Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Maria Laura Leticia Wiedenhöver

5084431

aE 2021-2022

03-12-2022

Personal Information

Name: Maria Laura Leticia Wiedenhöver
Student number: 5084431

Studio

Name of studio: Architectural Engineering
Design tutor: Anne Snijders
Research tutor: Pierre Jennen
BT tutor: Gilbert Koskamp

Graduation Plan

Project Title

The Bricoleur — Architect : Healing 1960s and 70s Concrete Buildings

Location

Utrecht University Campus, Utrecht, The Netherlands

Fascination of Studio

My fascination for wood and its application to join, support and even 'heal' structures led to my application for the Architectural Engineering (aE) studio. The aE studio pedagogy challenges me to strengthen my design and technical innovation at various scales. Fortunately, I received guidance from tutors who encourage the act of iterative making to test these ideas. With a will to preserve existing structures, and design with natural materials as a future architect, I aim to explore and deliver an architectural masters thesis which showcases a new kind of architecture that uses new and reused materials to craft a healthier built environment.

Problem Statement

Existing 1960s and 70s concrete buildings in the Netherlands are poorly insulated, lack the integration of natural materials, and are built without the circular economy in mind (Larsen & Marstein, 2000; Beim et al., 2019). This contributes to unhealthy spaces and sensory deprived experiences within buildings. With traditional concrete construction still dominating the Dutch building sector, there is risk of prolonging high amounts of $C0_2$ emissions into the atmosphere. This further inhibits the amount of building that can be done in the Netherlands which is not beneficial to the national housing shortage. Along with rising issues concerning PFAS and nitrates in Dutch soil and groundwater, an architectural project which seeks to reduce these various emissions by using local, natural and circular based architecture to refurbish existing concrete buildings, could serve as a valuable resource to the Dutch Central Goverment Real Estate Agency.

Overall Design Question

DQ: How can a biophilic design approach guided by exploring historic and modern wood-to-concrete connections lead to the harnessing of local, natural and circular based architecture in existing 1960s concrete buildings in the Netherlands such as the brutalist Hugo R. Kruytgebouw?

Thematic Research Question

TRQ: How does examining historic and modern wood-to-concrete connections lead to a local, natural and circular based architecture approach which 'heals' existing 1960s and 70s concrete buildings?

Sub-Research Questions

SRQ1: How can press-fit timber connections contribute to reducing material waste and $C0_2$ emissions during the construction process?

SRQ2: What are the advantages and disadvantages of historic and modern wood-to-concrete joinery methods?

SRQ3: How can biophilic design and timber 'heal' the existing brutalist Hugo R. Kruytgebouw?

Design Assignment

This graduation proposal argues for the rejuvenation of existing concrete structures. This is done through a local, natural and circular based architecture approach which utilizes biophilic design strategies and timber framing techniques. The project aims to challenge the contemporary building practices in the Netherlands, enhance the sensory relationship humans have with the built environment, and advance people's health and well-being (Kellert, 2015). Integrating dry connections, along with natural materials (i.e., timber, hemp and earth) can serve as a healthy building model for the Dutch government to adopt today to help lower emissions, reduce waste, and foster resilient growth and development in tune with the natural environment (Brilhante & Skinner, 2014).

Methodologies

Thematic Research

The research paper incorporates both literature studies and a research-by-design method. The first literature study examines material properties of timber and concrete and compares their material waste and CO_2 impact. The second literature study investigates advantages and disadvantages of historic wood-to-stone and modern wood-to-concrete connections. Following the literature studies is a research-by-design method applied to the existing Hugo R. Kruyt building. The literature study findings are used in order to revitalize the Kruytgebouw's construction and make it more suitable for its users well-being.

Following the research paper, a wood-to-concrete prototype is drawn and made, allowing for an connection technique to be fabricated and tested.

Design

The revitalization of the Hugo R. Kruytgebouw takes place by incorporating timber framing and biophilic design strategies to its existing unique pre-fabricated structure. Focus is placed on the facade and interior of the building along the plinth, body, and top. For each of these locations, various applications of timber and biophilic design are conducted. Along with adding new timber additions to the building, other natural materials such as hempcrete (hemp and lime mix), lime, and clay plasters are widely incorporated. These natural materials aim to 'heal' the brutalist Kruytgebouw's building climate, increase it's users well-being, and strengthen it's connection with the surrounding natural environment (Kellert, 2018, p. 27).

To reduce excess building materials and material waste in the Kruytgebouw's redesign, a personal design challenge is to craft and incorporate a fusion of locally reclaimed wood with new wood. Dry connections join these 'new' timber additions with the existing concrete structure, thus reducing the amount of steel connectors used. Upcycled windows from the Kruytgebouw are also reused and encased between locally produced rammed earth wall modules which incorporate demolished concrete aggregates from the site.

Reflection

Graduation Topic

This graduation project deals with an existing structure which is currently in the process of redevelopment. Thanks to the aE studio offering the theme, Second-Life, a design can be developed for a building which is currently in need of becoming state-of-the-art once more. Undertaking such a project allows my design abilities to be challenged and strengthened. With the guidance of previously taken courses and design studios in the Architecture Masters Track at the TU Delft, this project shall reflect my skills as an architectual designer and I aim to graduate with the degree: Masters of Science in Architecture, Urbanism & Building Sciences upon successfully delivering this project.

Relevance of Research

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 also remember that within the facades of 1960s buildings there 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. The ways in which buildings were constructed in the 1960s should not persist today. Therefore, revisiting traditional ways of making like building with timber, using press-fit connections, and implementing natural materials could help create a circular building model which does not harm users, pollute the environment or deplete natural resources (Uddin, 2020).

With the need to strengthen existing research on biophilic design strategies in architecture, this project could contribute to the future advancement of this topic and area of interest.

Literature

Brilhante, O., & Skinner, J. (2014). European Experiences of Building Codes for Promoting Sustainable Housing. Institute for Housing and Urban Development Studies (IHS) Rotterdam, The Netherlands.

Kellert, S.R. (2018). Nature by design: The practice of biophilic design. New Haven, CT: Yale University Press.

Manifesto. (n.d.). Shearing Layers of Change by Stewart Brand. https://www.openbuilding.co/manifesto

Pijpers, A. (2021, May 28) Considerations for the decision to redevelop the Hugo R. Kruyt building. Universiteit Utrecht.

Uddin, D. M. (2020, January 25). The Sustainable Development Goals (SDGs) and construction industries. https://www.thedailystar.net/star-infrastructure/news/the-sustainable-development-goals-sdgs-and-construction-industries-1859131

Admin, & Admin. (2018, February 21). Spirit of Place/Genius Loci. https://www.placeness.com/spirit-of-placegenius-loci/

Cypher, M. L., & Elamine, O. (2021, July 22). 'Green buildings' conveniently ignore the emissions from their construction. https://www.fastcompany.com/90657506/green-buildings-conveniently-ignore-the-emissions-from-their-construction

Kellert, S. and Calabrese, E. (2015). The Practice of Biophilic Design. www.biophilic-design.com