Parsons Brinckerhoff and Arup Use Bentley Software to Create Australia's Largest Road Project

ProjectWise Connects Project Teams and Bentley Design Software Enables Parallel Design Streams, Saving More Than AUD 6 Million

Project Summary

Organization
Parsons Brinckerhoff and Arup Joint Venture

Solution
Roads

Location
Brisbane, Australia

Project Objectives
- Reduce traffic congestion by 45 percent
- Fix roadway bottlenecks
- Reduce travel time to the airport for people living in northern suburbs while improving the overall connectivity with the city

Products Used
Bentley Rebar, InRoads, gINT, MicroStation, MicroStation Triforma, MXROAD, ProjectWise, RAM Concept, Structural Modeler

Fast Facts

- Joint team of Arup and Parsons Brinckerhoff employees designed and built a complex road infrastructure project involving multiple roads, tunnels, and bridges
- ProjectWise hosted all technical, design, analysis, and CAD data (2 million documents) and enabled 2,000 staff to work remotely from a single data source
- Integrated Bentley design software supported efficient, streamlined processes

ROI

- Substantially reduced the amount of time needed to design and build the entire project
- Saved AUD 3.6 million every 18 months for each 100 people that worked remotely rather than travelled to the work site
- Saved AUD 1 million by eliminating the need for five extra document controllers
- Saved AUD 1.4 million by eliminating the need for five additional designers intermittent systems into 24x7 systems

Designing and Constructing Three Projects Concurrently

When the city of Brisbane, Australia, and its suburbs needed to reduce heavy congestion going to, from and around Brisbane Airport, Brisbane City Council initiated development of a massive infrastructure project to solve the problem. The council's goal was to reduce traffic congestion by 45 percent, fixing notorious roadway bottlenecks, minimizing travel time to the airport for people living in northern suburbs – all while improving the overall connectivity with the city. The project consisted of two tunnels and a new airport connection – 6.7 kilometers of a mainly underground Airport Link toll road, as well as the Windsor-to-Kedron section of Northern Busway and an upgraded interchange improving access to the Brisbane Airport precinct. Once built, these roadways would become a vital addition to Brisbane's road network, providing a critical new link between the city's northern suburbs and two of south-east Queensland's most important economic centers – the airport and the city.

"We had to create an integrated project team of 2,400 staff working in almost 50 different offices. To do this, we chose to deploy Bentley's ProjectWise."

– Mark Patis, technical executive, Parsons Brinckerhoff

Each of the three distinct projects had to be designed and constructed concurrently due to the tightly integrated nature of their alignment and surface connectivity. "We identified early on that we couldn't deliver the entire project using conventional methods and a team located in a single office," explained Andrew Lewis, an associate at Arup and structural modeling leader for the roadway project. "So we teamed up with Parsons Brinckerhoff in 2006 to form the Parsons Brinckerhoff–Arup Joint Venture (PBAJV)." Together, PBAJV bid and ultimately won the design and construction of all project phases. "We knew that in order for our global, distributed teams to work together efficiently, we had to create an integrated project team of 2,400 staff working in almost 50 different offices," stated Mark Patis, technical executive at Parsons Brinckerhoff. "To do this, we chose to deploy Bentley's ProjectWise to create an engineering collaboration tool and 24/7 data source. "We also used integrated Bentley software to support all design and documentation phases of the project, further enhancing team performance for a successful outcome."

Tackling Major Collaboration, Document Management, and Engineering Challenges

The sheer size and complexity of the project brought huge collaboration challenges including coordination and management of the design teams; the number of drawings to be produced and reviewed; and ensuring people worked on the latest project information. "Our challenge was finding a way to manage the production of nearly 600 design packages that would involve more than 20,000 design drawings, and an estimated 2 million documents over the course of the project," stated Patis.

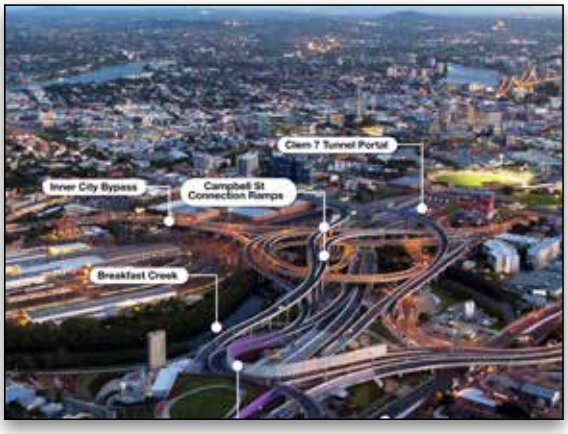
At the same time, the PBAJV team faced unique engineering challenges, as the Airport Link project involved the design and construction of underground roadway interchanges, multiple

Each of the three distinct projects had to be designed and constructed concurrently.

"The accessibility of ProjectWise allowed people from all over the world to access the latest documentation without the need to leave their local office and work remotely in parallel work streams. This increased efficiency and reduced total project costs for a massive roadway project."

– Andrew Lewis, Associate at Arup and Structural Modeling Leader for PBAJV

bridges, a large jack-box structure, and a connection to an existing interchange. For example, the Kedron Interchange involved construction of a unique, multi-level interchange that included a combination of surface roads, elevated flyovers, multiple bridges, underground ramps, and merges/diverges, which work together to provide free flow for all traffic movements. "What sets the Airport Link tunnels apart is the integration of the surface interchanges and the tunnels," explained Patis. "This brings with it huge challenges in terms of geometry, road safety, tunnel fire and life safety and constructability. It is so complex, in one location, five levels of roadway exist. The road geometry associated with these elements, combined with poor geological conditions, required some innovative design solutions to allow the construction."



The project consisted of two tunnels, a new airport connection and involved 6.7 kilometers of underground toll roads.

Paving the Way to Success with Integrated, State-of-the-art Solutions

Given the large scale and complexity of the project, PBAJV knew that the joint project team would require very strong document control systems and processes across all project documents – especially when they moved into the design phase. "It was clear we would not be able to deliver this complex project via conventional methods and processes," stated Lewis. "After evaluating a number of solutions to address these issues, we selected Bentley ProjectWise as our EDMS collaboration tool."

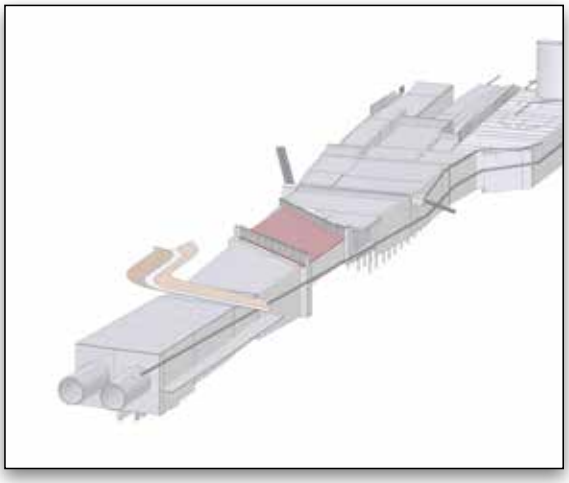
Providing a controlled and secure environment, ProjectWise gave the team confidence in its ability to host technical, design, analysis, and CAD data. ProjectWise offered key features essential to the success of the project, including document numbering and version control, customized folder structures, integration with key software applications, and tools to manage major design changes.

In parallel, the PBAJV project team evaluated solutions to address the project's complex engineering challenges. Choosing to deploy an integrated set of Bentley applications, which work seamlessly with ProjectWise, significantly improved team performance and helped ensure a successful project outcome. Key applications included MicroStation, MXROAD, Triforma, Structural Modeler, InRoads, gINT, and Bentley Rebar.

Fast-tracking the Deployment

Due to time pressures, PBAJV chose to fast-track the deployment of Bentley software. "We worked with Bentley services to have everything up and running within three weeks of the project being awarded," explained Lewis. "Eventually, we had 2,400 staff in different geographic locations, all working from a central document store, in conjunction with seven caching servers to provide a global collaboration environment."

Bentley solutions supported integrated design and document control processes, which helped the global project team work efficiently and overcome complex engineering challenges. People could share data with ease and engage in parallel design activities while ensuring quality control through tight version management of models, drawings and supporting documentation.



MXROAD enables multiple designers to work concurrently.

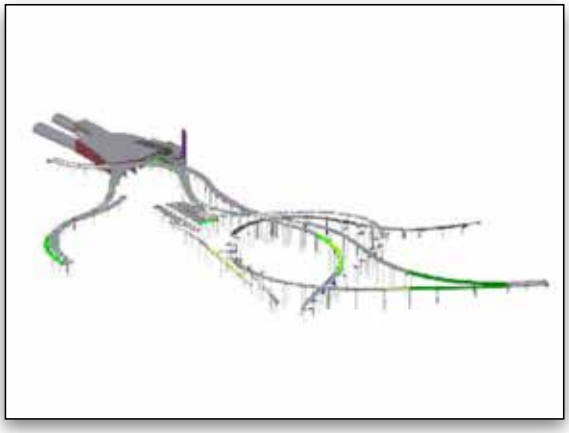
Enabling Global Document Access and Collaboration

"ProjectWise was central to the success of the project because it made data available across a web of cache servers throughout the Parsons Brinckerhoff and Arup networks," explained Lewis. Having a single source of truth for project data across the entire project team enabled both organizations to utilize and mobilize their global skills pool more efficiently.

"With ProjectWise, people were able to find documents much faster," noted Lewis. "We did a very conservative estimate of the time savings we realized, taking just 1,000 of the 2,000 staff into account. Over a 12-month period, we saved at least 23,000 hours of employee time because people could find things more quickly. And this number doesn't take into account savings gained because project teams consistently worked from the most up to date information, which minimized rework."

Efficient Design and 3D Modeling with Integrated Bentley Software

"The Airport Link project was the first major project undertaken by the designers using the referencing and integration capabilities of ProjectWise with MicroStation and MXROAD," stated Patis. MXROAD, which was used to design all roads, tunnels, and earthworks, as well as some structural components, enabled multiple designers to work concurrently within tight designated geographic areas across the project and share information via ProjectWise. A rigorous model version control process was employed via customized macros and routines within the MXROAD design process, providing a linkage between the 3D road model and the alignment drawings to ensure that the most current design data was used project-wide. The integration of MXROAD and ProjectWise also made it easy to employ skilled remote resources across Australia and internationally without having to relocate people.

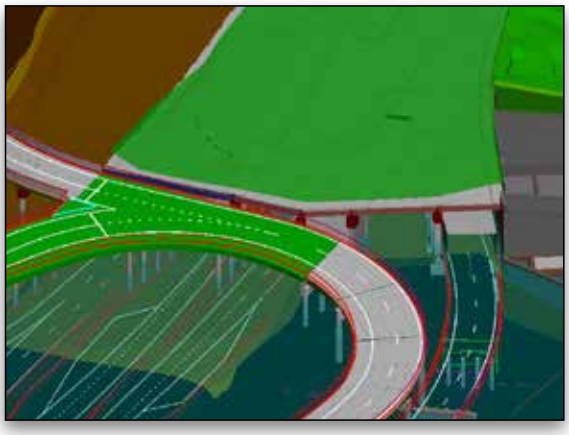


Version-controlled 3D models help stakeholders quickly review the right designs.

All major structures, including bridges, cut and covers, caverns, vent stations, and control buildings were modeled in 3D, using MicroStation, Bentley Structural, and InRoads. RAM Concept was used for the structural design of some of the control buildings and operations centers, and Bentley Rebar for 3D modeling and scheduling of complex tunnel elements.

Using 3D modeling for all design elements enabled interdisciplinary coordination and collaboration by allowing engineers to exchange models between the various disciplines. For example, road designers exported MXROAD design strings and surfaces for use by the structural team, and then the 3D structural models were referenced directly in MXROAD.

Models of the geological surfaces were generated using Bentley's gINT, and then imported into the road and structural models to accurately assess the geological conditions at critical locations. gINT data was also transferred to GIS software and used to develop a complex engineering model of geologic conditions that was then imported into MX and MicroStation.



3D models made it easier to check clearances for the tunnel structures.

The structural models were reviewed interactively against the various strata layers and borehole logs. In addition, 3D models made it easier to check clearances for the tunnel structures, sumps, plant rooms and equipment. For emergency evacuation routes, equipment clearances, and complex geometry, verified structural models were analyzed by the geotechnical, tunnel and structural engineering teams, and then issued to the contractor for set-out, formwork detailing and quantities. Version-controlled 3D models also helped stakeholders quickly review the right designs and validate integrated designs.

Realizing the Benefits

With Bentley software, PBAJV substantially reduced the amount of time needed to design and build the entire project. "For example, we streamlined the interdisciplinary review process, which allowed the design team to deliver 30 design packages per month – a demanding workload," explained Lewis. "We were also able to reduce response times for requests for information during construction, as well as the number of site instructions and design updates during this phase."

ProjectWise enabled both organizations to substantially reduce the need for travel and accommodation on the project as people could work and collaborate remotely using a single, trusted data source. Lewis estimates that for every 100 people that could work from home, PBAJV saved AUD 3.6 million every 18 months. "We could also make available the best skilled resources from Parsons Brinckerhoff and Arup global teams," noted Lewis.

3D modeling enables interdisciplinary coordination and collaboration.

A vast, geographically distributed team worked remotely as a single, cohesive unit to deliver the largest road infrastructure project – and public-private partnership – in Australia's history.

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Contact Bentley
1-800-BENTLEY (1-800-236-8539)
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In addition, using ProjectWise, a team of only five document controllers could manage the receipt and issue of all documentation on behalf of the PBAJV team. "Considering there were 50 separate design offices and 2 million documents, it is not unreasonable to estimate that an additional team of five document controllers would have been required to manage this process had we not used ProjectWise," explained Patis. Five additional document controllers over an 18-month period would have cost about AUD 1 million – money that PBAJV was able to save.

Using MXROAD and ProjectWise together, 22 designers were able to design in parallel by sharing files via ProjectWise. As a result, PBAJV completed work within tight time frames, shared data in a timely manner, and ensured aggressive construction schedules were met. "In addition, the parametric modeling function of MXROAD through design input files enabled a repeatable design process. As a result, alignment changes resulting from updated survey and ground condition data could be distributed amongst the entire project team with a high degree of confidence in accuracy and completeness of the data."

In addition, Bentley design software automated output of customized plans, long sections, and cross sections, all tailored to the exact structural, geotechnical and tunneling requirements on the project, which resulted in huge savings in design output and review time. "In review time alone, I'd estimate that an additional five designers would have been required if we hadn't used Bentley software," noted Patis. "Based on an 18-month design program, this would equate to about AUD 1.4 million in savings." Similarly, by using Bentley software to develop 3D models for 17 cut-and-cover structures and 25 multi-span bridges, the structural design team was able to work with a much smaller team. PBAJV estimates that by eliminating use of conventional methods for detailing, coordinating and set out of all structures in a 2D environment, they were able reduce the team size – and costs – by the equivalent of seven drafters.

Improving the Brisbane Community with a Successful Project

By the end of the project, ProjectWise hosted 2 million documents, 4.8TB of data, and 20,000 as-built drawings and sketches. A vast, geographically distributed team worked remotely as a single, cohesive unit to deliver the largest road infrastructure project – and public-private partnership – in Australia's history. And people living in the city of Brisbane and its suburbs are able to enjoy a much improved quality of life.

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Sustaining Infrastructure