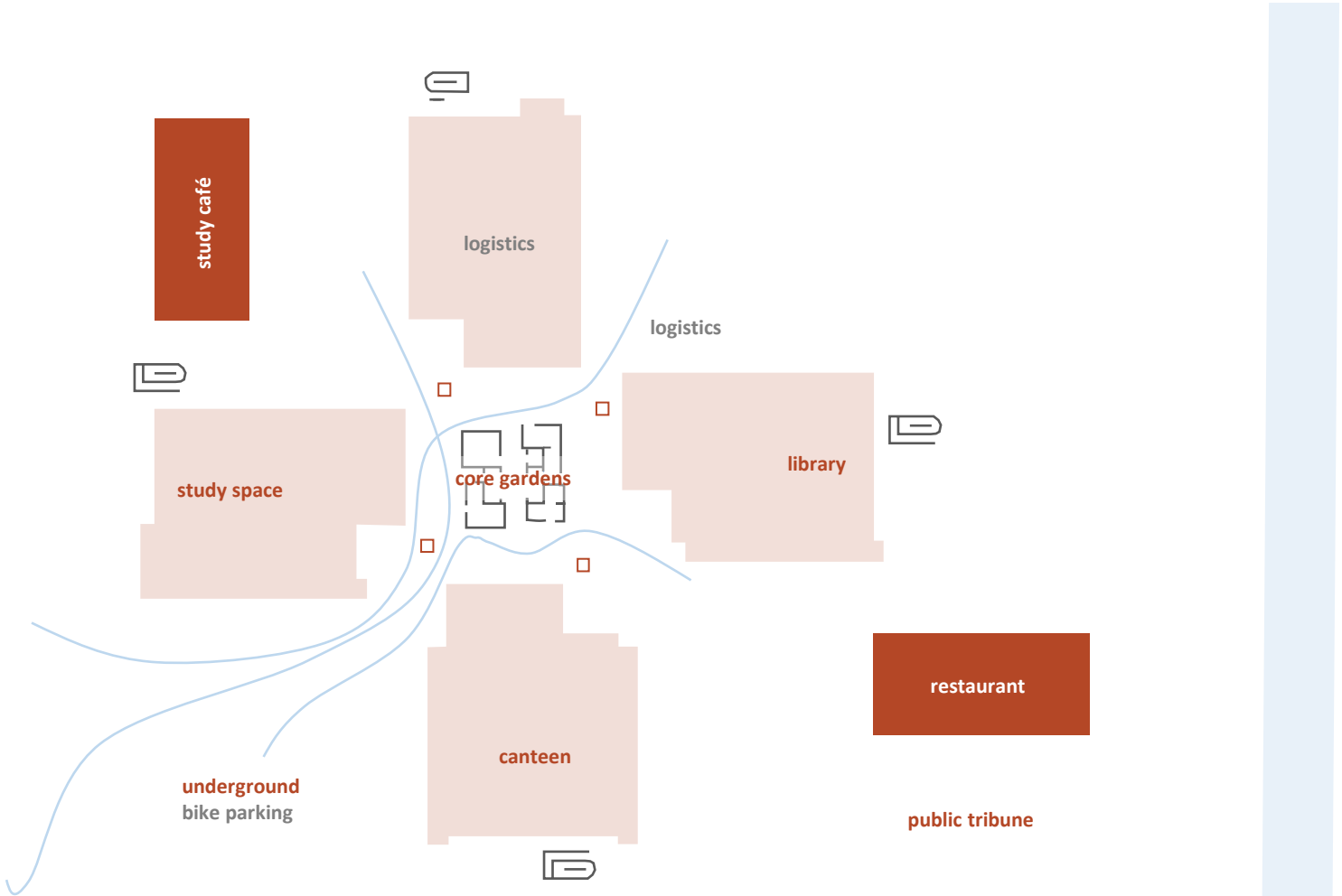
New plinth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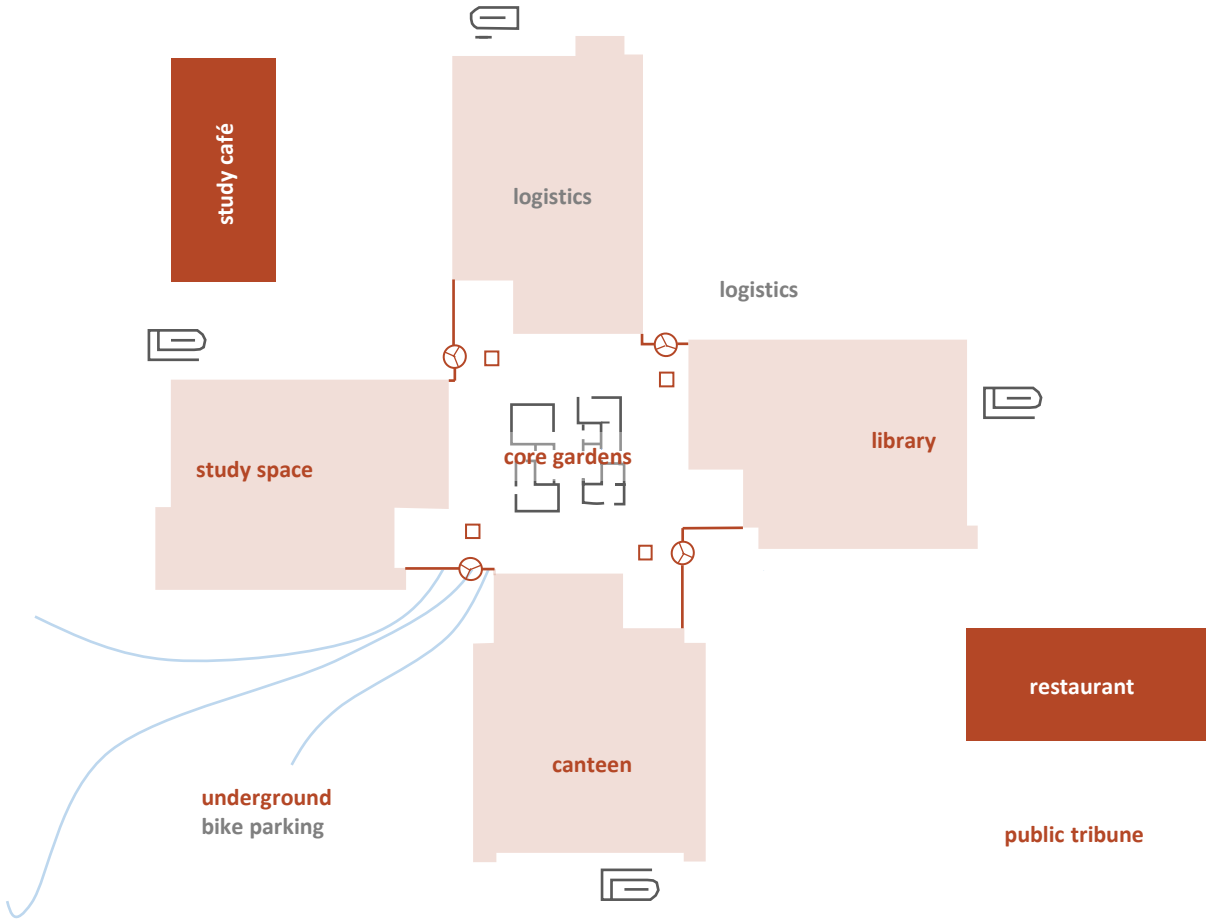
New plinth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study space
core gardens
library
restaurant
canteen
underground
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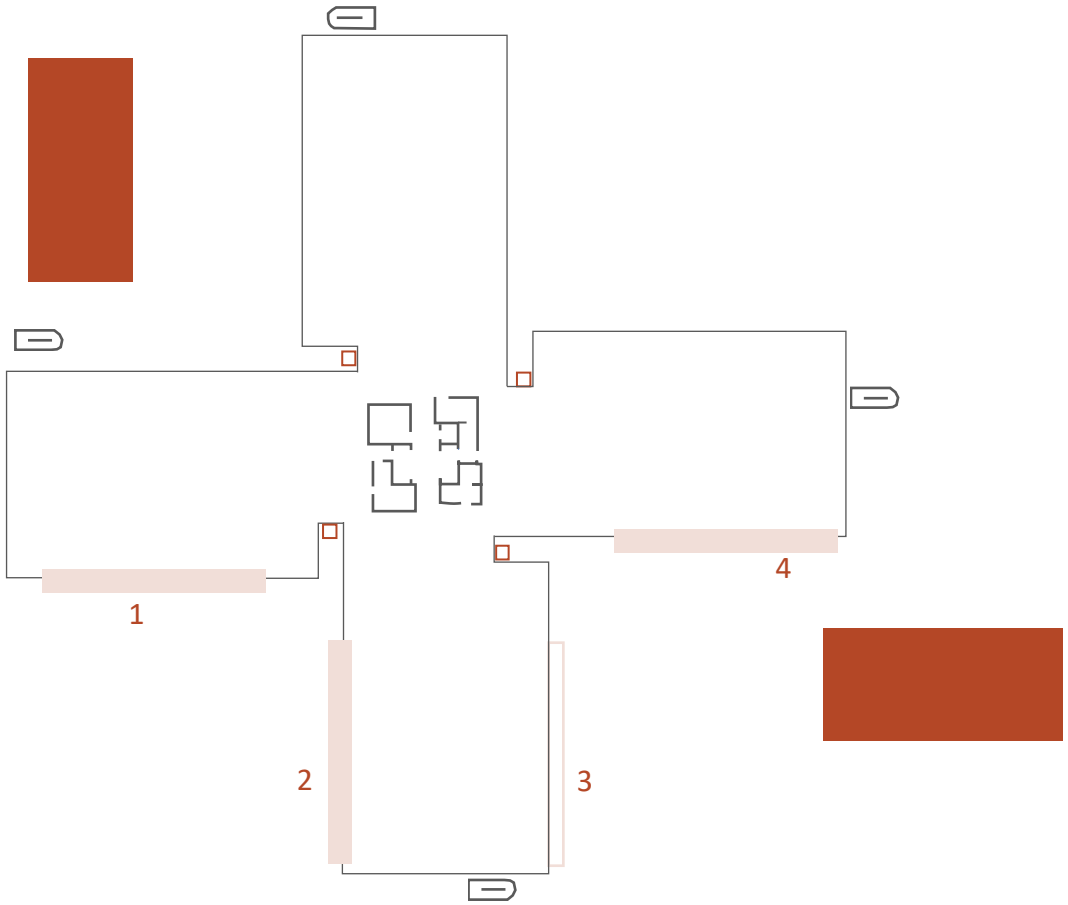
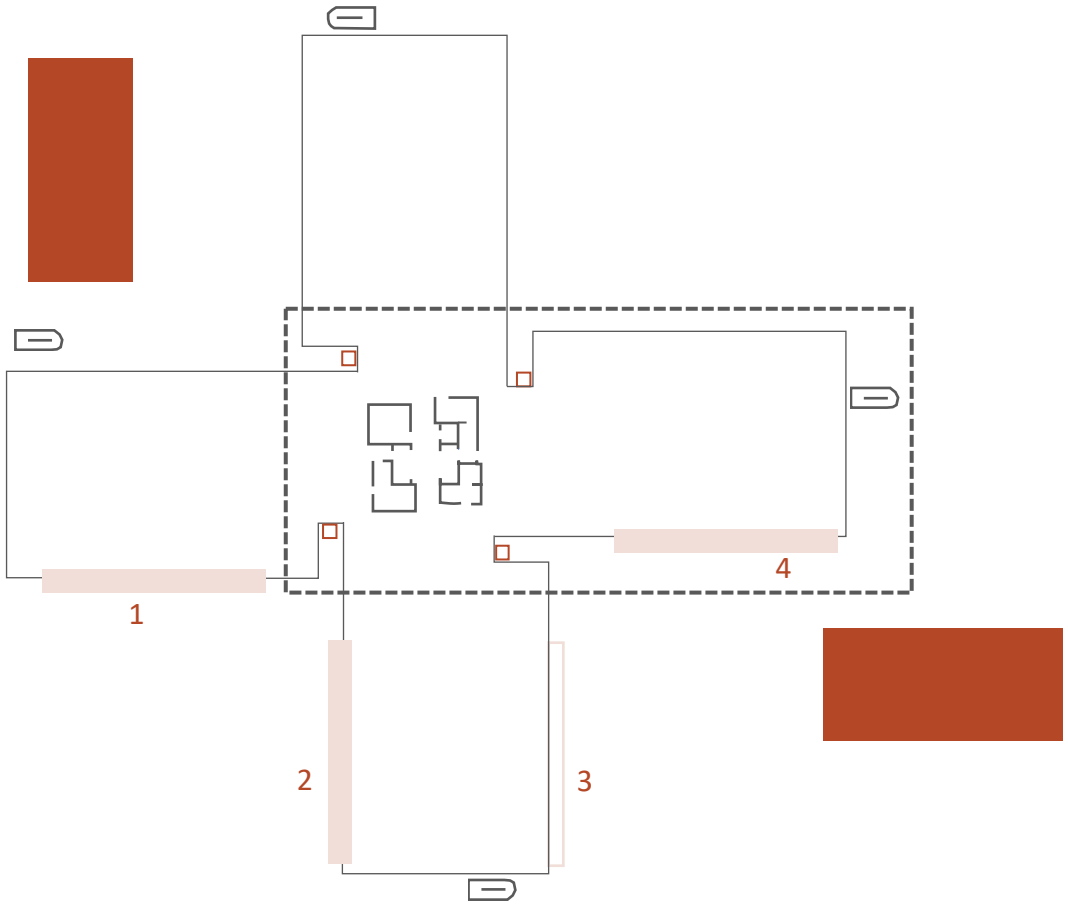
public tribune

New plinth

New body + wooden facade extensions



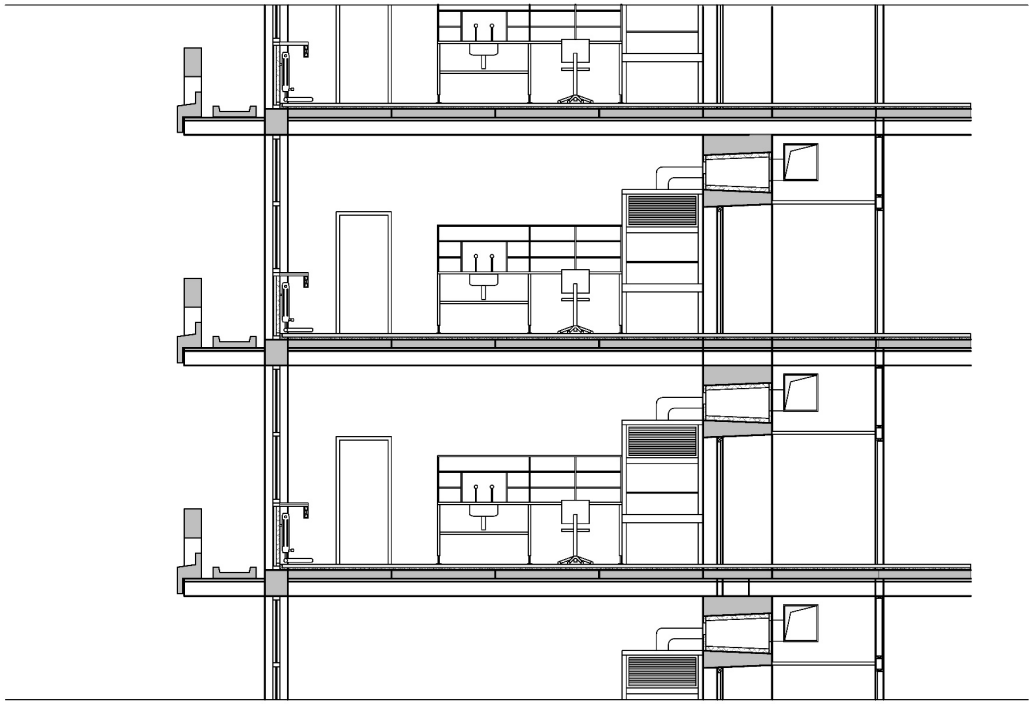
New body + wooden facade extensions

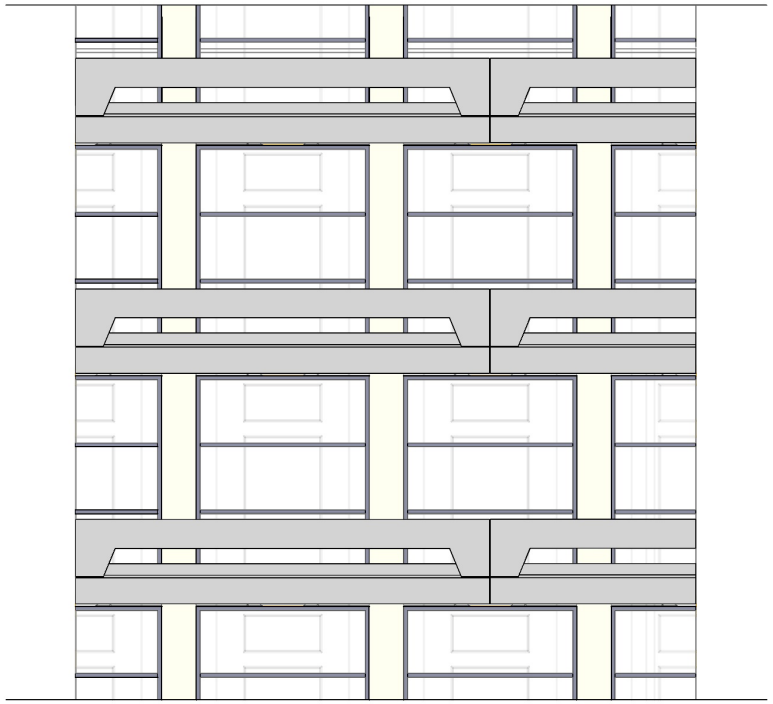


New body + wooden facade extensions

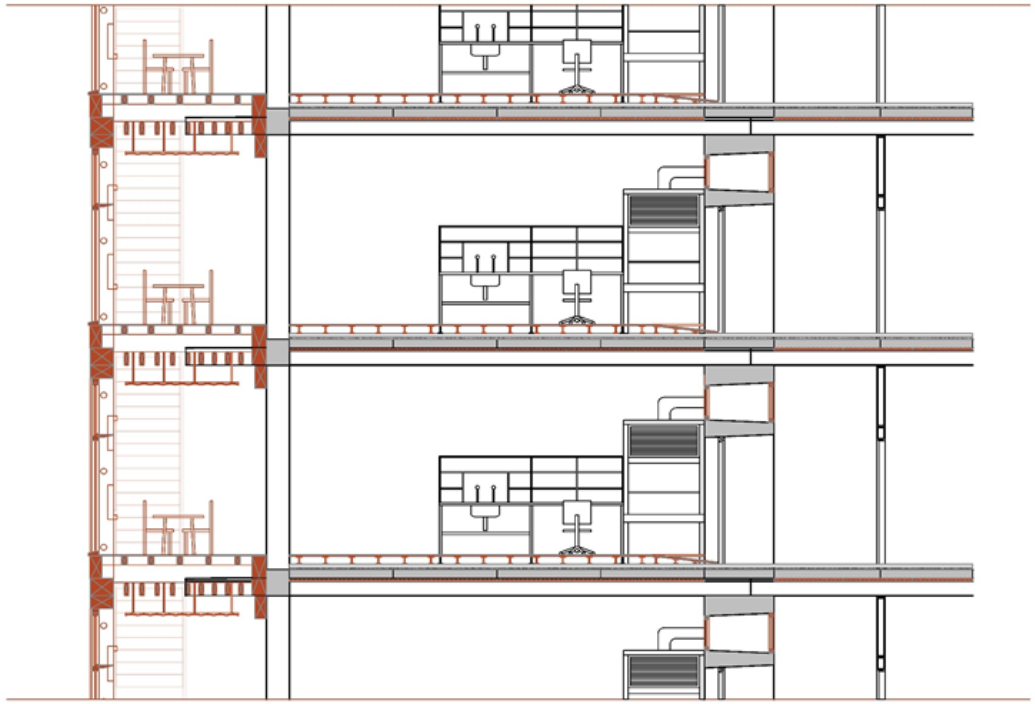
Existing spatial compartments and access points

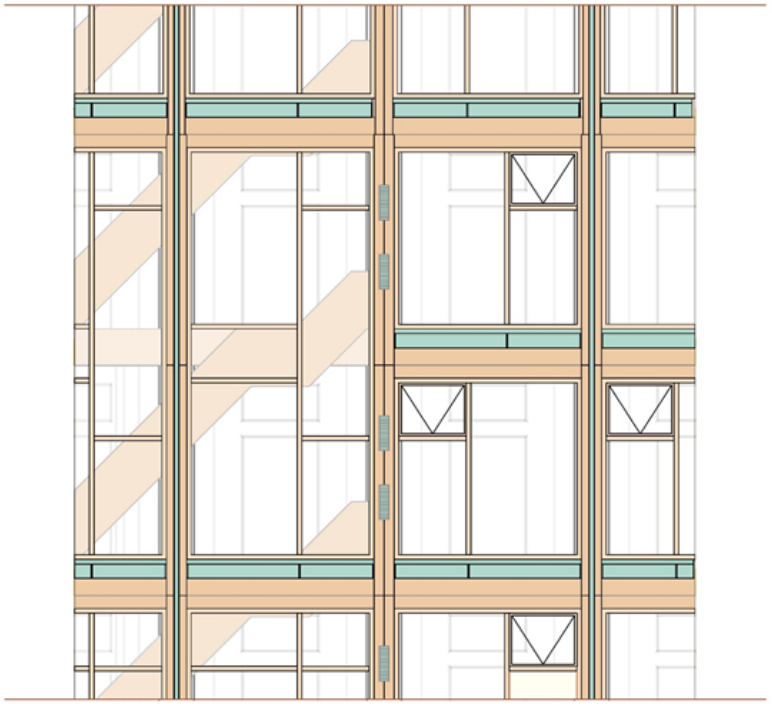
New spatial compartments and access points



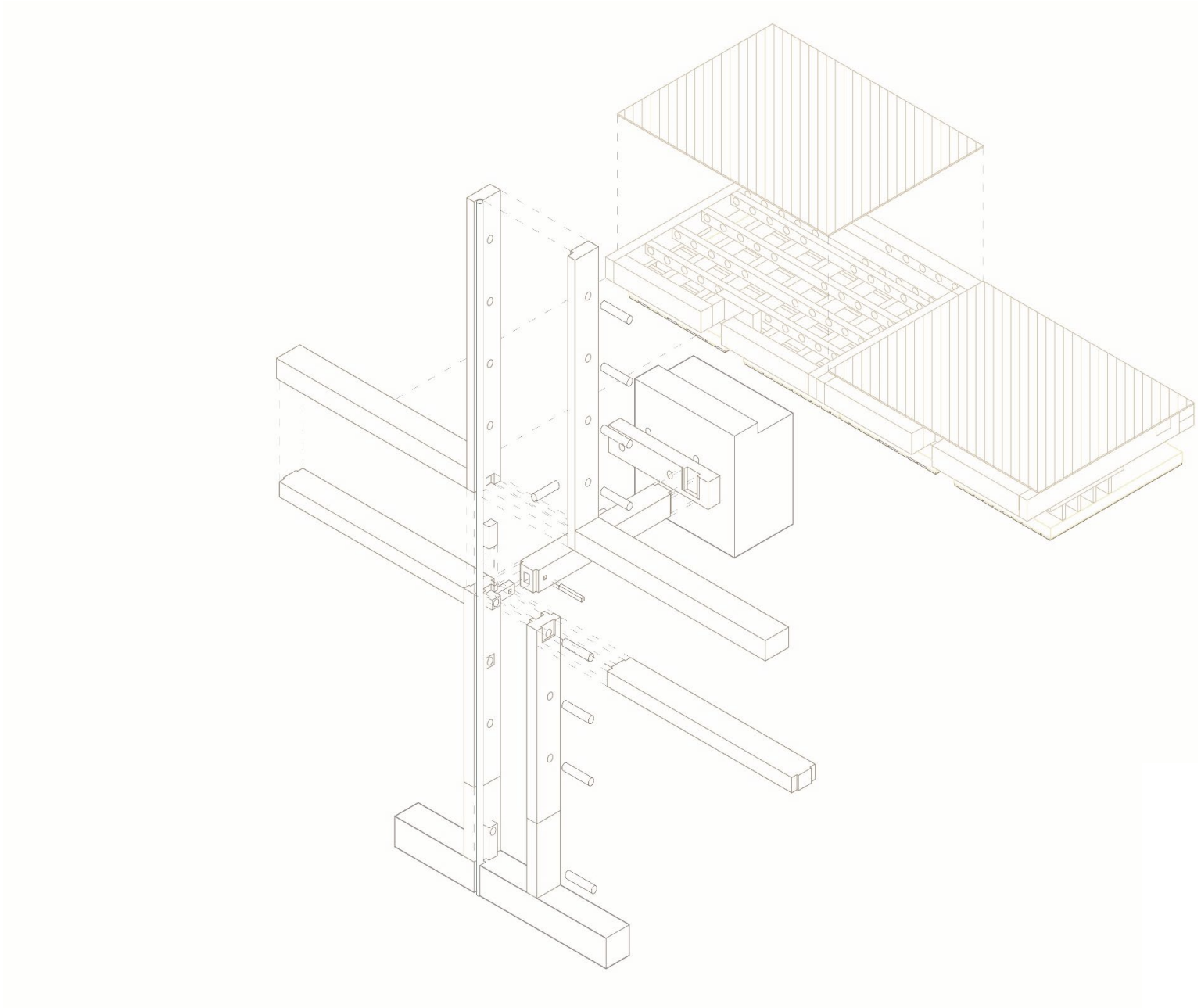


Existing body of the Kruytgebouw

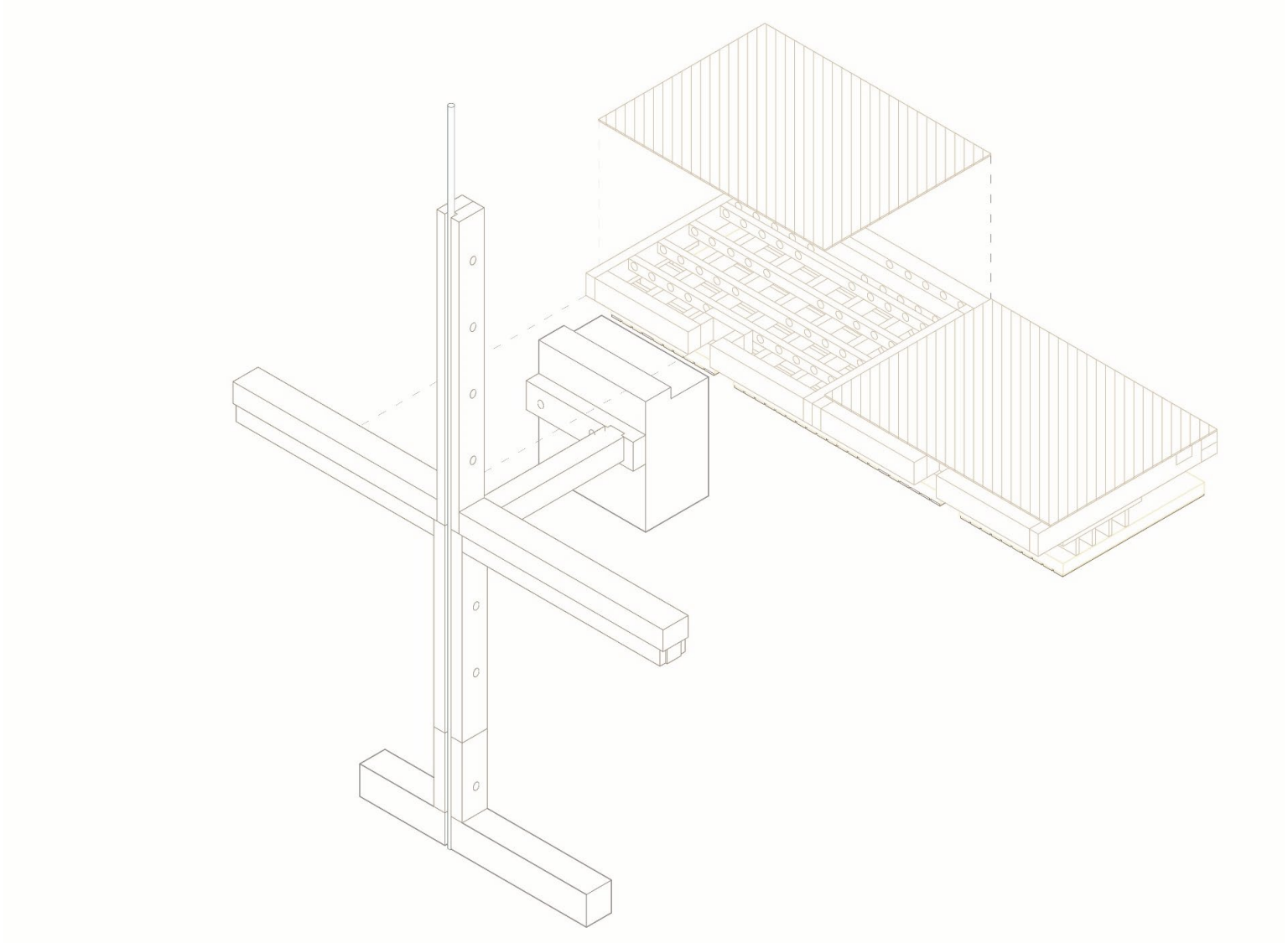




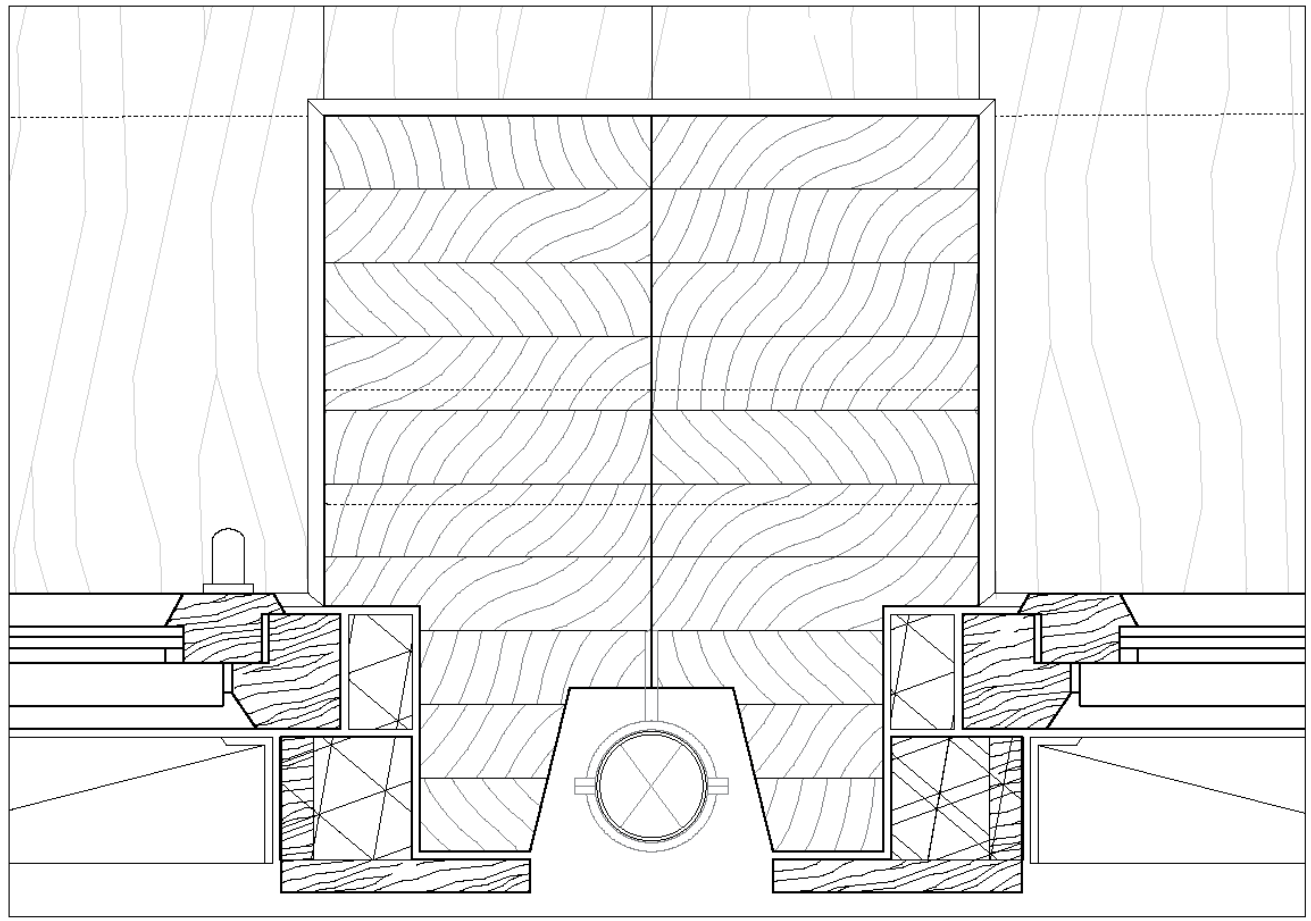
New body of the Kruytgebouw



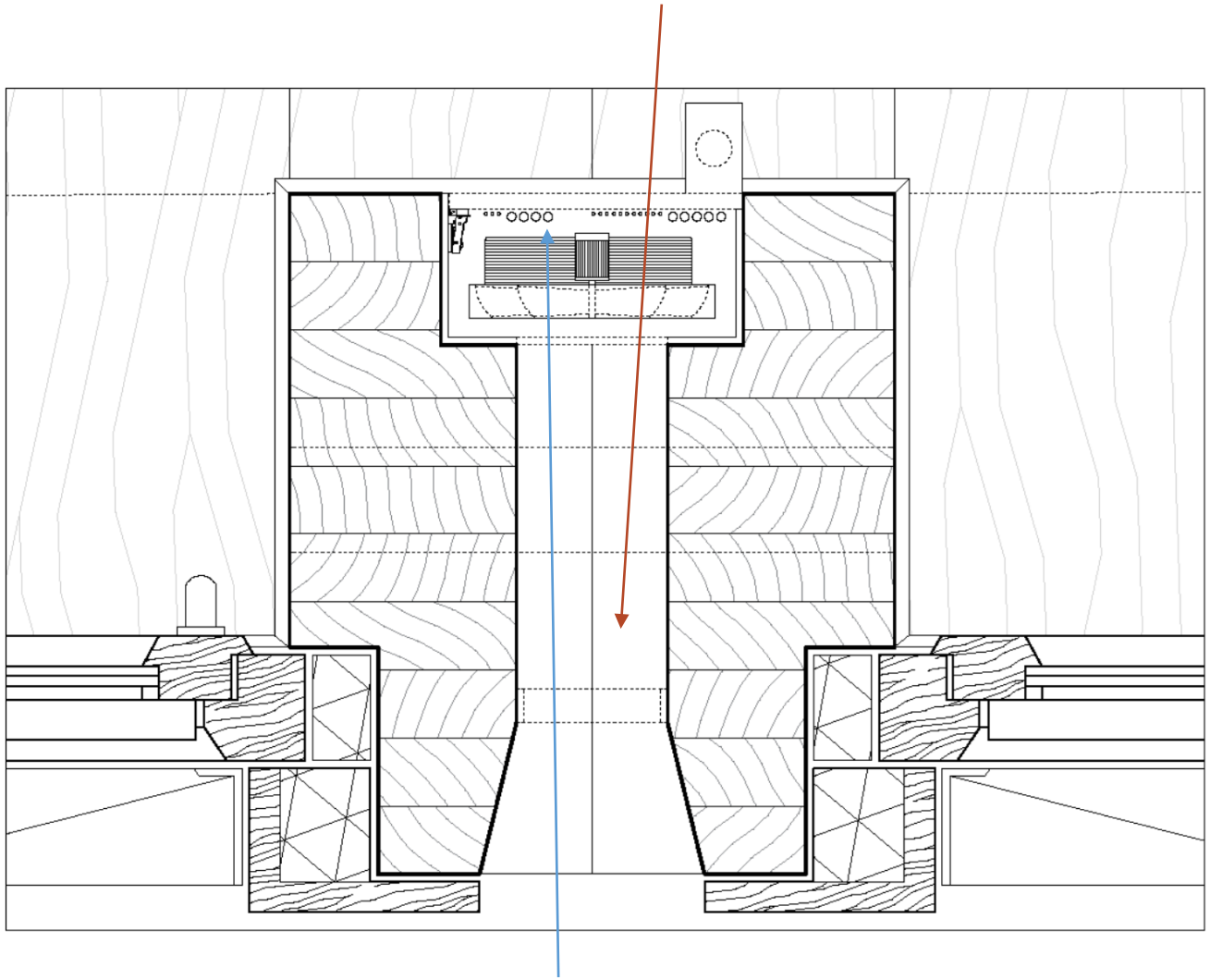
Prefabricated kit-of-parts axonometric (disassembled)



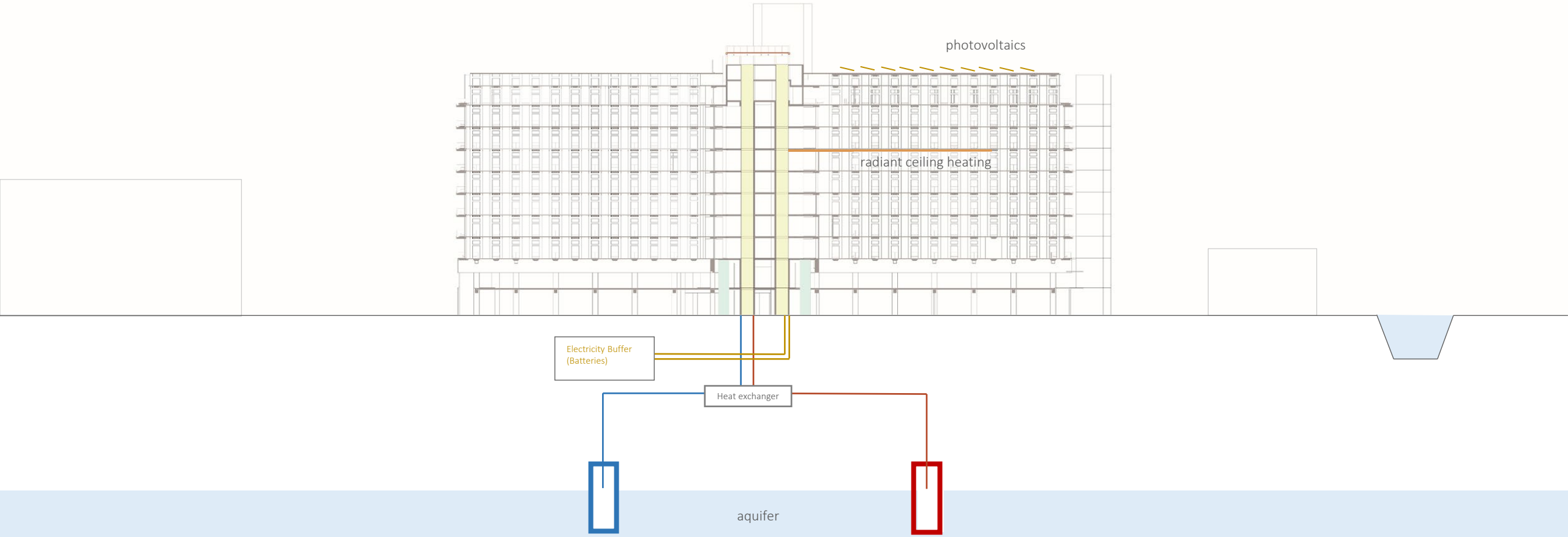
Prefabricated kit-of-parts axonometric (assembled)



Detail of rainwater column



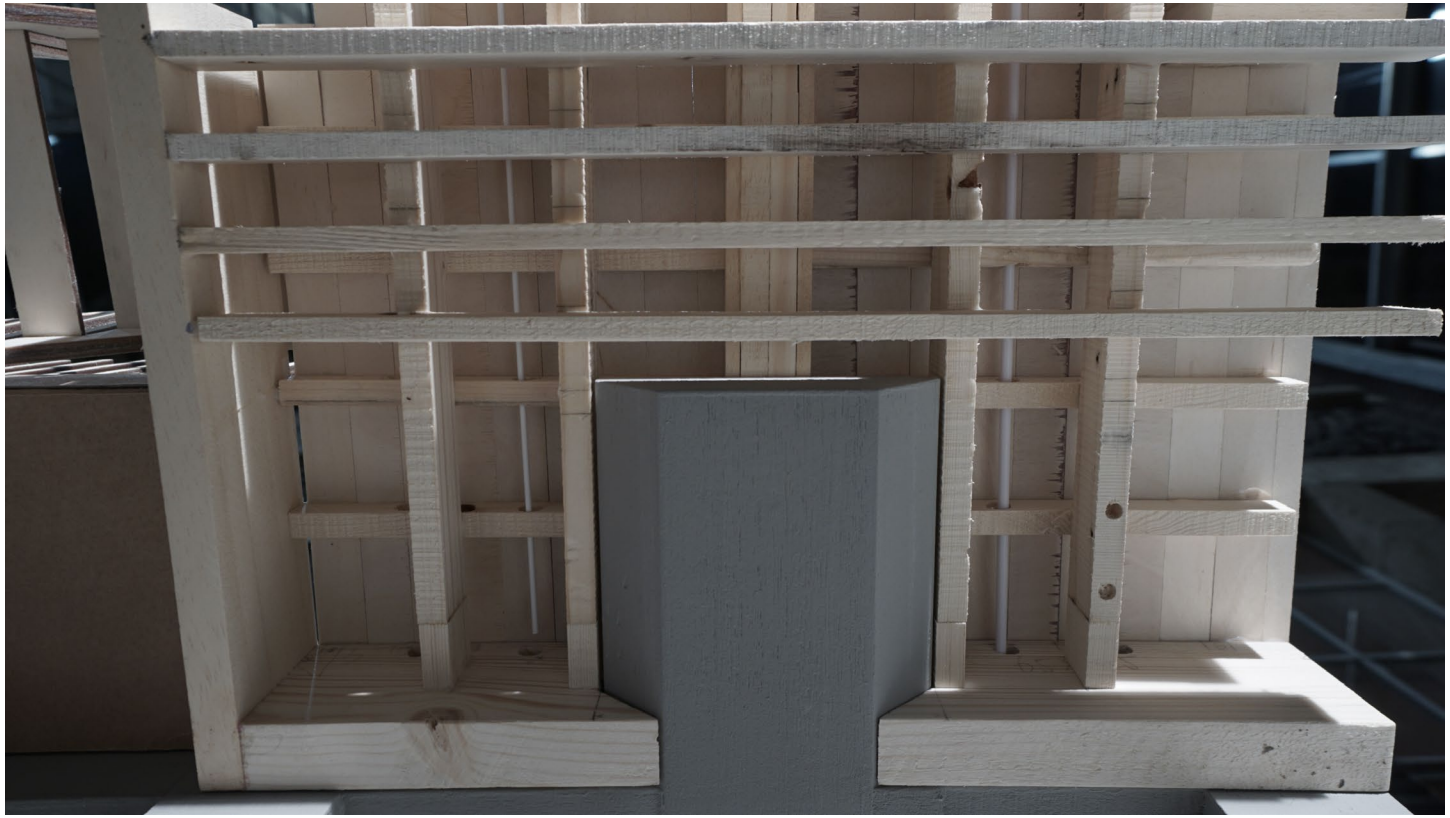
Detail of breathing window column



New energy concept of Kruytgebouw – Aquifer thermal energy storage (ATES) + concrete core activation + photovoltaics

Impression of materiality in plinth

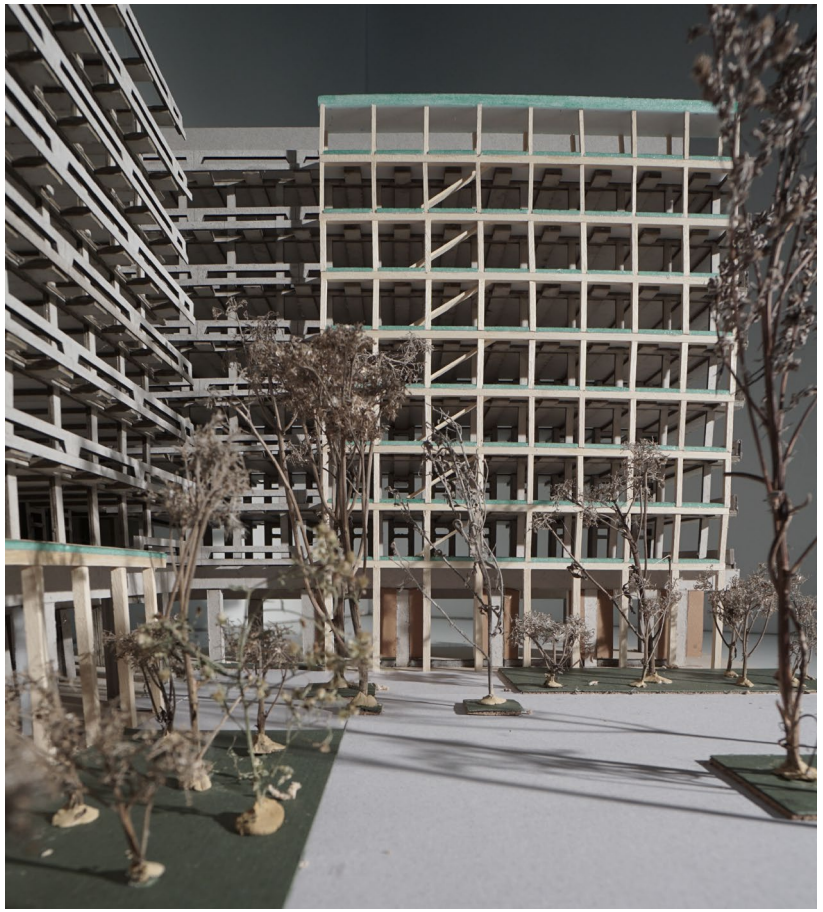
Looking up from ground floor



Looking up from laboratory extension

Impression of Kruytgebouw and site interventions

South-east natural corridor



Approach from southern boulevard