XVI WORLD WINTER SERVICE AND ROAD RESILIENCE CONGRESS
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Session Report

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Authors of these conclusions: Ms Caroline Evans & Juan Fernando Medoza Sánchez

TECHNICAL SESSION R8.1: RESILIENCE TO CLIMATE CHANGE OF THE ROAD NETWORK WEDNESDAY FEBRUARY 9, 18.30 AM TO 20:00 PM

1. KEYWORDS

Resilience, Climate Change, Network Resilience, Frameworks, Methodologies, Action plans

2. PRESENTATION OF THE SESSION

Road networks are exposed to various threats/hazards that affect their operation and structural integrity. In order to reduce vulnerabilities to these threats/hazards, road authorities and other organisations have implemented policies, strategies, and actions to increase the resilience of the transportation system.
The main objective of this session was to outline the progress of Technical Committee 1.4, including the coverage of the work being progressed by the working groups of the current PIARC cycle. These include identifying uniform and holistic methodological approaches to deal with climate change and other hazards based on case studies, and updating the PIARC International Climate Change Adaptation Framework for Road Infrastructure, published in 2015. Additionally, the session also presented other international examples and case studies that increase the resilience of the road transportation network to hazards, including climate change, and also included coverage of resilience assessment methodologies, and approaches to prioritize critical road segments for climate resilience investments.

3. PROGRAMME OF THE SESSION

Session Chair: Ms Caroline EVANS, Chair PIARC TC 1.4 Climate Change and Resilience of Road Networks, AUSTRALIA & Fabien PALHOL, PIARC TC 1.4 French Speaking Secretary, Cerema FRANCE
Session Organiser: PIARC TC 1.4 on Climate Change and Resilience of Road Networks.
Session Secretary: Fabien PALHOL, PIARC TC 1.4 French Speaking Secretary, Cerema FRANCE.

Person	Organisation, Position	Title of the presentation
Caroline EVANS	Chair of PIARC's TC 1.4; Principal Policy Advisor at the National Transport Commission, Australia	Welcoming and introduction
Marie COLIN	PIARC Working Group 1 Leader TC 1.4; Cerema, France	Overview of Uniform and Holistic Methodological Approaches to Climate Change and Other Hazards
Gordana PETKOVIC Stuart WOODS	PIARC Working Group 2 Leader TC 1.4; Norwegian Public Roads Administration, Norway PIARC Working Group 2 Co-Leader TC 1.4; Waka Kotahi NZ Transport Agency, New Zealand	Overview of the PIARC Climate Change Adaptation Framework for Road Infrastructure
Carline PONSART	Coordinator Transportation infrastructure resilience and climate change adaptation, Quebec Ministry of Transportation, PIARC TC1.4, Quebec/Canada	Resilience of transportation networks affected by erosion and marine submersion: towards and integrated and concerted management of infrastructure in coastal areas

Jan HUSDAL	Senior Principal Engineer, Norwegian Public Roads Administration, Norway	A simplified resilience approach for assessing road projects in Norway
Philippe SOHOUENOU	Transport and urban resilience lead, Resallience, France	A framework to prioritise critical road segments for climate-resilient investments
Louis BETTINI	PIARC English Speaking Secretary, TC 1.4, Principal Advisor Sustainability, Main Roads Western Australia	Questions and Answers
Juan Fernando Medoza Sánchez	PIARC TC 1.4 Spanish Speaking Secretary, Mexico, Head of Environment Research Group Mexican Institute of Transportation	Conclusion of the session.

4. TECHNICAL FINDINGS AND DEBATE

The session was integrated in two parts, the first focused on the progress reached by the Technical Committee 1.4, through its two working groups, and the second part were presented papers selected for oral presentation according to the Call for Papers for this Congress.

In reference to the activities of PIARC TC1.4, Working Group 1 covers uniform and holistic methodological approaches to climate change and other hazards, based on case studies. This Working Group is preparing a report that, through different methodologies based on case studies, can address climate change and other threats. Working Group 2 is working on providing an update of the PIARC International Climate Change Adaptation Framework for Road Infrastructure, published in 2015. The new version seeks to update the methodologies based on new case studies and establish a more interactive and flexible methodological structure, which is useful for any country, regardless of its level of progress in terms of adaptation to climate change. The progress on developing these reports by both Working Groups were outlined in the session.

In the second part of the session, this included a presentation on the resilience of transportation networks affected by erosion and marine submersion. This presentation showed a very interesting study on the management of impacts on coastal areas that affect road infrastructure (some hazards are: sea level rise, increased erosion rate, greater presence of extreme weather events). The project includes a coastal intervention prioritization index, coastal protection asset management system and regional intervention plans to improve resilience. Additionally, implementation of adaptation solutions, regional environmental impact assessments and the need to consult and mobilize external stakeholders to improve social acceptability were identified. This Action Plan on Infrastructure Management in the Context of Climate Change is structured around four objectives that aim to improve governance and management practices, develop expertise and improve knowledge transfer, analyse and assess risks and implement innovative adaptation solutions.

The session also covered a simplified resilience approach for assessing road projects based on the three R's: robustness, redundancy and recoverability. These parameters are scored based on their local, regional, or national importance and the scores are combined in a total score for the project which forms the basis for comparison between project solutions. The effect of these parameters are that they can be measured on a local, regional or national level, and this method can be incorporated into procedures for impact assessment in the project of selecting a project alternative, and in the procedure for risk assessment in the planning phase. This method represents a step towards implementing the resilience approach in planning of roads and road networks and assessing the performance of exiting roads.

Within the session, a presentation was also provided on a framework to prioritize critical road segments for climate-resilience investments which introduces a road network resilience assessment methodology developed by RESALLIENCE. This aims to support transport operators and public authorities in adapting their infrastructure to climate hazards using Geographic Information Systems (GIS) and data about the infrastructure climate risks, and land use to evaluate exposure, vulnerability and resilience of road networks to climate hazards. The method involves a series of aspects such as the infrastructure exposure; vulnerability to climate hazards; operational resilience of the road networks; and its impacts on the

functioning of society. The method includes the components of vulnerability (exposure and sensitivity), resilience (rapidly recover), and the territorial impact of the service.

5. RECOMMENDATIONS FOR DECISION MAKERS, FOR PIARC OR FOR INTERNATIONAL ORGANISATIONS

PIARC TC1.4 has carried out an extensive collection of case studies to identify best examples and best practices to assess climate risks and other hazards, to help decision-makers to increase the resilience of the road network. It was identified that the updated Framework, enables road owners and managers in high and low-middle income countries to tailor and apply specific sections of the Framework according to their particular requirements. This is intended to assist users in recognising systems and routines that are already in place and provides a good basis for adaptation work by ensuring that it is accessible, flexible, interactive, and applicable for all geographic areas and all starting points for adaptation.

It was also highlighted that there are a range of approaches that can be considered to increase the resilience of roads. These included discussions on a simplified approach where the impact of resilience is measured through these concepts individually for each highway project, and thus compared with other projects. This type of analysis allows evaluating hazards and their relationship with the project, and how it interrelates with the service provided by the highway, at an early stage of the project, but it can also be applied to existing infrastructure. Additionally, theoretical frameworks to prioritize critical road segments based on their criticality, were identified to be useful to ensure that investments for new road assets are climate resilient, through project evaluation. The role and importance of these aspects for identification of critical road sections and assets in a road network were outlined in the session. Additionally, Action plans for infrastructure coastal management which consider the need to act instead of react, coastal intervention prioritization indexes, coastal protection asset management systems, and regional intervention plans to improve resilience were demonstrated.

Finally, to conclude this session, it is important to emphasize that derived from the latest IPCC report, which indicates that climate change is irreversible, then the impacts of climate will continue to affect road networks, for which road administrations must be obliged to adapt its road infrastructure to climate change, to ensure the resilience of service provision.

6. PREPARATION OF THE SESSION

This session was planned, designed and organised as follows:

- The session was coordinated and led by PIARC TC 1.4 Chair Ms. Caroline EVANS, and Mr. Fabien PALHOL, PIARC TC1.4 French Speaking Secretary.

The Chairs wish to specially acknowledge all participants, attendees, and contributors and their affiliations as they are listed in the aforementioned Session Programme, PIARC's General Secretariat for their support, and the Canadian Organizing Committee for their hosting and provision of technical support.