Waterloo Architecture Masters Thesis Reviews

April 3, 2020

Elly Cho
Smart Aging: How Smart Materials in Architecture Can Respond to Changing User Needs
Supervisor: David Correa, Committee Member: Maya Przybylski
Internal Critic: Heinz Koller
External Critics: Nicholas Hoban, Sam Dufaux

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Sam Dufaux (Daniels Faculty, University of Toronto)
Sandrina Kramar (GSP Group, Waterloo Architecture)
Nicholas Hoban (Daniels Faculty, University of Toronto)
Marco Polo (Architecture, Ryerson University)

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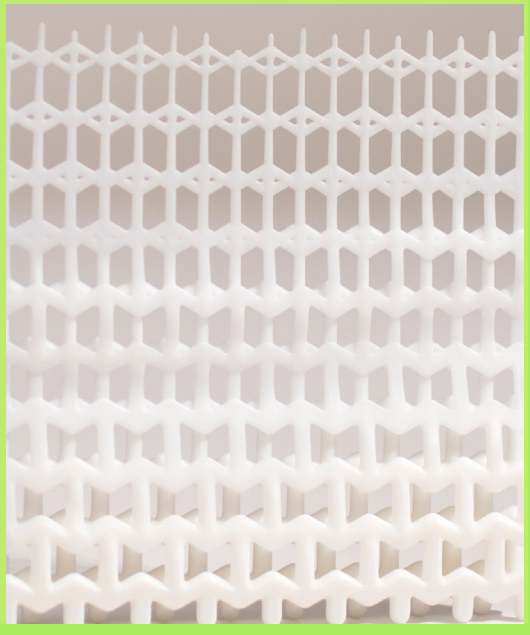
As smart materials and digital fabrication technologies advance in architecture, we can increasingly equip environments with the ability to respond and interact with their users. One area of interest is the development of habitats that respond and adapt to the needs of seniors to create safer environments to age-in-place. With the baby boomer generation reaching retirement age, the problems seniors face in the built environment place a growing pressure on us to reconsider where they live. Few designers, however, apply contemporary technological advancements in architecture to innovate the practical and social environments of seniors. This thesis explores how smart materials can prolong aging-in-place by addressing common environmental problems seniors face in their homes.

Rather than considering aging as a barrier of design, this research places seniors as drivers of design inspiration and innovation for creating environments that interact and care for their users. This thesis is broken into three parts, each addressing a stage in the design process. The first investigates the relationship of seniors to the built environment through qualitative research and identifies three moments of vulnerability: falling, slipping, and thermoregulation. The second identifies smart materials that would best respond to mitigating those vulnerabilities through a critical survey of multiple material properties for each moment. It also introduces preliminary design concepts for each intervention using those materials. The final part consists of an iterative cycle between prototyping and designing, resulting in a proof of concept design and prototype for each intervention: lightweight and form fitting protective apparel; a water responsive floor system that enhances grip and indicates wetness; and a heat and humidity responsive screen system that allows environments to thermally self regulate. Each case study grows out of a continuous negotiation between digital fabrication, material behaviour, and user needs, reciprocally enriching each other throughout the process.



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Robotic Stacking: Structurally Informed Free-form Timber Structure System Using Standard and Non-standard Components

Supervisor: David Correa, Committee Member: Maya Przybylski
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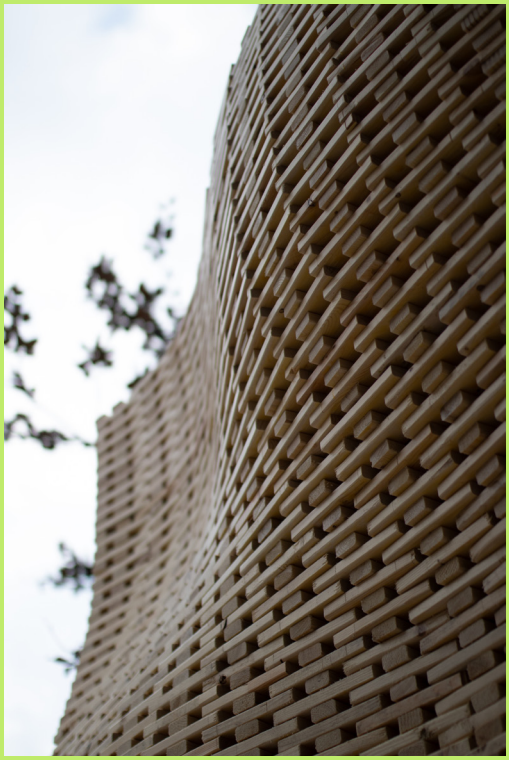
The presented work is part of an ongoing graduate thesis that investigates differentiation and variability in the design of a structurally-informed wall system with both standard and non-standard elements using a robotically controlled assembly processes. Exploring the wall as a fundamental space-creating building element, this project aims to construct a stand-alone structure with a unique complex geometry through a combination of standard and non-standard elements. While there is extensive work on the placement of standard construction components (without individual customization, e.g. bricks), or the development of innovative and highly complex free-form multi-component assemblies (where each unit is customized, e.g. segmented shells), limited work has been conducted in investigating systems that bridge the gap between the two. This consideration to optimize the structural, formal and aesthetic potential of hybrid systems that strategically combine the use of both standard and non-standard units is aimed at establishing a closer link between robotic design research and contemporary building practice. The success in using the robot ability to individually control a large number of elements in several of the examples work (e.g. Gantenbein Vineyard Façade, Structural Oscillations, among other similar projects developed by Gramazio and Kohler's research group at ETH) is contemplated in order to create the complex geometries and differentiation while benefiting the concept of automation, repeatability, and precision.



While the presented system has the potential to be implemented in a wider range of materials; the timber slat, a small profile of dimensional lumber, was selected as the medium of investigation due to its light-weight, workability, good strength-to-weight ratio and formal simplicity. The timber slat, as a base unit, permits a vast of degree of freedom in assemblies, while it also allows for the easy manipulation of its geometry during the fabrication process. The layered system of additive stacked structure of the sequential wall project is investigated as the primary organizational logic to control the consistency and mechanical behavior of the overall structure through the capacities and limitations of the overlapping and connection of elements. Considering both the structural load bearing capacity and the optimized use of standard and non-standard units, a "T" configuration system was developed. This system provides the wall out-of- plane bending stiffness and in-plane shear Capacity. Unlike the Structural Oscillations project, control over the stability of the wall during the build-up process is considered as part of the design system. The project demonstrates that a careful consideration of material use, structural logic and assembly process can result in emerging architectural possibilities, a new form of "digital craft" that is equally expressive as it is sensitive to the requirements of contemporary building practice.

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The Fabrication Commons: Creative Agency Through Intuitive Interfaces

Supervisor: Jonathan Enns, Committee Member: David Correa
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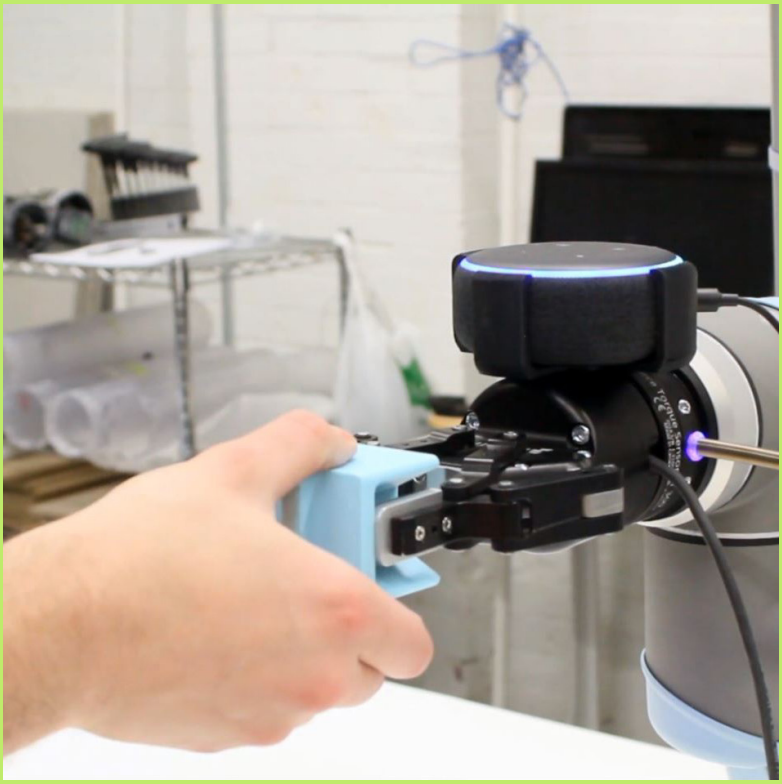
With digital fabrication tools and networking technology becoming increasingly attainable and versatile, there is an opportunity for more people to become makers instead of just being passive consumers. How can we take advantage of this to foster larger local and global communities of makers? Most digital fabrication research focuses on a singular novel process or application of a tool, and not the actual relationship between the users and the entire fabrication process. To engage a broader audience with digital fabrication, I propose a user-centric ecosystem that attempts to seamlessly link all of the individual elements of the workflow. My research involves designing a series of prototypes that lowers the barriers for inexperienced users, and allows them to create something unique. With more engaging, accessible methods of fabrication, people can benefit from the advantages of creating something themselves, and form communities that are more empowered and meaningfully connected.



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The Newfoundland Root Cellar: Adapting Passive Strategies for the New Corner Store

Supervisor: Jane Hutton, Committee Member: John McMinn
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Since the re-settlement program and the moratorium in Newfoundland urbanization has become a large issue amongst many Newfoundland towns. Newfoundland's island condition has exacerbated the issue causing a shortage of fresh produce leading to significant health issues and a loss of connection to rural roots. The people who move to larger cities in Newfoundland are not only leaving their family homes, gardens, and root cellars, they are leaving their communities. Through this urban migration there is fear growing that this next generation of Newfoundland will lose the collective memory of these deeply culturally rich practices. These practices that allowed them food security, community and sustainability. In today's era of climate crisis the ability to store fresh food over long periods of time through passive energy is something that cannot be left in the past. This thesis aims to revive this collective community knowledge by reinterpreting these rural practices into a commonly beloved semi-urban building shared amongst the community.

The all familiar corner store is a fixture in both small Newfoundland towns as well as the city of Saint John's, making it the perfect site for a root cellar intervention. Through design the root cellar and all its accompaniments are translated into an existing corner store located in the heart of the city of St. John's. The aim of the design is to maintain this valued knowledge while still incorporating its new urban context.