

# Diverging Diamond Interchange, Caloundra



*The DDI at Caloundra - artist's impression.  
Image Source: news.com.au*

## Project Summary

In recent years, some fantastic projects in Australia have really been 'pushing the boundaries' of what would previously have been deemed possible. One of those in particular is in Queensland - a Diverging Diamond Interchange (DDI) project.

Arup's Andy Lewis said, "It's the first DDI that's being delivered in Australia. It's under construction at the moment up on the Caloundra interchange on the Bruce Highway."

In a joint venture with Jacobs, Arup was appointed as designer for the Fulton Hogan Seymour Whyte Joint Venture (FHSW JV) to construct the Bruce Highway Upgrade – Caloundra Road to Sunshine Motorway.

Located on Queensland's Sunshine Coast, the project involves an upgrade of the Bruce Highway to six lanes, including major upgrades to both interchanges and the delivery of a service road for local traffic on the western side of the highway between Steve Irwin Way and Tanawha Tourist Drive (**Source: Arup website**).

## The Challenge

This upgrade is among Queensland's highest priority road projects, and is designed to meet the strategic transport needs of the Sunshine Coast region in this area well into the future. The upgrade will deliver critical safety benefits to motorists, improve efficiency and reduce traffic congestion, and ensure the Highway can cater for future traffic growth. The speed

limit on the upgraded Highway will be returned to 110km/hr, and immunity will be provided from a 1-in-100 year flood event (**Source: Arup website**).

The importance of the project, and the resultant public interest, meant all teams involved faced challenges when planning their approach - especially when it came to delivering it as efficiently as possible. It was necessary to 'think outside the box'.

## The Solution

Said Mr Lewis, "The whole project for the Bruce Highway upgrade was done in 3D, and that's not just the civil works, the highways and the earth works, but all of the structures as well. We managed to produce a fully coordinated BIM model of the project, which we then published into our visualisation platforms for media and public consultation exercises."

The team also used virtual reality for drive-throughs of their design, and took the models that were developed and published them through AR applications. They delivered a driving simulation

## For more information

To find out more about how you can create better designs faster with the 12d Model solution for civil engineering design, visit [www.12d.com](http://www.12d.com).



E: [sales@12d.com](mailto:sales@12d.com)  
Ph: +61 2 9970 7117

product through which they were able to produce a physical 'drive' which could be used on site on the project. They also had a number of other outputs including online media to allow the public to navigate and review the project.

Arup had been using these tools on a number of projects in the past, and their work on the DDI was a progression and a development of those skills - they learn a great deal on every new project, and are very quick to share with their teams worldwide the skills they hone. It's part of their strategy to share their digital engineering experiences across the Arup globe, to facilitate a finely tuned skills set for the best possible outcomes.

One of Arup's other innovations for the DDI project was a simulator, used mostly by their engineers to review designs. They are looking to develop this further in the road

safety audit space, to add in tools and functions to allow the auditors to assess the model, ensuring it is compliant with the codes.

Digital Engineering continues to expand into new areas. Mr Lewis stated, "It's forever evolving. There are new opportunities, technology is ever-changing, and we need to keep pace with what's happening in the industry and find new opportunities to engage with our clients to help us deliver our projects better."

Another exciting development in recent months for Arup has been that their clients are becoming increasingly accepting of the new technology Arup is offering - they're noticing a steep change where clients are far more receptive to new ways of engaging with, commenting on, and reviewing projects. Mr Lewis said, "It's very encouraging. We hope that continues because we can see there are significant efficiency benefits in moving away from the old drawing plan production. Slowly, we are seeing recognition that investing early helps deliver better quality models. We are seeing some encouraging signs that clients are warming to that sort of approach - that they will see the benefits later on during the construction, and obviously when they take over the project and need to maintain it. So

we're finally in a place where people are able to not only see the benefits of digital engineering and BIM for down the track, they are willing to invest upfront in those future benefits."

Prior to that, Arup had been prepared to cover these costs and 'put in the hard yards' to prove to the client that they will benefit downstream. Arup's firm belief has always been that they have to keep challenging conventional methods of delivery, looking for improvements. Mr Lewis said, "We need to do things smarter - that's part of our culture and



**DDI plans. Image Source: Construction Index (UK)**

we encourage all of our staff and people to look for those opportunities, and we will fund and support them in doing that."

For the Bruce Highway project in particular, the FHSW JV developed this innovative design solution, to transform the Caloundra Road interchange into a DDI - a unique design for

reducing traffic congestion and improving safety for motorists, pedestrians and cyclists. It also uses a smaller footprint than traditional interchange designs.

The project involves the following components:

### **Sunshine Motorway Interchange**

- New northbound loop connecting the Sunshine Motorway to the Bruce Highway.
- An upgraded northbound ramp from the Bruce Highway to the Sunshine Motorway, and an upgraded southbound ramp from the Sunshine Motorway to the Bruce Highway.
- Construction of new bridges for the highway over the Sunshine Motorway.
- New signalised intersection at the Sunshine Motorway interchange as a secondary access to the western service road for northbound highway traffic.

### **Caloundra Road Interchange**

- Transformed into a Diverging Diamond Interchange.

- Direct link to the western service road for traffic travelling north from Brisbane to the Aussie World precinct.
- New bridge over the highway with 6.5m high vehicle clearance.
- New signalised intersection with the western service road.
- New off-road shared cyclist and pedestrian paths across the interchange, including signalised crossings and underpasses at the southbound Bruce Highway access ramps to and from Caloundra Road.

### **Western Service Road between Steve Irwin Way and Tanawha Tourist Drive**

- Extension of Frizzo Road to connect to Steve Irwin Way in the south and Tanawha Tourist Drive in the north.
- Access to the Aussie World precinct off Frizzo Road, access to Glenview Road, Martin Road, Sippy Creek Road, Cunning Road and Wilson Road. The western service road will also provide access to Pignata Road, Laxton Road and Greenhaven Drive via an upgrade of the Pignata Road underpass, including new traffic signals.
- Access to Aussie World precinct via a revised southbound highway exit ramp to Pignata Road.
- Removal of the Frizzo Road northbound entry and exit ramps to the Bruce Highway.
- New shared path for cyclists and pedestrians along the entire length of the road, joining to existing pathways at Steve Irwin Way and Tanawha Tourist Drive.

**(Source: Arup website)**

### **The Result**

Arup's very innovative approach to this project and others will enable them to keep pushing the boundaries further and further in coming years. The use of 12d Model software has been a constant in their processes for many years, and they have no plans to change that. Mr Lewis stated, "The partnership with 12d has grown over the years - we've very much appreciated the support that we've been given and we've had a number of instances on

major projects where the expertise of the 12d Model developers was crucial - they spent time with us to help us develop the tools so that we could deliver those projects. I don't think we would have been able to deliver these without that overarching support from 12d Solutions. There's got to be a partnership between the people that are actually delivering the projects and those developing them, so that we can get our needs included in the tool set. Otherwise, it's hard to move forward."

Dr Lee Gregory, CEO of 12d Solutions, responded to this, saying, "On our side, as a developer, we don't build projects, so it's really this feedback as we work with people doing projects that feeds into our product. It's a great two-way street, and we all benefit from it."

These open approaches where all parties can see innovation develop, and see smarter ways of delivering projects, is well facilitated by BIM and Digital Engineering. Said Dr Gregory, "It's bringing back together all these different groups who previously were separated. We are all now talking to each other, be it architects, utility services, drainage engineers, etc. - often people we never even had on the one project. Digital Engineering/BIM has brought together lots of groups that never spoke much before, and it's to everyone's benefit."

Mr Lewis responded, stating, "Yes, with Digital Engineering, the whole principle of it is collaboration. We are seeing all the disparate teams now are making the effort to share and collaborate in real time, but also with some processing control in around the information that we're producing. So yes, it's making a steep change to the market, and in particular to the Arup business - for this DDI project and beyond."



**Bruce Highway.**

**Image Source: Roads and Infrastructure Magazine**



## Roads and Highways

12d Model's design option is the smarter solution for the design, modification and maintenance of Road and Highway projects.

Enjoy advanced 3D tools to design local and major roads, intersections, roundabouts, highways, interchanges and much more.



## Ports and Dredging

12d Model is the solution for port infrastructure and dredging, easily managing the very large datasets and complex volume calculations often required by these projects.

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12d Model is the most versatile solution for the creation of sustainable land development projects, including residential, commercial and industrial developments, recreational areas, landfills, and agriculture projects.

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12d Track has been specifically designed for the survey, design and construction of light, heavy and high speed rail projects.

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## Mining Infrastructure

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## Drainage, Sewer and Utilities

12d Model provides comprehensive tools for the design, analysis and optimisation of stormwater and sewer projects using rational, dynamic (hydrograph) and 2d drainage methods.

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## Surveying

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The 12d Field option runs on a ruggedized tablet and gives the user access to full 12d Model functionality, allowing you to take the entire project into the field with the most comprehensive pick-up and set-out tools.



## Oil and Gas

12d Model assists with the design, construction and mapping of oil and gas pipelines, original site exploration and the wide range of infrastructure required for oil and gas projects.

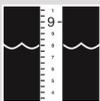
Accurate 3D modelling and the ability to share data between users allow teams to quickly and easily coordinate designs.



## Construction

12d Model is the ultimate software for construction with powerful set-out options, direct interfaces to machine control and detailed conformance reporting and auditing.

Manage 3D data and control volumes, quantities and progress claims with 12d Model. Set-out your project and undertake conformance and as-built surveys live on-site using 12d Field.



## Rivers, Dams and Hydrology

12d Model handles very large datasets and interfaces with a wide range of analysis packages, making it perfect for flood studies and the management of rivers and dams.

12d has partnered with industry leading analysis software, allowing users to apply 2D drainage analysis from within 12d Model.



## Environmental

12d Model's ability to handle very large datasets combined with flexible and comprehensive 3D analysis and modeling tools make it perfect for a wide variety of environmental projects.

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**Australasia:** Sydney  
E: [sales@12d.com](mailto:sales@12d.com)  
Ph: +61 2 9970 7117

12d Solutions Pty Ltd  
PO Box 351 Narrabeen  
NSW 2101 Australia  
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