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Resilience Metrics in Bridges
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ABSTRACT

Resilience in the face of disasters is a critical capability of communities, and a key requirement for sustainable development. Community resilience is by large determined by the resilience of its infrastructure. Bridges are key components of the transportation infrastructure, and therefore their functionality at a certain level in the aftermath of disasters is essential. To predict this functionality level is crucial for design, asset management and overall community response both before and after a potential disaster, and this prediction is achieved by a resilience analysis. Consequently, metrics used for quantification of resilience become important decision variables for policy-making, and the use of appropriate metrics can have a large-scale effect. The paper aims to analyse some of the most popular resilience metrics for bridges, highlight their potential and challenges, and provide a discussion for further enhancements.

Keywords: resilience, bridge, functionality, recovery, decision-making

1 INTRODUCTION

Resilience is commonly defined as the capability of a system to "bounce back" from a catastrophic event, i.e. to survive with minimal damage and recover rapidly. It is assessed through four dimensions (technical, organizational, social, and economic) and four properties (robustness, redundancy, rapidity, and resourcefulness) (Bruneau *et al.*, 2003; Cimellaro, Reinhorn and Bruneau, 2010). These are associated with three targeted outcomes: low probability of failure, limited consequences from failure, and rapid recovery.

Robustness is the capability of the system to maintain its functionality. This property reflects the level of damage or loss of functionality in the face of the disrupting event. Redundancy is the availability of backup systems or components in the system. This property will help the system survive when a component fails, and will increase the overall system reliability. Rapidity refers to the speed at which the system can recover and regain its functionality. A quick recovery is critical for minimizing the downtime and consequences. Resourcefulness is the capability of the system to quickly and effectively respond to the disruption by properly and timely utilizing the available resources. This capability is essential in preventing the damage propagation and enhancing the recovery rate.

These properties can be combined to define representative metric(s) of resilience because quantification is essential for decision- and policy-making both at the pre- and post-disaster response.

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