BONDLESS INNOVATION

Evualiting Direct Adhesion in a Concrete-Glass Interface for Free-Form Transparency.

Reflection P4
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by

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GRADUATION PROCESS

How does your research complement or extend the objective of the graduation studio?

My thesis represents an interdisciplinary approach that bridges the gap between the Structural Design & Mechanics Chair and the Building Product Innovation Chair, thus complementing and extending the goals of both academic domains. By exploring the creation of a hybrid facade panel integrating concrete and glass, my research addresses fundamental challenges in both structural design and building product innovation.

In collaboration with the Structural Design & Mechanics Chair, my experimental research contributes valuable insights into the structural validation of various design considerations for the hybrid interface. A deeper understanding of how to optimize the structural integrity of the hybrid panel, leveraging the strengths of both concrete and glass materials.

Simultaneously, my research aligns with the objectives of the Building Product Innovation Chair by emphasizing research by design methodologies. By applying structural insights to facade design, my thesis evaluates the practical applicability of the hybrid interface in architectural contexts. This approach gives valuable insights in understanding of building product development, considering not only structural performance but also aesthetic and functional considerations.

Moreover, my thesis reflects the essence of the building technology track within the MSc AUBS program by embracing an interdisciplinary mindset. This interdisciplinary approach enriches a sustainable mindset to innovative solutions that transcend traditional disciplinary boundaries.

How is the experimental research re;ated to the design?

The experimental research forms the foundation of the design parameters for a hybrid interface. Extracting insights and conclusions from the structural validation experiments provides valuable guidance on which interface design parameters to enhance for optimal performance in a hybrid facade panel.

Additionally, this research contributes to TU Delft's design exploration concerning hybrid concrete-glass panels, a domain previously unexplored from a structural perspective. The experiments showcase the practical feasibility of such interfaces.

This thesis also contributes significantly to the development of a new design language for free-form transparency. By establishing design boundaries based on experimental feasibility, the structural validation enhances the design process and vice versa.

How did the research methodology perform, and did it yield the intended outcomes?

The innovative interface design involving direct adhesion between concrete and glass represented a completely novel approach. The scarcity of sources and prior research created a significant research gap, resulting in a multifaceted investigation. This resulted in a challenging literature review to establish a solid foundation of literature upon which to rely.

Additionally, the world of concrete casting proved to be more complex than anticipated, and it goes without saying that this was not a straightforward process. Moreover, the drying time of concrete emerged as a crucial factor, limiting the achievement of the intended results.

Although the tests yielded modest results in the end, they demonstrated the potential of a hybrid form through innovative interface design. While the results are still premature to offer structural validation for real facade implementation, they serve as a foundation for further exploration and development.

SOCIETAL & SUSTAINABLE IMPACT

Why an integration of conrete and glass on both societal level and material level?

On a societal level, this thesis aims towards a novel architectural design language. Free-form transparency remains a rarity in architecture, where window systems in office buildings showing a monotony to the external environment. Through this research, I aim to challenge architects to explore opportunities for transparency devoid of frames, connective tissue, or adhesives, thereby breaking free from monotony and embracing design freedom in a sustainable way.

At the material level, concrete and glass are characterized by weak interface adhesion. With this research my intention was to demonstrate that by cleverly leveraging material properties and design principles, it is possible to achieve outcomes that may initially appear unattainable. Attempting to render the impossible, or the improbable, more feasible.

Overall, this exploration seeks to address the integration of concrete and glass from both societal and material perspectives, urging architects to rethink design conventions while showcasing the potential of innovative material application.

What is the impact in terms of sustainibility?

While concrete and glass may not initially appear as sustainable materials, the development of a hybrid panel combining both presents a promising avenue towards sustainability. The direct bonding method employed eliminates the need for adhesives, thereby facilitating the disassembly and 100% recycling of both materials at the end of their service life.

Moreover, the raw materials for the panel can be sourced from recycled concrete and cullet glass waste, contributing to an environmentally friendly production process.

Concrete, typically associated with significant emissions from cement production and reinforcement, offers sustainable solutions in this design. The absence of reinforcement and the use of cement partially composed of by-products from steel production showcase viable sustainable alternatives for concrete.

In the case of cast glass, emissions primarily stem from the extended furnace time required for annealing. However, by implementing design guidelines that restrict the maximum dimensions and weight of the glass, emissions during production can be minimized. Kiln-casting further enhances sustainability by utilizing recycled cullet glass waste, minimizing waste generation, and ensuring recyclability at the end of its lifespan.

To what extent are the results applicable in practice?

The experimental approach for a concrete-glass panel, inspired by MVRDV's Kintsugi facade design, already demonstrates the potential and pursuit of such hybrid interfaces (MVRDV, z.d.).

However, the designed panel itself does not significantly contribute to the feasibility of a hybrid collaboration between concrete and glass. Instead, the design interface contributes to a conceptual framework of material combination without the reliance on adhesives or intermediates. For a real-life implementation of a cocnrete-glas hybrid system shows the capacity of shear stress and partly of beniding stress but further research is required to fully structurally understand the behaviour of such interface designs.

The final design neglects considerations for thermal comfort and the thermal properties of the panel. Addressing these aspects is crucial for practical applicability. Nonetheless, this thesis extends beyond facade design; the hybrid interface holds potential for diverse applications. It can provide valuable insights for artists, designers, or implementations requiring visual separation.