The Venue:

- **CentreStage** international design competition winner.
- 575 seat main theatre.
- 237 seat flexible studio space.
- Two rehearsal rooms.
- Spacious foyers and public amenities.
- Outdoor courtyard.
- $91 million Project.
- More than 70 specialists involved during Design Development.

Strategic Location: in the transportation hub of Perth’s CBD to facilitate easy audience commute and complement the Northbridge area.

Stacked Theatres: The Architect elected to locate the Main Theatre on top of the Studio Theatre and vertically stack the foyers that directly connect to Roe, William and James Streets through the public concourse level. This arrangement conceived the main concourse, studio theatre and main theatre foyers as a single space separated vertically, highlighting the sense of interaction and allowing spectators to momentarily become spectacle while minimizing the building footprint.

Below Ground Concealment: To achieve the architectural concept without impacting the low-rise Northbridge buildings surrounding, a large portion of the building had to be located below the ground level.

Design Considerations:

- **High Watertable Level** with very high permeability characteristics as the whole area was reclaimed from Lake Kingsford using highly porous sand fill by the early 1880’s - 65MPa uplift pressure.

- **Potential Acid Sulphate Soils (PASS)** caused by the natural organic deposits at the base of the reclaimed lake site. Aerating these deposits may lead to acid formation which causes Occupational Health and Environmental concerns - Limit De-Watering.

- **Vulnerable Neighbourhood** which forms a significant part of Perth’s heritage - Steel and retention system.

- **Limited Accessibility** This prime location at the entrance to Perth’s CBD warrants high accessibility of construction equipment, deliveries to the site and confines the construction space - Thoughtful selection of construction method and material.

- **Watertightness** reducing the risk of water ingress by dependence on forming an inherently watertight concrete shell - Special Mix Design.

- **Acoustic Isolation** of sound and vibration from outside sources and between the compartments inside the venue - No rigid links.

- **100 Years Design Life** to first major maintenance of the structure established by the design brief - Careful Selection of material and stress level.

Conventional Soil Retention System:

- **Stainless Steel Anchors**
- **Access for Re-Stressing**
- **Larger Buoyancy Forces**
- **Increased De-Watering**
- **Limitations to redeveloping the adjoining sites**
- **High Cost**.
- 340mm Dia. Belled-End Piles.
- 32mm Macalloy Stress Bar.
- Full compression on concrete section at all stages.
- P/T duct filled with MC 2020 Migrating Corrosion Inhibitor – Reduce rate of both Cathodic and Anodic reaction.

### Post Tensioned Belled-End Piles

- Upper and lower stiffness values.
- Design limiting tensile stresses in reinforcing steel.
- Low shrinkage blended cement with pore-blocking ingredient.
- 600mm Raft with 82 P/T belled tension piles.

### 3D Modeling

- Finite Element Mesh
- Uplift Shear Stresses

### Top-Down Construction

- Top-Down construction to laterally stiffen the soil retention system and limit settlement of adjacent buildings.
- Seismic stiffening diaphragms established, to a large extent, outside the excavation envelope within the limited scope available.

Airey Taylor Consulting Engineers & Scientists
DESIGN ACHIEVEMENTS
- Extended design life;
- Minimisation of the environmental impact;
- Limiting the impact on surrounding buildings;
- Managing high uplift pressure;
- Cost effectiveness.

SUSTAINABILITY ASPECTS
INNOVATIVE ANSWER
- Engagement of Soil Mass to resist buoyancy;
- High stiffness diaphragm wall - Reduce retaining wall deflection to limit the effect on the adjacent structures;
- Skewback construction technique - Eliminate the use of the highly expensive permanent ground anchors; Reduce dewatering operation;
- Comprehensive Soil Structure interaction - for the soil retention system considering construction stages;
- Optimised Design - elimination of the use of the highly expensive permanent ground anchors and rotational fixity at Basement 2 raft;
- Self consolidating blended cement matrix with pore-blocking hydrophobic additives to minimise the permeability to enhance the functionality and prolong the design life.

ISOLATION OF SOUND AND VIBRATION FROM OUTSIDE THE VENUE
- The outside noise source includes trains passing through Perth’s Main line station which is across the road, location of vehicles noise from public transport buses, trucks and cars travelling along Roe and William Streets and commuter noise.

Acoustic Considerations
- ISOLATION OF SOUND AND VIBRATION FROM OUTSIDE THE VENUE: The outside noise source includes trains passing through Perth’s Main line station which is across the road, location of vehicles noise from public transport buses, trucks and cars travelling along Roe and William Streets and commuter noise.
- ISOLATION BETWEEN THE COMPARTMENTS WITHIN THE VENUE: Internal isolation is required to prevent noise transfer between the different compartments of which the venue is comprised as multiple unrelated activities can simultaneously take place within the different compartments of the venue.

Design Requirements
- Noise Control Requirements:
  - No solid links between isolated compartments
  - Links can only be established through resilient elements
  - Minimum mass requirement
FULLY INDEPENDENT ENCLOSURES.

CONNECTION THROUGH RESILIENT LINKS.

Below-Ground, Noise-Sensitive Enclosures

Base Isolation

TRANSFER FLOOR

Noise Control - General Arrangement

3D Modeling of Studio Theatre Structure

Main Theatre spanning across the below-ground compartments.

Noise sensitive enclosures connected to main envelope through resilient links only.

Main envelope conceived as a "Cocoon" wrapping the noise sensitive enclosures.
• CONTROL OF STRESSES AND DEFLECTION THROUGH MULTI-STAGE PRE-STRESSING OPERATION.
• PLANNED TEMPORARY PROPPING DESIGNED TO PREVENT OVER-STRESSING THE FLOATING FLOOR PADS.

FLY TOWER CONSTRUCTION

MAIN THEATRE CONSTRUCTION

MAIN FOYER
AIRBORNE NOISE BARRIER

PRESTRESSED U-TRUS, T-FRAME
A PERIPHERAL TRUSS SUPPORTS PRE-CAST CLADDING ON BOTH FACES.
THE STRUCTURE DEPTH FACE IS TEMPORARILY PROPPED TO LIMIT DEFLECTION DURING CLADDING.
STRESS ENDS TENDED FOLLOWING THE INSTALLATION OF THE CLADDING PANELS FACILITATED BY REMOVAL OF TEMPORARY PROPS FROM UNDER THE TRUSSES TO ALLOW DEFORMATION.
MAIN ENTRY

DOUBLE CANTELEVERED CONFIGURATION:
CENTRE OF MASS OUTSIDE CENTRE OF
SUPPORT.
SELF-WEIGHT AND LOADING CAUSE THE
CANOPY TO TWIST AND DEFORM IN NON-
SYMMETRICAL MANNER.
INFINITELY APPLIED COUPING FORCE
EXERTED BALANCING TWIST ENOUGH TO
RECTIFY THE LOCKING TWIST.

The "Bronze Box"