Toward Crack-based Assessment of Shear-distressed Reinforced Concrete Infrastructure

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Abstract

The prioritization of repair and rehabilitation efforts for concrete infrastructure is typically informed by damage observed during routine field inspections. Field observations are qualitatively categorized into condition states based on pre-established measurement limits that do little to account for the member-specific details that affect structural behaviour. As a result, conventional strategies do not typically provide reliable, quantitative predictions about the implications of observed damage. Several mechanics-based approaches for the assessment of shear-distressed reinforced concrete structures have been proposed within the last decade. This paper presents an overview and brief comparison of two assessment procedures. Ultimately, this research aims to develop recommendations for refined numerical procedures that assist infrastructure renewal experts to successfully manage the existing infrastructure inventory.

Keywords: concrete; cracking; damage assessment; shear.

1 Introduction

There is a growing inventory of aging and degrading reinforced concrete infrastructure [1–3], and the number and range of efforts required to maintain this infrastructure are similarly increasing [1]. The challenge of assessing this infrastructure is often exacerbated due to out-of-date design and detailing practices, which typically fall outside the scope of modern design code recommendations [4]. Additionally, the production of construction materials accounts for approximately 10% of global carbon emissions [5]. As a result, the successful management of existing infrastructure plays an important role in promoting sustainable engineering practices. For example, extending the service-life of structures that are at intermediate stages of distress is typically a more cost-effective and sustainable approach for bridge preservation than focusing solely on the replacement of bridges with “poor” condition ratings (i.e., avoiding a “worst-first” strategy) [6].

Structures are commonly rated based on visual defects, such as cracking [7–10]. Generally, these rating methods are qualitative (e.g., good, fair, poor, or severe), and they rely on broad measurement ranges for assessing relative damage levels (e.g., a crack width between 0.3–1.0 mm is commonly considered moderate). Additionally, many guidelines recommend penalizing strength or stiffness for capacity load rating [11–13]. These