

# Timber design comes out of its shell for performance space

Construction is now complete on the Performance Shell entertainment facility in Western Australia's South Hedland, near Port Hedland. The facility, which was developed as part of a major infrastructure scheme for the Pilbara Cities Initiative, will be used to host an array of concerts and community events.

The design concept of a timber-framed Performance Shell structure was conceived by the Advanced Timber Concepts Research Centre (ATC) attached to the School of Architecture at the University of Western Australia; and a preliminary structural arrangement developed in conjunction with structural engineer Bill Smalley of Scott Smalley Partnership. The theatre complex includes changing rooms, storage areas, public ablution facilities and machine rooms for the landscape systems and structures.

Melbourne-based company Timberbuilt provided the specialised timber engineering design services required to turn the architectural concept into a reality.

Working closely with the architectural team and structural engineer Smalley, Timberbuilt designed a structural system using laminated veneer lumber (LVL) manufactured by Western Australian company Wesbeam from Pinaster Pine. Timberbuilt director Bruce Hutchings said LVL was ideally suited to the project application.

"LVL is manufactured by laminating multiple layers of peeled timber veneer to make a structurally uniform and predictable material suited to high load critical applications," he said. "The Performance Shell structure is located in wind region D and will in all probability be required to resist severe cyclonic wind loadings."

The structure of the Performance Shell comprises a series of eight curvilinear segmented arch frames which are bound into a cellular "shell" by a series of transverse members and crossed tension bracing of each cell. The arch frames spring from buttress supports to a maximum height of around 6m and span 15m. The frames, each differently shaped, lean outwards from their support points with the plane of the rearmost frame angled at 36 degrees to the horizontal.

The structure was modelled by Tim-



The South Hedland Performance Shell in WA incorporates laminated veneer lumber into its design.

berbuilt from a computationally derived digital model prepared by ATC using Cadwork, a Swiss developed 3D modelling software package. The software was then used to create machine data files for the operation of a Hundegger, CNC carpentry machine to precisely cut, shape and bore each of the timber components. Prefabrication at the Timberbuilt factory in Melbourne included assembly of each frame in half segments with base brackets attached. The frames were jointed at the apex on site by bolting through prebored holes, lifted into place and the base welded to the base plates attached to the concrete buttresses. The transverse blocking pieces were supplied accurately shaped and fitted with the connections ready for attachment to the arch frames. All components were identification marked and packed onto a trailer base for the journey to South Hedland via Perth.

The structure was erected on site in less than four days. A further two days was required for the installation of the specialised opaque fibreglass membrane which is tensioned above the upper curvature of the shell form. The membrane, which was fabricated and installed by the MakMax/Taiyo Membrane Corporation, protects the stage area from sun and rain.

The stage flats and the exterior walls

of the back stage facilities are constructed from locally sourced rammed earth while the interiors are lightweight and prefabricated to minimise site construction time and ensure a high standard of construction. Application of the rammed earth was designed to complement the locally sourced landscape, which features a gently sloping grassed amphitheatre that forms the seating area for the theatre.

"The project is of interest both because of the successful demonstration of the use of advanced design and fabrication technology and the innovative structural and design engineering with LVL," said ATC principal Patrick Beale.

"The collaboration between the architectural, engineering and fabrication participants facilitated by the application of this technology was particularly rewarding."

The Performance Shell was built as part of a newly developed urban centre, which the project team said is the first major piece of new infrastructure in the city. It includes revisions to the stormwater system, the road network and community facilities. The project was developed by LandCorp with urban and landscape design by Urban Design Landscape Architecture. ■