

PIARC (World Road Association) Strategic Plan - 2024-2027

TECHNICAL COMMITTEE 4.4 - TUNNELS

Overview

TC4.4 will address the new cross-cutting topic of sustainability by focussing on the operation and maintenance of road tunnels. New aspects regarding reduction of energy consumption and use of renewable energy sources for tunnel operation will be the focus of this work. Operating and ensuring the safety of users is a major challenge for owners and operators of road tunnels. The new topic of digitalization of Road Tunnel Design and Management will address digital approaches which could help operators in their tasks related to safe and efficient infrastructure operation and management. Further work of TC 4.4 will focus on active modes of transport (pedestrians, cyclists) in road tunnels which are increasing in many cities but also on rural roads. The very fast developments in the area of vehicles powered by New Energy Carriers (NEC) like electric vehicles, hydrogen, etc. will be further investigated based on the successful work already done in the 2020–2023 work cycle. Other topics to be addressed by TC4.4 in the 2024–2027 work cycle are the organisation of the 3rd International Conference on Tunnels and the dissemination and possible further update of the DG-QRAM risk assessment software for the transport of dangerous goods in tunnels (depending on available funding). The results of all the work will then also be incorporated into the further development of the Road Tunnels Manual.

4.4.1 Sustainability of tunnel operation: new approaches

Purpose: The purpose of this work is to update an existing report “First steps to a sustainable approach (2017R02EN) with new aspects regarding reduction of energy consumption and use of renewable energy sources for tunnel operation. The topic of sustainability is fast evolving and has an major impact for road tunnel operators.

Preliminary research questions:

- Energy efficiency and sufficiency (e.g. ventilation, lighting) including self-supplying of energy at tunnels,
- Monitoring of energy consumption,
- Impact of thresholds on energy consumption (e.g. required air quality, lighting level),
- Tools and methods for assessing the sustainability in the planning & design phase (LCA, SD indicators),
- Tools and methods for constraining operation and maintenance cost in both soft and hard aspects; eg. the former is to set the frequency of daily/ periodical inspection,
- Lifetime related design and optimization of tunnel equipment, operation & maintenance, condition monitoring of tunnel equipment,
- Reduction of operational costs.

Importance to roads agencies: This work is important to road agencies/road industry because the operation of existing and new road tunnels in a sustainable way plays a very important role due to the increase in energy prices in the recent years and the objective of CO2 reduction in order to fight climate change.

Audience: This work is important for road agencies and operators of road tunnels in particular.

Deliverables: Technical report, case studies, briefing note.

Background to TC's work on this topic: Existing report "First steps to a sustainable approach (2017R02EN)" which should be updated

Low and lower-middle income countries: The topic of sustainability is important for HIC as well as LMIC. LMIC are in particular affected by high energy prices.

Gender inclusion & diversity: Not appropriate for this topic.

Potential duration: 42 months for the production of three deliverables (case study, briefing note and report). The briefing note will serve as input for TC4.5. The detailed planning will be produced in the work plan of the WG1 group from the start of the next cycle.

4.4.2 Impact of the development of active modes of transport (walking, cycling, wheelchairs) in road tunnels

Purpose: The purpose of this work is to summarize international experiences and good practices regarding pedestrians (including reduced mobility users, e.g. in wheelchairs) and cyclists in road tunnels.

Preliminary research questions:

- Roadway sharing issues (coexistence of road traffic (including buses) and cycles, road traffic and cycles and pedestrians) / separate tubes,
- Geometric considerations, necessary cross sections, design aspects,
- Possibilities for retrofitting of existing road tunnels regarding active modes of transport,
- Safety measures to protect road users (like pedestrians, cyclists, reduced mobility users e.g. using wheelchairs) including evacuation issues, smoke ventilation strategies and air quality issues (sanitary ventilation),
- Intermodal aspects (e.g. bus stops in underground facilities)
- Impact on risks for safety and how to take them into account in risk analyses and in the safety documentation.

Importance to roads agencies: This work is important to road agencies/road industry because the use of cycles has increased in urban areas in particular in a number of countries, as a result of environmental concern and/or political decisions.

Audience: This work is important for road agencies and operators of road tunnels in particular.

Deliverables: Technical report, case studies.

Background to TC's work on this topic: Existing report "General Principles to Improve Accessibility for Persons with Reduced Mobility in Road Tunnels (2019R20EN)".

Low and lower-middle income countries: The topic is very relevant for LMIC because they have a high percentage of road users using active modes of transport.

Gender inclusion & diversity: Regarding reduced mobility users a special focus will be on pregnant women and families with small children.

Potential duration: 36 months.

4.4.3: Digitalization of road tunnel design and management

Purpose: The purpose of this work is to investigate the impact of the Digital Transformation on different aspects of road tunnel design, operation, safety and maintenance/inspection.

Preliminary research questions:

- Digitalization of operation, maintenance and inspection (e.g. IoT sensors for tunnel equipment like e.g. emergency call stations),
- Handling and digitalization of data from new ways of inspecting tunnels, such as the use of drones and robots
- Project development using BIM methodology and experiences acquired,
- Digital twins for life cycle management, the support of fast and smooth commissioning of a new or renovated tunnel and its equipment or the use of digital twins in the training of tunnel control centre staff, first responders and stakeholder's management,
- Centralization of documentation and easy access,

Importance to roads agencies: This work is important to road agencies/road industry because it could reduce design and operating costs and could as well increase availability and resilience of the tunnel.

Audience: This work is important for road agencies and operators of road tunnels in particular.

Deliverables: Case studies, survey, briefing note, workshop or conference.

Background to TC's work on this topic: No existing technical reports dealing with this topic in particular. Similar topics already addressed include "Improving Road Tunnel Resilience, Considering Safety and Availability", "Introduction to the RAMS Concept for Road Tunnel Operation" and "Improving safety in road tunnels through real-time communication with users".

Low and lower-middle income countries:

Gender inclusion & diversity: Not appropriate for this topic.

Potential duration: 42 months.

4.4.4 Tunnel operation and safety issues related to the usage of new energy carriers (NEC) in road vehicles

Purpose: The purpose of this work is to further investigate this fast emerging topic by collecting and sharing international experiences. There are some relevant open questions after the work done in the 2020-23 work cycle which should be addressed in the 2024-2027 work cycle.

Preliminary research questions:

- Incidents with NEC vehicles, collection of data internationally, probability of incidents,
- Intervention / incident management, implications of incidents (e.g. with busses),
- Impact of NEC powered HGV vehicles,
- Impact of NEC vehicles on existing regulation,
- New developments in battery technologies, e-fuels (hydrogen, synthetic fuels) vehicles,
- Pollution and health impact during burning,
- Technologies / solutions to recognize / detect NEC vehicles.

Importance to roads agencies: Due to the currently still small number of NEC vehicles on the roads, there is still far too little experience with problems with these vehicles - especially commercial vehicles - in road tunnels. The expected results of the work within the WG will foster the knowledge base for safe operation and incident management of road tunnels.

Audience: Tunnel operators shall have a better base for decisions how to operate tunnels and how to handle incidents with NEC vehicles. Engineers will benefit from a broader knowledge base concerning important design parameters for ventilation and safety systems.

Deliverables: Technical report, case studies, workshop or conference.

Background to TC's work on this topic: Joint (online) workshop with ITA Cosuf in October 2021, Collection of Case Studies Report 2022R05EN "Impact of New Propulsion Technologies On-Road Tunnel Operations and Safety", Technical Report 2023RXXEN (in preparation).

Low and lower-middle income countries: Developments and experience from NEC vehicle influences on road tunnel operation and safety, which is currently collected in high-income countries will be collected, analysed and processed in order to provide a solid data base for use in low- and middle-income countries.

Gender inclusion & diversity: Not appropriate for this topic.

Potential duration: 42 months.

4.4.5 Update of the Road Tunnel Manual

Purpose: To further update the online Road Tunnel Manual (RTM).

Preliminary research questions:

- Who are the users of the RTM? What are their experiences/feedback? What is missing and what could be improved?
- Include outputs from 2020-2023 work cycle and first outputs of 2024-2027 work cycle.
- Translation of the RTM in other languages than EN, ES and FR if there is support by national volunteers.

Importance to roads agencies: This work is important to road agencies/road industry because they are the users of the RTM.

Audience: Road operators, designers, planners, etc.

Deliverables: Survey, webinar, manual.

Background to TC's work on this topic: In the 2020–2023 work cycle: Update of the RTM with new pages on civil works, preparing and uploading of the French version of the RTM, update of content regarding reports from 2016–2019 work cycle.

Low and lower-middle income countries: The online RTM is of particular interest for LMIC, because it is huge resource containing all PIARC knowledge on tunnels. The RTM is especially aimed at helping LMIC with a low tunnel culture / low knowledge about tunnels.

Gender inclusion & diversity:

Potential duration: 45 months.

4.4.6 Preparation of the 3rd International Conference on Road Tunnel Operation and Safety

Purpose: To prepare the next International Conference on Tunnels.

Importance to roads agencies: This work is important to road agencies/road industry because they will participate in the conference.

Audience: Road tunnel operators, Safety Officers, Tunnel Managers, designers and planners, engineering companies, etc.

Deliverables: Article in Routes/Roads magazine, workshop or conference.

Background to TC's work on this topic: The 2nd International Conference on tunnels was organized in Granada / Spain in October 2022.

Low and lower-middle income countries: LMIC will also participate in the Conference. Special focus will be on topics relevant for LMIC. Lower registration rates will be offered for participants from LMIC.

Gender inclusion & diversity: Selection of Session Chairs & Co-Chairs and presenters will also consider gender and diversity aspects.

Potential duration: 45 months.

4.4.7 Dissemination and possible update of DG-QRAM

Purpose: The purpose of this work is to

- Organise further training sessions with users of the DGQGRAM software,
- Collect feedback of users of Version 4.10,
- Implement improvement tasks within phase 3 (continuation of phase 2 from last cycle, depending on funding),
- If relevant (enough improvement tasks implemented within phase 3), organise a Worldwide Webinar to share the advances in the software with users,
- Possible release of a new updated software version (depending on funding).

Importance to roads agencies: Numerous road agencies are using the DGQGRAM software and/or have set up risk analysis methodologies that are based on this software. They recommend or require that these analysis are included in the safety documentation of operating tunnel bodies or, at least justify some of its content. The improvements make the software more accurate or more user friendly (reducing risk of mistakes) which enhance the quality of the risk analyses.

Audience: The improvements make the software more accurate or more user friendly which of course interest users. Moreover, this is the only available software dedicated to risk of dangerous goods transport on roads.

Deliverables: Survey, webinar, managed software application.

Background to TC's work on this topic: The DGQGRAM software was update to version 4.10 in the 2020–2023 work cycle. A worldwide webinar was organized and training sessions took place.

Low and lower-middle income countries: LMIC are also users of the DGQGRAM software.

Gender inclusion & diversity: Not appropriate for this topic.

Potential duration: 45 months.