Engineering a resilient and sustainable, rural, regional and remote road network

Engineers Australia submission to the House of Representatives Standing Committee on Regional Development, Infrastructure and Transport

February 2023

ENGINEERS
AUSTRALIA

Contents

Engineering a resilient and sustainable, rural, regional and remote road network

Engineers Australia
11 National Circuit, Barton ACT 2600
Tel: +61 2 6270 6555
Email: policy@engineersaustralia.org.au

engineersaustralia.org.au

Introduction

This submission is guided by *Engineers Australia's position on climate change* which states *'Engineers Australia recognises the scale and urgency of the challenges presented by climate change, the disruption it causes, and the pivotal role of engineering in enabling a socially just transition to a sustainable society.'* Climate change induced extreme weather events will continue to pose a threat to existing transport infrastructure around Australia. Overcoming these issues imposed on the transport network due to climate change induced extreme weather events need to be a high priority of both government and industry.

Transport significantly contributes to the Australian economy. It is estimated there are just under 20 million vehicles, which travel an average of over 12 thousand kilometres per vehicle per year on Australia roads.[1] Over 20 per cent of these vehicles are registered freight vehicles.[2] Due to the vastness of our land, transport will continue to be vital component in Australia's domestic capability and economy.

About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia. With over 115,000 members across Australia, we represent individuals from a wide range of disciplines and branches of engineering. Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

Contact

Engineers Australia would appreciate the opportunity to continue engaging with the committee on this topic. To discuss the content of this submission further, please contact Michael Bell, Senior Policy Advisor, at mbell@engineersaustralia.org.au or on +61 08 6214 6321.

Summary of recommendations

- Apply circular economy principles in road construction when identifying recommendations to the terms of reference.
- Review the opportunities identified by Infrastructure Australia's A pathway to Infrastructure Resilience and develop a pathway forward to implement the change identified.
- Create design criteria for climate resilience which is standardised nationally.
- Circular economy principles should be adopted in reviewing engineering and construction standards to include more climate resilient and recycled materials.
- The Commonwealth Government should undertake a national evaluation of the current rural, regional and remote road network identifying existing corridors, relevant climate risks, criticality and vulnerability.
- Greater protection needs to be given to identified corridors to maintain their usability and climate resilience.
- The actions from Infrastructure Australia's Replacement Materials report should be reviewed and implemented. This has the dual benefit of contributing to greater uptake of materials which have waterproofing benefits as well as realising broader circular economy benefits.
- Funding allocation should prioritise climate resilience in areas prone to extreme weather events.
- The Commonwealth Government should coordinate with the states and territories to develop and integrate national standards for climate resilience.
- The sector must better communicate the desired outcomes of road projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.
- Funding should be provided to develop a national risk and causation model which can help to underpin planning.
- Governments must allocate funding for training and upskilling of the labour force in new and existing digital tools.

[1] 'Survey of motor vehicle use, Australia' *ABS* (accessed 7 November 2022) https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/latest-release
[2] ibid

1. A resilient road network for the future

Australia's regional, rural and remote road network can play a critical role when a natural disaster hits. Severe weather events can impact the road network in multiple ways. Flooding, landslides and extreme heat and cold can damage roads making them unsafe for use. Road closures due to fires, floods and other natural disasters can prevent residents moving to safety and emergency services aiding the community. Australia has always been prone to natural disasters, however, climate change induced extreme weather events are only going to make these disasters more intense and frequent. Natural disasters, such as the 2021/22 bushfires and floods, have highlighted the importance of adapting our transport system to be more sustainable and resilient. A report by Engineers Australia *Exploring national mobilisation issues in a collapse of global governance* found in the event of major disruptions to global supply chains there would be a prompt effect on transport and freight which in turn would affect the movement of goods and people.[1] While this was looking at geopolitical factors which would affect the network, the principle stands in relation to the impact of severe weather events on our roads. Where regional, rural and remote communities rely on road-based transport infrastructure, the consequences of that infrastructure being unusable are significant and will influence a towns food security, healthcare services and the ability of people to contribute to society and the economy from limitations in their ability to travel.

The engineering profession is a vital contributor to the discussion and implementation of ways to increase the resilience of the road network. Engineers are trained to solved complex problems. They use this training to design solutions to the challenges faced throughout all stages of an asset's life cycle, from scoping, planning, design and delivery to operation, maintenance and decommissioning. However, the unpredictability of climate change makes it hard to know the intensity of these future events. For example, the Richmond Valley floods in 2022 saw levels exceed the record 1954 height by more than a meter.[2] Similarly, the regional Queensland town of Gympie experienced its worst flood since the 1880s in 2022.[3] Mitigating and adapting the road network to lessen the implications of weather events cannot be looked at in isolation. Consideration also needs to be given as to how to mitigate against climate change broadly to lessen the severity and frequency of these events all together.

Mitigation:

Transport is the third-largest emitting sector in Australia, responsible for just under 20 per cent of national emissions (scope one and two emissions only). Looking at ways to reduce emissions within the transport sector and the decarbonisation of infrastructure should be done in parallel to limiting the severity of these events on the network. An industry report prepared by the Clean Energy Finance Corporation in collaboration with the Green Building Council of Australia and the Infrastructure Sustainability Council shows analysis of eight road projects across the country found asphalt, concrete, steel, aggregates and pipes accounted for around 97 percent of embodied carbon.[3] Having a greater focus on circular economy principles and sustainability is proven to reduce emissions and has additional benefits to improving resilience.

Planners, engineers and others need to consider how we can reduce or eliminate the need for emissions intensive modes of transports (such as internal combustion engine automobiles). By designing regional, rural and remote towns to be more self-sustainable and shift to other transport modes we can be less reliant on the road network as it stands.[4] Reducing emissions intensive and less efficient modes of transport will be critical to meet Australia's recently legislated emissions reduction targets, which include a 43 percent reduction on 2005 emissions levels by 2030 and net zero emissions by 2050.

[3] 'Australian buildings and infrastructure: Opportunities for cutting embodied carbon' *Clean Energy Finance Corporation* (accessed 23 February 2023)
[4] 'Climate change and transport' *Engineers Australia* (October 2020) https://www.engineersaustralia.org.au/sites/default/files/2022-06/climate-change-transport-discussion-paper.pdf

Adaption:

Climate change induced severe weather events are increasing the design value of climate related factors.[5] A such, planning, designing, constructing, maintaining, operating and decommissioning of transport infrastructure must consider the impacts of climate change over the entire lifespan of the asset. This means we must design for higher temperatures, thermal expansion, heat degradation, and passenger comfort. Road infrastructure should also consider how it can support improving the micro-climate, planning for sea-level rise and storm surge increases in coastal transport links, and preparing for a wider range of extreme events like bushfires, cyclones, and floods.

The committee should consider recommendations aimed at adopting circular economy principles in both reducing embedded carbon and utilising recycled/recovered material in their construction. A key part of this will be ensuring greater resilience is offered as a means of enduring severe weather events.

A connected system

Work has already been done on looking at the resilience of infrastructure in Australia. Infrastructure Australia's *A pathway to infrastructure resilience* report outlines opportunities to improve resilience from a systems approach, a change in planning, governance and coordination as well as the place and asset level.[6] This report also highlights the interdependencies which exists between sectors and failures which can cascade down. A broader lens needs to be applied to resilient infrastructure, and options to overcome this need to be explore. Due to current governance arrangements and legacy systems, many assets typically operated individually within asset-class silos. Roads are a good example of this, with the road network often crossing over between state-owned roads, locally owned roads and privately owned roads.[7]

Recommendations:

- Apply circular economy principles in road construction when identifying recommendations to the terms of reference.
- Review the opportunities identified by Infrastructure Australia's *A pathway to Infrastructure Resilience* and develop a pathway forward to implement the change identified.

2. Terms of reference

2.1. Road engineering and construction standards required to enhance the resiliency of future road construction.

In addressing resilience in future road construction, there needs to be a greater definition and consistency in the criteria relating to climate resilience itself. Criteria needs to be established that aligns with relevant standards to ensure design and construction of future road networks are consistent in meeting the requirements of climate resilience. For example, members of Engineers Australia have advised there are at times inconsistencies around how the design for future climate change is specified. Other measures which can enhance the resilience of road construction include:

1. **Greater reinforcement in the design of road edging.**

   Road edging has several benefits in helping to improve road resilience. When effectively designed it directs water away from the road surface into the drainage system. By directing water effectively away from the road surface can also reduce flooding. When heavy rain occurs the increased volume of

[5] ibid
[6] 'A pathway to infrastructure resilience' *Infrastructure Australia* (August 2021) https://www.infrastructureaustralia.gov.au/publications/pathway-infrastructure-resilience-0
[7] ibid

water causes erosion which can damage the road service, increasing the risk to drivers and also repair costs. Well designed edging can prevent this by ensuring the road surface remains intact.

Road edging can also increase safety and stability on the road. In the event of low visibility and/or extreme wind, guardrails can prevent vehicles leaving the road or colliding with other objects.

2. **New designs for porous substrates.**

   An example of a porous substrate would be permeable pavement. This is a pavement with a porous surface which allows water to run through, preventing it from pooling or needing to redirect the water. Other benefits include, helping to prevent ice formation, staying cool in summer and the fact it can be produced with recycled materials.[8] This can also help to reintegrate drainage back into the natural drainage system, further improving drainage outcomes. A key to the successful adoption and implementation of these new designs is investigating and testing new recycled or recovered materials that bind well to create the specified porosity.

3. **Modular ground inserts.**

   Modular ground inserts can help to enhance durability and flexibility and have the added benefits of being able to be installed quickly and easily, without significant disruption to road and commuters.

Innovative solutions should also be considered for areas which are prone to floods. An example of this would be designing certain sections of the road to fail in an extreme weather events, lessening the impact on other parts of the road network. By identifying high risk areas and creating a solution which will fail in a known location, but in a more controlled and defined manner, could help to increase predictability and mean that reconstruction can be pre-prepared and more rapidly deployed.

It is important however, that any new materials or innovation is carefully considered to ensure they meet design guidelines and the relevant authorities' requirements. Without ensuring new materials meet the requirements they could compromise the structural stability and design life of the asset.

Mentioned above are just some examples of new technologies which could be integrated into the road system through design standards. These technologies need to be assessed to ensure they are right for the individual circumstances of each road. When they are assessed suitable, the use of them is sometime prohibited by an increase in costs. However, the whole-of-life cost and other benefits (such as circular economy principles) should be considered and given more weight than just financial investment.

Recommendations:

- Create design criteria for climate resilience which is standardised nationally.
- Circular economy principles should be adopted in reviewing engineering and construction standards to include more climate resilient and recycled materials.

2.2. Identification of climate resilient corridors suitable for future road construction projects.

When identifying climate resilient corridors consideration should be given to the environmental landscape and natural features considering elevation, the risk of natural disasters and the propensity to provide safety in severe weather events. However, identification of climate-fit corridors may not be the best value for money outcome. From a circular economy point of view, the reuse, repair and refurbishment of existing infrastructure would be a preferrable outcome where secondary materials may offer a least-cost solution.

Engineers Australia would recommend undertaking an evaluation of the current national road network using a framework which includes:

[8] 'Permeable asphalt' *Permeable Surfaces Australia* (accessed 17 February 2022) https://www.permeablesurfaces.com.au/category/asphalt

1. Further defining the criteria and application of 'climate resilience' as it pertains to the national road network.

2. Evaluating the climate risks to existing corridors., including the impact on physical assets (for example capital and operating expenditure) against the impacts on the economy.

3. Mapping and scoring assets in the existing corridors based on criticality and vulnerability.

4. Identifying and prioritising risk mitigations for the assets based on their criticality and vulnerability.

5. Developing an action plan based on highest value risk mitigation options to get the best vulnerability reductions.

By undertaking this review and considering the potential risks and impacts of climate change, identification of high-risk areas will help prioritise mitigation strategies to reduce vulnerability.

Design considerations

Where new climate resilient corridors are found suitable, and it is the best way forward, we need to ensure we expand these corridors and build accessible roads. Often, not enough space is set aside for public infrastructure, however, by having more clearance either side of a road, we reduce the risks of the road being closed due to fire hazards. Wider roads also have other economic benefits such as increasing Australia high-wide load corridors. It also allows for other infrastructure provisions such as pipelines.

Consideration should also be given to other transport infrastructure which can improve climate resilience. One example of this is road tunnel infrastructure. Roads within tunnels are not exposed to increased ambient temperatures, high winds, direct rainfall, or surface ponding, scour and other risks that apply to surface roads. The most vulnerable impact of climate change for tunnels is increased overland flow / flooding entering at the portal locations. However, tunnels are typically designed to provide for high flood immunity. Therefore, tunnels can assist with providing climate resilience to the national road network, particularly in critical / vulnerable locations. It is acknowledged that tunnels are not always feasible or required, however where they are, they should be prioritised.

In addition to the road network, rail corridors can also add to the resilience of a network by opening alternative means of transport to towns which have limited access via road. In an event a town is cut off due to road closures, supplies can still be sent via other means. While this inquiry is for roads, identifying and protecting corridors for rail will have numerous benefits for regional and rural Australia.

Recommendations:

- The Commonwealth Government should undertake a national evaluation of the current rural, regional and remote road network identifying existing corridors, relevant climate risks, criticality and vulnerability.
- Greater protection needs to be given to identified corridors to maintain their usability and climate resilience.

2.3. Opportunities to enhance road resilience through the use of waterproof products in road construction.

Engineers are not only involved in the design and construction of roads, but they are also often involved in the development of new technologies to improve the design, construction, operation, maintenance and decommissioning of roads.

Historically, designers and planners have struggled with the opportunity cost of both the financial cost and resilience, especially when funding arrangements have not always been aligned in this regard. New porous technologies, such as porous pavement and foam bitumen can be more cost effective, and often have similar strength capabilities and have a higher resilience to extreme heat and floods.

Water proofing can also be achieved through the soft plastics which aligns to circular economy principles. These plastics can be used as an additive, melted down to form part of the bituminous binder, which helps to waterproof the aggregate.[9]

The importance of utilising these products needs to be reflected in the funding allocation. Funding should be considered as part of a broader cost/benefit analysis, which should include the cost of constructing the road as well as the social and economic cost in not having the road available due to severe weather events. This is particularly critical for roads which don't have alternative routes.

Maintenance also needs to be prioritised, as often the resilience of these roads is only as good as the maintenance which is undertaken on them.

Some of the main barriers to the uptake of innovative solutions to water proofing and the use of recycled materials in roads more broadly (which have many circular economy benefits) is a low familiarity of available materials, negative perceptions and a risk averse mindset, lack of consistency across the country and a lack of stable supply.[10]

Recommendations:

- The actions from Infrastructure Australia's *Replacement Materials* report should be reviewed and implemented. This has the dual benefit of contributing to greater uptake of materials which have waterproofing benefits as well as realising broader circular economy benefits.

2.4. The Commonwealth's role in road resilience planning.

Over the next decade the Australian Government has committed $120 billion in transport infrastructure across Australia.[11] This investment need to be made in a sustainable way, driving outcomes and supporting a productive, safe and equitable transport sector. This is particularly important for national highways (which often stretch over large regional, remote and rural areas) where the financial responsibility lies with the Commonwealth Government.

The Commonwealth Government needs to consider how funding is allocated to ensure the right areas a prioritised. This will require new business models and collaborations between Government and industry, as continuing to invest public money in the transport system, based on historical approaches, will not deliver the outcomes required for a sustainable and resilient road network needed for tomorrow.[12] One way to achieve better outcomes for vulnerable roads would be to tie resilience measures to funding allocation.

The Commonwealth Government should also coordinate between the state and territories to develop and integrate national standards for climate resilience across all jurisdictions. In addition, industry has a crucial role to play in building a resilient transport infrastructure. Government and industry need to consider how the sector balances collaboration with competitiveness, while working towards a shared goal which includes embedding sustainability, resilience and circular economy principles into all projects.

Finally, funding should be allocated to develop a more sophisticated national risk and causation model which helps to underpin planning. The Commonwealth could run a national resilience centre, to lead the modelling of scenarios, their risk of occurrence and consequence to social and economic activity. While some of this may already occur, it would likely benefit from a more coordinated approach.

[9] 'Replacement materials: understanding the market for replacement materials across major infrastructure road projects' *Infrastructure Australia* (December 2022)
[10] 'Replacement materials: understanding the market for replacement materials across major infrastructure road projects' *Infrastructure Australia* (December 2022)
[11] Bell, M. 'The future of transport' *Engineers Australia* (January 2023) engineersaustralia.org.au
[12] ibid

Recommendations:

- Funding allocation should prioritise climate resilience in areas prone to extreme weather events.
- The Commonwealth Government should coordinate with the states and territories to develop and integrate national standards for climate resilience.
- The sector must better communicate the desired outcomes of road projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.
- Funding should be provided to develop a national risk and causation model which can help to underpin planning.

2.5. Any related issues.

Digital engineering tools

Broad uptake and use of digital technologies within the transport system can help to improve designs and increase resilience. The use of new technology, such as digital twins, smart sensors (e.g., internet of things IoT), digital engineering, and digital asset management tools, will ensure Australia is future ready and that our infrastructure can be managed efficiently, sustainably, and effectively. In addition to these technologies, flood monitoring and real time travel information systems can help to enhanced safety to road users through real-time identification and notification of hazards

Recommendations:

- Governments must allocate funding for training and upskilling of the labour force in new and existing digital tools.

ENGINEERS
AUSTRALIA