PROCEEDR - Optimising Resource Use for Roadside Infrastructures

The roadside infrastructure is today equipped with various devices having a relevant impact on the total amount of materials used for road construction. In the last decades, the number of products used alongside roads has been widely increasing. At the same time, the road infrastructure accounts for extensive use of natural resources, and is a major generator of the waste as well as comprises assets with a lifespan of up to 100 years. Therefore, the national road authorities decided to take a lead and encourage the proper handling of scarce materials. To become more material-efficient, national road authorities must recycle and reuse materials and use more renewable and biodegradable materials. Among road equipment's, **noise barriers** and **safety barriers** are the most relevant ones. Hence, both have been chosen to serve as study objects of this research project to help the national road authorities to reduce their environmental impacts and to contribute to a circular economy.

Photos: Different types of integrated noise and safety barriers of different materials in Europe (steel & transparent left side and fully concrete type right side).

Noise barriers will offer the chance of comparing a large variety of materials and solutions which varies from the most classical options (wood, concrete or metallic cassettes) to the most innovative ones (e.g.cassettes in recycled PVC, sound-absorbing natural fibres, etc.). The assessment of technical performance is based on tests and calculations according to the product standard EN 14388 where acoustic, structural, safety, fire and durability characteristics are considered. Noise barriers will also offer the chance to explore innovative solutions for foundation works always required for the installation alongside roads. Roughly one-third of the total economic value of the noise barrier is represented by foundation works and alternative solutions, such as ground screws or metallic poles hammered (respectively filled) into the ground, can be used instead of concrete kerb and ground cementation.

The performance of **safety barriers** is assessed according to crash tests of different vehicle types according to the product standard EN 1317-5. Given the high technical constraints to achieve minimum levels of performance required, the use of other materials than steel or concrete has been rarely considered. Timber can be used for safety barriers installed alongside rural roads where lower containment levels are required. Furthermore, for the scope of the present research, safety barriers will allow the evaluation of the impact on the sustainability of additional materials used for improving the behaviour of steel or concrete (i.e. preserving steel from corrosion or concrete for weathering effects or other degradation causes). Even a limited improvement achieved by using new materials and/or improving the corresponding industrial processes may lead to a significant impact on the overall sustainability of road infrastructures given the extended use of safety barriers alongside roads.

Project summary

This research project aims to create two tools (an online tool and a software tool) to enable National Road Administrations to identify innovative and sustainable solutions to facilitate the transition from linear to a circular economy in the field of roadside infrastructure. Achieving a circular economy requires minimising the demand for primary resources and reutilizing resources in high-value applications. National Road Administrations need a wider range of material options to change from linear to circular economy. At the same time, high functional demand and technical performance requirements still need to be met (e.g. safety, acoustic, structural, maintenance, etc.). New innovative and sustainable options could be bio-based, renewable resources (such as wood or composites with natural fibres) and the use of recycled/recyclable materials. Therefore, the scope of this research is to gather an overview of innovative and sustainable solutions in the roadside infrastructure sector, and in particular for noise and safety barriers, providing relevant tools for choosing these solutions most suitably and cost-effectively. In doing so, valuable lessons may be learned for application to other circulation fixtures.

In general, the assessment of the application of such solutions should be based on an **environmental life cycle approach** taking into consideration cradle-to-cradle impacts, including resource impacts, long-term environmental performance (maintenance) and end of life (decommissioning). To assure a holistic life cycle engineering approach a **lean Life Cycle Cost Assessment (LCCA)** will be applied. The relevant aspects that will be considered are (i) the technical requirements (e.g. safety, acoustic and structural performance), (ii) durability, (iii) maintenance, (iv) costs and (v) different functionalities. In addition to that, security of supply, adaptability, lifespan extension options, high-value recycling/reuse options, carbon capture capacity should also be considered.

Therefore, the analysis of the **overall sustainability** of the roadside solutions in this project is based on technical and design aspects and involves environmental and economic prerequisites. Among the basic work requirements proposed by CPR for construction works, noise & safety barriers need to fulfil mechanical resistance, safety in case of fire, safety in use, noise protection, hygiene specifications for materials used. A sufficient level of performance regarding the above requirements guarantees that the product meets functional and technical needs and represents the essential conditions for further investigations on a full set of Key Performance Indicators (KPIs) of the **environmental, societal** and **economic** for all life cycle stages.

Therefore, the research will result in the following outputs:

- Overview of relevant use cases and State-of-the-art review to identify research gaps on durability of sustainable and innovative products;
- Practical guideline based on the evaluation of the use cases, including recommendations for industrial stakeholders on how to provide data for further sustainability assessment requested by NRAs;
- Online tool for a comparative study on costs and benefits and total life cycle – and where possible on other harmonised indicators (e.g. economic and social impacts);
- Software tool to model and assess resource efficiency (for example on climate change), when using the suggested materials for the specific applications;
- Final report providing practical recommendations for NRAs how to implement sustainability policy by using the developed tools.

Project consortium:

Chalmers University of Technology, Sweden (Coordinator); AIT Austrian Institute of Technology GmbH, Austria; European Union Road Federation, Belgium; Transport Research Limited, United Kingdom.