CASE STUDY: SELWYN AQUATIC CENTRE

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ABSTRACT
The Selwyn Aquatic Centre Expansion project, located in Rolleston, Canterbury, consists of a long span mass timber superstructure above the 25m lap pool. The exposed mass timber provides numerous benefits both to the end user; through the warm, inviting environment, and to the client; by meeting the project's sustainability and durability goals. Perhaps more importantly it has addressed a common issue of corrosion affecting ferrous structural members in chlorine rich, moist environments.

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1 PROJECT OVERVIEW

In recent years the Selwyn District of Canterbury has experienced high population growth rates double that of major centres of New Zealand.[1] The community has a high proportion of young families, and this has led to an increased demand for leisure facilities. The initial design brief called for a new "learn to swim" pool with provision for a fitness centre and associated café, however a risk assessment of the options available identified that each caused learner swimmers to walk past the existing deep-water competition pool. During design development an innovative solution was adopted whereby the learn-to-swim pool was instead formed by reducing the depth of the existing pool while a new competition standard pool was constructed beyond.

The new pool hall required long span construction in excess of 30m so it was essential that the structural system was considered at the earliest stages of design.

2 PROJECT DRIVERS

Warren and Mahoney has long recognised the value of promoting timber buildings and has a 2030 goal of reducing embodied carbon in all new projects by 40%. Timber is a renewable resource which is often locally grown and acts as a natural carbon store; it therefore has negative carbon emissions. In comparison, steel

Figure 1: Selwyn Aquatic Centre Extension

and concrete have high embodied carbon from intensive manufacturing processes.

Research has shown that the use of natural elements, like wood, in the interior of a building can provide a healthier, happier environment.[2] This is particularly important in a facility designed to promote health and happiness.

Although material costs often exceed concrete and steel, mass timber is well suited to precision off-site fabrication; because of this, programme times can be reduced resulting in cost efficiencies for the client. Additional cost efficiencies can be found in reduced foundation requirements due to the lighter structure when compared to steel or concrete.

3 TIMBER AND POOL ENVIRONMENTS

The environment of a swimming pool is particularly aggressive towards ferrous materials because of the combination of high humidity and chlorine working together. This puts the qualities of timber to the fore. Glue laminated timber (glulam) is an excellent choice of material in such an environment as it will neither rust nor corrode.

Timber does not come without its drawbacks, however. As a natural material timber is always moving – swelling with increased humidity and shrinking back in dryer conditions as it seeks equilibrium with the surrounding atmosphere.[3] This can cause large sections of solid timbers to twist, split or bow. Untreated timber in contact with water or humid air can be prone to rot or disfigurement.

The adoption of glue laminated and laminated veneer lumber (LVL) timber sections in a pool environment addresses these directly. Manufactured from selected grade, kiln dried timber the multiple short lengths adhered using durable moisture-resistant adhesives control the movement and offer increased stability.

In addition, New Zealand grown Pinus Radiata is readily treated to NZS:3640 Hazard Class H1.2, H3.2 or H5[4] - depending on the Service Class application as defined in NZS:1328.1:1998.[5] This pressure treatment results in a highly durable product which is suitable for indoor swimming pool environments.

Figure 2: Feature Glazing

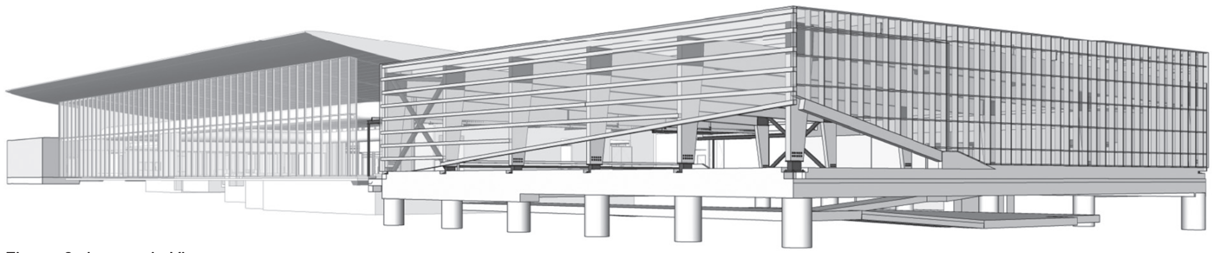

Figure 3: Isometric View

4 STRUCTURAL SYSTEM

The primary superstructure of the pool extension includes exposed glue laminated timber portal frames with steel knee joints in the north-south direction, LVL roof purlins and a single bay of steel roof and wall bracing in the east-west direction.

4.1 Portal Frames

The six exposed GL12 glued-laminated portal frames are spaced at 6.7m and span 31.5m. The pin-base portals consist of 1305x280 rafters and tapered 1305-740x280 columns. The members are governed by gravity deflection while the connections are governed by ULS seismic forces. Elastic seismic loads have been adopted for the lateral resisting system in both directions.

The portal segments are connected by a steel knee joint with epoxy rods. The steel knee allows for the entire compression zone on the timber to occur parallel to grain, creating a stiffer, stronger connection by avoiding perpendicular to grain bearing. M24 threaded rods are used for the epoxied connection to transfer the tension caused by the joint moment, and the joint shear. Couplers are added at the end of the rods to increase the bearing area and thus the shear capacity. An additional threaded rod is installed perpendicular to the grain between the primary rods to help prevent splitting at the shear interface (Figure 4). The epoxy used in the connections is East 221 (Polymer Developments) which has demonstrated good performance in structures for periods of over 20 years.[6] Further guidance on the design of portal

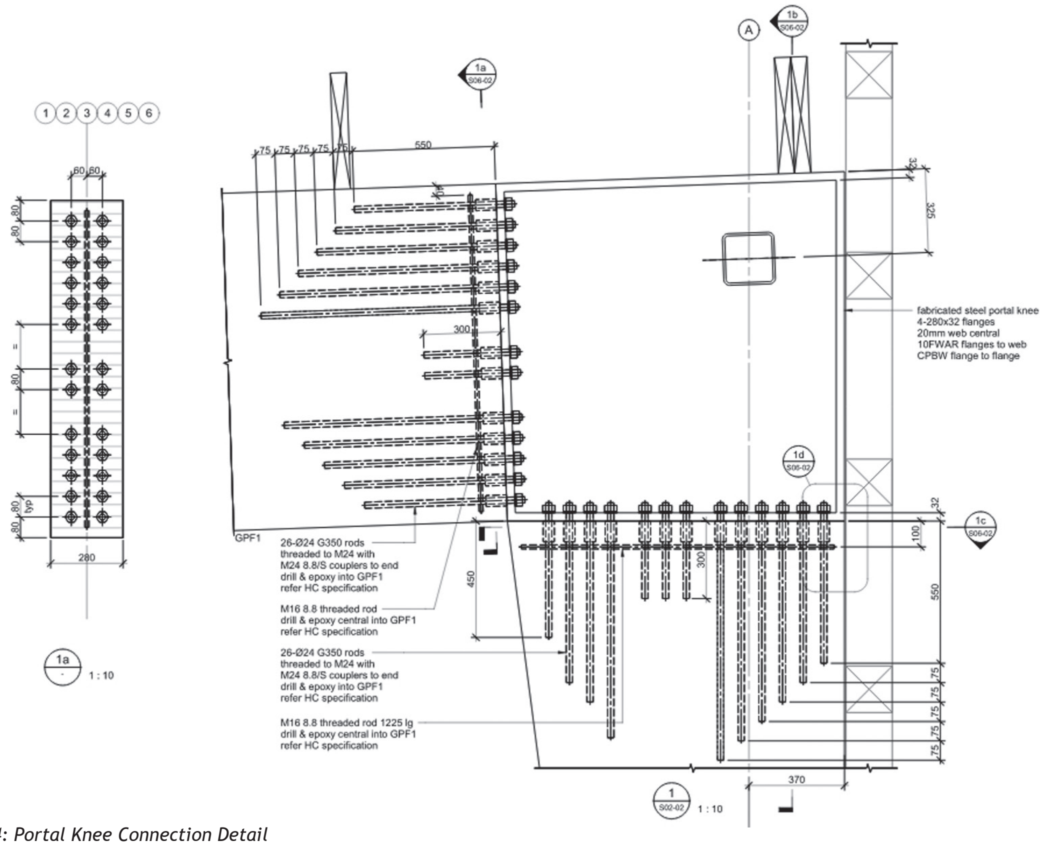

Figure 4: Portal Knee Connection Detail

connections can be found in NZ Wood Design Guides Ch. 12.5 – Portal Knee Connections.[6]

The members were fabricated by block gluing two 140mm wide sections together. This allowed for the installation of the concealed steel brace connections. The block gluing also allowed for the 280mm wide beam to achieve GL12 glue laminated timber rating without the need for 280mm wide laminations which can more difficult and expensive to source than 140mm laminations to achieve the GL12 rating. The epoxy rods were pre-installed by the timber manufacturer in a controlled offsite environment while the knee joints were assembled onto the rafters on site to limit the required transportation length. The rafter and knee joints were then lowered on the temporarily braced columns allowing the timber superstructure to be erected relatively quick and easy on site.

Figure 5: Portal Frame Installation

4.2 Bracing

The single bay of steel tension-compression roof and wall bracing is used for the east-west lateral resisting system. Five lines of SHS collector struts transfer the lateral load from the western portals into the bracing nodes on the eastern bay. The single bay of tension-compression wall bracing was opted for based on the aesthetics, to allow unobstructed views through the skylights, and to reduce the number of bracing bays required. The bracing nodes are prefabricated into the glue laminated timber portals to create a clean architecturally exposed joint.

5 DURABILITY

Durability in a pool environment is an important aspect in the design. All structural elements and connections are designed with consideration of performance in the humid and chlorinated environment. As such, a Xypex additive is used in the 35MPa concrete, and greater than code minimum cover (50mm) is specified for concrete elements. Concrete directly exposed to the pool environment is lined with a Degadur resin coating. H3.2 glue laminated timber is used for the walls and portal frames where exposed to the wash down zone in the pool environment. Light timber is generally kept above the wash down area or raised and encased behind the vapor barrier.

Figure 6: SHS Braced Bay

Structural steel is typically exposed for continuous observation. Steel coatings are classified as Corrosivity Category C4 (high), in line with AS/NZS 2312.1-2:2014, for pool environments.[7]

Structural bolts are duplex coated – galvanized and epoxy topcoat to meet Category C4. Stainless steel bolts are not used because of the potential risk of stress corrosion cracking. BS EN 13451-1:2011 – Swimming Pool Equipment discusses the use and potential risk of stress corrosion cracking in some stainless-steel materials.[8] Due to its composition, certain stainless steel, including typical grades 304 and 316 can be susceptible to stress corrosion cracking which can happen spontaneously and is often invisible to the human eye. The standard specifies certain acceptable grades of stainless steel that can be used in pool environments. Given that these grades can be more difficult to obtain in New Zealand, the duplex – galvanized and epoxy coated system was specified.

6 CONCLUSION

The Selwyn Aquatic Centre Expansion project is a case study outlining the successful use of mass timber for the long span structure in a pool climate which can be harsh on steel members and fasteners. The timber structure provides numerous benefits that help meet the project sustainability, durability, and construction goals. The exposed timber provides a warm, inviting environment for patrons to enjoy the health and fitness facility.

7 REFERENCES

1. Selwyn District Council Website 18/11/2021. (Selwyn leads the nation in population growth).

2. Pollinate report, 2018: “Workplaces: Wellness + Wood = Productivity”.

3. Multi-Storey Timber Buildings Manual, Beattie, Buchanan, Gaunt, 2001

4. Standards New Zealand NZS 3640:2003 Chemical preservation of round and sawn timber.

5. Standards New Zealand AS/NZS 1328.1:1998 Glued laminated structural timber - Performance requirements and minimum production requirements

Figure 7: Portal Base Connection

6. King, D. and Van Houtte, A. (2020). NZ Wood Design Guides Ch.12.5 – Portal Knee Connections. WPMA, New Zealand.

7. Standards New Zealand (2014). AS/NZS 2312.1:2014: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. Part 1: Paint Coatings.

8. British Standards Institution (2011). BS EN 13451-1:2011: Swimming Pool Equipment. Part 1: General safety requirements and test methods

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