

Wiwili Bridge: A balanced cantilever bridge in a high seismic risk area

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Abstract

A 312.5m long and 12.1m wide prestressed concrete box bridge is currently under construction in Wiwili, northern Nicaragua. The 125m main span will be erected by balanced cantilever method from two double wall piers 10m and 12m high. The design introduces some innovation in the classic balanced cantilever type by adopting external tendons for the second stage prestressing cables.

Challenging seismic risk, Wiwili bridge is designed to endure 0.43g peak ground acceleration. Different risk scenarios including a frequent event of 150-year return period – bridge to remain within the quasi-elastic range with no damage – and design event of 1350-year return period have been considered. The ductility capacity of the main span pier walls and the hysteretic damping provided at the plastic hinges has been assessed with the displacement demand. Additionally, isolating LRB bearings have been considered at the abutments and pier P1.

Keywords: balanced cantilever; external tendons; displacement demand; ductility capacity; LRB bearings.

1 Introduction

Wiwili bridge is 312.5m long four span prestressed concrete bridge that will cross the river Coco in northern Nicaragua. Both the 125m main span and the adjacent spans will be erected by balanced cantilever construction from piers P2 and P3. The approach span will be cast-in-situ on formwork.

This paper describes the structural design of the bridge including features such as the external tendons proposed for the second stage prestressing cables. Seismic design is highlighted as one of the main design challenges. Different risk scenarios considered are explained and associated earthquake-resisting systems such as plastic hinges, isolation bearings and displacement stoppers are identified. Finally, the displacement-demand based seismic bridge design methodology is covered.

2 Bridge Situation

2.1 Location and context

Wiwili is a municipality in northern Nicaragua, divided by river Coco. The only way to cross the river is by boat or taking a 135km and 4-hour long detour which includes a ferry trip.

A new bridge, one of the largest in the country, was planned by local transport authority MTI with Inter-American Development Bank funding. The bridge will carry a 7.5m wide two-lane single carriageway and two 1.5m wide walkways over the river. MTI commissioned Constructora MECO as contractor. Construction is ongoing and expected to finish by the end of 2021.