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Structural Monitoring of a Closure Strip in the Staged Construction of a Slab-on-Girder Bridge on Highway 401

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Abstract

Highway bridges are routinely rehabilitated or replaced in stages to avoid lane reductions. In recent years, the Ontario Ministry of Transportation (MTO) has seen an increase in inquiries and concerns from engineers and contractors related to staging. Some of the potential problems relate to settlement and movement of plastic concrete due to live load vibration, and shear and rotation at the construction joint, resulting in compromised reinforcement bond and reduced concrete quality at the construction joint. In support of a recent guideline advising designers of issues that shall be considered when designing bridges rehabilitated or replaced in stages, the MTO monitored the Hwy 401 Westbound Collectors Bridge over the Ramp from the Hwy 401 WBL Express to DVP/Hwy 404, during replacement. The paper describes the bridge's behaviour as the closure strip concrete sets up. The relative ratio of strain between girders across the closure strip provides an indication of the development of load transfer over time.

Keywords: monitoring; closure strips; staged bridge rehabilitation; cast-in-place concrete.

1 Introduction

Highway bridges are routinely rehabilitated or replaced in stages to avoid lane reductions. The bridges in Ontario are designed and rehabilitated according to the Canadian Highway Bridge Design Code [1]. In recent years, the Ontario Ministry of Transportation (MTO) has seen an increase in inquiries and concerns from engineers and contractors related to staging. Complications during multi-staged bridge rehabilitations have led to construction delays and claims. Some of the potential problems relate to settlement and movement of plastic concrete due to live load vibration, and shear and rotation at the construction joint, resulting in compromised reinforcement bond and reduced concrete quality at the construction joint. Although there is little field evidence that traffic vibrations cause detrimental effects in new concrete at construction joints between stages, particularly where differential vibrations are minimized by diaphragms between stages, it is prudent to mitigate live load affects where measures can be applied at reasonable costs. Accordingly, the MTO released a guideline [2] to advise designers of issues that shall be considered when designing bridges rehabilitated or replaced in stages.

In support of the guideline, the MTO monitored the Hwy 401 westbound Collectors Bridge over the Ramp from the Hwy 401 WBL Express to DVP/Hwy 404, during replacement. The bridge was chosen for monitoring due to its semi-continuous construction sequence, slenderness, and narrow spacing of girders. The Bridge Office of the MTO has been involved with monitoring a number of bridges [i.e. 3-5]. Other experimental studies and monitoring of the concrete closure

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