

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

TECHNICAL COMMITTEE 4.2 – BRIDGES

Overview

In 2024, bridge owners and managers are faced with a growing number of challenges. Bridges are aging and often subject to more severe operating conditions and environments than had been envisioned during their design. In addition, some design approaches or design codes currently in use of yesterday are limited in how they can accommodate or adapt for these challenges. New causes of deterioration or damage appear almost routinely in many countries and require vigilant attention from managers, especially when the design of structures or routes are not redundant. This is often the case for the causes of deterioration and damage that effect post-tensioned grouted duct bridges. As such, this topic will be a particular focus in this cycle.

Recent advancements in the digital world and the development of new technologies offer new opportunities to address these challenges. The Technical Committee will also study how the digitization of bridge monitoring and management methods can help bridge managers better understand the condition of their bridges. With the lack of human resources the industry continues to face, more focus will be on the use of technology to help manage bridges.

In addition, this cycle will include work based on the principle of bridge redundancy with a view on improving resiliency. This work could bring new approaches for bridge design and management that facilitate risk-based actions or activities. The adaptability of the infrastructure to emerging and severe conditions (including those linked to climate change) is also a vital issue.

The interest shown in the previous cycle on the work regarding forensic engineering justifies the continued collection and sharing of case studies and the lessons learned from the failures they document. The Technical Committee believes that transparency and the sharing of knowledge is critical to maintaining reliability and safety.

Finally, the members of the Technical Committee will not lose sight of the great challenge: the fight against climate change. Close collaboration is planned with Technical Committee 4.5 in order to supply its work on the decarbonization of infrastructure.

4.2.1 Digital transformation for bridge inspection and management (including monitoring data analyse)

Purpose: The purpose of this issue is to identify, evaluate and compare digital technologies and methods, for surveying, collecting information on, evaluating and monitoring bridges (including Monitoring, AI, big data analyse...) to better manage and maintain the bridges stock.

Importance to roads agencies: This work is important for public authorities and bridge managers because in a context of ageing bridges, the pressure on structures is increasing, in particular, due to the consequences of climate change and the pressures on public finances, bridges managers need more than ever to find new tools and/or new methods to maintain or increase the safety, quality and reliability of bridges management. Digital solutions to help managers are already numerous and managers are often caught off guard when faced with these choices. This work should help inform them about the solution and help them choose what meets their needs.

Audience: Road authorities, bridge engineers, academics.

Deliverables: Technical report, case studies, seminar.

Background to TC's work on this topic: This is an original topic for TC.

Low and lower-middle income countries: The LLMIC have the same needs to seek solutions to improve the safety, sustainability, resilience and reliability of their points as other countries.

Gender inclusion & diversity: Not applicable.

Potential duration: 2,5 years for Case studies collections and 4 years for full report.

4.2.2 Management and monitoring of post-tensioned grouted duct bridges

Purpose: The purpose of the work is to (1) evaluate the methodologies and technologies used for the condition assessment of external or internal grouted P/T tendons, and (2) identify the details that should be incorporated in new construction or repair to facilitate the use and to increase the durability of those methodologies and technologies.

Importance to roads agencies: This work is important to road agencies/road industry because of the number of failures observed during the last years around the world.

Audience: Bridges engineers, technical staff.

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

Background to TC's work on this topic: Full report on 2000 on this topic: PIARC . 1 . 11.08.B - 2000

Low and lower-middle income countries: Collect case studies in LMIC is possible.

Gender inclusion & diversity: Not applicable.

Potential duration: 2.5 years for case studies collection and 4 years for technical report.

4.2.3 Requirements and evaluation methods for structural redundancy of road bridges

Purpose: The purpose of this work is to explore the concept of structural redundancy regarding the resilience of the infrastructure. Structural redundancy is a theoretical concept which need to be include in bridge design and to be detailed in its practical dimensions. On the other hand, it can be particularly interesting to know the existing redundancy of existing bridges in order to avoid unnecessary future retrofitting interventions that could be expensive for the bridges owners.

Preliminary research questions: Redundancy and ultimately resilience can be found in many aspects. Questions arise about the availability of bridges, socio-economic influences and the cost-effectiveness of measures.

Here are aspects to be considered from the redundancy in design of new bridges as well as overdesigning in order to anticipate the future needs (for example platooning, traffic increase, material degradation). Furthermore, the modification of existing bridges for increasing redundancy should be taken into account.

Importance to roads agencies: Especially against the background of climate change and ageing of materials, it is important for all road authorities to align their bridge infrastructure in such a way that availability is given. This work is important because the way we will build and maintain in future our bridge stock will change.

Audience: It is expected that engineers as well as road authorities will benefit from the issue. The engineer might find information about the design, whether a manager of road infrastructure might get information for future decisions of maintenance in total.

Deliverables: Technical report, article in Routes/Roads magazine.

Background to TC's work on this topic: The work of this committee in the last cycle (2020-2023) related to climate change can be used as a background information.

Low and lower-middle income countries: It is expected that this issue will lead to participation especially of LMIC as LMIC did call for "building strong new bridges".

Gender inclusion & diversity: Gender inclusion and diversity are not applicable to this issue.

Potential duration: It is currently expected that the committee will collect information during the first half of the 2024-2027 cycle and publish them in a technical report and in an article for the Routes/Roads magazine during the second half of the cycle.

4.2.4 Forensic engineering case studies

Purpose: The purpose of this work is to continue the collection of case studies on forensic engineering initiated during the 2020-2023 cycle, in order to build and feed a global clearinghouse or database on bridge failures. The goal is to create a recurring exchange of lessons learned from failures within the bridge engineering community in order to avoid their reoccurrence.

Importance to roads agencies: This work is important to road agencies/road industry because bridge failures can include fatalities or serious injuries and will result in a loss of mobility for emergency services, the traveling public, and freight that supports regional economic health.

Audience: It is expected that bridge engineers will be the primary users of the work to continue their learning and development in addition to preventing a reoccurrence of similar failures. The work will also be available to universities who might use it to identify research priorities or as an instructional aid. Finally, the work may be used by administrators to justify the development or use of funding to address known safety issues.

Deliverables: Case studies.

Background to TC's work on this topic: As stated in the Purpose, this is an effort to continue the work started during the 2020–2023 cycle. That work resulted in the report titled "Forensic Engineering for Structural Failures." The report provides a valuable reference or primer for those conducting a forensic investigation, but there was deemed significant additional value in sharing the case studies which all contained relevant lessons learned.

Low and lower-middle income countries: It is expected that LMIC will benefit from the continued exchange of lessons learned from bridge failures. In addition, it will provide an example to those that may be reluctant to share information on failures as they can be perceived as a sign of incompetence.

Gender inclusion & diversity: Gender inclusion and diversity are not applicable to this issue.

Potential duration: It is currently expected that the committee will collect additional case studies at the beginning of the 2024–2027 cycle and publish them at mid cycle.