

## Executive Summary

The sixth meeting of PIARC Technical Committee E.1 (Adaptation Strategies and Resiliency) was held in Beijing, China, on 15-19<sup>th</sup> October 2018. The meeting was Chaired by Jürgen Krieger (BAST Germany) and involved 12 delegates from Germany (2 delegates), Japan, Norway, Mexico, South Africa, Austria, China (2 delegates), PIARC General Secretariat (2 delegates), and Australia (via skype).

The Technical Committee E.1 meeting comprised a two-day meeting, followed by an International seminar and Technical site tour.

The activities of TC E.1 are divided into two Working Groups and a Taskforce:

- Working Group 1 (WG1) aims to investigate and disseminate information regarding current adaptation strategies being adopted to increase the resilience of road infrastructure.
- Working Group 2 (WG2) involves the refinement of the *International Climate Change Adaptation Framework for Road Infrastructure* (based on the Special Project developed in the 2011-2015 cycle) and follow-up of its implementation.
- Case Study Taskforce has been formed to consolidate case studies for input into the WG1 and WG2 reports. The outputs of these working groups are complementary, with the results of WG1 informing the refinement of the Framework developed by WG2.

On October 1<sup>st</sup>, 2018, Working Group 1 submitted the final draft report to the PIARC Strategic Theme Coordinator for review. This involved the completion of a 50-page report entitled: *Adaptation methodologies and strategies to increase the resilience of roads to climate change – Case Study Approach*. This report consolidates over 80 world-wide case study examples (including over 20 case studies from Australia and New Zealand). Additionally, in October 2018 the final draft report for Working Group 2 on the review of the *PIARC International Climate Change Adaptation Framework for Road Infrastructure* was submitted to the PIARC Strategic Theme Coordinator for review.

The objective of the Technical Committee meeting was to seek final comments from the Technical Committee on the reports developed for WG1, WG2 and the Task Force, and included discussion of future activities. Caroline Evans, Working Group 1 Leader, has conducted the English reviews of the WG2 and Task Force reports. The final reports for TC E.1 are near complete, and a timetable for final review and editing has been scheduled for completion. These reports are on track for release at the World Congress, to be held in Abu Dhabi in October 2019.

An International Seminar was also held on 17-18<sup>th</sup> October followed by a Technical tour to visit the National Centre for Materials Service Safety, USTB.

The next Technical Committee meeting will be held in Oslo, Norway in May 2019.

## Background

The work of the Technical Committee E.1 builds on the outputs of the previous cycle to further refine the *International Climate Change Adaptation Framework for Road Infrastructure*.

The previous fifth meeting of PIARC Technical Committee E.1 (Adaptation Strategies and Resiliency) was held in Vienna, Austria in April 2018.

The objective of this previous Technical Committee meeting was to report progress on the work program for climate change adaptation and resilience, including development of the Working Group reports, sharing of case studies and determining the next steps.

## World Road Association Update

The Chair provided an update on discussions with the General Secretariat regarding the timelines for the delivery of the TC reports. TC E.1 is progressing on schedule according to the expectations provided from the General Secretariat. PIARC General Secretariat also presented the draft version of the next Strategic Plan.

The Chair provided an overview of the Call for Papers for the XXVIth World Road Congress and outlined the number of abstracts received and due for review by the end of October 2018. TC E.1 proposed the following topics:

### **Methodological approaches and tools for climate change adaptation of roads (11 abstracts received)**

The objective of this topic is to address best practice approaches of adaptation strategies and case studies to increase the resilience of roads to climate change effects and extreme weather. This includes the consideration of:

- Data requirements, methodologies and approaches for collecting data and information relevant to climate change adaptation of road infrastructure
- Methodologies and approaches for vulnerability and criticality assessments of road infrastructure with regard to possible impacts resulting from climate change (project and system level)
- Adaptation measures with regard to different possible impacts resulting from climate change
- Benefit cost analyses with regard to the adaptation of road networks to climate change and extreme weather

### **Frameworks for Climate Change Adaptation of roads (8 abstracts received)**

With regard to the adaptation of roads to climate change and related weather extremes, risk management approaches on network level (i.e. PIARC Framework) have been developed and used. Under this topic the following aspects should be addressed:

- Examples for the implementation of risk management approaches on network level with the aim to identify, propose and prioritize the most appropriate measures and to mitigate risks associated with climate change and/or extreme weather events; as well as suggestions and conclusions from these implementations
- Results and suggestions from exercises, where existing risk management approaches have been assessed on national, regional or local level
- Benchmarking of existing risk management approaches for the adaptation of roads to climate change and/or extreme weather

### **Road infrastructure resilience (32 abstracts received)**

In addition to the normal operation of road networks, additional challenges for owners and operators of road infrastructure will arise. These include:

- Aging infrastructure, state of repair (especially bridges and other engineering structures)
- Climate change and extreme weather events (e.g. heavy rain, storms, heat-waves)
- Natural disasters (e.g. landslides, floods, storm damages, wildfires, earthquakes)
- Man-made disasters (e.g. terrorist attacks, very large accidents with or without involvement of dangerous goods)
- Cyber and cyber-physical threats (e.g. tunnel and traffic control centres)

Road owners and operators must address these key challenges to ensure a reliable operation of their road networks, mobility and supply chains.

Papers were proposed to cover the following topics:

- Methodologies and approaches for (all hazard) resilience management
- Case studies on resilience engineering

The Technical Committee also discussed proposed topics for the next Strategic Plan. The need to continue the work of this Committee was outlined by way of inclusion of the suggested refinements to the Framework from WG2 into the development of an updated Framework, and inclusion of worked examples of the methodological approaches identified in the WG1 report. This is under consideration by PIARC General Secretariat. A position paper on proposed options for the next cycle has been developed by the Chair Jürgen Krieger, Caroline Evans, and Gordana Petkovic, and sent to PIARC General Secretariat.

## Work Program

At the Technical Committee meeting, the Chair provided an overview of the Committee's work plan and each Working Group Leader presented on the progress towards achieving the objectives according to the Strategic Plan. Key information is discussed in the following section.

## Meeting Outputs

### **Working Group 1 – Adaptation Strategies to Increase Resiliency (Caroline Evans, Australia, Working Group Leader)**

*Update on agreed tasks:*

The Working Group 1 Leader presented (via skype) on the objectives of WG1 which is to identify case studies on climate change data requirements, vulnerability/criticality assessments, adaptation measures and benefit-cost analysis, as methodologies underpinning the PIARC *International Climate Change Adaptation Framework for Road Infrastructure*.

- The final draft report for WG1 was presented by Caroline Evans (CE) to both WG1 and TC E.1. The main points of the WG1 draft were discussed in terms of structure and case study examples, which have been provided by the Case Study Task Force.
- The final draft report has been completed and was sent by the TC E.1 Chair to the Strategic Theme Coordinator for Review on 1<sup>st</sup> October 2018.
- More than 60 case studies have been included in the WG1 Report, of which 20 are from Australia and New Zealand.
- It was agreed that WG1 will continue to liaise with WG2 on common text and cross-referencing of relevant sections.
- Additionally, a discussion took place within the TC meeting on the implications of the International Standard ISO 14080 with the work of TC E.1. This standard was assessed against the definitions, methodologies and stages of the WG1 and WG2 reports to ensure consistency.

The final draft report from WG1 is near complete within the schedule advised by the PIARC General Secretariat. Working Group 1 is awaiting comments from the Strategic Theme Coordinator to finalise the report by December 2018.

### **Working Group 2, Refinement of Climate Change Adaptation Framework**

Gordana Petkovic, Norway (Working Group 2 Leader) provided an update on the progress of WG2. The WG2 report has been drafted and it presents the work that has been done by the TC E.1 on investigating the applicability of the Climate Change Adaptation Framework (developed in the 2011-2015 cycle, as a Special Project), experience from its application, and possibilities for its refinement.

The main output for the refinement of the Framework is being formed from case studies collected by the Case Study Task Force. In addition, WG2 are developing examples of implementing the Framework. Two examples of implementation are reported: a regional road network in Mexico, and applicability of the Framework in Queensland, Australia.

An update of the final draft WG2 report was presented in China. Complementarities between the WG1 and WG2 reports were discussed to ensure that these reports are aligned. The draft final report has been submitted to the Strategic Theme Coordinator and will be finalised by December 2018. Caroline Evans has conducted the English review of this report.

### **Case Study Task Force (presented by Beata Krieger, Germany)**

Beata Krieger, Germany provided an overview of the work undertaken to collect the case studies and the results. A technical report of the work has been developed and will be published only in English. The report deals with the collection, classification and provision of case studies on climate change adaptation and resiliency of road infrastructure. The report provides an overview of the work undertaken by the TC E.1 internal Task Force. This report can serve both as a background report to the two TC E.1 reports E.1.1 and E.1.2 and is a valuable stand-alone report for readers wishing to inform themselves about current methodological approaches, procedures and practices related to the adaptation of road infrastructure to climate change and about resilience of road infrastructure with regard to climate change.

To date 72 have been collected and will be included in the reports for WG1 and WG2. By the end of this cycle, more than 100 case studies will be available. Caroline Evans has conducted an English review of and final version has been sent to the Strategic Theme Coordinator. It is expected that this report will be finalised by December 2018.

### ***International Seminar on Resilient Roads and Climate Change Adaptation***

From 17-18th October an international seminar was held. The Technical Committee comprises the Leaders and co-leaders of WG1 and WG2, and French and Spanish Speaking Secretaries of TC E.1, and Caroline Evans assisted in finalising the program and providing technical advice. Two parallel sessions were held throughout the 2 days. The topics covered included:

- 1) Impact of Climate (change) on road infrastructure
- 2) Impact of Climate (change) on traffic operation and countermeasures
- 3) Energy saving and emission reduction construction technology and materials for infrastructure
- 4) Impact of infrastructure and traffic operation on the environment (climate)
- 5) Climate change adaptation framework, policies and practice
- 6) Resilient road infrastructure: data requirements, assessment and improvement (I and II)
- 7) Innovative (smart) technologies and systems

### ***Technical Site Tour and Workshop***

On Friday 19th October, the Technical visited the National Centre for Materials Service Safety, USTB. In particular, TC E.1 toured the laboratories (road engineering lab, driving simulation chamber lab, and traffic control lab), and the existing testing facilities (accelerated pavement testing, laboratory for large-scale experiments on structures, etc).

A seminar was also held including a welcome ceremony and introduction of the Department of Road Engineering of the Beijing University of Technology (BJUT). This included a presentation of key research being undertaken at BJUT.

## **Emerging Issues**

There are no specific emerging issues, other than those highlighted in this report.

## **International Seminars**

See above. This was the final international seminar for TC E.1 for this PIARC Cycle.

## **Benefits from Other Associated Activities**

Following the PIARC Technical Workshop on 'International Adaptation Strategies and Increasing the Resilience of the Infrastructure', held on 10 May 2017 further progress took place with Queensland Department of Transport and Main Roads to consider the PIARC Framework in the Queensland context, and transfer case studies into the PIARC reports for WG1 and WG2. A National Asset Centre of Excellence (NACoE) project has therefore been developed to pursue this initiative and provide a direct linkage to PIARC TC E.1. This project involves integrating the existing PIARC International Climate Change Adaptation Framework for Road Infrastructure, and other approaches into Queensland practice. This related project is progressing with an estimated completion by April 2019.

## **Learnings and Dissemination**

The outputs of the WG1 and WG2 reports will assist in informing Austroads members to analyse road networks and to select and assess the adaptation measures with regard to the consequences of climate change.

## **Conclusions and Future Meetings**

The Working Groups will continue to meet at TC meetings, supplemented by WebEx meetings.

The next proposed meetings are:

- Oslo, Norway, May 14-16, 2019
- Abu, Dhabi, October 2019 (Final conference)

**Caroline Evans**  
**Principal Economist**  
**Arcadis**  
**November 2018**