



airey taylor consulting  
engineers  
scientists

## **Copy of Application text for Engineers Australia People and Places Awards 2022**

### **Section 1: executive summary**

#### **Executive summary - Provide a background description of the entry in detail including the reason the project came into existence**

The sculpture is the work of Western Australian artists Sharyn Egan and Jahne Rees with significant input from the Whadjuk Noongar community.

The sculpture welcomes visitors to Rottnest Island (Wadjemup). Entitled Koora-Yeye-Boordawan-Kalyakoorl (Past-Present-Future-Forever), it celebrates Rottnest Island's rich Noongar heritage and importance as a national tourist icon. This project was made possible by funding from the Australian Government and the State Government of Western Australia.

Standing at a height of 9 metres it features precast limestone aggregate concrete and aluminium and matches the colours and form of the beachside setting.

The design was in response to an expression of interest advertised publicly by Rottnest Island Authority (RIA). On behalf of RIA a panel comprising of Noongar representatives, a landscape architect, and professional artists assessed submissions against the criteria advertised.

The sculpture responds to an overarching theme of Gnalang Wadjemup (Our Wadjemup), integral to Noongar culture yet encompassing universal principles of welcome to all who visit the Island.

The climate and coastal attributes of Rottnest Island include exposure to strong winds and salt spray. Materiality was therefore a criterion. The sculpture needed to be low maintenance, durable, corrosion resistant, and aesthetically sympathetic to its surroundings. Artists were asked to note that on-going maintenance of the artwork will be difficult on the Island and should design with that in mind.

Special design attention was to be given to durability for the conditions of salt, rain and winds for the exposed beach-side setting.

Named "Koora-Yeye-Boordawan-Kalyakoorl" (meaning Past-Present-Future-Forever) the resulting and striking sculpture bridges ancient, recent and future history with unprecedented significance for conciliation in Western Australia. It explains the colonial use of the Island as a prison colony for indigenous men while commemorating the spiritual significance of the western end of the Island to the Whadjuk Noongar people as the entryway to the afterlife. This testament to the endurance of the indigenous people into the future stands as a monument for future generations.

Airey Taylor Consulting (ATC) provided Structural Engineering services to the project. Their technical solutions ensured the aesthetic response and final form was made possible, while enhancing durability and enabling safe installation.

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ATC's structural design uses custom shaped glass-fibre reinforced polymers as reinforcement to the low-strength limestone aggregate concrete. Glass- fibre reinforcement will never rust or lead to cracking as would steel reinforcement in the same setting. This is accomplished without the need for additives, cathodic protection and with less cover to bars and lower concrete strength than is suggested in the Building Code for the setting.

Further engineering innovation included the design of temporary post-tensioning to protect the long span and curved shape of the perforated limestone aggregate concrete "shield" during transit. The sculpture was successfully installed without significant cracking after transport from the workshop on the mainland to the Island.

This entry statement was launched in December 2021 and has attracted universal praise from visitors, volunteers, government and media, as well as inspiring indigenous people who were sensitive to the Island's history to visit for the first time.

**Explain why this project should win the Engineers Australia Excellence Awards: project awards 2022. Please include an explanation on which part of the project is to be judged on engineering excellence (all or part of the project).**

This project holds enormous significance for both the Engineering and broader communities and would be a worthy winner of an Excellence Award.

As a significant project to the First Nations people of Western Australia, it is highly appropriate that the careful Structural Engineering response has created a technical first for durability in a beachside monument. As the name of the work "Koorra-Yeye-Boordawan-Kalyakoorl" (meaning "Past-Present-Future-Forever") suggests; it serves as a bridge from the ancient spiritual past of the Whadjuk Noongar people into the everlasting future while promoting a message of hope and conciliation.

This project elegantly demonstrates a state-of the art Structural Engineering solution for a problem affecting a huge number of structures nationwide. More than 85% of Australia's population live within 50 kilometres of the ocean. Many of our coastal structures suffer from corrosion due to rusting of the steel reinforcement within concrete.

This is commonly called "concrete cancer" and it causes widespread cracking and structural damage readily observed in marine and quasi-marine settings around Australia. Conventional solutions include admixtures and cathodic protection; but these are expensive, environmentally unfriendly, sometimes ineffective and often require maintenance or repeat applications.

The solution adopted by Airey Taylor Consulting (ATC) of custom shaped glass fibre reinforced polymer rods in place of steel as reinforcement permanently addresses this risk without requirements for further maintenance.

The relevant building Code (AS3600) recommends a 40MPa mix with 45mm cover to protect the steel reinforcement from saline intrusion and rusting. Compliance with this standard would have prevented the realisation of the narrow and curved artistic form of the main "shield" design desired by the team.

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ATC's use of custom shaped glass fibre reinforced polymers as reinforcement meant that the 200mm thick and curved artistic form of the main "shield" using low strength 25Mpa limestone aggregate concrete that could be inscribed following casting by the Artist.

Glass fibre reinforced polymer rods were used in the base and mount of the entry statement. The complete absence of steel and character of glass fibre reinforced polymers exceeded the RIA's requirements for durability and satisfies the artist's desire to create a monument that speaks to the endurance of the Whadjuk Noongar people.

Additional innovative engineering expertise was used in the creation of a temporary external post-tensioned mount to handle the precast structure safely during fabrication, transport from the mainland workshop to the Island, and installation. Despite the form's sensitivity to cracking during elevation, rotation and movement, the 9 m high and 2.75 metre wide span (permeated with voids) sculpture was installed without visible cracking.

We would like the entirety of the Engineering solutions created assessed for Engineering excellence, with a particular view to the durability solutions adopted.

## Section 2: Judging criteria

***Actual or Potential contribution to social and/or economic outcomes improving quality of life*** : contributes to the local, regional or national economy or improving quality of life by using scientific and technological advances to solve problems in a more efficient and effective manner relevant to the scale of the project.

The intent of Rottnest Island Authority in commissioning the piece was to create an iconic monument of national significance for its global audience of visitors. The sculpture and entry statement form part of a \$17.2 million program of works funded by the Federal Government to revitalise the Island. As such, the sculpture serves as an emblematic change reflective of the improvement of the economic standing of the Island and its facilities as a tourist attraction.

However, the core accomplishment of artists Jahne Rees and Sharyn Egan is that their design successfully provides so many layers of social meaning in a single unified form; perfectly matching the location and serving as a striking, poignant and hopeful structure for conciliation of Indigenous and broader community. In terms of the improvement of the quality of life of Western Australians; the bridging of knowledge and customs from ancient times to the present is invaluable - reclaiming the Island from a poorly acknowledged dark past with an unflinching view while pointing towards a brighter future for all.

Airey Taylor Consulting's engineering skills helped the artists meet the intent of the Rottnest Island Authority for a work that complemented the natural setting as much as possible while providing a new benchmark for durability.

The main arc of the limestone aggregate concrete Shield contains the silhouette of an indigenous warrior detailed in perforations in the front aspect of the curved mass, in turn penetrated and framed by aluminium bars. The hand-crafted durable aluminium penetrates through the concrete shield, appearing as a whale taking the spirit to the afterlife from one perspective, and bars over the silhouetted gaps depicting an Indigenous warrior from another.

The bars (when viewed front on) represent the recent past of the Island's use as a prison for Indigenous men, while the whale (when viewed from the side) represents the cetacean spirits

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who take the spirits of the deceased from the western edge of the Island to their final resting place beyond the ocean (“Koorinup”). The perforations also contain lighting to illuminate the silhouette with a poignant and ghostly glow at night.

The striking nature of the form promotes closer engagement by visitors, and when approached, bilingual sandblasted text across the inside curved of the shield is revealed; explaining the history of the island; the enduring spiritual significance to the Whadjuk Noongar people, and welcoming visitors to the site with hopes for a brighter future for all. The text outlines the significance of the sand ceremony (where visitors should announce themselves to local spirits by rubbing sand in their armpits and casting it into the ocean while requesting protection of the local guardian spirits). The base of the sculpture depicts the Dark Emu constellation, visible to all Indigenous people past, present and future.

For structures in this location, the relevant building Code AS3600 recommends a 40MPa concrete mix with 45mm cover to protect steel reinforcement from saline intrusion. This requirement would have prevented the realisation of the narrow (200mm thick) and curved (1500mm radius) artistic form of the main “shield” design desired by the team, and the type of low strength limestone aggregate concrete used to match the location’s sandy beaches..

ATC’s Structural Engineering design used custom shaped glass fibre reinforced polymer (GFRP) rods in place of steel reinforcement in the main concrete “shield” structure, enabling the artists to use 25MPa limestone aggregate concrete to match the surrounding landscape and with only 30mm cover despite the corrosive setting.

The stresses of rotation, handling, and movement along the length of the curved span were significant; and ATC designed extended temporary post-tensioning to protect the “shield” from cracking during fabrication, transit, and installation. The embedment of the sculpture (and aluminium “spear”) in concrete cast flush with the ground creates a free-standing monument with no visible lateral restraint, with GFRP reinforcement used throughout the mounting and footing.

In their launch speech, Jahne and Sharyn kindly thanked Airey Taylor Consulting for the Structural Engineering innovations that will help the monument endure into the future. All stakeholders have been delighted with the result, with the WA Minister for Tourism David Templeman “This incredible artwork pays overdue recognition to the Noongar people at Wadjemup and spreads a hopeful message of reconciliation that we can all share.”

***Significance of the work as a benchmark of Australian engineering*** : demonstrates innovation and sets new benchmarks, and/or continues current high standards, thereby raising the standard and standing of Australian engineering relevant to the industry and/or field of technology.

Airey Taylor Consulting (via Managing Director Peter Airey AM) presented a nationally streamed seminar on 19 August 2021 for Engineers Australia about the firm’s development and use of glass fibre reinforced polymers as reinforcement in Australia over the past decade. A formal paper explaining the Structural design parameters for the use of the material was presented by ATC Staff to the 30<sup>th</sup> National biennial conference of the Concrete Institute of Australia on 5 September 2021. The firm’s work is acknowledged as both pioneering and continuing to set the pace for development of GFRP design in Australia.

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GFRP design is directly and strategically linked to the development of durable structures for Australia's future. More than 85 percent of our national population lives within 50 kilometres of the ocean, and concrete structures suffer from corrosion due to susceptibility of steel reinforcement within concrete to rust due to salt ingress in coastal regions. This "concrete cancer" causes widespread cracking and structural damage and can be readily observed in marine and quasi-marine settings around the country. Conventional countermeasures such as admixture additives and cathodic protection are expensive, environmentally unfriendly, and often require maintenance or repeat applications.

The Wadejump entry piece, launched in December 2021, represents the boldest use of the material in Australia to date to address the problems of corrosion suffered by our nation's coastal concrete structures. It both continues ATC's pacesetter development of the use of GFRP and sets new standards in the possibilities of the materials for the Engineering community.

The sculpture will never suffer from concrete cancer despite location directly on the beachfront while using low strength limestone aggregate concrete and thin cover. No other anti-corrosion treatments were used, and no upkeep or maintenance is required to maintain its condition as installed.

ATC's use of custom shaped glass fibre reinforced polymer rods also extended the limits of possible aesthetics in terms of a built concrete form.

ATC's use of custom shaped glass fibre reinforced polymers as reinforcement meant that the 200mm thick and curved artistic form of the main "shield" using low strength 25Mpa limestone aggregate concrete that could be inscribed following casting by the Artist.

Glass fibre reinforced polymer rods were used in the base and mount of the entry statement. The complete absence of steel and character of glass fibre reinforced polymers exceeded the RIA's requirements for durability and satisfies the artist's desire to create a monument that speaks to the endurance of the Whadjuk Noongar people.

Additional innovative engineering expertise was used in the creation of a temporary external post-tensioned mount to handle the precast structure safely during fabrication, transport from the mainland workshop to the Island, and installation. Despite the form's sensitivity to cracking during elevation, rotation and movement, the 9 m high and 2.75 metre wide span (permeated with voids) sculpture was installed without visible cracking.

In a setting displayed to an international audience, the design possibilities opened by this practical proof-of-concept to the national Engineering community are evident. GFRP reinforcement allows designers to create structures which do not degrade due to the need for them to be reinforced when in marine or quasi-marine environments.

***Extent to which the work has incorporated contemporary ethical, environmental, health, safety and security principles : for those directly or indirectly involved and members of the community in general***

While the Rottnest Island Authority (RIA) convene a regular Indigenous Consultation group; part of the commissioning parameters of the Wadjemup Entrance piece was for the artists to gain cultural knowledge and feedback during the creation of the work.

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The consultation process adopted by Jahne Rees and Sharyn Egan from commencement and at multiple points throughout development of the sculpture ensured the forms and message adopted were suitable and appropriate. The sensitivity of the messaging had to capture both the ancient positive and spiritual message of the Island with the more tragic recent history as a prison in a manner that was both considerate, accurate and ethical.

The Shield form of the piece (selected as a symbol of strength, protection and endurance) with silhouette of an Aboriginal man as recessed space, thus also contains the dual forms of whale and prison bars depending on the viewing angle.

This overall form and the use of the limestone concrete to match the setting with hand crafted aluminium elements met universal positive feedback from RIA and Aboriginal consultation groups even at the first showing and henceforth; the text required some revisions and omissions prior to the final content being realised.

For the text, artist Sharyn Egan has particularly acknowledged the input of Barry McGuire, an Elder who speaks fluent Noongar and was able to provide the central story of the whale journey from the Western End of Wadjemup (Rottnest) to Koorinup (the final resting place of the spirits) in original language for text on the Shield form. For the text itself; she thanked Sandra Harder and Meg Collard of the Noongar Language Centre; who were able to supply both expressions of Noongar language in phonetic spelling and English equivalents for the text. The entire consultation process was conducted in under 5 months; showing how cohesive and positive the experience of creation was.

In terms of the broader community, much like the layers of meaning to the piece; the Entry Statement presents a striking visual message both at day and night. The viewing community are able to select their level of engagement – from cursory inspection of the symbolism of the structure, to reading the text, to participation in the sand ceremony detailed in the work. The sand ceremony asks that visitors to the Island actively link ancient spiritual custom to the present through a simple ceremony involving the introduction of individual to Elders Past and local spirits by rubbing sand under their armpits and casting it into the nearby Thomson Bay.

Matching the artistic message was the technical support of the Engineering team to help achieve this vision in the most durable fashion possible. This was achieved without environmentally harmful additives to the concrete form and with the maximum possible integration of the piece into the naturalistic setting of the bay. Much of the structural support is intrinsic to the concrete form and base of the piece (rather than via external guy ropes or tethering) so that the 9 metre tall Shield component cannot be interfered with by visitors and always remains secure.

During manufacture, ATC ensured that all people working with the Glass Fibre Reinforced Polymer reinforcement used adequate breathing and handling protection. Their solution of a post-tensioned concrete spine helped for the with safe handling of the concrete shield – initially poured with the convex side up, then lifted, stood up, and laid down with the concave side showing for polishing, grinding, sandblasting and text additions.

***Extent to which the work has delivered excellence*** : opportunity for applicants to highlight or showcase key successes of their project

From the inclusive and ethical consultation process, the outstanding artistic design enabled by the Engineering solutions, and final durability achieved – this project represents a purely

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excellent result for people of Western Australia and all visitors to one of our most treasured tourist attractions. It is a true monument (rather than a plaque or footnote) that links the true history and meaning of place to the future for as long as is possible due to leading edge Engineering Excellence.

It has fulfilled the artists' vision for the creation of a location suitable monument in their material of choice (lower strength limestone aggregate concrete) that will never suffer from the concrete cancer endemic to coastal structures despite positioning directly on the beach; and thus endure for future generations.

To the Engineering community it offers a clear vision of the possibilities of the use of glass fibre reinforced polymer rods as reinforcement in any type of concrete in coastal or quasi-marine environments for near permanent life of the structures where it is adopted. That it accomplishes this in such an iconic work of national importance is a wonderful success for the entire team involved and all communities it enriches.

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