West Gate Tunnel

Aurecon Jacobs JV

The Contractors for the project are CPB and John Holland, and the design work is being one by Aurecon Jacobs JV.

SCOPE:

The West Gate Freeway is a critical link in Melbourne's transport network, carrying 200,000 vehicles each day.

12d DIMENSIONS:

- Tunnels

Project Summary

The West Gate Tunnel Project is broken up into 3 sections – the West Gate Freeway (out west), the Tunnels (in the middle), and the Port to City (in the east).

The Freeway section involves upgrading from eight lanes to twelve, including an express lane between the M80 Ring Road and the West Gate, and 4 interchange upgrades.

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.

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Artsts' impression—from West Gate Tunnel website

The Challenge

The summary on the West Gate Tunnel website lists:

- Extra lanes on the freeway between the M80 Ring Road and Williamstown Road
- Entry and exit portals where the tunnels connect with the West Gate Freeway
- Ventilation structure at the tunnel exit to remove air from inside the outbound tunnel
- Interchange upgrades at the M80 Ring Road, Millers Road, Grieve Parade and Williamstown Road
- Ramps to Hyde Street to connect trucks directly with local industry
- Noise walls to reduce traffic noise for residents and open spaces
- Walking and cycling paths to complete missing links in the Federation and Kororoit Creek trails and better connect communities, including new overpasses over Williamstown Road and Stony Creek
- Pedestrian bridges replacing the existing overpasses
- Freeway Management System to support good traffic flow and safety
- New open spaces and planting thousands of trees and other plants in the freeway area.

The Tunnels component includes two three-lane tunnels, one inbound tunnel of 2.5km and one outbound tunnel of 3km – all to take motorists and trucks off residential streets.

The website also lists:

- Twin tunnels under Yarraville between the West Gate Freeway and the Maribyrnong River
- Entry and exit portals where the tunnels connect with surface roads
- Ventilation structures at each tunnel exit to remove air from inside the tunnels
- Walking and cycling paths on Hyde Street, Harris Street, Maribyrnong Street and a bridge over Whitehall Street
- New landscaped open space in Altona North and Footscray
- Freeway Management System to support good traffic flow and safety
- Tunnel safety features for smooth operation of the tunnel, including automatic detection for over-height trucks, fire systems and emergency access and exits.

The Port to City section involves a new bridge over the Maribyrnong River River to connect the tunnels, with an elevated roadway along Footscray Road connecting to CityLink, Dynon Road and Footscray Road, running above the centre of Footscray Road, as well as direct links to Port of Melbourne, CityLink and an extension and widening of Wurundjeri Way.

The website also lists:

- Ramps to the port at MacKenzie Road and Appleton Dock Road for direct freeway access
- Walking and cycling paths for quicker and safer cycling to the city with a new veloway and bridges over Footscray Road and Moonee Ponds Creek

12d° Model

- Extending Wurundjeri Way north to Dynon Road to create a city bypass
- Freeway Management System to improve traffic flow and safety

New open spaces and planting thousands of trees and other plants in the freeway area.

The Solution

Design Production - Workflows
12d Model and 12d Synergy are both in use on this project, along with various other packages.

12d Model was selected to do the long sections and cross sections across the entire job, as well as the modelling of the tunnel components and the bridges over the Maribyrnong River.

The team needed to develop efficient processes for bringing in data from other packages. They worked out the best workflows for them, with particular attention to consistency across the entire project.

With their incoming 2D CAD and 3D Models, the main advantage of 12d Model was that they could copy sections of the bridge and tunnel modules and make sure everything was aligned. The process they came up with was running a Chain for each 2D Drawing and each 3D Model that would create a project for each DWG, and then in that Chain they'd also create a date stamp model and use a 12d Synergy search to look for that date stamp model (and compare against a search in another package). From there, they'd work out what was out-of-date and re-run just that Chain.

The team copied DWG files to the 12d Synergy Server and gave them their own Chain, Project, and Mastershare labels – applying a naming convention. Dummy models were created at chain runtime (date analysis). Ongoing date modification analysis was performed using Excel Queries. 12d Synergy was their single source of truth.

Custom Reporting
The team needed a lot of custom reporting due to other software packages being used, with different types of reporting requirements. They learnt to be prepared on the BIM journey for 'curly' output requirements, and to 'make friends with' Excel and VBA.

They experimented with XSLT Files (12d Report Definition Files), and adapted to Legacy Workflows developed on previous jobs for MX (the hand they were dealt).

The next challenge was how to get data out of 12d Model so it could go into Dynamo and Revit to produce the tunnel rings – for this they enlisted Matt Monk to create a macro to report the perpendicular points between the centre of the tunnel and report it back to the control road which is not in the centre of the tunnel.

Chain Usage
Users were upskilled on how to use parameters in their chains – this happened on the job, with great success.

Custom Widgets were created, with Prompt Result Inputs – (yes, no, cancel). The 'cancel' widget was particularly useful in case something fell over halfway through running of the Chain.

Two of their favourite uses were:

- Prompt Result Values > PVFs for filename concatenation
- Using Widget button to pick result and GoTos they could loop within chains (also very nifty) – naming something differently each time it was used on any number of strings
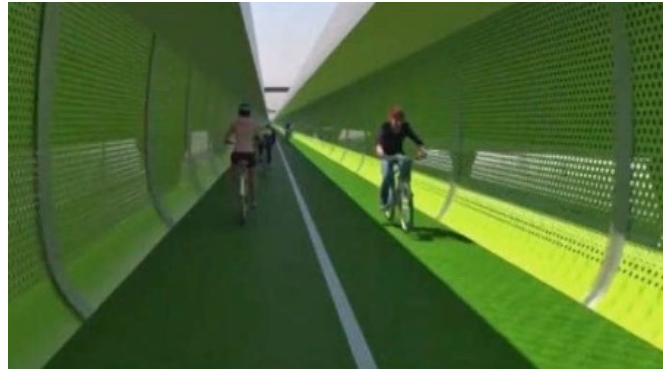
Artsts' impression—from West Gate Tunnel website

They employed one Road Design Output PPF per Zone with multiple PVFs, leading to a huge process improvement to the speed of their output, which was noticed by users.

Snippet Usage
- Road Barriers – used extensively – need penetration details on stormwater pits; option to change height of first string/extend barrier
- Kerbs
- Vehicle Clearance and Roll Allowance (AGRD and RTA values) – vehicle clearance was a parameter set by the project (going under bridges *etc*.) but the sway envelope allowed gathering of AustRoads figures – design speed, left and right crossfall, *etc*.
- L-Shaped Retaining Walls – ability to insert after a string, *etc*. Means you can set wall thickness, vertical offset to top string, footing RL, footing thickness, leg length forward/back – quite dynamic and went together pretty well
- Road Deck Slabs/multi-floor tunnel portals for space proofing – took existing 12d 2-point slab snippet and added ability to put crossfall, RL, *etc*. Insert a string higher up in MTF and be able to trace it.
- Pavement Wearing Course (for XSs)
- Sign Legibility (*Guide to Traffic Management: Traffic Control Devices*) and Sight Line – input speed, sign dimensions, offset to control line, how many words on sign, type of vehicle, number of lanes, etc. -> draws a mesh with sign in distance and ability to profile string
- ITS Trenches by Trench Type/make your own (experimental at this stage)
- Also experimented with Sub-Soil Drains (how to attach to a pavement layer and such) and Trench
- Structure items modelled in 12d Model as space proofing prior to modelling
- Tunnel Mesh
- Tunnel Portals
- Basic Bridge Crossings

2D Road Design Exports

- PVFs within Chains used extensively for exporting hundreds of DWGs
- Naming Convention Control
- Consistency
- Repeatability
- Quickly expandable
- Temporary Entity duplication > String Info Change
- Long section/cross section MESH colour control

- Label style manipulation
- Not good for point count with MESHES

Discoveries, Advice, Notes

- Coexisting with other packages on large projects is possible, but not without challenges
- 12d Model holds its own, and then some (in particular with mesh modelling)
- Don't forget to model useful information!
- Projects are getting bigger and we are hungry for more information/data in our models. This is a MAJOR challenge.
- Get involved in the Forums, ask for enhancements. Users drive it forward.

The engineers they worked with said, "You've taken 12d Model further than we've ever seen!"

Artsts' impression—from West Gate Tunnel website

3D Road Design Exports

- General
- Road TRIA, MESH and STRS > DWG and IFC > Navisworks
- Road TRIA, MESH and STRS > SML > Contractor Setout
- Bridges
- Road STRS > LandXML > Civil 3D > Revit > IFC >12d > LS/XS
- Drainage
- 12d Object to Trimeshes > Trimesh > DWG and IFC

Result

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.

A complete range of flexible and customisable volume calculation tools allow teams to extract and present the information quickly and easily.

Land Development

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.

Easily manage all aspects of your land development project from earthwork quantities, road design utilities and drainage design.

Airport Infrastructure

12d Model provides a solution for the design, construction and analysis of new airports, as well as the upgrade and maintenance of existing runways and airport infrastructure.

Easily manage large airport infrastructure projects and share data across multi-disciplinary teams.

Rail

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

Extensive railway tools in 12d Track allow the rail designer to quickly and easily design their projects. These options are built on the existing 3D modelling and design tools available in 12d Model.

Mining Infrastructure

12d Model's powerful set of exploration, site investigation, survey and analysis tools are crucial for the initial design, construction and ongoing operation of mining projects.

Comprehensive tools for the survey, design and construction of access roads, railways, earthworks and services allow for the coordinated design and management of mining infrastructure from within 12d Model.
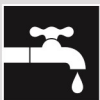
Drainage, Sewer and Utilities

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

Powerful clash detection management allows for efficient 3D modelling of service networks such as gas, electricity, telecommunications and water prior to construction.
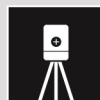
Surveying

12d Model is a complete surveying package providing the tools to manage all facets of surveyed data including LIDAR, topographical, as-built, conformance, traversing, geodetics, data mapping, labelling and much more.

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.
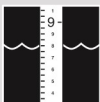
Rivers, Dams and Hydrology

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.

Existing workflows can adopt 12d Model easily as it allows users to directly interface with GIS systems and most software packages and file formats.

Why Choose 12d?

- Powerful data processing & intelligent functionality.
- Modular, easy to update & completely customisable.
- Seamless integration with major industry software and hardware.
- Used in over 55 countries worldwide.
- Friendly support & training from industry experts.

12d Model