Seismic Analysis of Integral Abutment Bridge – Comparison of Framed Abutment with Fixed Base and Hinged Base

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Abstract

Integral Abutment Bridge (IAB) is the bridge in which the superstructure and substructure is monolithically casted. The advantages of IAB bridge are: less maintenance, better seismic performance due to increased redundancy. In this study, the IAB bridge with 1.0 m diameter pile in 2x10 pile configuration is compared with 1.5 m diameter piles in 1x8 pile configuration. The limit equilibrium method as per IRC:SP:115 is used instead of soil structure interaction for backfill. Soil pile interaction is represented by the linear soil spring. The site - specific response spectra is used for Elastic Response Spectrum Analysis. Temperature loading, Creep, shrinkage, differential settlement; Live load and live load surcharge are applied in the model as per IRC:6-2017. The beam element is used to model the superstructure and pile. Plate element is used for pile cap and abutment wall. The time period of hinged base model is significantly larger than fixed base model. The pile top displacement and abutment top displacement is higher in hinged base model than the fixed base model.

Keywords: Soil-Structure Interaction (SSI); Integral Abutment Bridge (IAB); Pile Foundation; framed abutment with fixed base; framed abutment with hinged base.

1 Introduction

Integral Abutment Bridge (IAB) is the bridge in which the superstructure and substructure is monolithically casted. The IAB has no expansion joints and bearings whereas conventional simply supported bridges having bearings and expansion joints.

There are several advantages of Integral bridge over conventional bridge in terms of service life and maintenance. During the strong ground motion, simply supported bridge may fail due to failure of bearings, deck unseating and deck pounding.

The challenging aspect of the design of IAB is that it requires global FEM model in which superstructure and substructure is modelled as a single unit. The monolithic connection in IAB allows the transfer of the lateral demand induced from temperature and seismic action in superstructure to the abutment pile foundation. However, as the conventional bridges allow the movement and rotation of superstructure at bearing, bending moment is not transferred to be substructure.

Most of the bridge constructed in Nepal are simply supported bridges. Very few IAB bridges have been constructed in Nepal. Recently, Integral bridge have started gaining popularity in the seismic region due to its better seimic performance [6]. The better performace during seismic event is due to the monolithic connection of IAB which increases redundancy [7].

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