

This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.



A Steel Performance at Mandurah

The Mandurah Performing Arts Centre presents a striking new landmark in the city of Mandurah approximately 75 kms south of Perth, and is a fine example of structural steel construction meeting an extremely tight budget whilst satisfying the architectural and functional requirements of a state-of-the-art theatre complex.

The facility comprises an 800 seat main theatre, a multi purpose 160 seat studio theatre, an art gallery, dance studio and music rooms.

Located at the entrance to the Peel Inlet in the heart of Mandurah, the structure is founded on fill material which was dredged from the inlet, deposited then compacted on an adjacent site. Tests established that the existing ground and subsequent fill would be suitable for conventional pad foundations for a light-weight structure.

After careful consideration, steel construction was adopted for the Performing Arts Centre as it offered distinct advantages, such as:

- **The ability to achieve varied, complex details:** Use of light-weight steelwork and prefabricated frames allowed the architect to achieve the special details required.
- **Speed of erection:** Steel framing was considered the best option for the construction of large open volumes and spans required for this type of structure.
- **Minimum Weight:** The steel framework was light-weight, which was a distinct advantage on this site, since it enabled significant savings in the foundation design by allowing conventional pad footings.

The Structure

Roof:

The main roof of the auditorium comprises steel trusses spanning 21 metres. The main trusses are fabricated from 100x100x10 EA angle chords and diagonal members to form a very simple and economic roof structure. The trusses support a heavy sound insulated roof, suspended air conditioning equipment and extensive walkways. These suspended walkways, which give access to the multitude

of stage lighting equipment, were prefabricated using cold formed steel members to minimise their weight.

Fly tower:

The fly tower structure incorporates the main stage, as well as being utilised for back stage scenery and prop storage. The steel framed 20 metre high tower supports the fly grid and counter weight system over the stage area. The fly tower was constructed using universal beam columns varying from 360UB's to 250UB's with a system of tubular steel bracing. The fly tower grid was fabricated from 380PFC channels in pairs supporting the suspended flies and lighting over the stage.

Upper circle:

The upper circle's tiered seating was constructed to combine minimum weight, stiffness and strength to span 21 metres of the auditorium. This was achieved using 360UB raking members supported on a 1200WB



member. The raking members support prefabricated steel angle seating trusses and timber flooring.

Walkways:

Around the perimeter to the eastern side, exposed steel cantilevered roofs are featured over the walkways and entry. To the south side, a boardwalk provides a pedestrian promenade to Manjar Bay. It consists of timber walkways supported on UB steel framed members and CHS steel piles. The majority of the tube piles used were approximately 9 metres in length with deep, soft ground requiring 18 metre long piles. In areas of soft ground, covering end plates were welded onto the bottoms of the piles, allowing them to achieve the required set at a shallower depth. This method assisted in reducing price overruns in pile costs.

Over the boardwalk, high level exposed steel beams are supported by fully welded four leg steel crucifix frames on precast columns.

Exposed steel feature:

Exposed steelwork was extensively featured in the southern and eastern foyers. Both main foyers have full height glass walling some 50 metres long and 7 metres high. These glass walls are supported on vertical 110x12mm flat steel fins at 2.7 metre centres and 65x35x3.0RHS horizontal members at 1100mm centres. The fully welded sub-frames are in turn supported by the main 219.1x4.8CHS columns and 250UB37 transoms. The exposed steelwork is detailed to offer clean lines and minimum interruption to the magnificent views across the inlet. Great care was required in the detailed connections, as this steel may be viewed very closely within the foyers. Only steel could

provide the extremely tight tolerances required. Within the southern foyer is a steel framed feature staircase leading to the upper circle seating and administration offices.

Acoustics

To maintain and enhance the acoustic and visual qualities in the main auditorium, a very colourful acoustical fabric mounting system known as 'Snap-Tex' was used on the rear wall to ensure the area not only looks good but that it sounds right too. The ceiling has timber panels suspended off steel frames to suit acoustics and architectural details, by hiding catwalks and lighting.

Surface Treatment

Being close to the inlet, the site is exposed to both wind loads and wind borne salinity. Thus, all steelwork was abrasively cleaned to class 2^{1/2} and then coated with 75µm. of inorganic zinc silicate primer. Where visible, steel was top coated with a high built epoxy Dulux Ferrodor EPX 250µm. Stainless steel bolts and dome nuts were also used as a feature, where visible. All connections were detailed to avoid entrapment of moisture or salt deposits.

Boardwalk piles were abrasively blasted to class 2^{1/2} and coated with a bituminous base one metre below water level and top coated above water level.

Erection

All steelwork was erected on site using a 50 tonne capacity mobile crane. Steel wall frames were preassembled on site and erected to the final position as one unit, saving time.

Conclusion

"A complex structure that went well and was quick to erect", said Barry Edwards of Cooper & Oxley. This outstanding project represents an excellent example of steel's versatility by achieving tight tolerances, speed of erection and minimum weight. The project will remain a landmark civic facility to serve the new millennium.

Client: Western Australian State Government / City of Mandurah
 Architect: Hames Sharley
 Structural Engineer: Halpern Glick Maunsell
 Builder: Cooper & Oxley
 Fabricator: Symonds Engineering
 Piling: Ground & Foundation Supports
 Distributors: Steelmark Eagle & Globe
 Tubemakers Steel
 Union Steel

Photography: Martin Farquharson

Front cover: Exposed steel cantilevered roofs are featured over the walkways.

Opposite, top: Southeast elevation and boardwalk.

Below: Steel frame members over water.



Above, centre: Steel roof trusses, raking members and four leg crucifix frames.

Above: Fly tower under construction.

Left: Full height glass walls supported by steel subframes and columns.

