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THE [NOT SO] PRIMITIVE HUT: LESSONS LEARNED FROM VIRTUAL ARCHITECTURAL RECONSTRUCTIONS

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Synopsis:

Toronto Metropolitan University Architectural pedagogy prioritizes digital technologies as tools for designing, visualizing, and producing future construction. These same tools have the potential to also allow students to revisit and learn from the past through virtual reconstruction and collaborations with other authorities including archaeologists and historians. Though this historic reconstruction is gaining traction, it is important to note that the production and navigation of these works are invaluable territories for research and reassessing long-held beliefs in architectural pedagogy. As Canadian architecture schools scramble to Indigenize their curricula, this has been a challenge for numerous reasons, most notably an inability for faculty to find an accessible, sincere, and comfortable entry point for discussion. As part of an ongoing open educational resource collaboration among architecture, archaeology, and video game design faculty, a series of high-fidelity virtual reconstructions of the largest pre-contact Indigenous settlement in North America were generated as teaching content for multiple stakeholders. Within the context of architecture, the virtual construction provided an opportunity to go beyond the potential tokenization of Indigenous content in the classroom. Instead, it served as an excellent basis to reinforce the similarities in the various systems at play in both indigenous construction and contemporary practice. This presentation highlights the notable similarities used to introduce core concepts to beginning design students that articulate the technical sophistication found in Indigenous architectural design methods and materials centuries ago still at play in current praxis.

1 INTRODUCTION

Throughout the past decade, Canadian post-secondary institutions have faced immense pressure to Indigenize their curricula. This pressure has been present across numerous disciplines, with a great opportunity in architectural education for comparing Indigenous construction methods to contemporary praxis. Implementing historical-indigenous research in general curricula offers opportunities to understand the Indigenous peoples and their practices as well as to draw from their concepts to employ them in modern practice. The use of indigenous knowledge in tension with a science-based curriculum is important to the greater insight into the philosophical nature of science rather than the general understanding of science from a Westernized perspective (Mckinley and Stewart 2011). Integrating indigenous curricula in architectural pedagogy should be considered in both historical and theoretical courses as another perspective of the built environment that draws from the religious relationship of Indigenous people and their environment.

Nevertheless, implementing indigenous education has been challenging due to a lack of Indigenous instructors across Canada and the difficulty of determining appropriate dissemination methods. With the imperative use of digital technologies as a visualization tool in architectural pedagogy, students are now able to explore previous methodologies and learn about the various aspects of historic architectural design. In response to the challenge of Indigenizing architectural pedagogy, a project initiative led by Toronto Metropolitan University's Department of Architectural Science and Sheridan College was undertaken to allow students to engage with Indigenous content in more interactive ways. A multidisciplinary team was formed, including architecture, archaeology, and video game design faculty, to generate content highlighting aspects of Canadian First Nations settlements. To strengthen educational experiences, Virtual Reality (VR) was used alongside various other digital tools in all of the involved disciplines with the goal of immersing students in virtualized contexts specialized to a desired narrative of instruction. Notable commonalities of Indigenous construction methods and current architectural design techniques were hypothesized and investigated using the virtual architectural reconstructions of Indigenous settlements, exposing the sophistication of the centuries-old construction assembly practices. Through the application of digital tools such as VR and AR in architectural education, parallels between indigenous and contemporary building practices are emphasized and used to understand architecture in both the past and present.

2 PROJECT OUTPUTS

2.1 Longhouse 1.0 – 5.0 an archeological recreation of the Indigenous past within Canada

2.1.1 Process.

In 2012, the Longhouse project began with the goal of producing educational content to inform users about Indigenous architecture and related elements of Indigenous settlements. With the benefit of various digital technologies, including 3D modeling, VR, and photogrammetry-based reconstruction, the project depicts aspects of Indigenous building practices which can be used in

architectural pedagogy to explore the similarities between building science and construction seen from Indigenous longhouses to contemporary building practices. The historical context of the Longhouse project is based on archaeological reporting, documentation, and studies regarding the excavation of the Mantle Site located within Whitchurch-Stouffville, Ontario. Archaeological remnants were uncovered, originating from an ancestral Indigenous village of the Huron-Wendat Nation. The findings, which date back earlier than the 17th century, were examined under Mr. Martin Cooper and Dr. Ronald Williamson, along with the field direction of Mr. Andrew Clish. Representatives of the Huron-Wendat Nation, Heather Bastien and Luc Laine, also supported the analysis of the site (Birch et al. 2022). The Longhouse project was funded by the open educational resources funding, e-Campus Ontario, empowered with the Truth and Reconciliation Mandate that urged Canadian universities to implement indigenous education into their curricula.

It was difficult to accurately depict Indigenous settlements as most of the historical documentation regarding cultural aspects, as well as details with respect to the formation of their villages, was documented by Western accounts, including journals and illustrated sketches. In order to enhance the representation of Indigenous Nations, digital technologies were used to elevate the narrative and historical significance of the information being discovered (Dye et al. 2012).

Throughout the development of the Longhouse project, five evolutionary phases of detailed virtual modeling took place. The first iteration consisted of experimental and interactive experiences that aimed to recreate and place an Indigenous settlement in a virtual environment. Initially, virtual longhouses were created for entertainment purposes and were later recognized for their rich educational values. Digitizing the longhouses was made possible by utilizing video game engines such as Unreal Engine and Unity, which led to the production of one of the first Indigenous settlement VR experiences in Canada, however, it was not yet archaeologically accurate. With the goal of improving the accuracy of the Longhouse project, team member Dr. Michael Carter explored the visualization in Southern Ontario Archaeology, using depictions in the archaeological record of the Mantle Site report. Photo-realistic visualizations of the Indigenous sites were created using parametric models made in Houdini, a three-dimensional procedural design and animation computer program (fig. 1).

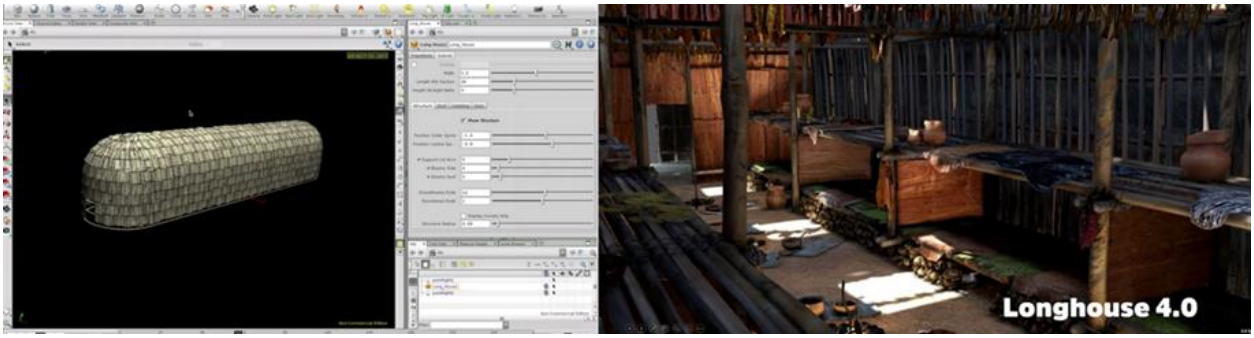

Fig. 1: Screen capture of longhouse model creation using Houdini Software.

The virtual construction of the longhouses was taken to a new level of detail in the third version of the project, Longhouse 3.0. Within the 3D modeling software, accurate textures, props, and construction materials were added to the settlement by referring to the activities and possessions

of the Indigenous inhabitants. In the fourth iteration of the Longhouse project, users were able to navigate the 3D model of the longhouses with the use of a video game controller, receiving an engaging and immersive experience (fig. 2). The atmosphere of the Indigenous longhouse was something that participants could feel by exploring the digital space. Materiality, construction technique, scale, decor, and lighting were detailed aspects of the project, allowing users to gain an understanding of what it may have felt like to be inside an authentic longhouse.

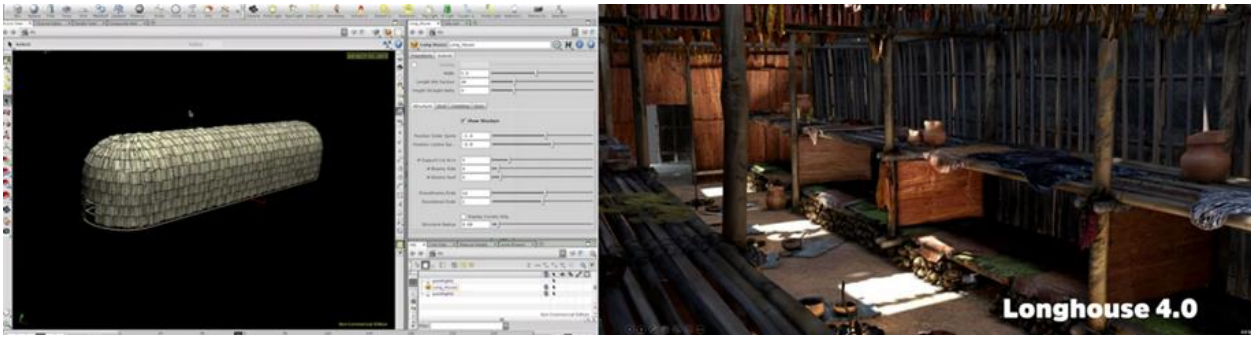

Fig. 2: Showcase of a longhouse interior within the Longhouse 4.0 build.

2.1.2 Results and Execution.

Currently, the Longhouse project is in its fifth version, with the culmination of detail from the previous versions resulting in a high-fidelity depiction of the Mantle site from the late 16th century. The project aims to reconstruct the Indigenous settlement in scale, function, and atmosphere and uses virtual visualization technologies to expand Indigenous content in architectural pedagogy. The day-to-day lives of the Indigenous inhabitants of the Huron-Wendat Nation village in Whitchurch-Stouffville, Ontario, were recreated with the implementation of the site and activities and the use of Unreal Engine. Details were modeled to accurately represent the settlement, including the surrounding agricultural fields and the crops needed to feed the village. According to the archaeological report, tools and resources that the inhabitants used were placed in the interior spaces of the digital longhouses highlighting the organization of relevant artifacts. The layout of the longhouses in the explored settlement is depicted per the Mantle Site report, which consists of the non-planned layout resulting from the impermanent settlement. It was common for the Indigenous peoples to relocate their community every decade when resources within the vicinity were depleted, and villages moved to rich resource environments as nature replenished the previously inhabited land (Birch et al. 2022)(fig. 3).

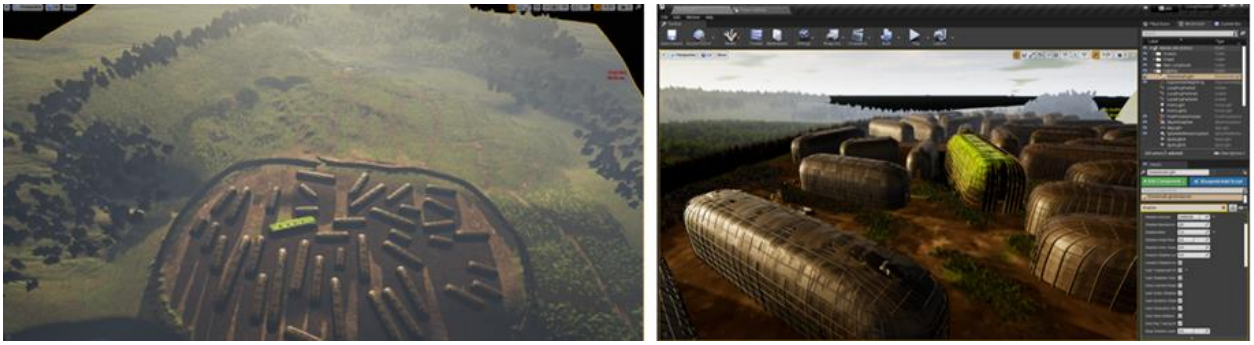
Fig. 3: Layout of Huron-Wendat Village according to the archaeological record.

The construction details and assemblage of the longhouses were topics that prompted many questions and conversations between architectural and archaeological representatives due to the lack of information. However, one aspect of building science that the archaeological record emphasized was the expansion and contraction of the structural elements that reinforced the longhouses. This led to suggestions regarding construction methods used and motivated discussions that uncovered procedural discrepancies in understanding the longhouses' structural systems. Based on current construction practices, ideas and assumptions were gathered to interpret elements of the construction of the longhouses. With the visualization of the longhouses' construction methods and finer structural details, the virtual reconstruction of the settlement has led to opportunities in architectural education involving architects and archaeologists using immersive digital tools as a medium for discussion.

Within the final iteration of the Longhouse project, activities that the Indigenous peoples of the Huron-Wendat village would have taken part in are showcased. This includes examples such as the drying racks used for food storage inside the longhouses and what the disassembled structure of a longhouse would look like during a relocation of the settlement. Moreover, displayed on the outskirts of the settlement are multiple views depicting the construction sequence of a typical longhouse articulating the construction process and structural assemblies for students' understanding (fig. 4). The 3D digital model accurately depicts details such as the layering of bark that formed an envelope system for the building, and the lashing that used to bind structural members together.

Fig. 4: Layout of sequential phases of longhouse construction from primary structure to finishing envelope (Left). Details within the model showcase the lashing utilized to hold wooden members together (Right).

Within the virtual simulation, users are guided through the settlement along a 'touchstone path' that displays descriptions of general elements or activities when one of the various interactable stones is activated. An example of this includes a touchstone that is placed in the center of the village (fig. 5). This touchstone explains the history and layout of the settlement that is represented based on the Huron-Wendat Societies shown in figure 6.

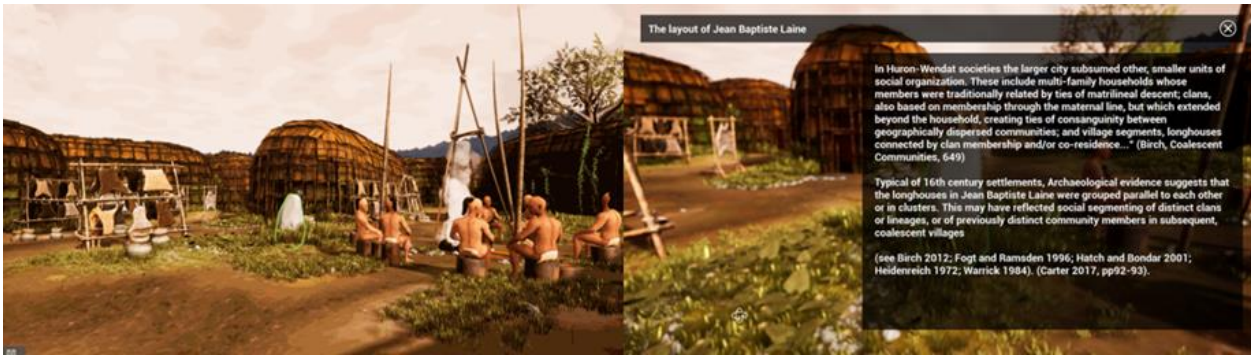

Fig. 5: Perspective view within simulation with touchstone path rock.

Fig. 6: When the touchstone is activated, a description of the settlement is shown in reference to the Mantle site report.

Alongside the digital video game of the Huron-Wendat Nation settlement, a slide deck was produced highlighting the commonalities between the Indigenous longhouse construction and modern-day architectural praxis. The main topics equally as relevant as they were roughly 400 years ago include heat, air, moisture, structure, and program/circulation. The slide deck includes information outlining macro and micro aspects of the building science and architectural characteristics. To aid in explaining the topics, drawings, diagrams, and animations were created using architectural conventions allowing architecture students to better recognize and understand the content (fig. 7).

Fig. 7: Textured section drawing of a longhouse to showcase the circulation and organization of space (Left). Isometric views of the longhouse fragment highlighting details such as the lashings (Right)

Producing content with a high level of detail and precision enhances students' interactive experiences, communicating the challenges associated with assembling a unique and purposeful structure like an Indigenous longhouse. The architectural illustrations of typical longhouses present clear interpretations of the construction process and the level of detail required for the residences. The lashing used to secure the structure of the longhouses is an example of a fine detail that could often be overlooked or simplified. However, it is a detail imperative to the stability and assembly of a longhouse and can be understood and appreciated in the model and illustrations. The comprehensive representation of the Indigenous longhouses provides a contemporary educational experience for architecture and archaeology students to learn about the construction and atmosphere of a 16th-century Indigenous settlement and how it resembles current-day construction.

3 RELEVANCY

3.1 Preservation

Through the production of a detailed architectural model and simulation of the site's environmental conditions, the interactive experience of the longhouse is an effective tool for analyzing Indigenous architecture. Moreover, it offers several advantages in its use as a videogame aid in preserving heritage while introducing it to a larger engaged audience (Guzek et al. 2016). The platform allows for greater accessible learning, where students can virtually interact with the structures and site, which would otherwise be difficult to see due to physical distance and travel constraints. The digital model allows instant access to a simulated environment where students can leverage digital conditions such as lighting simulations. With Indigenous structures deteriorating over time and vanishing from the landscape, 3-D digital models provide a lasting understanding of scale, atmosphere, and material choices as a preserved image of Indigenous heritage. While 2-D drawings such as floor plans and photographs assist in educating students about historic buildings, immersive 3-D content engages students and provides an overall better understanding of the structure. Through transforming Indigenous oral traditions of stories to pass on information about their heritage, immersive digital content allows architecture and history to be preserved and further examined by students and instructors (Carter 2017).

3.2 Contemporary Praxis

The utilization of digital simulation in architectural education is examined as a comparison of indigenous longhouses and architectural projects built within the last few decades for their macro and micro details. Moreover, the analysis made by students in using the simulations emphasizes the historical impact of the longhouse construction techniques and their relevance in contemporary construction, such as assembly details and hierarchical programming of spaces. The following table outlines the details within the digital simulation.

Table 1:Macro and micro details examined within the simulation

	Macro Detail	Micro Detail
Heat	A centralized hearth to heat the building evenly	Reusing heat to assist in drying goods on the ceiling
Air	The ventilation of air to create a stack effect for the passive exchange of air and the use of a vestibule as a buffer	
Moisture	Convex profile that sheds water	Overlapping bark on the exterior to ensure proper drainage away from interior and downwards
Structure	The internalized vertical structure that supports majority of components and the exterior condition that supports only itself	The flexible joints of lashing that allow for stresses and deformations
Programming/Circulation	Having the storage and utility programming at the entry and residential areas at higher ground	Acknowledging cool zones (vestibules)

The comparison between the historical and contemporary draws distinct parallels with respect to discrete building elements. Elements addressed include longhouses utilizing heat, air being ventilated using vestibules and roof openings, moisture control using bark layered walls, a

structural system that supports interior and envelope components, and functional planning of circulation and program for efficient storage within the building. Each historic component can be translated and found in current architectural practices despite technological advances and complexities of modern construction. As students analyze indigenous practices, the understanding of primitive structures builds a framework for future studies of more complex architectural structures and buildings.

Table 2: Indigenous vs. Contemporary Structures

	Indigenous Context	Contemporary Precedent
Heat	Fire pits used as a heat source and for cooking are located along the central axis of the longhouse	Sluice Point by Omar Ghandi: an open and programmable space with a rotating fireplace that allows the center of activity to shift [4]
Air	The curved structure of the bark creates an envelope that allows for resistance against outdoor air infiltration	The Centre for Cellular and Biomolecular Research by Benisch and Architects Alliance utilizes natural ventilation through a double-skin façade system that circulates air [5]
Moisture	The convex profile of the longhouse allows for water to shed and prevents water infiltration	The Snowboarders Cabin by Scott and Scott consists of an A-frame structure to allow snow and water to shed, preventing damage to the envelope system [6]
Structure	The longhouse has an internal structure that supports structural components and an external structure that supports the envelope	Conventional buildings today utilize the same technique, such as the TD Centre by Mies van der Rohe, which consists of an internal structure to support the load of the floors, and an external structure to support a curtain wall system [7]
Programming/Circulation	A vestibule is located at the entrance that leads to the main living spaces located further into the longhouse	Conventional homes have a mud room / vestibule at the entrance, while the kitchen and bedroom spaces are located further within

3.3 Educational Resource

3.3.1 Engagement.

During the COVID-19 pandemic, digital immersive educational experiences presented a unique and successful opportunity that differed from conventional pedagogy prior to the pandemic. With virtual reality and video game content for learning, students could physically engage with the new and innovative content presented. Due to the separation and isolation required during the pandemic, these virtual simulations were beneficial in presenting students with comprehensive content while being separated physically. Learning in an in-game setting with carefully considered and implemented details contributes to an engaging atmosphere from which students can learn (Guzek et al. 2016). This learning method resulted in a higher level of engagement with the presented material as opposed to conventional memorization and regurgitation of facts. Using the aforementioned digital technologies can assist in the indigenizing of university curricula and aids in igniting curiosity by utilizing unfamiliar software and pedagogical methods.

3.3.2 Construction and Assembly.

The Indigenous longhouses were constructed with meticulous attention to detail in their fabrication and assembly. The visualization needed to be able to show a high level of detail when conveying the longhouses. More refined details were captured and displayed by employing virtual reality and video game design. This brought the composition together holistically while discerning the importance of the small construction details. This type of representation is a standard method of exploring various phases of construction due to its ease of manipulation and real-time visualization functions (Whyte et al. 43-55). Virtual technologies provide the opportunity of interacting with a digitally modeled spatial creation which assists users in identifying challenges in the design and assembly of a structure. While immersed in a scene using a virtual reality headset and video game software, users can experience details at a one-to-one scale and determine construction methods along with any potential conflicts that might arise. VR can be used for proactive construction deficiency management that gives users the ability of a more effective, safe, and high-quality level of detail in a project (Ahmed 1839-1852). In the Indigenous settlement virtual reconstruction initiative, the visualization techniques, as mentioned earlier, were used alongside the highly detailed digital model that included details such as the lashing of the structural joints, which easily could have been overlooked and oversimplified. It is a crucial detail in the structural assembly of a longhouse, and with the proper visualization and level of detail, this aspect of the project can be experienced comprehensively (fig. 8)

Fig. 8: Detail showing the lashing of the structure in the Rhinoceros 3D model

With the use of virtual reality and video game design, a greater understanding of construction and assembly methods can be achieved while stimulating one's imagination with a visual design process. The ability to sample a designed model in a first-person view, before or after it is built, allows designers to understand context and space in future or existing projects without being on-site. This can aid in improving project outcomes and address the gaps between design and construction and provide an effective and efficient way in examining precedents (Ashok 2020).

3.3.3 Online Resource.

As information has become more accessible online without many institutional barriers, the potential to collaborate has been spurred by the pandemic. To enhance educational experiences for students and strengthen their personal research, educators can draw from the various content of the Longhouse project that is published to an online educational resource (OER). The OER is a repository of rich content for different disciplines beyond architecture and archaeology curricula to investigate and integrate. From an extensive 3D model database and parametric controls for construction through to Indigenous-led content and insights, the OER content is more than merely architectural simulation. While it is anticipated to have an audience of hundreds in architecture over the next year, the diversity of academic touchpoints from this content is quite robust. This content, while created through architecture, is equally an outlet for other disciplines to potentially investigate inroads for indigenizing their respective curricula as well. The initiative provides students with the ability to engage themselves with historic construction methods and materials that can prove useful for future architectural careers. Furthermore, educators and students in all fields of study may repurpose, further investigate, and/or contribute to the given research to create a database for all to consume and benefit from.

4 Conclusion

Virtual reality and video game development have continuously proven to be an essential recourse for both educators and students alike. Educators are given the opportunity to create innovative, appealing, and immersive content for students. This is particularly useful given the sharp rise of online teaching and learning throughout the COVID-19 pandemic. Three-dimensional digital design has now become a necessary aid in understanding historic constructions like Longhouse 5.0, particularly given the often-neglected detail inherently missed by traditional two-dimensional drawings such as floor plans and photos. The interactive medium enhances visual experiences and immersion through the encouragement of a student's desire to understand construction details and assemblies at a larger scale. This understanding is gained through interactivity within three dimensions as opposed to the traditional two-dimensional drawings which do not showcase important spatial characteristics such as atmosphere. Additionally, collaboration is encouraged through the digital nature of the VR and AR platform, which is demonstrated successfully through the various practices involved in this project. This is partly because experiencing and analyzing the project using digital tools doesn't require an architectural education. This process has ultimately afforded a larger capacity for experiential learning amongst students and educators. Parallels can then effectively be drawn and mutually understood between indigenous architecture and contemporary structures today.

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