Auranga Abodo Seating Pavilion

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Abstract
Sustainability within the built environment has become a significant issue with the design and fabrication of architecture. Construction waste is just one of many issues that need to be resolved. To tackle this problem, Unitec’s School of Architecture’s fabrication classes have integrated an approach to work with industry partners such as Abodo Wood and Made Group to design and deliver architectural products made out of construction waste. The results of the programme have led to students designing and producing a pavilion for the Auranga community in South Auckland. To ensure the most appropriate architectural outcome was produced, students worked with community representatives to design a functional structure that met the requirements of their selected site.

Keywords: Building and sustainability, community design, construction waste, street furniture.

Introduction
Over the last few years, Unitec’s School of Architecture has worked with material suppliers within the architectural industry to create sustainable projects for private clients and communities. This enables students to learn how to embed theoretical practices within real-world projects. This paper has three main research outcomes:

1. To understand how circular-economy principles can be embedded into a design–build elective.
2. To learn the aspects of social resilience and construction practices with respect to reusing construction waste means embracing life-cycle thinking and helps to achieve circularity goals.
3. To design street furniture that is well integrated into a public space and to create a sense of place and identity.

To achieve the research outcomes, the paper will primarily review how students can work with recycling timber from offcuts to then create well-designed architectural outcomes for Auranga’s village town square.

Circular Economy
Scholars and practitioners define circular economies as reducing, reusing, and recycling. There are entrepreneurs across the globe that are looking to redirect waste by adding value to it through upcycling and creating new products. In Aotearoa New Zealand, Critical Design founders Rui Peng and Andy Crowe have developed valuable and usable products from soft-plastic waste, such as plastic bags, shampoo bottles, milk bottles and ice-cream containers. Their products enable designers and makers to create beautiful furniture and interior architectural spaces.¹ Victoria University of Wellington Architectural PhD candidate Ged Finch’s XFrame construction system is designed to introduce circularity into the architectural and construction sector. Finch’s approach to circularity within architecture is to design a construction system that can be disassembled and reassembled countless times. The product currently offers a modular framing and commercial fit-out system of thirteen standard CNC plywood parts.²

Background
The Auranga Abodo Seating Pavilion stems from past projects conducted within the school. In 2017, students within a special elective class collaborated with Prefab NZ and Carter Holt Harvey to create the ‘interactive pod’ for the Build NZ | Designex expo, Festival of Architecture and NZ Life and Leisure magazine’s “In Your Backyard”

The purpose of the project was to demonstrate how students can work with digital fabrication technology to create a CNC plywood ‘kit of parts’ to be assembled at a variety of architecture and construction expositions. The project explored themes of mass customisation and modular prefabrication principles to allow the design to be adapted, transformed, and customised to suit different functions and spaces.

In 2018, a special elective summer-school course in collaboration with Prefab NZ and Carter Holt Harvey (CHH) led to the creation of the BRANZ Modular Road Show exhibit (Figure 2). This project used a form of interior plywood from the CHH range and the modular Prefab NZ principles. The project brief required students to create an interactive experience that visitors could touch, with areas for staff to display product literature and store personal items, that could also act as plinths or tables to engage with customers.

Much like the 2017 project, the learning outcomes of this project were to explore themes of CNC production and modular prefabrication design principles.

While these projects successfully worked with plywood, the designs did not push the boundaries as to what was possible and allowed a lot of leftover material to be sent to landfill. To avoid additional material being sent to landfill, the use of circular-economy principles became a major teaching opportunity to be embedded within fabrication courses. The added benefit of working with upcycling and processing waste material is that it allows students to engage with tacit skills they would not otherwise be introduced to when working with plywood. Subsequent projects, therefore, worked towards a more sustainable approach to material use.

6 Besen, Patel, Couchman, and McPherson, “Architecture as a Tool for Inclusion and Community Building,” 175.
Through the preassembly exercise, it was discovered how difficult it was to put the panels together. A lot of time and attention were required for a successful outcome. The final product showcased a brand-new application of LVL timber with an aesthetic appeal that can be applied to other visual applications. From the learning outcomes of this project, the EDFAB 4.0 research team worked with offcut material to create the kitchen for their research house (Figure 4).⁷

In 2021, students in the undergraduate Digital Fabrication course collaborated with Made Group to design and develop a pop-up structure that embedded ideals of circular economies to produce a piece of street furniture for Auranga’s village town centre. The brief for this project asked students to work with offcuts provided by Abodo’s factory. Prototyping led to the production of laminated panels and glulam beams made from Abodo’s Vulcan cladding product. The final design was a ‘bike pod’ structure that enables members of the community to store their bikes and provides a place for rest (Figure 5).⁸

This project became an exercise to investigate what possible added-value developments could be made to recycling efforts with local material suppliers. Although the bike pod was a success, several critical failures plagued the project and led to the following issues:

1. The delamination of the panel material due to the incorrect specification of outdoor glue.
2. The pod was too small and did not offer enough seating.
3. The quality of craftsmanship was low.
4. Better structural systems and fixings were needed.

Outside of courses, the students were required to learn software packages such as Rhinoceros 3D and fabrication workflows; they faced various challenges throughout the project. It was anticipated that students could collect waste material from the Auranga building site. Unfortunately, this exercise could not take place due to Covid-19 restrictions. As a response, the students and their course lecturers approached the industry for support to fill the gap. A positive outcome of this action led to students forming essential stakeholder relationships within the architectural and construction industry. The same industry connections became essential stakeholders for the 2022 project iteration.

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⁸ Yusef Patel, “Unitec Students Create Street Furniture for an Auckland Housing Community During Covid-19,” NZIA Community Kōrero: Conversations with the Auckland Branch, March 2022, 5–6, https://www.researchbank.ac.nz/bitstream/handle/10652/5712/Patel%2c%20Y.%20%282022%29.pdf?sequence=3&isAllowed=y
Project Brief
Students from the 2022 Digital Fabrication class had another chance to collaborate with Made Group to create a new, more permanent, feature piece to replace the multi-functional bike pod. Instead of starting from scratch, the students were given the previous course designs to develop and add their concept ideas. To ensure the students were provided with support, scheduled meets were planned with the project client, Made Group, and the material sponsors, Abodo Wood. The key points that needed to be updated for the 2022 design were:

1. Push the design complexity and increase the size and scale of the pavilion.
2. Add more durable and permanent pavilion structural elements.
3. Resolve issues around the glue and lamination fabrication, material layering.
4. Community involvement to emphasise place and ownership.

Abodo provided the project with unlimited amounts of offcut material from their production line. The only limitations of this was the majority of offcuts were from Abodo’s Vulcan cladding range, and the number of offcuts produced was proportional to the number of product orders they had in a given month. To ensure the project was viable, it was determined we were to only use Vulcan cladding offcuts for the project. The advantage of this design constraint would allow for an efficient production process.

While initially a simple brief that gave a lot of flexibility to the students, it went through four design iterations. Made Group developed the brief alongside the students in regard to the structure, which became a gateway structure that would create a greater connection with the community. This made the whole process difficult, due to the ever-changing brief that kept altering the parameters of what the project was meant to achieve.

Developed Design and Prototyping
The design and development of the 2022 Auranga Abodo Seating Pavilion underwent four distinct phases. The first was a ‘mini’ design competition for all the digital fabrication students to design, develop and produce scaled 1:10 prototypes of their version of the bike pod. The students had the opportunity to discuss and present their work to Made Group and the Auranga community. The winning design (Figure 6) was selected for its angular, dynamic form. Key feedback asked the students to consider the following:

1. Increase the scale and size of the structure. The students need to push themselves to create a gateway-like structure.
2. Remove the need for panels, as it was an issue with the previous iteration concerning wind loading and delamination.
3. Find ways to include patterns and designs representing the site and material sponsor.
4. Increase the amount of seating.

The second design iteration was developing and prototyping the winning design from the feedback provided. It resulted in a concept (Figure 7) that used three times the amount of recycled Abodo product. The development of the design led to the plan of having a series of vertical laminated square-profile lengths to match the angular form and including more seating space. The concept incorporated awa (stream) design motifs that define the Auranga site, the community’s growth, and the story behind upcycling the Abodo material. The seats were designed to face each other, to encourage conversation between strangers. The incorporation of steel joints allowed for better durability. The cross-grain timber beams also allowed for better durability.

![Figure 6. Selected winning design. Image: Esha Patel](image)

![Figure 7. Developed design render. Image: Yusef Patel.](image)
Figure 9 describes the processing and fabrication of the Vulcan glulam beams. In Step 1, the students collected Abodo’s Vulcan cladding boards, which had a tongue-and-groove interlocking system on the sides. These were shaved off to create a square profile using Unitec’s workshop equipment. In Step 2, students cut timber to the appropriate length. The horizontal pieces were cross-cut to roughly 90mm x 90mm, and the vertical-grained lengths were sorted and preserved to make up the 3-metre lengths (Figures 8 and 10). In Step 3, students placed laminated offcuts within jigs. These jigs used a compressive clamping method where two sides were fixed, and the other two were adjustable. The students wrapped the jigs in paper to ensure they were protected from the PVC glue (Figure 11). Clamping with applied pressure on each side of the beam kept the timber in place and straight as the PVC glue expanded like foam (Figure 12). In Step 4, the beam was thicknessed down to ensure inconsistencies of thickness were eliminated. It also ensured the finishing of the beam was straight, smooth and square. In Step 5, the 3-metre lengths were cut down to their final sizes, which varied in length between 600mm and 1200mm. These final lengths were then ready to be pocketed, drilled and detailed for the final construction of the portals.
Figure 11. Applying Loctite glue. Photo: Yusef Patel.

Figure 12. Clamping beams in the jig. Photo: Kyah Suckling.
The prototype of the structure at 1:1 was tested at two industry events: the 2022 BuildNZ Mega event and Whakaora – Our Thriving City Regenerative Design Jam at AUT University (Figure 13). The limitations of budget led to all the steel elements being prototyped with plywood or Perspex. The prototypes highlighted a number of issues that needed to be resolved:

1. Refinement of the metal joining elements, specifically in the areas of tolerance and bracing.
2. The community voice was missing, and we needed to gain their feedback via Auranga’s community forums.

The third iteration of the project engaged the Auranga community by giving them a voice in the design of the pavilion’s privacy panels. After consultation, the panels were decorated with the five values symbols of the Auranga community. The developed design concept (Figure 14) incorporated refined metal jointing and bracing elements. It was important to showcase the values that underpin the Auranga development.
and Made Group’s aspirations for the community. The five values symbols represent:

1. Courage: To trust the unseen reality.
2. Integrity: To stand the test of fire.
3. Humility: To serve people where they are at.
4. Wisdom: To find the ingenious way through.
5. Love: To give our best to others unconditionally.

Made Group requested two changes after looking at the proposal:

1. Material options need to be explored. The goal was to select a metal that looked rustic and matched the neighborhood’s style.
2. Value symbols need to be distributed between the metal panels. Each panel would then represent each value of the community, with written values corresponding to it, as it would be a better way to educate and engage the community.

The students took the feedback and made changes. The use of simple renders enabled the students to explore different steel options for the aesthetics of the project, these being stainless steel (Figure 14), black carbon steel (Figure 15), and Cor-Ten steel (Figure 16). Throughout the process of developing these iterations, we discussed the reality of producing the awa rings design. The students concluded that we would take these rings away from the design, as the expense to fabricate this element was unreasonable with the budget given. Observation and discussion with Made led us to remove one seating side to allow for a practical and usable bike stand. The multiple evaluations of the third and final design iterations has pushed out the final delivery of the pavilion being built in Auranga to early February 2023.

**Evaluation and Future Progress**

Overall, the last two years of the Digital Fabrication course advocated teaching students to think about circular-economy principles rather than just producing design–build outcomes that push the limits of digital fabrication technology. By investigating the excess-material streams and engaging in conversations with local communities, students understood how to create projects that are socially responsive to their surroundings. Students also learned strategies to ensure that their projects did not end up in a landfill in the long term.
Upcycling waste materials promotes circularity and sustainability and frees up resources. This is important, as Aotearoa New Zealand’s building industry is currently facing long delays and increasing material costs due to issues that have stemmed from the Covid-19 pandemic. ⁹ In fact, the project was delayed due to issues procuring the glue specified by Abodo and design issues during the client consultation stages of the project. Not all the recycled timber products for the project came from Abodo, as the students sourced all the seating timber material from Auranga’s housing developments.

Using the offcuts of Abodo wood, students were able to create a series of beams for the pavilion, demonstrating how timber can be recycled and kept out of landfill. This demonstrates how Abodo's wood products can have an extended life cycle by being reused and recycled for other purposes.

Placing the pavilion in the square by the Better Way Café encourages Auranga locals to use the space. The pavilion acts as an extension of the green space, giving locals the opportunity to enjoy the pre-existing public space while encouraging friendly conversations in a subtle way.

By using offcuts of Abodo’s exterior cladding, the amount of construction waste is reduced as students are able to divert it from going to landfill. Instead, offcut materials are repurposed to create beams. This helps to extend the life cycle of the timber by creating a piece of street furniture that locals can enjoy for many years. While glue-laminating the beams with alternating wood-grain direction created a unique aesthetic quality, the time required to produce the beams was larger than if the wood grain had been running in one direction. Alternative methods of glue-laminating could be explored to find more efficient ways to construct the beams.

**Bibliography**


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**Authors**

Adam Collett is completing his Master of Architecture (Professional) at Unitec, Te Pūkenga. He has been provided an industry postgraduate scholarship in association with Abodo Wood, Made Group, and Auranga township to complete waste research. The focus of his research revolves around digital fabrication and community design. He also practises as an architectural intern at Sin Architects (BJA Architects Ltd). https://orcid.org/0000-0003-2875-0367

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