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GALVANIZING COMPLEX STEEL STRUCTURES

HOT DIP GALVANIZING AND ROCKET SCIENCE



Leaning Tower of Gingin, Gravity Discovery Centre – Gingin, WA

Corrosion control has a big part to play in making sure that assets provide a satisfactory return on their investment to the community. Durability and low maintenance mean that financial reserves are not expended unnecessarily and to the detriment of future investment. Also, durability is a key component of sustainability – the longer an asset lasts, then the less natural resources and energy are required to replace it.

This article is of general interest, but demonstrates how material selection and corrosion control can contribute to the wider community and why the galvanizing industry needs to keep highlighting its importance to our everyday life, even when it does not appear so apparent.

It's not often that hot dip galvanizing is associated with astrophysics and rocket science, however, something is happening out West that may provide the answers to some of the biggest questions human beings have about the Universe. At the Gravity Discovery Centre (GDC) in Gingin, the finishing touches are being put on another stage of a long-term project to both educate Australians and participate globally in the wider expansion of knowledge about the Universe and the science required to study it.

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Editorial

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THE GRAVITY DISCOVERY VISITOR CENTRE

The GDC is a visually striking, architecturally-designed concept that combines high-tech materials with a highly efficient passive solar design, integrated closely into the environment. The intention was to minimise the impact of the Centre on the environment while providing a state-of-the-art learning experience. Its existence owes a great deal to the work of Emeritus Professor John de Laeter and Professor David Blair of the University of Western Australia.

The Gravity Discovery Centre is the public education arm of the Australian International Gravitational Observatory (AIGO), a research facility of The University of Western Australia (UWA). The Centre is located near Gingin, north of Perth and is a valuable teaching resource, integrating art, science and technology and providing a cross cultural understanding of cosmology.

The materials used in the construction of the GDC are environmentally responsible and sustainable. These provide a predominately maintenance free facility that has both economic and environmental advantages. Integration into the natural environment is of paramount consideration and the minimization of the environmental footprint demanded that as little as possible of the natural vegetation was disturbed.

The GDC uses a number of different methods to provide visitors with exposure to some of the biggest questions in science and the Universe. At the GDC, visitors can learn about the origin of the Universe, black holes, time travel and gravity waves. Many of the exhibits are interactive and people can literally get physically involved while learning about science.

The Cosmology Gallery also provides visitors with an insight into the way different cultures view the origin of our Universe. There is a special focus on Dreamtime cosmology which looks at the way indigenous Australians view the origin of the Universe.



Dreamtime at the Gravity Discovery Centre



No longer considered a planet - Pluto laid to rest! The selection of materials for the GDC will hopefully give it a longer lifespan.

The United Group Leaning Tower of Gingin

The galvanized tower is the final and most spectacular phase of the Gravity Discovery Centre and each year approximately 20,000 students and tourists will visit the complex to learn about the world class research on gravity waves being conducted at the Observatory – the only gravity observatory in the Southern Hemisphere (there's another one in Pisa, Italy!)

The Tower has been designed to eventually have a galvanized steel walkway which connects to the mezzanine levels of the Discovery Gallery and Cosmology Gallery. The walkway becomes a tree top walk through huge paperbark trees and allows disabled visitors to reach one third of the tower height, where there is a viewing platform located.

The Leaning Tower provides a magnificent view across the vast coastal plain from the sea to the Darling Scarp. At the top of the tower there is a platform that allows visitors and students to repeat Galileo's ground breaking free fall experiments from the top of the Leaning Tower of Pisa and to allow studies of impact craters caused by their falling objects. Galileo's experiments not only uncovered the key universal nature of gravity but also represented the first true use of scientific observation to determine the truth behind natural phenomena.

The Leaning Tower is the central part of an interactive education experience which focuses on gravity, meteorite impacts and the history and formation of the Earth. The aim of this experience is to excite students about science (especially students in the age range 8-15) and help turn around the declining interest in science, technology and innovation related careers.

The design development of the Leaning Tower and its construction was a major team effort between a number of organizations that donated time, money, expertise and materials. Hatch Associates and United Group Resources donated engineering and design services throughout conceptual phase to detail design. United Group Resources undertook all design drafting work and prepared the shop detail drawings for steelwork fabrication. United Group Resources also donated services for the project management, (planning and costing) and construction of the Project. Mr Jon Birman, CE of United Group Resources provided the project coordination for the tower and organised the industry contributions to the project. The Galvanizers Association of Australia was also represented on the project by its WA State Chapter members. All of the GAA WA State Chapter members donated their services free of charge and are proud to be Australian companies supporting Australian science and education.



A view from the top of the Leaning Tower



So much steel to protect...

Behind the Leaning Tower of Gingin

The Leaning Tower of Gingin was designed to provide a structure to replicate the feel of Galileo's testing on the iconic Leaning Tower of Pisa 400 years ago. Of course, Gingin tower's "lean" of almost 15° was intentional, as opposed to that of its Italian namesake, which leans at a mere 5°!

The inclination of the tower means that the structure had to be designed to cope with a permanent and complex spectrum of stresses in the steel members. United Group began seriously working on the design and ultimate construction of the structure about five years ago and has donated most of the engineering design and project management for the tower.

GAA members from the WA State Chapter had no hesitation in offering to donate all of the hot dip galvanizing to such an iconic and worthwhile project. GAA members felt that Australian companies should put something into the project to contribute to the work that had already been undertaken by the other people involved in the project. Not only did GAA members provide the hot dip galvanizing, but another member, OneSteel Australian Tube Mills, also contributed a significant amount of the tubular structural steel used in the tower.

The tower is made up of approximately 100 tonnes of steel and the base contains approximately 300 cubic metres of concrete (about 750 tonnes).

The design and detailing of the structure, and its individual structural components, provided some unique challenges. The triangular plan arrangement combined with the 14.8° inclination of the tower introduced deceptively complex geometry and meant that many of the components at different levels were unique. This complexity also meant that beams at each level and supporting the viewing platforms had horizontal flanges to support the floor plate with webs which are inclined.

United Group Resources used the Tekla Structures (X-Steel) shop detailing software package to ensure that each component would be properly shop detailed, regardless of the complexity of the geometry. The seamless integration of engineering design and shop detailing is a significant feature of United Group Resources' workflows and project delivery techniques. These methodologies remove inefficient contractual interfaces and dramatically improve cost effectiveness and fabrication/construction efficiency for the downstream stakeholders. The result was that the Tower was erected easily and with a minimum of effort and disruption to the operation of the Centre. The construction phase too had its challenges – it's not easy to erect a structure which is leaning and constantly trying to fall over. Gravity always works, especially when building a Leaning Tower!

Corrosion Protection of the Leaning Tower

Integrity of the steelwork in such an iconic structure was always going to be of the highest importance. To ensure the structure's durability, all of the tower structure is made up of hot dip galvanized steel. This is consistent with most of the structural steel used in the other buildings on the site. The owners and designers wanted to make sure that the steel was protected by a system that was robust, simple and removed the financial and onerous burden of maintenance common to most other coatings. The site's remoteness and exposure to the elements also makes the UV resistance of galvanized steel a major consideration.

The robustness of the galvanized coating was also important because many steel members required multiple handling during the erection process. The structural steel in the main centre, all of the existing and proposed elevated walkways to facilitate disabled access and treetop views and now the Leaning Tower are all protected by the superior performance of hot dip galvanizing.

The tower is fixed at its base with hinged supports on the front legs. This will allow it to be lowered to ground level for maintenance or upgrade.

Checker plate was used on the walkways and platforms for statutory compliance as well as making access slightly easier for all types of footwear. The balustrade system was also increased in height to provide a greater feeling of security for users of the Tower.



The hinged base of the Leaning Tower

Conclusion

The United Group Leaning Tower of Gingin is a truly iconic structure that was built with the help of many Australian organizations. It will be a significant part of the Gravity Discovery Centre that is dedicated to increasing the knowledge of young people of science and the Universe. This is increasingly important as it can play a part in addressing the shortage of young people taking up careers and study in science.

The galvanized steel will give the structure the long life demanded by its owners and it might yet last as long as the original Leaning Tower of Pisa! The Galvanizers Association of Australia is proud to be part of such a project and encourages people in Perth and beyond to visit the Centre and have some of their questions answered on the workings of both our world and the Universe. Hopefully, many of these will no longer be a mystery after a visit to the GDC.

Acknowledgements

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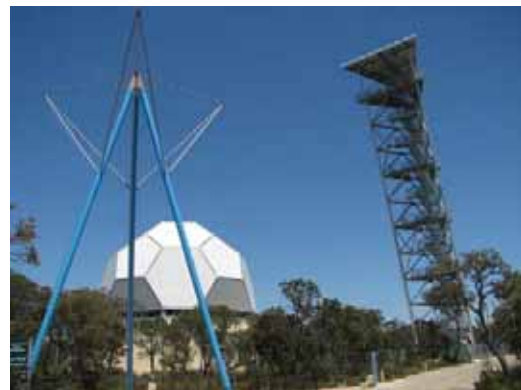
GAA members

Hartway Galvanizers
MGalv
Western Galvanisers
OneSteel Australian Tube Mills

Further information www.gdc.asn.au

The Visitor Centre contains a lecture theatre (seating 50), display area, office and related amenities and a shop where books, science toys, posters and souvenirs are on sale.

Besides the Leaning Tower of Gingin, other buildings and areas for exploration and learning include the Southern Cross Cosmos Centre, Cosmology Gallery and the Zadco Telescope Dome.



A view of the GDC

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We provide information, publications and assistance on all aspects of design, performance and applications of hot dip galvanizing.
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