RESILIENT TIMBER HOMES DESIGN COMPETITION

HARDWOOD RESIDENCE

TECHNICAL REPORT

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INTRODUCTION

Can a home located in a flood-prone locality be both practical and beautiful, built primarily with timber while ensuring unparalleled comfort, functionality, and desirability? Hardwood Residence poised to challenge conventional notions of standard homes as a trailblazing project. Its mission is clear: to champion sustainable and locally sourced timber construction in a flood-prone locality, pushing the boundaries of what is possible in residential design.

This project stands as a testament to the enduring beauty and versatility of timber, promoting it as the building material of choice. By seamlessly blending aesthetics with resilience, Hardwood Residence showcases the immense potential of timber to create homes that not only harmonise with the environment but also elevate the living experience.

CONCEPTUAL FRAMEWORK

TIMBER AS MATERIAL

PASSIVE DESIGN

FLOOD RESILIENCE

SUSTAINABLE LIVING

The conceptual framework of the new project is built upon four key principles. Firstly, the utilisation of timber material throughout and hardwood in particular and timber construction stands as a core idea in resilience against flood and with biophilic qualities, whilst aiming to establish renewable timber as the new standard in resilience construction. This approach emphasises the importance of sustainability and environmental consciousness by promoting local sourcing and labour such as using spotted gum or blackbutt timber for structure and charred-hardwood timber cladding spotted-gum whilst allowing repairability, thus reducing the carbon footprint associated with the project. By championing locally sourced timber as a primary construction material, the design aligns with the growing global focus on eco-friendly and renewable building practices.

Secondly, the design of the house prioritises passive heating and cooling strategies to minimise the building's net energy consumption. Harnessing the power of natural elements, such as north light and cross-ventilation, the project maximises energy efficiency and reduces the reliance on mechanical heating and cooling systems. This approach not only reduces the environmental impact but also contributes to long-term energy savings for the occupants. By integrating passive design principles into the project, the conceptual framework emphasises the importance of sustainable living and the creation of a comfortable and energy-efficient living environment.

Thirdly, the conceptual framework of the new project utilises flood resilient principles principle such as Flood Resilient Building Guidance by the Queensland Government Agency and the Reducing Vulnerability of Building to Flood Damage published by the NSW Government. This principle recognises the sensitive flood context of the site location and integrates design and construction intent to mitigate potential risks and enhance resilience. By implementing flood-resistant design strategies, such as resilient material choices, and construction systems, and detailing, the project aims to reduce the vulnerability of the building to flood damage and allow easy repairability. This commitment to flood resilience demonstrates the project's dedication to creating a safe and sustainable home in a flood-prone area, prioritising the well-being and security of its future occupants.

Lastly, the conceptual framework of the new project also focuses on sustainable living. The house is carefully crafted to ensure quality design, comfort, encourage indoor outdoor connection, reducing impact of suburban living towards larger ecosystem by reducing built area, increasing water permeability while considering the practical requirements of a 3-bedroom family home with future expandability. Through thoughtful and logical programming of spaces, the design optimises functionality, with flexible spaces for different uses such as study space, carport spaces as additional outdoor space, encourage community interaction through street interaction.

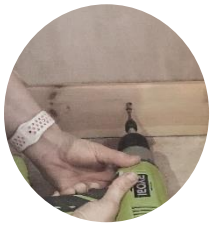
HARDWOOD STUDWORK

SEALED & CHARRED HARDWOOD CLADDING

WATERPROOF RIGID FOAM INSULATION

LOUVER WINDOWS FOR WATER EGRESS

SEALED MARINE PLYWOOD LINING & CABINETRY



REMOVABLE SKIRTING

CABINET LEGS INSTEAD OF KICKPLATE

SCREW FIXINGS FOR REMOVABILITY & REPAIRABILITY

PROGRAM RESOLUTION

The project design considers the issue of flood resistance and incorporates various measures through resilient materials and construction methods. Following the Flood Resilient Building Guidance provided by the Queensland Government agency and the Reducing Vulnerability of Building to Flood Damage published by the NSW Government, the construction of the house utilises water resilient timber hardwood for stud framework. The facade cladding employs charred-hardwood timber; where the sealing and charring maximises the resilience of hardwood against already water resistant hardwood.

Additionally, the wall insulation is rigid foam insulation, which is water-resistant compared to standard batt insulation. To ensure quick drainage, the windows feature integrated louvers strategically positioned for efficient water runoff. Moreover, the internal wall lining and cabinetry utilises sealed marine plywood, commonly used in maritime and naval construction, offering additional flood-resistant properties. Furthermore, all electrical outlets are planned to be installed above flood water level, minimising potential damage during flooding events.

In terms of mold prevention, the project employs quick-draining assemblies and joints. The concrete flooring is waterproof, preventing water from settling and creating a favourable environment for mold growth. Coupled with the strategic placement of window louvers and large sliding openings, the design facilitates water expulsion after flooding. Furthermore, removable skirting boards are employed for ease of drainage, limiting the development of mold and moisture-related issues. Fixed cabinetries are installed without kickplates to allow easy access and water expulsion underneath.

The project also prioritises easier repairability, replaceability, and recyclability of components to minimise recovery time and cost in the aftermath of a flood. All timber pieces are installed with screws, enabling straightforward replacement or repair when necessary. This approach not only ensures the resilience of the structure but also contributes to sustainable construction practices by promoting the reuse and recycling of materials, along with the optimisation of the recovery process and reduces the impact of flooding events on the building and its occupants.

25%

Up to reduction on insurance premiums through flood resilient design.

31%

Decrease of built floor size in proposed design to original.

$900

Up to per year saved on energy bills through passive design

20%

Up to less cost from prefabrication

70%

Up to less labour hours onsite

50%

Up to less less waste onsite

COST & BUILDABILITY

The implementation of a flood resilient design aims to reduce insurance premiums by up to 25% on flood prone insurance against worst case premiums of $50,000 in South Australia. This is achieved through the incorporation of resilient flood construction while minimising financial burdens associated with insurance coverage.

Another noteworthy cost-saving measure implemented in the project is the reduction of the floor size. The initial proposed housing has a built area of approximately 274 sqm has been strategically downsized to 189 sqm, resulting in a significant 31% reduction – inadvertently reducing less energy cost as well as impact to environment. Despite this reduction, the project ensures that spatial comfort and functionality are not compromised. By optimising the layout and design, the project achieves a balance between cost-efficiency and a comfortable living environment.

The design emphasises passive heating and cooling strategies, resulting in minimal reliance on mechanical services. Cross-ventilation design tactics, along with the use of a concrete slab with high thermal mass from winter sun, contribute to heating of spaces. This approach not only reduces the need for costly mechanical systems but also maximises energy efficiency, further lowering the overall construction and operational costs of the building. Furthermore, the project design strives to achieve a 7-star home rating for energy efficiency, to be consulted with energy consultant. This higher rating indicates that the home consumes 18-28% less energy for heating and cooling compared to a 6-star home with the potential energy savings of approximately $900 per year can be achieved.

To optimise cost and buildability, the proposed design proposes prefabricated timber wall and roof truss to be worked out in collaboration with a prefabricator and structural engineer. This approach allows for major cost reductions up to 20% and time reductions of up to 70% labour hours during construction, minimises on-site waste up to 50%, and reduces disturbance to the local area.

While locally sourced resilient timber has been strived for, the project provides alternative material calculations within the spreadsheet, suggesting comparable materials that can be used to reduce costs if necessary.

SUSTAINABILITY

5%

less carbon upfront emission than steel construction

In the realm of construction, addressing the environmental impact of standard materials like concrete, steel, and insulation is crucial, considering their contribution of a staggering 11 percent of global greenhouse gas (GHG) emissions. Recognising this challenge, the proposed project house takes a bold step towards sustainability by fully embracing timber construction in resilient flood design — an approach that lowers upfront embodied carbon emissions. The technical report's spreadsheet analysis demonstrates a compelling comparison between the current provisions of timber construction in the project design versus the design utilising steel frame construction.

WINTER SUN

CROSS-VENTILATION

RENEWABLE

STORMWATER PERMEABILITY

This analysis reveals a 5.25% decrease in total estimated upfront carbon emissions when timber construction is employed. Moreover, the use of resilient hardwood timber in the project is sustainable, renewable and contributes to reduction in carbon emissions throughout its lifecycle, thanks to the timber's durability, recyclability, and ease of repair throughout screw fixing. The project not only reduces its carbon footprint but also presents a viable solution for mitigating climate change through sustainable building practices.

By harnessing passive design through winter solar gain through north oriented roof, cross-ventilation and stack effect cooling with clerestory windows thus reduction of energy usage, the project relies less on the energy grid coal power generation which contributes to 33.6 percent nationwide carbon emission.

The project also maximises open outdoor spaces through reduction of built space, thus reducing impact to the ecosystem and utilise permeable paving to allow rainwater and stormwater to permeate through the ground and reduce stormwater risk collectively. This approach effectively reduces urban heat and extends to offering a carport instead of a closed garage. By embracing these principles, the project creates a more sustainable and environmentally friendly environment while providing ample space for additional flexible outdoor activities with carport.

CONCLUSION

Through the utilisation of timber-based construction the implementation of cost-saving measures without compromising on build quality and design, the project successfully achieves a remarkable balance between affordability, sustainability, and functionality. This innovative approach not only reduces the environmental impact associated with standard materials but also provides a resilient and viable solution for sustainable construction, particularly in flood-prone areas.

The Hardwood Residence attempts to stand as a testament to the effectiveness of timber-based design in creating environmentally responsible buildings that is resilient to flood.

At its very core, the project is crafted to provide a beautiful, biophilic, comfortable, functional, resilient and lasting home for the family, through the essence of timber as material both as finishing material and structural construction particularly in hardwood. Thus, it aptly bears the name Hardwood Residence.

High Level Cost Estimate

Project: Resilient Timber Homes Design Competition - Hardwood Residence

Prepared by: Lee Yang Yang, Edmund Limadinata, Amanda Lau **Date of Estimate:** 12.6.2023

Notes:

- All prices are indicative and will need to be verified by professional quantity surveyor, and have been sourced from Rawlinsons Australian Construction Handbook 2023 (Pages 107- 169) for 'Adelaide' region.

- Exclusions include: demolition, site preparation, earthworks, waste removal, footings, temporary services, services connections, lighting, electrical, gas, mechanical, or plumbing work (incl. roof plumbing), floor finishes, paint, joinery, any fixtures or fittings, labour, etc.

			Premium Resilient Timber Finishes		Affordable Comparable Non-Timber Finishes	
Flooring/Paving						
Concrete Slab	188.79 m2	m2	$92.80	$17,519.71		
Cobblestone Pavers (190 x 190 x 50mm)	58.76 m2	m2	$83.50	$4,906.46		
Walls						
Charred Hardwood External Timber Cladding Sealed	103.85 m2	m2	$297.00	$30,843.45	$87.50	$9,086.88
Marine Plywood Internal Timber Lining Sealed	306.72 m2	m2	$159.00	$48,768.48		$0.00
Bathroom Wall Lining (Tile & Fibre Cement Backing)	88.65 m2	m2	$169.80	$15,052.77		$0.00
Timber Framing	244.40 m2	m2	$84.50	$20,651.80		$0.00
Hardwood Stud Framing	244.40 m2	m2	$88.00	$21,507.20		$0.00
Expanded Polystyrene Insulation	244.40 m2	m2	$34.00	$8,309.60		$0.00
Sarking	203.02 m2	m2	$7.15	$1,451.59		$0.00
Doors & Windows						
Doors (Solid Core) Incl. Hardware	9	Count	$916.90	$8,252.10		$0.00
Sliding Doors	23.06 m2	m2	$178.57	$4,117.82		$0.00
Roller Door	9.31 m2	m2	$305.00	$2,839.55		$0.00
Gate	1	Count	$2,230.00	$2,230.00		$0.00
Pedestrian Gate	1	Count	$1,090.00	$1,090.00		$0.00
Highlight Windows	10.66 m2	m2	$670.00	$7,142.20		$0.00
Louvres Windows	11	Count	$1,060.00	$11,660.00		$0.00
Fixed Windows	11.76 m2	m2	$303.00	$3,563.28		$0.00
Ceiling & Roof						
Roofing (Timber Frames with Zincalume Steel Roof)	182.48 m2	m2	$201.00	$36,678.48		$0.00
Roof Insulation	182.48 m2	m2	$17.10	$3,120.41		$0.00
Eave Soffits	16.00 m2	m2	$269.50	$4,312.00	$69.40	$1,110.40
Polycarbonate Roofing	105.70 m2	m2	$58.90	$6,225.73		
Ceiling Lining (Plywood Veneer)	111.76 m2	m2	$159.00	$17,769.84	$87.30	$9,756.65
Ceiling Lining (Plasterboard 10mm)	70.72 m2	m2	$46.80	$3,309.70		
Ceiling Insulation	182.48 m2	m2	$31.50	$5,748.12		$0.00
Misc						
Posts	36.92 m	m	$48.00	$1,772.16		$0.00
		Subtotal		$288,842.45		$246,335.66
		Preliminaries	11%	$31,772.67	11%	$27,096.92
		Total ex tax		**$320,615.12**		**$273,432.58**

A HOUSE - HARDWOOD RESIDENCE

ESTIMATED UPFRONT CARBON EMISSIONS

			SAME DESIGN WITH STEEL FRAME	CURRENT DESIGN WITH TIMBER FRAME
MATERIALS	**SQM**	**GHG/SQM**	**GHG**	**GHG**
CONCRETE SLAB 100MM THICK	188.79	41.6	7853.664	7853.664
STEEL FLOOR SUBSTRUCTURE WITH GLASSWOOL INSULATION	0	123.8	0	0
TIMBER WALL HARDWOOD FRAMING WITH EPS INSULATION	244.4	30.51	0	7456.644
STEEL WALL FRAMING WITH EPS INSULATION	244.4	33.8	8260.72	0
CHARRED TIMBER CLADDING	103.85	2.2	228.47	228.47
ALUMINIUM GLAZING	76.05	82.48	6272.604	6272.604
PREFAB TIMBER ROOF STRUCTURE INC. INSULATION	182.48	35.56	0	6488.9888
STEEL FRAME ROOF STRUCTURE INC. INSULATION	182.48	39.75	7253.58	0
TOTAL			29869.038	28300.3708
			100%	94.75%

NOTES:
CALCULATION IS ESTIMATES ONLY, ACTUAL CALCULATION WILL NEED TO BE VERIFIED BY EXTERNAL ESD CONSULTANT
CALCULATION IS LIMITED TO SUBSTRUCTURE AND SUPERSTRUCTURE ONLY
CALCULATION IS LIMITED TO PRODUCT STAGE A1 - A3 ONLY, EG RAW MATERIALS, TRANSPORT AND MANUFACTURING
INTERNAL LINING & INTERNAL DOORS HAS NOT BEEN INCLUDED