SCION Innovation Hub, Te Whare Nui o Tuteata

Region	**Asia and the Pacific**
Award Scheme	**Dubai International Award**
Themes	**Energy** **Environmental Resilience** **Innovation** **Planning & Design**
Sustainable Development Goals	**Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable** **Goal 13 - Take urgent action to combat climate change and its impacts**

Summary

The building design for ‘Te Whare Nui o Tuteata’ provides a welcome to SCION’s national Timber Research Institute in Rotorua, New Zealand; an educational invitation to come “Walk in Our Forest” and learn new and sustainable ways of resourcing and building with timber.

Background and Objective

SCION is a government funded Crown Research Institute (CRI), which is a government-owned company that carries out scientific research for the benefit of New Zealand. Each of the seven CRIs is aligned with a productive sector of the economy or a grouping of natural resources.

SCION specializes in research, science and technology development for the forestry, wood and wood-derived materials and other biomaterial sectors.

One key aspirational aspects is to highlight timber technology as the favored construction material for environmental sustainability promoting the following benefits;

Renewable Resource: Wood is a renewable resource, unlike concrete and steel which require significant energy for production and contribute to carbon emissions.

Carbon Sequestration: Trees absorb carbon dioxide (CO2) from the atmosphere as they grow. When wood is harvested and used in construction, it continues to store that carbon, effectively sequestering it and reducing greenhouse gas levels in the atmosphere.

Energy Efficiency: Timber is a lightweight material that requires less energy to transport and manipulate compared to heavier materials like concrete and steel. This reduces the overall carbon footprint associated with construction.

Low Embodied Energy: The process of turning trees into timber products requires less energy and produces fewer greenhouse gas emissions compared to the production of steel or concrete.

Sustainable Forestry Practices: Responsible forestry management ensures that trees are harvested sustainably, promoting biodiversity, and maintaining healthy forest ecosystems.

Recyclability and Reusability: Wood can often be recycled or repurposed at the end of its life cycle, reducing waste, and extending its usefulness.

Aesthetic and Biophilic Benefits: Timber construction can create aesthetically pleasing and comfortable living spaces, promoting human well-being and connection to nature.

Overall, timber construction supports sustainable development goals by reducing carbon emissions, promoting responsible land management, and offering efficient, eco-friendly building solutions.

Actions and Implementation

The approach to site master planning offered the new building as an insertion within the existing 50 year-old ageing campus, which achieves a lot in improving the sprawling sites key adjacencies.

The predominant use of timber as the construction material of choice is illustrated primarily by the open mesh of the Diagrid is at the core of design with timber offering a negative carbon figure when evaluating the building's carbon footprint.

Prefabrication and careful co-ordination of timber components throughout has been essential to the realisation of this project.

Key to the architecture is the expression of the Timber Diagrid structure. The three level, Laminated Veneer Lumber structure, provides the gravity and lateral framework. The diagrid legibly demonstrates that timber structural buildings do not need to be designed like steel and concrete buildings but instead can act more like trees where strength follows the continuous grain of the wood. The LVL Diagrids are assembled from a limited number of repeating, multi story components, to promote repetition, and to simplify both fabrication and site erection.

Extensive prototyping and testing allowed a laminated LVL node to be used at key junctions. The structural node transfers loads and holds a seismic fuse to yield and be replaced after an earthquake. With this simple shift in thinking the structural size of the timber has reduced by around a quarter.

The spatial form, structure and envelope are integral with the building's sustainability initiatives. Structural elements provide an organizing element for flexible services reticulation and the floor plate arrangement, together with the double skin façade, work intrinsically with the mixed mode ventilation strategy. Extensive glazing offers an abundance of natural light to limit active lighting with the design strategy for the fritted pattern to the facade evoking a leafy forest, as well as being vital for the building's thermal strategy. Used in conjunction with low-end performance glazing to regulate the internal temperature and loads, the pattern increases frit density to north and western facades and alters in gradient up the height of the building to help regulate internal temperatures.

Outcomes and Impacts

Te Whare Nui o Tuteata, connects the former disparate wings of the SCION Campus, and provides a new public interface to Rotorua and the wider community.

Externally, the peaked entry speaks to a growing relationship with Manawhenua. Patterned glazing, serving an important environmental purpose, visually connects to the surrounding indigenous and exotic forestry, asking visitors to 'come walk in our forest.'

Within, the innovative timber diagrid is expressed, and used to add visual complexity, a demonstration of the possibilities of innovative timber design as a structural and environmental solution within the NZ construction and Timber industries. The Three-sided, three-level atrium provides an active and interconnected spatial experience for building users and visitors.

This combination of a flexible, expressive architecture, structurally innovative and resilient engineered timber use, and a world leading environmental outcome in terms of both carbon sequestration and energy use, contribute on all fronts to a successful outcome for this new, public interactive face, of SCION.

Since the completion of the project, publicity for SCION has been achieved on both a local and global scale with visitor numbers and enquiries from the public and industry partners increasing dramatically. Global recognition has also been achieved which has been assisted by the project winning multiple top tier, prestigious awards.

Significantly, as a measurable outcome, the SCION Innovation Hub also achieved embodied carbon zero at the time of completion. Furthermore, to measure all life and end-of-life carbon, the new building was assessed to achieve the 2030 target set by the Royal Institute of British Architects (RIBA) of 500kg of carbon/msq making it 10 years ahead of its time.

The building demonstrates efficient and effective use of renewable materials in construction and is a sustainable alternative to building with steel. Sustainable initiatives such as the double skin façade, which provides passive ventilation to the interior environment, LED lighting and solar shading all contribute to reducing the ongoing annual operation costs.

Utilising low energy light fittings together with the mixed mode ventilation system including double skin façade to lower heat gain and loss, the operational energy required and carbon emissions that the building produces each year is substantially reduced. Based on energy use modelling data, the Innovation hub is modelled to use just 80kwh per m2 per year. This equates to 11kg CO2/m2 (compared to 17kg CO2/m2 for the Reference Building described above).

Through the predominant use of timber materials, the building has a Sequestered Carbon total value of -530,488.38 kg carbon, equating to a Sequestered Carbon value of -284.29 kg carbon /m2 (approximately -300kg carbon / m2). The building containing 454 m3 of wood in the primary structure alone, stores approximately 418 tonnes of CO2-e for the life of the building. This storage is equivalent to the emissions from 160 return flights from Auckland to London. SCION advise New Zealand radiata pine forests can regrow this amount of wood in only 35 minutes.

Te Whare Nui o Tuteata provides an invitation to researchers, the timber industry, and the community to come understand the value of timber research and innovation and be part of the future. The building represents a real prototype, rather than just a possibility, for all future buildings and lays a marker on New Zealand’s journey to be carbon zero by 2050.

Sustainability and Scalability

Te Whare Nui o Tuteata represents more than 10 years of advancement and sophistication in the way timber structural buildings are not just put together but conceptualised. The project is about benefitting futures and encouraging our participation with the environment. Thinking harder about how what timber is good at and how timber buildings might be better prefabricated and pieced together has resulted in a globally significant scientific demonstration of how we might build tomorrow.

The learnings taken from the SCION project demonstrate scalability for several reasons:

1. **Prefabrication:** Mass timber elements are often prefabricated off-site, allowing for efficient and rapid assembly on-site. This prefabrication process can be easily scaled up by producing more components in factory settings.

2. **Construction Speed:** Compared to traditional construction methods, mass timber structures can be assembled quickly due to their lighter weight and ease of handling. This speed enhances scalability as projects can be completed faster.

3. **Design Flexibility:** Mass timber offers versatility in design, accommodating a wide range of architectural styles and building types. This adaptability makes it suitable for scaling projects of varying sizes and complexities.

4. **Environmental Benefits:** As a sustainable material, mass timber aligns with growing global trends towards eco-friendly construction practices. Its scalability supports the construction of larger buildings while maintaining a low environmental impact.

5. **Structural Performance:** Advances in mass timber technology have improved its structural properties, enabling taller and larger buildings to be constructed with confidence in safety and durability.

6. **Market Demand**: Increasing awareness and demand for sustainable building materials and practices drive the scalability of mass timber construction. More developers and investors are willing to invest in larger projects using mass timber due to its environmental benefits and market appeal.

The biggest challenges for a growing market in New Zealand include:

1. Timber expands and contracts as it gets wet and subsequently dries out meaning the dimensional stability of timber elements during highly variable weather conditions during erection. Development of temporary protection strategies are important to mitigate this issue

2. New Zealand has a considerable forestry industry which has the capacity to meet the demands of the New Zealand (and some overseas) construction markets, however the number of merchants and fabricators is still limited. This means for larger scale projects; the source of timber supplier and fabricator needs to be known at an incredibly early stage in the project phase to ensure project timeframes can be aligned with available providers.

As a direct example of using the SCION project learnings, RTA Studio, in collaboration with the structural engineers have designed and developed the diagrid structure to allow it to be implemented at a larger scale on a building project that is six times larger than SCION and introduces alternative geometries to suit differing site, programme and seismic conditions. Key to this was simplification of the individual parts and connections to allow them to be made with simpler, faster machinery and prefabricated into various assemblies by the site install team, rather than through specialist prefabrication in the factory. This means the timber fabrication factory has a smoother and much more efficient workflow and saves valuable specialist factory floor space leading to a more commercially viable outcome.

Gender and Social Inclusivity

Within a cultural context, a project priority was to uplift the connection between SCION and mana whenua (the indigenous people (M?ori) of Aotearoa (New Zealand) and re-engage with the Rotorua community.

The project benefitted from collaboration with Nga Hapu e Toru in particular who hold mana over the whenua. RTA Studio/Irving Smith Architects facilitated a collaboration process which involved a regular working group of key department representatives, RTA Studio/Irving Smith Architects, and representatives from Nga Hapu e Toru.

Initial meeting held between SCION and Mana Whenua representatives who expressed a willingness to work with the design team in coordinating cultural thinking into key aspects of the building design. Two Design Workshops were held with mana Whenua during a critical juncture of the design where concept options were tabled by the architects for the main entrance of the building, the arrival and visitor procession was established to be in keeping with Te Aranga principles, and the overarching concept approach for the building and façade systems were discussed and agreed.

The shared design intent was to create a harmony between traditional and contemporary. This was achieved by digitising the traditional kowhaiwhai, allowing it to be physically carved into the canopy posts using a computer Numerical controlled (CNC) machine, the same technology used to create the timber structure of the building.

The success of this collaboration allowed meaningful connections between SCION and mana Whenua and culminated with the building being gifted the prestigious name "Te Whare Nui o Tuteata." This name acknowledges the mana of the tupuna Tuteata, from whom Nga Hapu e Toru descend and the connection to the whenua, Titokorangi.

"The gifting of our tupuna name signifies the beginning of a special relationship which is mutually beneficial to the hap?, and to SCION.

" Veronica butterworth hap? representative

Innovative Initiative

Te Whare Nui o Tuteata represents a world first commercial building constructed using a three level, engineered Timber Diagrid. This high level of invention reflects SCION's ambitions for this building to act as a centerpiece of the replanned campus, and a public showcase of the research led timber innovation occurring within.

Key within this innovative response is the timber node, and its seismically resilient connections to adjacent structure.

For this key detail, two prototypes were built from Laminated Veneer Lumber and lab tested to confirm their structural performance and their buildability with available timber technologies in the NZ industry. This significant prior testing and proving process, contributed to the repeatability of timberwork, and to a speedy site erection sequence.

The Innovation Hub is carefully designed to be both a resilient and repairable structure, increasing its longevity.

Careful attention to acoustic performance enhances this ability to sustain multiple functions within the single open volume of the internal space.

Service space, located in the subfloor, below the raised timber roof, again enable rework of replacement of Building services systems over the buildings lifespan, with simple access to all zones. While currently connected to the Campus wide heating system, the building is designed to connect to a wood chip burner in future, to further reduce ongoing energy use when this technology becomes feasible.

Resources devoted to delivery

As SCION is a government funded Crown Research Institute (CRI), the project was government funded.

As a commercial mass timber construction project, Te Whare Nui o Tuteata required several key resources across different stages of development, construction, and operation. Here are the main resources involved:

1. **Design and Engineering**:

    - **Architects and Engineers:** Professionals specializing in timber construction methods, including architects, structural engineering, services, fire, acoustics, and sustainable design.

- **Software and Tools:** CAD software, BIM (Building Information Modelling) tools, and simulation software for design optimisation and structural analysis.

2. **Materials:**
    - **Mass Timber Products:** Cross-laminated timber (CLT), glued laminated timber (glulam), and Laminated Veneer Lumber (LVL) engineered wood products.
    - **Connectors and Fasteners:** Specialised fixings and fasteners designed for timber construction.
    - **Envelope and Enclosure:** Roof and wall claddings, along with glazed curtain wall façade systems.
    - **Insulation and Finishes:** Thermal and acoustic insulation materials, as well as interior and finishes.
3. **Construction and Labor:**
    - **Skilled Labor:** Carpenters, installers, and construction workers trained in timber construction techniques.
    - **Timber Fabrication and general Construction Equipment:** CNC machines, Cranes, lifts, and other specialized equipment for handling and erecting large timber components.
    - **Safety Equipment:** Personal protective equipment (PPE) and safety systems specific to timber construction.
4. **Regulatory and Compliance:**
    - **Consents and Approvals:** Regulatory approvals for building codes, fire safety, environmental standards, and zoning regulations.
    - **Consultants:** Legal advisors, environmental consultants, and experts in regulatory compliance.
5. **Project Management:**
    - **Project Managers:** Professionals overseeing budgeting, scheduling, and coordination of subcontractors.
    - **Software Tools**: Project management software for scheduling, cost tracking, and communication among stakeholders.
6. **Logistics and Transportation:**
    - **Transportation:** Trucks and logistics for transporting mass timber components from manufacturing facilities to the construction site.
    - **Storage and Handling:** Temporary storage facilities and proper handling equipment at the construction site.
7. **Utilities and Infrastructure:**

- **Utilities:** Water, electricity, and other essential services required during construction and for ongoing operation.
- **Infrastructure:** Access roads, temporary access for construction vehicles, and site amenities.

8. **Commissioning and Operations:**
    - **Testing and Commissioning:** Performance testing of building systems and components post-construction.
    - **Maintenance:** Ongoing maintenance plans and resources for maintaining timber structures over their lifespan.

These resources collectively supported the planning, execution, and sustainability of the project, ensuring compliance with regulatory requirements and achieving project objectives efficiently and effectively.

Conclusion

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