Experimental and Numerical Studies on Post-Facture Behavior of Simply Supported Composite Twin I-Girder Bridges

Heang Lam, Weiwei Lin, and Teruhiko Yoda

Waseda University, Tokyo, Japan

Contact: lamheang@aoni.waseda.jp

Abstract

This study is carried out to investigate the post-fracture behavior of the composite twin I-girder bridge systems. In the experimental program, one intact specimen and one damage specimen were tested under static load with displacement control method. Different cases of fractures are performed in numerical analyses based on finite element method and nonlinear analyses. Significant reduction of system stiffness and load carrying capacity is observed in post-fracture condition. The failure modes of both intact and damage specimen are governed by the crush of the concrete slab. Nevertheless, composite twin I-girder bridge system will not collapse under dead load and be able to carry a certain level of live load. Numerical analyses for different damage conditions proved that the fracture at mid-span section is the most fracture critical location for composite twin I-girder bridge system.

Keywords: Post-fracture behavior, composite twin I-girder bridge, fracture critical location

1 Introduction

Bridge collapse is often unpredictable and lead to the loss of human lives and increase the concern over the safety of the public infrastructure. In the United States alone, 503 bridges collapse were reported between 1989 and 2000 [1]. Meanwhile, in Japan, a survey on the damage of steel plate Girder Bridge reported a total of 212 of bridges damaged cases including severe corrosion, fracture of the main girder, and the severe crack of the concrete deck [2]. Furthermore, it has been reported that around ten thousand bridges had been in service for over 50 years by 2016 and this number will be doubled (around twenty thousand) in the next 5 years [3][4]. The safety consideration for old age bridges is becoming more and more important for current bridge infrastructures in Japan.

Composite twin I-girder Bridges are commonly used for medium-span bridges due to their low construction cost and simple construction procedures comparing to other types of bridges. Such bridges are currently classified as fracture critical in the United States [5]. However, it has been reported that many bridges have had a full-depth fracture of the main girder and did not collapse, usually owing to the alternative-load-carrying mechanism of catenary action of the deck under large rotations at the fracture [6]. To investigate the behavior of the composite twin I-girder bridges in fracture critical condition, an experimental program is conducted on two small scale bridge test specimens. The post-fracture behaviors of the bridge specimens were reported base on the experimental results and also numerical analyses.

https://doi.org/10.2749/vancouver.2017.0206
Distributed by structurae