Transportation Association of Canada

Primer on

The Sustainability Considerations for Bridges

MMM Group

Introduction

The concept of sustainability is most widely recognized from the United Nations World Commission on Environment and Development as follows: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." To the bridge engineering community, this definition means planning, designing, constructing and managing bridges that maintain a balance between the three pillars of sustainability: social, economic, and environmental considerations.

The road and highway bridge engineering community has long been considering many aspects of sustainability, such as safety, durability, and aesthetics. However, these efforts are rarely aligned to the goal of improving sustainability, and are sometimes done without a clear understanding of the positive and negative effects on sustainability. This is understandable given the lack of a standard framework or guidance on bridge sustainability.

In recent years, there has been new focus on sustainability of transportation infrastructure, as the realization of impacts on the environment and the social and economic wellbeing of neighbouring communities and society in general have become widely recognized. Considering the growing awareness of sustainability, most authorities recognize that sustainability will need to be an important consideration when making decisions, setting policies, and meeting performance measures sought by stakeholders. Therefore, guidance was required to provide broader direction on sustainability considerations specific to bridge planning, design, construction and management.

Sustainability Concepts

Sustainability is about the interconnected goals of preserving and protecting the environment and preserving the ability of society to sustain itself. While there are many definitions, sustainability, at its core, means supporting the natural, social and economic systems upon which we depend now and will depend in the future (e.g., clean air and water or safe and efficient transportation systems).

In other words, sustainability is creating net gains in these systems while avoiding all significant adverse effects to them.

A bridge constitutes a large investment of natural, material, financial, and human capital and thus has the potential for significant positive and negative effects to the environment and society throughout its long life (75 years or more).

Improving sustainability of a bridge may be viewed by some engineers and material scientists as involving the use of innovative material to create more resilient structures whereas designers may see it from an innovative design perspective to enhance community mobility. Some may focus on the use of innovative techniques in construction to reduce traffic delays, while others still may support durability to reduce maintenance. While sustainability accommodates all these viewpoints, it is not limited to these alone and has much wider and interconnected aspects.

The sustainability objectives help focus and describe the various aspects of considering sustainability for bridges.

Sustainability Objectives

The sustainability objectives provide direction for improving the sustainability of infrastructure projects and the rationale for undertaking specific actions. The objectives have the additional benefit of providing a tool for clearly communicating sustainability to stakeholders. The sustainability objectives are as follows:

- Reduce virgin material use
- Optimize waste stream
- Reduce energy use
- Reduce emissions to air
- Maintain or improve hydrologic regime characteristics
- Maintain biodiversity
- Engage community values and sense of place
- Improve safety
- Improve access and mobility
- Improve local economy
- Increase lifecycle efficiency
- Promote innovation

The objectives provide clearer direction and justification on how to support natural, social and economic systems during the life of a bridge. While there may be numerous indirect sustainability benefits, the description of the objectives focuses on the direct benefits to bridge sustainability. Each objective is linked to other related objective(s) and the sustainability pillars that can be further linked to the policy, plan or program. The significance of an objective will depend on context; what is germane to one agency/region/project may be less so to another. Therefore, assigning relative importance to the objectives is left to the practitioner.

Sustainability Practices

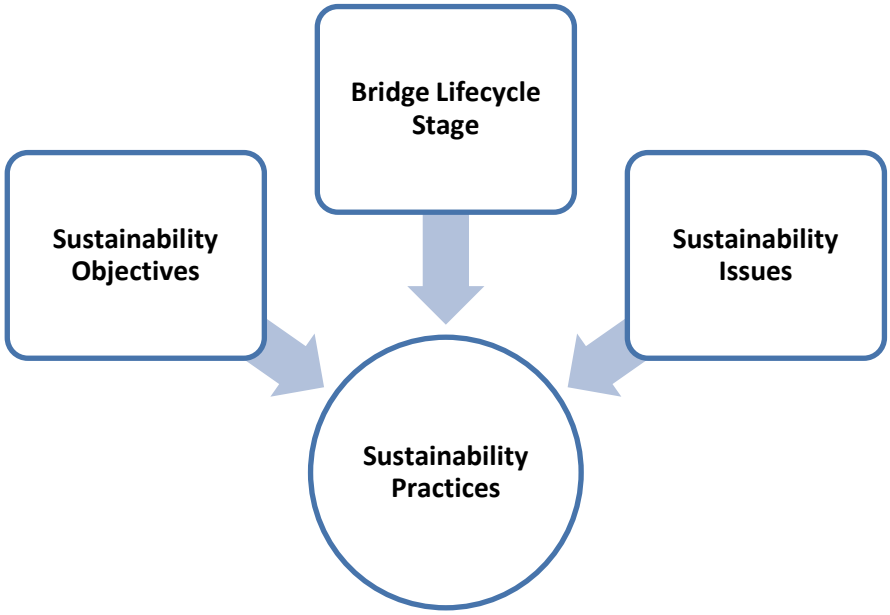
The sustainability practices help practitioners obtain above listed objectives. The practices provide overviews of approaches that can be considered in the life of a bridge in order to achieve one or more of the sustainability objectives. The practitioners may chose from the following practices:

- Addressing scour
- Bridge aesthetics
- Bridge lifecycle cost analysis
- Durability
- Embrace public participation
- Hazardous material reduction
- Importance of safety for bridge users
- Improve material reuse and recycling
- Improve the quality of receiving waters
- Increase local procurement
- Lifecycle assessment
- Maintain or improve access for bridge users: pedestrians and cyclists
- Maintain or improve access for transit
- Maintain or improve aquatic ecosystems
- Maintain or improve terrestrial ecosystems
- Material reduction
- Reduce and divert construction waste
- Reduce bridge greenhouse gas emissions
- Reduce construction traffic delay
- Reduce fossil fuel combustion in construction, maintenance and deconstruction
- Reduce noise pollution
- Resilience

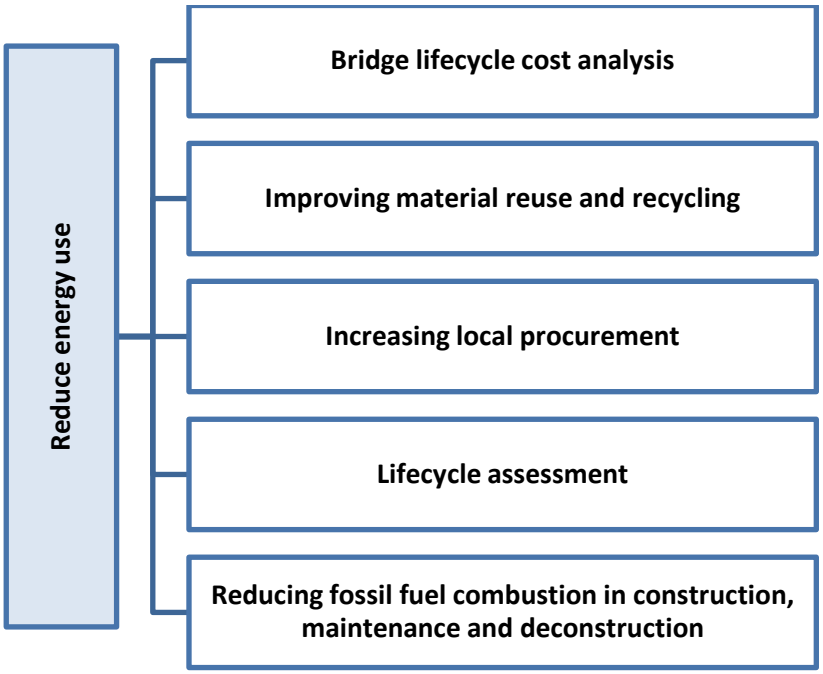
The *Sustainability Considerations for Bridges Guide* consists of 22 practices. Each practice is presented as a fact sheet and includes description, rationale and considerations for undertaking the practice as well as potential barriers and some examples where the practice has been used.

Considering Sustainability

It can be daunting to know where to start when considering sustainability of bridges. To this end, practitioners can select sustainability practices to achieve certain goals in three ways as shown below:



Sustainability objectives: Once sustainability objectives are determined, the practitioners can refer to specific practices for guidance in achieving the objectives. For example, the sustainability objective of reducing energy use is related to the sustainability practices shown below.



Bridge Lifecycle Stage: Sustainability practices are related to various project stages such as: planning, design, construction, in-service (i.e., operation, maintenance interventions and rehabilitation) and decommissioning. The relationship with the practices can either be strong (S) or moderate (M) to reflect the stage of the project wherein practices are customarily done.

For example, the following sustainability practices are related to the planning stage of a bridge:

- Addressing scour: S
- Bridge aesthetics: S
- Importance of safety for bridge users: S
- Maintain or improve access for bridge users: pedestrians and cyclists: S
- Maintain or improve access for transit: S
- Maintain or improve aquatic ecosystems: S
- Embrace public participation: S
- Reduce bridge greenhouse gas emissions: S
- Maintain or improve terrestrial ecosystems: S
- Resilience: M
- Durability: M
- Reduce noise pollution: M

Sustainability Issues: In considering sustainability of bridges, there may be issues or questions raised that could assist practitioners in finding the appropriate practices and guidance to meet the project objective. For example, under the topic of access and mobility the following question may be raised:

Question

- Has there been consultation on, and / or consideration given to the ability of pedestrians and cyclists on and beneath the bridge?

Related Sustainability Practices

- Importance of safety for bridge users
- Maintain or improve access for bridge users: pedestrians and cyclists
- Embrace public participation

More Information

The information in this primer is extracted from the Transportation Association of Canada publication *Sustainability Considerations for Bridges Guide,* which provides a framework and strategies to improve the sustainability of bridges for owners, bridge engineering teams, and stakeholders.

Disclaimer

Every effort has been made to ensure that this primer is accurate and up-to-date. The Transportation Association of Canada assumes no responsibility for errors or omissions. The primer does not reflect a technical or policy position of TAC.

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