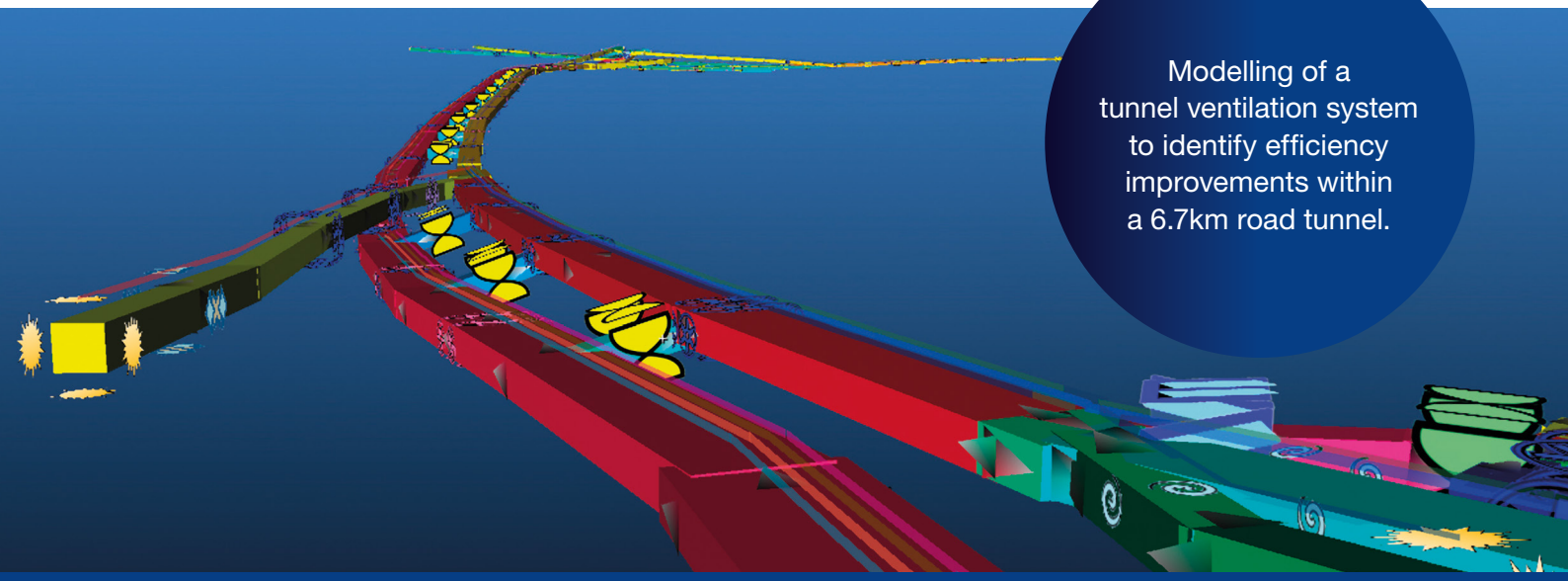
Case Study

Tunnel ventilation efficiency optimisation

AirportlinkM7, Brisbane, Australia



Modelling of a tunnel ventilation system to identify efficiency improvements within a 6.7km road tunnel.

A major road tunnel operator was looking to maximise the efficiency of their ventilation system to reduce costs and their environmental footprint. Utilising Ventsim™ Tunnel DESIGN they were able to gain insight into operational improvements that led to power usage savings of over 10%.

Transurban is a major toll road owner and operator with assets in Australia and North America.

The AirportlinkM7 is a 6.7 kilometre twin tunnel, with three lanes in each direction, to the north of Brisbane. It links two other tunnels providing a route through to Brisbane Airport and was completed in 2012 and owned by Transurban since 2016.

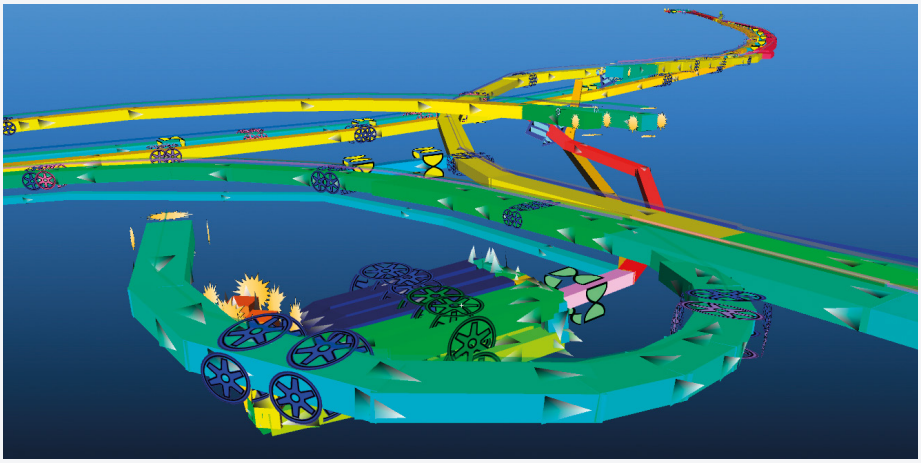
The challenge

Transurban's Brisbane roads are powered approximately 80% by renewable energy generated from wind power. This environmental consciousness extends into their operational approach as they seek to minimise their power requirements and further lower their carbon footprint.

Road tunnel operations involve complex ventilation systems. The system incorporates fans for air supply, exhaust and smoke extraction. They are designed to operate alongside advanced fire safety systems and air quality monitors to ensure that the build-up of harmful gases is avoided and tunnel users are fully protected.

In each of Transurban's tunnels there can be up to 32 large axial fans and 170 jet fans. As a result, the ventilation system is a major power consumer, potentially representing more than 50% of the power used by an operating tunnel.

Transurban's drive for business improvement and in particular their focus on energy efficiency led them to engage with Howden, based on our Ventsim software solution. Ventsim is extensively used within the design and simulation of underground ventilation systems.



“We assessed other products on the market, but Ventsim stood out as a highly visual tool that would deliver the modelling solutions in an engaging way that would be easier for non-technical people to understand.”

Michael Kost, Senior Manager
Asset Analytics Technology, Transurban

The solution

Ventsim has long been used successfully within the mining sector to plan, simulate and select optimal systems for ventilation. It offers infrastructure tunnel designers and operators a similarly effective way to understand the impact of tunnel usage and identify areas of improvement. Ventsim engineers were able to adapt the core functionality of the software as they engaged with Transurban and understood the complexities of their tunnel operations and modelling requirements.

The first stage of the project was to build a model of the tunnel within Ventsim. The model was built initially using scaled maps of the tunnel, but this was enhanced at a later stage by using lidar scan data to provide the exact sizes of the airways.

The next stage was to build the ventilation system into the model. This involved entering the fan specifications including expected performance parameters from each fan – performance curve and jet fan thrust.

The final model, incorporating the entire tunnel ventilation system using axial and jet fans, was completed enabling Transurban to fully simulate conditions within the tunnel. The model was calibrated to a specific day, and traffic data and fan operation were adjusted hourly. To ensure accuracy, airflow data from sensors within the operational tunnel were used for comparison.

The outcome

The model presented a strong correlation with the sensor data for both airflow and gas level and was used to perform analyses of the impact on the energy usage for various operational scenarios. This was then trialled in the actual tunnel to prove out the simulated target improvements.

The results have been very positive. Substantial energy savings of over 10% reduction in power usage have been achieved contributing to Transurban’s sustainability goals. Air quality has also been improved. Consequently, Transurban has updated its current operation procedure.

The model now provides a benchmark system to continually monitor the tunnel usage, providing insight for future changes in traffic profiles and ensuring an optimised ventilation system can be maintained.

Transurban plan to expand the principal to other tunnel assets, with additional modelling already complete. This will further strengthen their procedural controls and commitment to environmentally responsible operations.

For further information get in touch with our team today:

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