Simplified approach for the seismic analysis of precast girder bridges with gap

E.F.Ayoub

Cairo Univ. Assistant Prof. & Euro Consultant Senior Engineer, Cairo, Egypt

M.Youakim

Euro Consultant Director, IABSE member, Cairo, Egypt

P.Nady

Euro Consultant Junior Engineer, Cairo, Egypt

Contact: Essam.Ayoub@euroconsult.com

Abstract

Precast girder bridges are very attractive structural systems to bridge engineers due to their construction rapidity. In their deck arrangement a gap is introduced between the precast girders and the inverted pier cross head. Under longitudinal seismic effect the gap can be closed and the superstructure movement will be locked by the web of the pier cross-head. Usually a rigorous and sensitive non-linear time history analysis will be required for this type of structures. In this paper, a simplified approach will be introduced to estimate the base shear force transmitted to the bridge substructure under seismic loading. In the present approach the modelling of the elastomeric bearing element stiffness is modified in such a way that under earthquake loading the relative displacement between top level and bottom level of bearing equals to the gap value. The seismic analysis with slight, moderate and sharp earthquake accelerations is performed based on the response spectrum analysis as presented by AASHTO LRFD.

Keywords: Seismic; Gap; Bridge; Elastomeric Bearing; Precast Beam; Modelling; Response Spectrum.

1 Introduction

The seismic analysis of precast girder bridges equipped with 'buffer gap-elastomeric bearing' is not quite simple due to the complexity of the high nonlinearity caused by the compound behaviour of the deck under earthquake activity. Under mild seismic condition the deck will displace according to the combined stiffness of both elastomeric bearings and piers and no locking will be expected. However, under more severe earthquake, the deck will undergo large amount of displacement and locking between precast girders and pier cross head will be predicted. Many research works have been published in the literature for the seismic analysis of bridges having gap. In 2019, Miari et al. [1] examined the pounding in bridge structures in several seismic events which may lead to severe damages and the unseating of the bridges. They suggested different mitigation measures to overcome the drawbacks of this phenomenon, including dampers, shock absorbers, memory alloy

https://doi.org/10.2749/ghent.2021.1375
Distributed by structurae