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ALIGNING NEEDS AND SUSTAINABILITY: A CASE STUDY OF BIO-BASED TEMPORARY HOUSING

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ABSTRACT: As a result of repeated natural disasters in the last decade, Australia has an acute need for innovative and scalable models for provision of temporary housing. Common criticisms of currently available housing systems revolve around their high production costs and a heavy reliance on imported building solutions. To address these limitations, a model for temporary post-disaster housing has been developed to utilise locally available and renewable timber resources, to enable faster, cheaper, low-carbon, and scalable temporary housing delivery options for Australian disaster recovery. This paper presents the first temporary house prototype constructed using a novel hybrid timber-cardboard sandwich (TCS) composite, developed as the result of a significant collaborative effort between academic, government, industry, and community partners. A full-scale 11 m^2 prototype was built to benchmark the affordability, sustainability, design flexibility, fabrication complexity, embodied carbon, and durability of the TCS House system. The prototype was also used to explore strategies to maximise use of renewable and recycled materials in temporary housing construction, by providing direct links between the forestry and wood products sector and local community end users.

KEYWORDS: *Temporary housing, Post-disaster, Cardboard structures, Sandwich panels, Circular construction*

1 – INTRODUCTION

In Australia, natural disasters continue to generate considerable negative impact on economic, social, and health aspects of displaced people, including long-term psychological harm [1, 2]. No region in Australia is immune to the effects of natural disasters [3], which are increasing in frequency and intensity across the country [4-8]. After disasters, State and Territory governments assume responsibility for response, recovery, and mitigation. Reports and studies consistently highlight that providing an effective post-disaster housing response is a crucial and effective humanitarian response to alleviate post-calamity suffering and hasten community relief and recovery [9]. In recent years, the Australian government has allocated substantial financial aid [10] to support housing solutions for affected people, aiming to reduce risks, rebuild communities, and restore a sustainable built environment. However, the urgency following disasters often leads to reactive rather than deliberate decisions, resulting in shortcomings in temporary housing solutions [11]. These systems heavily rely on conventional supply chains for sourcing materials and skilled labour, which can be severely limited in disaster-affected regions. Moreover, they struggle to integrate or adapt to local resources, hindering cost-effectiveness and perpetuating dependency on external support. Consequently, current

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approaches do not effectively support a scalable model for post-disaster housing responses.

This project seeks to develop pioneering, sustainable, and low-cost prefabricated temporary housing by utilizing locally available renewable resources, such as recovered waste cardboard and under-utilized timber materials in Northern New South Wales (NSW), Australia. It aims to showcase resource-efficient building design and construction while radically expanding the capacity to use renewable and recycled materials in temporary housing.

2 BACKGROUND

2.1 CARDBOARD-BASED STRUCTURES

To develop a scalable delivery model for temporary and post-disaster housing, a new construction material that is cost-effective, sustainable, and readily available is needed. Cardboard meets these criteria effectively. This lightweight, paper-based product is commonly used for packaging and has been explored as a construction material for over 150 years [12]. Although cardboard-only systems have been limited to short-term use due to moisture vulnerability [13], proper moisture control can extend their serviceability to over 30 years [14]. Some researchers have improved cardboard-based buildings by combining cardboard with other materials to meet building code requirements, though these often result in proprietary manufacturing processes with costs comparable to conventional construction [15-17].

Increasing the use of cardboard in construction supports a circular economy, as cardboard is highly recycled and prevalent in Australia's waste streams. Timber-Cardboard Sandwich (TCS) panels represent an innovative class of lightweight and low-cost structural composite materials made from bio-based and recycled waste materials, combining low-cost timber facings with a block-laminated corrugated cardboard core [18]. A modern, cost-effective fabrication technique was developed, enabling full composite action in TCS beams under flexural loading. These beams, composed of over 90% waste material by volume, exhibited significantly improved bending stiffness and strength compared to conventional structurally insulated panels (SIPs). TCS columns have similarly demonstrated comparable high capacity under eccentric axial loading [19]. Timber-Cardboard Web-Core Sandwich (TCWS) panels utilise block-laminated cardboard arranged in a non-monolithic web-core configuration to achieve a 50% reduction in density compared to conventional TCS panels while exhibiting up to 33% greater strength than similar foam-core and bio-based sandwich panels at equivalent densities [20] TCWS panels thus enable lighter and more cost-effective wall solutions for housing applications and will be the focus of this project for the construction of temporary housing system.

2.2 ROUNDWOOD THINNINGS

Contemporary wood products are largely sourced from managed plantation and native forest ecosystems. To manage forest health and wood growth productivity, these forests are 'thinned' at a typical age between 8-15 years depending on species and climate. Thinning involves the removal of small diameter and/or ill-formed trees, reducing competition for resources and allowing the remaining trees to reach a significantly larger size at maturity [21]. This process generates a large volume of small-diameter logs, typically under 200mm with natural tapering. These can be challenging to economically saw into conventional wood products [22] and so the resource is perceived as having limited market use beyond low-value and short-lived wood by-products, such as mulch, chip, or pulp products [23]. This project extends on research exploring innovative structural uses for small-diameter roundwood logs to construct durable, economical, and carbon-sequestering covered outdoor spaces [24, 25].

3 – PROJECT DESCRIPTION

Temporary housing structures streamline effective post-disaster housing responses by supporting the re-establishment of typical household routines, ensuring sustainable and resilient community recovery, and facilitating the transition to permanent housing during the reconstruction phase. However, reliance on bio-based and sensitive materials, rather than industrial and fossil-based materials, often results in shorter lifespans and greater variability in performance. This challenge can be addressed by incorporating innovative and compatible products to enhance durability and weather protection, while minimising integrations that compromise the ease of assembly, relocation, demolition, and modification.

The project aims to address limitations and expand the utilisation of TCS composites and forestry thinnings for the production of bio-based temporary structures, through three key advancements:

a) Integrating existing TCWS structural sandwich panels with external cladding and internal lining layers to improve durability and amenity;
b) Developing novel structural connections for the low-cost and rapid assembly of bio-based sandwich panels;
c) Developing a deployable external framing system using minimally-processed hardwood thinnings.

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These advancements were developed for construction of a full-scale temporary housing prototype, Figure 1, to demonstrate the capacity for locally-available, bio-based materials to support the economical and scalable delivery of post-disaster housing.

4 – DESIGN PROCESS

The house prototype was designed to incorporate two distinct living areas: an enclosed, habitable space formed from bio-based sandwich panel construction, Figure 2; and an external, covered space formed from a roundwood thinning braced frame construction, Figure 3. All referenced wood products were sourced locally from NSW-based manufacturers.

4.1 BIO-BASED SANDWICH PANEL CONSTRUCTION

4.1.1 FLOOR CHASSIS

The base of the house consists of particleboard floor panels attached to a welded steel base chassis. Floor panels are a 22 mm thick Australian Panels STRUCTAflor Ultimate (R-Flor) structural flooring product, made of particleboard with a foil laminated on the underside. This laminated foil is a low-emittance (high-reflectance) surface that reduces radiative heat transfer and moisture ingress through the floor. It additionally incorporates a termicide to protect against insect damage.

The steel base chassis consists of cold rolled steel C-section joists at 600 mm spacing, welded to two hot-rolled steel I-section bearers. Additional lifting bar and lifting point features were also included to support movement of the structure using a forklift, crane, or dolly. The total dimensions of the base are 3.6 m in length and 3.0 m in width with total weight of 204 kg.

Figure 1. Bio-based temporary housing prototype.

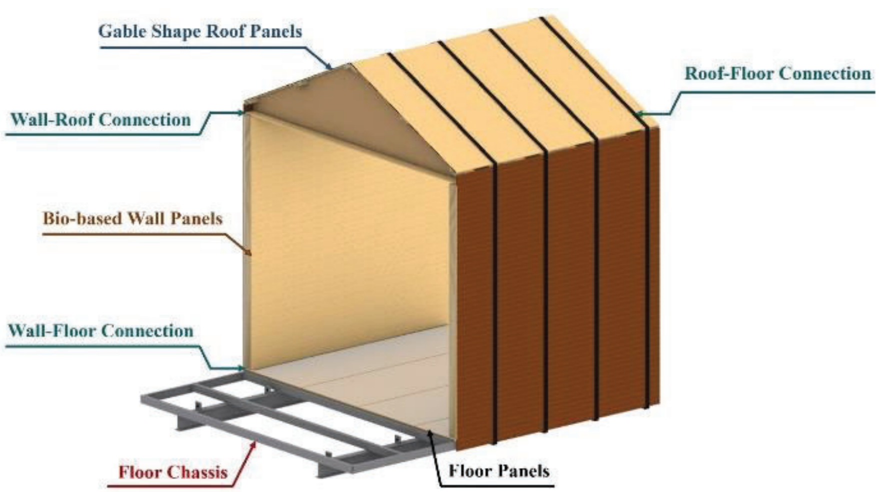

Figure 2. Components of the enclosed habitable space formed from bio-based sandwich panel construction.

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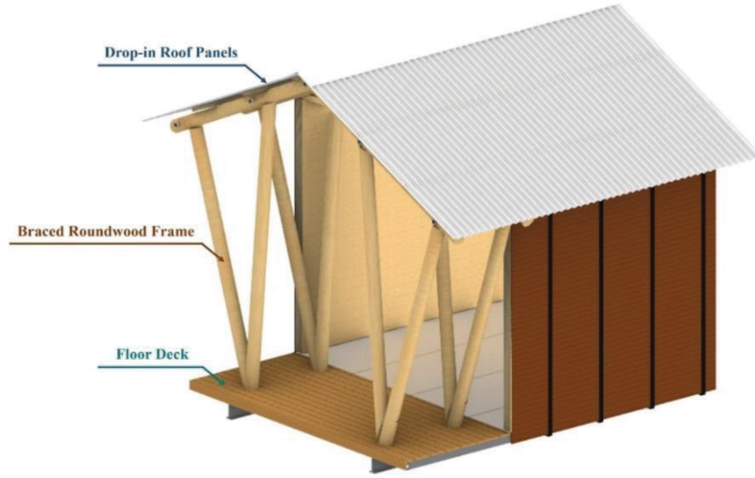

Figure 3. Components of the deployable roof system formed from a roundwood thinning braced frame construction.

4.1.2 BIO-BASED WALL PANELS

The enclosed habitable space is formed from a modified version of the TCWS panels. The original panel design consisted of two 7 mm thick Radiata Pine plywood facings bonded to a 90 mm thick block-laminated corrugated cardboard core, Figure 4. Core spacing intervals are set at a 300 mm centre-to-centre spacing, following structural design and optimisation for typical residential housing load conditions [26].

Individual wall panel dimensions were 1.2 m wide and 2.4 m long. For wall panel assembly, two modified panel arrangements were trialled. First, a wood-based cladding product was laminated onto external wall surfaces using exterior-grade PVA adhesive. Cladding panels were 5.5 mm thick Weathergroove Natural Weathertex board, made primarily from hardwood forestry residues and pulplog. Second, internal lining was bonded to a single internal wall surface, for comparison with the original plywood finish. The internal lining face is a 9 mm thick General-Purpose Interior Easycraft VJ 100 GP medium-density fibreboard (MDF). External and internal linings were offset by half a panel from the TCWS panels, creating continuous, 2.4 m long laminated walls. Insulation batts were also placed between core studs.

4.1.3 GABLE SHAPE ROOF PANELS

Gable-shaped roof panels were trialled for the first time by fabricating TCWS panels with a non-uniform cross-section profile, Figure 5. Roof panels had a span length of 3 m and pitch angle of 25°. Gable-shaped block-laminated cardboard cores were manufactured as full-length, 100 mm wide profiles, with end heights of 90 mm increasing to a central height of 690 mm. These were placed at 300 mm centre-to-centre spacings across the panel width of 1.2 m. Radiata Pine plywood facings

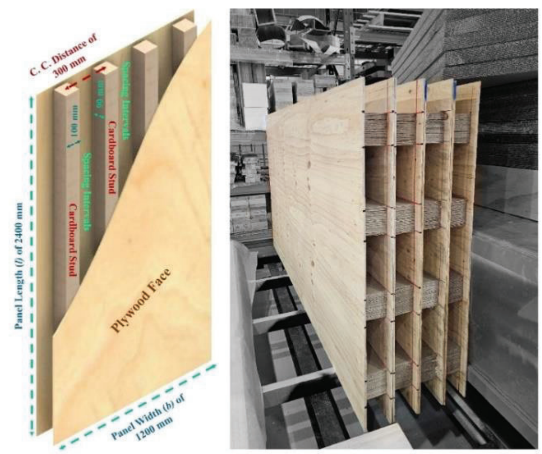

Figure 4. TCWS wall panel details.

were used for top panel faces and a Hoop Pine plywood manufactured by Big River Group was used for the bottom panel face, using a laminated splice joint to attain the required 3 m span. Short-length timber stud offcuts were additionally laminated to the internal surface of the top face for screw-fixing of roof battens, discussed further in the next section.

4.1.4 CONNECTION DETAILS

Three low-cost connection techniques were employed to connect the wall-floor, wall-roof, and roof-floor bio-based sandwich panel junctions.

For the wall-floor connection, a timber stud sole plate was screw-fixed to floor sheeting and joists. Stud depth was sized such that if could fit snugly into a gap in the panel base, Figure 6 (left), to resist lateral shear. Stud width was 45 mm and the panel gap was 35 mm, keeping the panels 10 mm above the ground floor surface.

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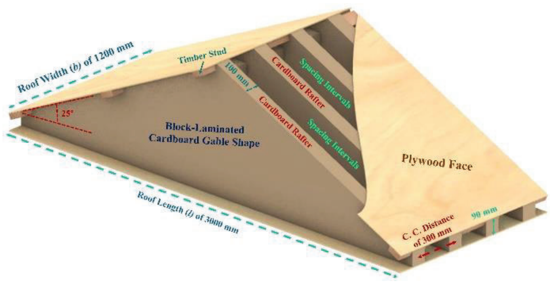

Figure 5. TCWS roof panel details.

The timber sole plate extended along the full length of the wall, minus 45 mm at each end. This accommodated two ‘edge studs’, Figure 6 (right), which were bonded into panel edges and provided longitudinal shear resistance when assembled.

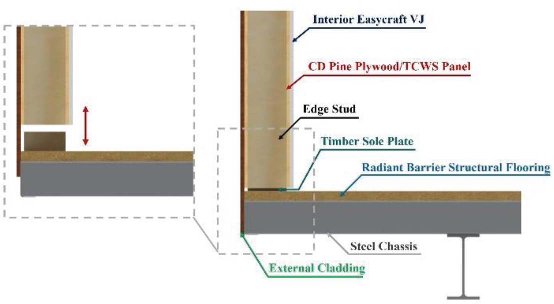

Figure 6. Wall-floor connection details.

For the wall-roof connection, the same technique was used by screw-fixing a timber stud top plate to the bottom edge of the roof panels. Roof panels thus similarly inserted into a gap at the top of wall panels to provide bidirectional shear resistance, Figure 7.

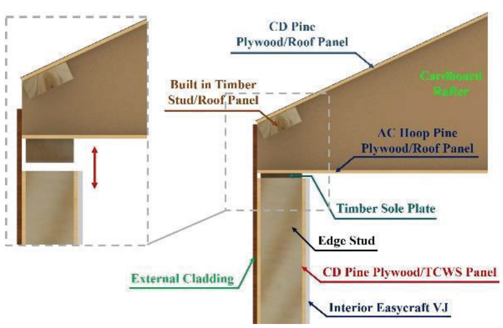

Figure 7. Wall-roof connection details.

The two preceding connections provide no resistance to uplift, which is often a governing structural design case for timber connections in residential timber-framed housing. Thin timber sheets and cardboard materials are challenging to connect using conventional mechanical wood fasters. Instead, an alternative approach was used, with a continuous roof-floor connection created by employing tensioned straps [27, 28]. This will be discussed further in the next section, as this connection also integrates components of the deployable roof system.

4.1.5 FABRICATION AND ASSEMBLY

The enclosed habitable structure was assembled in four stages, summarised as:

1. fixing the floor panel and sole plate to steel chassis;
2. lamination and tilt-up insertion of the wall panels;
3. lamination and crane-lift insertion of the roof panels;
4. placement and tensioning of straps.

Steps 2 and 3 are illustrated in Figure 8 and 9, respectively. Temporary lateral bracing was used prior to the assembly of the roundwood braced frame, discussed further in the next section. Interior timber surfaces (floor, one wall, and roof surfaces) were applied with a Cabot's CFP Floor Water-Based finish, applied in three coats.

Figure 8. Wall panel assembly.

Figure 9. Roof panel assembly.

4.2 DEPLOYABLE ROOF SYSTEM

Roof sheeting and an external, framed deck area was developed to provide overhanging eaves on both sides of the structure. This enhanced durability of the bio-based sandwich panel construction, both reducing thermal load and risk of moisture ingress on wall panels, as well as providing a similar building profile to conventional

‘Queenslander’ timber houses common to the region, Figure 3.

However, in creating eaves, the total width of the assembled structure increased to just under 4.2 m, above the legal wide load road limit of 3.0 m. Two deployable sub-systems were developed to allow the roof to package up within this with for transport, while still being quickly deployed on site: a deployable roundwood frame and drop-in roof sheet cassettes.

4.2.1 DEPLOYABLE ROUNDWOOD FRAME

The lateral bracing system of the house consists of a chevron bracing or inverted V-bracing frame, Figure 10a. The frame was constructed from two pairs of identical triangulated frame sections, connected by a single bolt at the apex. Frame bases were also each connected by a single bolt to steel cleat plates welded to steel chassis bearers.

Frame geometry was determined such that when this apex bolt was removed, opposite sections can hinge about their base bolt connections and fold into the structure, Figure 10b. Once folded in, they are resecured for transport, to fit within the 3 m limit.

Frame sections were each comprised of three Spotted Gum thinnings provided by a local hardwood sawmill Hurford’s. The roundwood member and connection design were selected to balance processing and fabrication cost against durability and user perception of timber quality. Logs were first debarked through a log profiler applied with a boron-based preservative, with all members having a uniform 125 mm diameter. Simple half-lap joints were used to for all member connections, as they could be fabricated with hand tools only. Single M20-8.8/S structural bolts were used to connect all half-lap joints, including the hinged connection to the base cleat plate and the apex connection.

4.2.2 DROP-IN ROOF SHEET CASSETTES

Roof sheets were designed and installed using a novel drop-in technique, allowing for easy removal and reinstallation, shown in Figure 11a. First, a set of primary batten members were installed onto the roof panels. These were attached with screws to the timber blocking bonded internally to each panel. Once deployed, frame rafter elements were screw-fixed to these batten members to connect back to the sandwich panel construction.

Second, roof sheets were screw-fixed to a second set of battens while on the ground. These partially pre-assembled ‘roof sheet cassettes’ were threaded with ratchet tie-downs. Using the straps, panels were light enough for four people to lift safely. Two people lifted the panels onto the roof using the straps, while two other people aligned the roof sheet cassettes. The locations of each batten set were offset such that the roof sheet cassettes could drop-in and lock into place, Figure 11b.

For ease of installation, roof sheets were installed in two sections per side. Each side of the roof in this prototype comprised five Zincalume sheets, 780 mm wide. The front section consisted of three sheets, while the rear section included the remaining two sheets. After installation of all sheets, a ridge cap was placed on top of the structure to cover the gable apex. The same ratchet straps, two per cassette, were used to lift roof sheet cassettes onto the opposite roof face. Roof sheeting extended over the roundwood frame to create covered space that acts an external balcony and entrance for the house. A decking floor was installed in this space, with Yellow Stringybark decking boards screw-fixed to hardwood offcut joists at 450 mm spacing. Exterior timber was applied with two coats of CUTEK® Extreme CD50 timber protection oil.

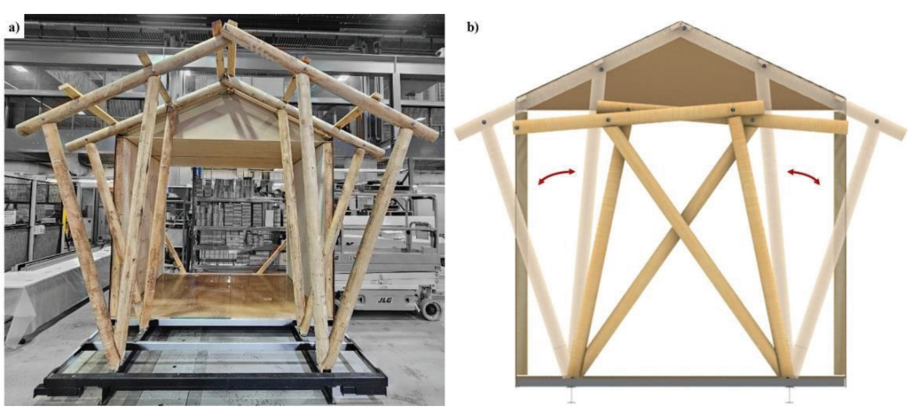

Figure 10. a) Lateral bracing system featuring chevron (inverted V) bracing frame.; b) Folding path of the deployable bracing frame

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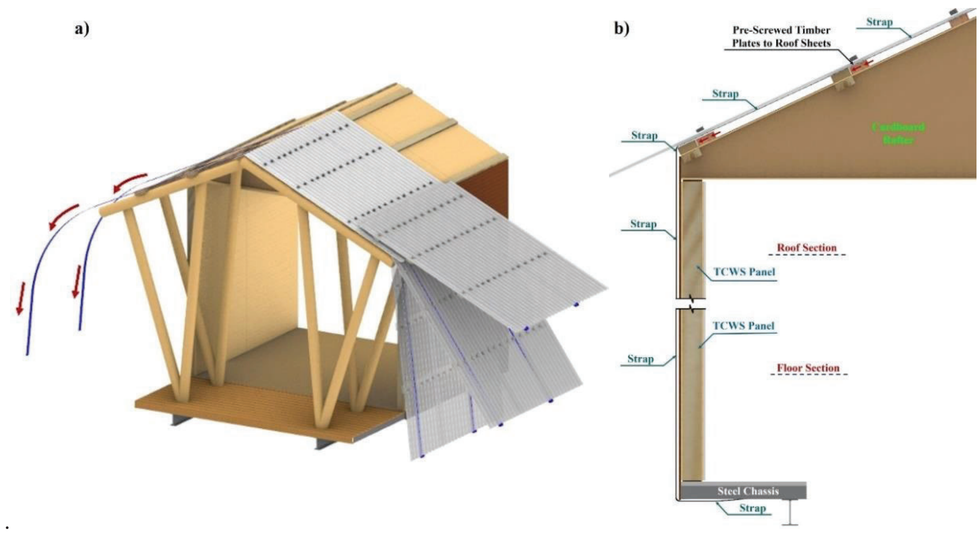

Figure 11. a) Drop-in roof panels details; b) Roof-floor connection details.

4.2.3 CONNECTION DETAILS

The roof-floor connection was formed by extending the ratchet straps, running across the batten layer in opposite pairs of roof sheet cassettes, to run continuously around the entire external perimeter of the house. Ratchet straps are load rated, with the specific straps used in this prototype rated to 2500 kg (~25 kN) each. This provides sufficient capacity for resisting wind uplift forces, on both the roof sheet cassettes and the roof panels. Multiple straps also enable bracing action in the longitudinal axis of the house direction, with wall racking action resisted by straps, similar to tension rod tiedown systems. Ratchet straps are also easily released and retightened manually. This approach allowed for flexible adjustment, disassembly, and reassembly, to significantly streamline the overall installation process, Figure 11b.

4.3 ENVELOPE

The habitable space formed from bio-based sandwich panel construction has been enclosed with front and back walls, to complete the structure as a lock-up and liveable house. This also forms a closed box to limit internal wind pressure generation during transport. End walls were fabricated using translucent polycarbonate sheets to allow for natural light entry, Figure 12a. The front wall and entryway included sliding doors, which were custom-fabricated using off-the-shelf gate hardware, Figure 12b.

5. RESULTS

5.1 TRANSPORT AND ASSEMBLY

In Lismore, the house was exhibited for public drop-in sessions held across three days to gather community feedback on design elements, as this community was recently strongly impacted by bushfire and flooding disasters.

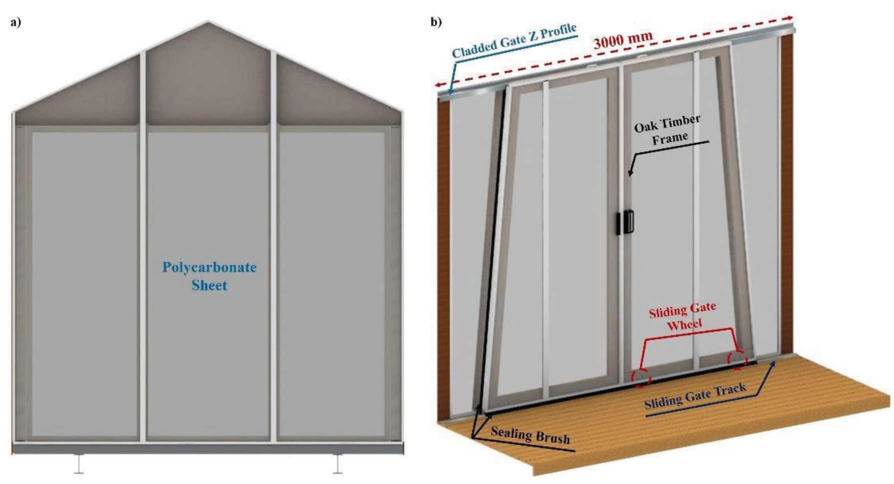

Figure 12. a) Translucent end wall; b) Sliding door.

Pack up for transport proceeded in the following stages. Ratchet straps were removed and prefabricated roof sheet cassettes panels were manually detached and placed stacked inside the structure, Figure 13a. The roundwood frame was uncrewed from the primary batten layer, disconnected at the apex, and manually lowered into its folded position, Figure 13b. Straps were used to support the weight of each frame of the primary batten layer during folding and frames were reconnected at the central roof beam junctions once folded.

The lateral bracing capacity of the folded roundwood frame was uncertain, so a temporary internal bracing frame was installed to provide additional reinforcement during transport, Figure 13c. Ratchet straps were reinstalled over the house to tie down all panels to the base frame. Straps were also installed around the structure to tie the folded frame back to the sandwich panel assembly. The house was then transported to Lismore using a tilt truck, Figure 13d, with the base frame connected directly to the truck bed. The house was loaded and unloaded with ease, using only the truck winch.

The house was reassembled by a team of four people in approximately 3 hours, using only two ladders, an impact driver, and hand tools. There was no visible damage during transport from the three-hour drive or from the disassembly and assembly process. Overall, this demonstrates the effectiveness of the house design for streamlined transport and construction.

5.2 QUANTITIES AND COSTINGS

As part of the project scope, a cost and materials analysis of all systems and sub-systems was conducted. Details are presented in Tables 1, 2, and 3. Table 1 shows the total cost of each sub-system used and its percentage of the total cost. Prices are listed primarily based on retail cost of all materials, giving the total cost of the structure as \$11,098 (1,028 / m^2). The highest percentage of this was the floor sub-system at 32.1%, followed by the doors at 16.5%. The relatively high cost of the floor sub-system is attributed to the steel chassis, which was sourced from an external vendor and so includes materials and labour.

Tables 2 and 3 show the material proportion by weight and volume, respectively. Data is aggregated in total, as well as for: waste and recycled materials; residue and under-utilised timber materials; combined waste/recycled/residue/under-utilised timber materials; and bio-based materials of any type.

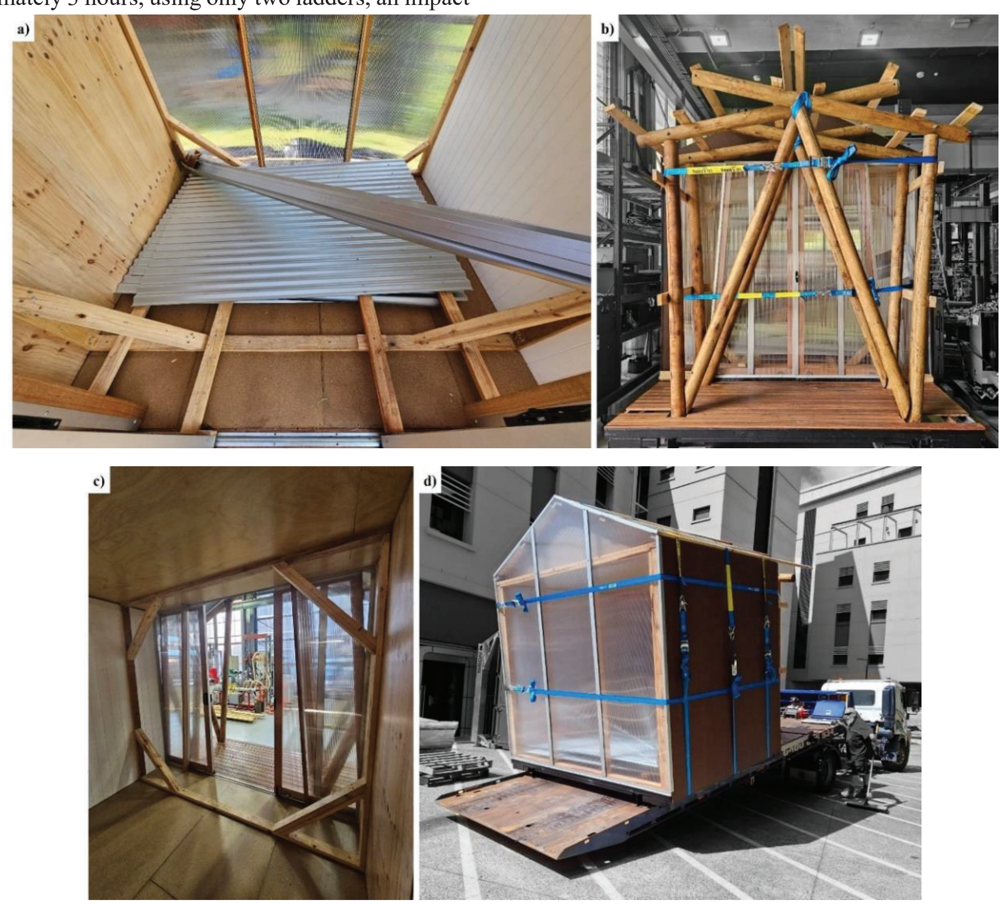

Figure 13. a) Internal pack-up. b) External pack-up. c) Internal bracing frame. d) Transport.

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Based on Table 2, the total weight of the structure is 1473.9 kg, which represents 13% of waste and recycled materials, 44% of residue and under-utilized timber, and 74% of bio-based materials.

In terms of volume quantities, Table 3 shows a total volume of 3.8 m^3, with 62% for waste and recycled materials, 22% for residue and under-utilized timber, and 72% for bio-based materials. The relatively higher volume waste and recycled, as compared to bio-based, is due from the insulating material, which is made from recycled glass This shows that nearly three quarters of the structure is made from bio-based materials.

Table 1. Cost breakdown, material retail price only.

Sub-System	Cost	Percent
Floor	$3,568	32.1%
Wall-A	$753	6.8%
Wall-B	$684	6.2%
Roof Panels (x2)	$1,358	12.2%
Connections	$99	0.9%
Roundwood Bracing	$314	2.8%
External Decking	$659	5.9%
Roof Cassettes	$509	4.6%
End Wall	$1,139	10.3%
Doors	$1,836	16.5%
Miscellaneous	$180	1.6%

Table 2. Material breakdown by weight.

By Weight	Weight (kg)	Percent
All materials	1473.9	100%
Waste and recycled	194.0	13%
Residue and under-utilised timber	646.0	44%
Waste/recycled and residue/under-utilised	840.0	57%
Bio-based (any)	1090.0	74%

Table 3. Material breakdown by volume.

By Volume	Volume (m^3)	Percent
All materials	3.8	100%
Waste and recycled	2.34	62%
Residue and under-utilised timber	0.84	22%
Waste/recycled and residue/under-utilised	3.17	84%
Bio-based (any)	2.74	72%

6. CONCLUSIONS AND FUTURE WORKS

This project demonstrates the great structural potential in using TCS composites as a building material. The issues discussed within this paper show the feasibility of practical application and advance progress towards technology commercialization. Key findings of the project are summarised as follows.

1. The study provides valuable insight into the design thinking and methods, exploring how the bio-based sandwich composites can contribute to new, sustainable housing designs.

2. The developed connection details demonstrate how existing materials and connection strategies can be repurposed for novel and low-cost construction of bio-based sandwich panels.

3. Integrating existing TCWS structural panels with external cladding and internal lining layers provides an effective solution to enhance the structure's durability and comfort, overcoming the limitations of cardboard composites in adverse weather conditions.

4. The use of roundwood as a lateral bracing frame provided an efficient structural and architectural solution that maximized the use of under-utilized thinning timber, enhanced the structure's appearance, while allowing for rapid assembly and installation without the need for lifting equipment or working-at-heights.

5. To support future design refinement and commercial development, the full-scale prototype provides an extensive benchmark on cost and material footprint.

As bio-based construction methods continue to evolve, these systems are poised to play a key role in providing environmentally, socially, and economically viable building solutions. To accelerate housing construction, future research should focus on developing cost-effective, market-ready structural solutions. Specifically, efforts should target prefabricated floor, wall, and roof systems, which could enable high-volume residential and commercial projects using models like the TCS House. Additionally, research should explore how digital technologies can enhance and scale construction processes. Furthermore, studies on the structural behaviour of TCS houses under fire conditions, their insulation performance, and the physical connections used are required, as there is limited available technical data and no available design standards or codes.

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REFERENCES

1. Mulchandani, R., et al., *The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up.* BMC Public Health, 2020. **20**: p. 1-7.
2. Fernandez, A., et al., *Flooding and mental health: a systematic mapping review.* PloS one, 2015. **10**(4): p. e0119929.
3. Middlemann, M.H. and M. Middelmann, *Natural hazards in Australia: identifying risk analysis requirements*. 2007: Geoscience Australia.
4. Climate Council, *Cranking up the intensity: climate change and extreme weather events.* Climate Council, Australia, 2017.
5. Department of Home Affairs, *National Disaster Risk Reduction Framework*. 2018: Commonwealth of Australia.
6. Re, M., *Australia and New Zealand: Expect the unexpected-Scientific facts and economic impacts of natural disasters*. 2015, Munchen, Germany: Munich Re.
7. Owen, C., et al., *Strategic Emergency Management in Australia and New Zealand.* 2013.
8. Head, L., et al., *Climate change and Australia.* Wiley Interdisciplinary Reviews: Climate Change, 2014. **5**(2): p. 175-197.
9. Fordyce, S., *Survival Architecture and the Art of Resilience.* Design and Culture, 2020. **12**(3): p. 360-364.
10. Cross, A.R., *Australian bushfires report*. 2021, Sydney, Australia [cited 2022 January 2].
11. Charlesworth, E. and J. Fien, *The Role of Design in Displacement: Moving Beyond Quick-Fix Solutions in Rebuilding Housing After Disaster.* The Handbook of Displacement, 2020: p. 629-650.
12. Latka, J.F., *Paper in architecture: Research by design, engineering and prototyping.* A+ BE| Architecture and the Built Environment, 2017(19): p. 1-532.
13. Twede, D., et al., *Cartons, crates and corrugated board: handbook of paper and wood packaging technology*. 2014: DEStech Publications, Inc.
14. Palms, J. and G.E. Sherwood, *Structural sandwich performance after 31 years of service*. Vol. 342. 1979: Forest Products Laboratory.
15. Latka, J.F. *TECH–Transportable Emergency Cardboard House*. in *Proceedings of IASS Annual Symposia*. 2016. International Association for Shell and Spatial Structures (IASS).
16. Fiction Factory. *WIKKELHOUSE*. Available from: https://wikkelhouse.com/#design.
17. Wolf, A., et al., *A full performance paper house.* Journal of Facade Design and Engineering, 2021. **9**(1): p. 117-130.
18. Abu-Saleem, M. and J.M. Gattas, *Fabrication and structural characterisation of hybrid timber-cardboard sandwich beams.* Engineering Structures, 2024. **305**: p. 117678.
19. Abu-Saleem, M. and J.M. Gattas, *Eccentric compression behaviour of hybrid timber-cardboard sandwich columns.* Construction and Building Materials, 2024. **440**: p. 137365.
20. Abu-Saleem, Mahmoud, and Joseph M. Gattas, Timber-Cardboard Web-Core Sandwich panels for lightweight housing applications. Structures, 2025. **73**: p. 108315.
21. Underhill, I.D., et al. *Structural Veneer Based Composite products from hardwood thinning–Part I: Background and manufacturing*. in *Materials and Joints in Timber Structures: Recent Developments of Technology*. 2014. Springer.
22. McGavin, R., et al., *Utilisation potential and market opportunities for plantation hardwood thinnings from Queensland and northern New South Wales.* 2006.
23. Ximenes, F., et al., *Carbon stocks and flows in native forests and harvested wood products in SE Australia.* Project No: PNC285-1112, 2016.
24. Baber, K.R., et al. *Inventory-constrained design of a variable small diameter round timber structure*. in *Proceedings of IASS Annual Symposia*. 2023. International Association for Shell and Spatial Structures (IASS).
25. Gattas, J.M., K. Baber, and G. Stringer. *Sustainable modular timber membrane shade structures from under-utilised plantation thinnings*. in *Proceedings of the 18th East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-18), Chiang Mai, Thailand.* 2024. Springer.
26. Abu-Saleem, M. and J.M. Gattas. *Design and Optimisation of Timber-Cardboard Sandwich Panels for Temporary Housing Applications*. in *Proceedings of the 18th East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-18), Chiang Mai, Thailand.* 2024. Springer.
27. Xin, Z.-Y., K. Baber, and J.M. Gattas, *A novel tension strap connection for rapid assembly of temporary timber structures.* Engineering Structures, 2022. **262**: p. 114320.
28. Gattas, J.M., et al. *Post-tensioned strapping connections for rapid assembly of low-cost timber structures*. in *Proceedings of IASS Annual Symposia*. 2023. International Association for Shell and Spatial Structures (IASS).

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