Improving road tunnel safety

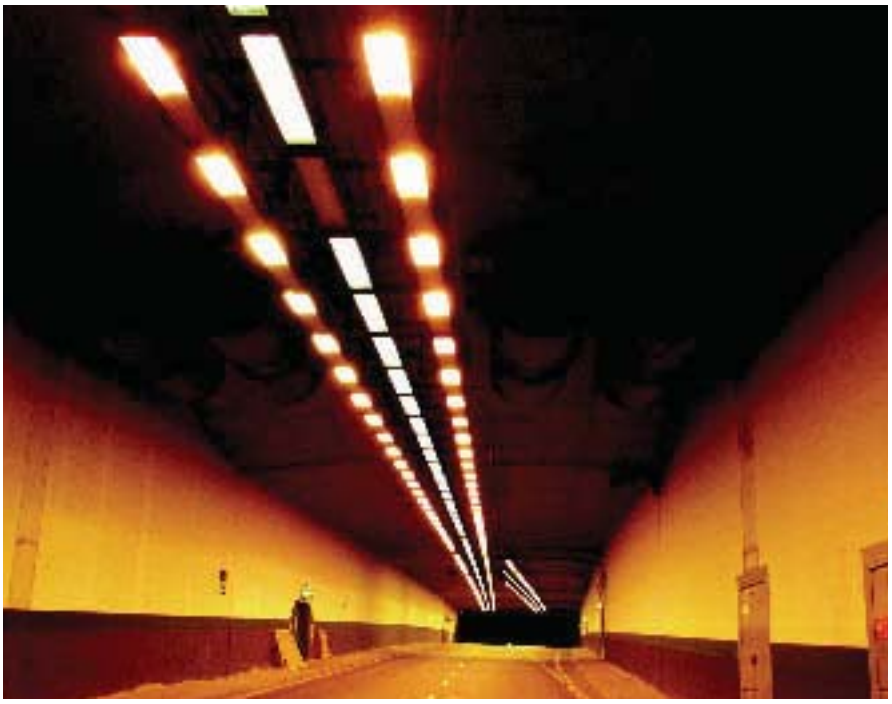
Tunnels are no more dangerous than the rest of the road network; in fact, they are generally safer. However, in case of an incident in a tunnel, the possible consequences in terms of life safety, damage to infrastructure assets and disruption to traffic flow are significantly magnified.

A recent example is the fire on the double-decker bus in the Limehouse Link Tunnel in London, which occurred on 30 October 2005. Mercifully, the fire happened on a quiet Sunday morning with little traffic and there weren't any injuries or fatalities. But traffic through the East End of London was severely disrupted during the immediate aftermath of the fire, as well as during the subsequent tunnel refurbishment; which required the full closure of the tunnel until 15 November 2005.

Accidents and fires in road tunnels are related to traffic density and as road traffic tends to increase over time, so the risks related to incidents may also increase. The Organisation for Economic Co-operation and Development estimates that by the year 2020, there will be roughly a 50 per cent rise in the number of vehicles on Europe's roads, compared with 2004. The increased risk related to the additional traffic density may be reflected in more accidents, as has been borne out by experience.

On mainland Europe in the previous decade, there have been tunnel fires with multiple fatalities at Mont Blanc (1999), Tauern (1999) and Gotthard (2001). In response to these serious incidents, the Conference of Western European Road Directors (WERD) officially requested Switzerland, France, Austria and Italy to create an informal group (the so-called Alpine Countries group) to prepare a common approach to this issue. On 14 September 2000, WERD approved the measures for enhancing tunnel safety proposed by the Alpine Countries group. In addition, Switzerland, France and Germany undertook their own reviews of tunnel safety and updated their guidelines.

A number of research projects relating to road tunnel safety have been



Inside Medway Tunnel

commissioned by the European Union. These include a research project on durable and reliable tunnel structures (DARTS), a thematic network on Fires in Tunnels (FIT), a research project on upgrading methods for fire safety in existing tunnels (UPTUN), the drafting of harmonised European guidelines for tunnel safety (SafeT), innovative systems and frameworks for enhancing of traffic safety in road tunnels (Safe Tunnel), and safety improvement in road and rail tunnels using advanced information technologies and knowledge-intensive decision support models (SIRTAKI). The outcome of these research projects has been a significant improvement in the knowledge available regarding the current risks in road tunnels, as well as opportunities for reducing these risks to acceptable levels.

The United Nations Economic Commission for Europe set up a Group of Experts to prepare recommendations on road tunnel safety. The recommendations – that were published in 2001 – included enhanced safety measures for road users, tunnel operation, tunnel infrastructure and vehicles. Following these recommendations, the European Union published directive 2004/54/EC on the 'minimum safety requirements for tunnels in the trans-European road network' in 2004. The directive sets out the required organisation, management and infrastructure requirements for tunnel safety.

At the international level, the Road Tunnels Committee of the World Road Association (PIARC) had produced a number

Entrance to Medway Tunnel

of recommendations, including a recent report on fixed fire suppression systems in tunnels. PIARC also conducted a joint project with the Organisation for Economic Co-operation and Development (OECD) on the transport of dangerous goods through road tunnels. The recommendations of the joint study have now been implemented in the 2007 version of the European Agreement Concerning the International Carriage of Dangerous Goods by Road.

European automobile clubs have monitored the safety levels in tunnels since 2000, using a checklist approach to estimate the safety potential (measures to avoid incidents, or to reduce their severity should they occur) and the risk potential (the likelihood of incidents occurring, and the possible extent of damage). The European Tunnel Assessment Programme (EuroTAP) uses the safety and risk potentials to publish overall evaluations of tunnel safety as a guide for motorists. There are five possible evaluations, ranging from 'very good' to 'very poor', with the latter indicating an immediate requirement for improvement.

One tunnel that obtained a 'very poor' rating in 2006 was the Medway Tunnel in Kent, United Kingdom. The Medway Tunnel is 725 metres long, and was opened to traffic in 1996. From the site of the old Royal Naval Dockyard in Chatham across to the Hoo Peninsula in Rochester, it comprises cut-and-cover approach tunnels and an immersed tube tunnel under the River Medway. There are two separate tunnel tubes each carrying two lanes of unidirectional traffic, with escape doors connecting the two tunnel tubes every 75 metres.

With some 46,000 vehicles using the tunnel every day, the EuroTAP assessors were concerned about a number of issues, including daily congestion within the tunnel, lack of an automatic fire alarm system, no automatic ventilation response in case of a fire, and the lack of a continuously manned tunnel control centre. In order to address these issues, Medway Council appointed Serco, in association with Halcrow, as consultants to analyse the current deficiencies and prepare specifications for improved tunnel safety systems.

The work in preparing the specifications is now complete and these will ensure a high standard of safety for the users of Medway Tunnel when the improvements have been implemented.

The main design recommendations are:

- The replacement of the tunnel's Environmental Control System, including use of dual redundant supervisory Programmable Logic Controllers (PLCs), dual redundant Supervisory Control and Data Acquisition servers and replacement of all tunnel PLCs. This will include separation of the servers and supervisory PLCs into the West and East Service Buildings, the introduction of new functionality to cater for the new proposed systems, and flexibility for remote operation and integration with Medway's Urban Traffic Management and Control system. Continuous monitoring of the tunnel will be provided at the Medway Council Control Centre (located at Strood).
- The replacement of the existing Closed Circuit Television system and Pan, Tilt and Zoom (PTZ) cameras, and the inclusion of additional PTZ cameras for improving tunnel

Emergency exit at Medway Tunnel

coverage, monitoring barriers and improving service building security.

- Introduction of a video-based traffic incident detection system using fixed cameras in the tunnel, with smoke detection functionality. The incident detection system will have the ability to automatically trigger the appropriate ventilation response in case of a fire emergency, to control the spread of smoke.
- Introduction of radio systems for Police, Fire and Ambulance and a new system for Medway Tunnel Maintenance Staff.
- Introduction of mobile telephone coverage inside the tunnel and public radio re-broadcasting with emergency Voice Break In facilities.
- Introduction of a Voice Announcement system using loudspeakers inside the tunnel, to make emergency announcements to other tunnel users.
- Introduction of an optical fibre communication cable network to support the implementation of the new/upgraded systems.

In addition to this work, Medway Council also appointed Mott MacDonald to provide advice on the structural fire protection issues related to the tunnel. Such fire protection would be required to protect the tunnel from the remote possibility of structural collapse and inundation in case of a major fire. The study considered the provision of passive fire protection utilising either

Control centre at Medway Tunnel

sheets of fire protection material, or spray applied material. In addition, the possibility of a fixed fire suppression system (deluge and high-pressure mist) was considered. It is likely that the improvement works related to structural fire protection will be carried out in tandem with those relating to the Environmental Control System.

A key issue highlighted by EuroTAP was the absence of an emergency response plan for the tunnel. In order to address this issue, Medway Council commissioned Mouchel Parkman to prepare an emergency plan that was discussed with the Rochester Bridge Trust (owners of the tunnel), Kent Police, Kent Fire and Rescue Service, the South-East Coast Ambulance Service Trust, the Environment Agency and the Highways Agency. The emergency plan provides procedures for dealing with a major incident at, or within, the tunnel on the A289 within the Medway Unitary Authority.

The overall investment expected for improvements in the Medway Tunnel is substantial, and will lead to a significantly enhanced safety level in terms of avoiding incidents, reducing the consequences of any accidents should they occur, and assisting the emergency services in dealing with emergency situations. Similar investments to enhance road tunnel safety are currently planned or being undertaken for a number of other road tunnels in the United Kingdom, including the Holmesdale Tunnel on the M25 orbital motorway around London, the Blackwall and Rotherhithe Tunnels in the East End of London, and the New Tyne Crossing project in Newcastle-Upon-Tyne. This particular project will involve refurbishment of the existing Tyne Tunnel, as well as the construction of a new submersed tube tunnel.

These investments in safety are directed to ensuring that despite the continuing growth in traffic, the risk levels to road users are kept down to acceptable levels, and as far as possible, to enable the free flow of traffic. ■

biography

Fathi Tarada

Fathi Tarada studied for a Bachelor's degree in mechanical engineering at the University of Sussex, and carried on to undertake research work in gas turbine technology at the same university, for which he was awarded a Doctorate. He also has a Masters degree in business administration from the Open University. Tarada is a Chartered Engineer, a Fellow of the Institution of Mechanical Engineers, and a member of the Institution of Fire Engineers.