



Evaluation of Non-Prismatic Open Cross-Section Bridge Arch for the Toronto Port Lands Bridges

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Abstract

The Cherry St North, Commissioners St, and Cherry St South bridges are a series of four signature steel tied arch bridges located in Toronto, Canada. The bridges are being constructed over the Keating Channel and a new extension of the Don River. The arch legs of the bridges are composed of non-prismatic open sections using curved plates. The centre domes at the tops of the arches are also composed of open steel plate sections with plates in double curvature. Steel plate hanger from the arches to the closed steel box tie girders serve to transfer the superstructure gravity loads to the arches. The in-plane and out-of-plane structural stability of the non-prismatic open section arch legs required detailed consideration during design. This paper discusses the various approaches used to analyse and design the arch legs, including the use of approximate methods.

Keywords: Arch, Bridges, Non-prismatic, Open-section, Curved, Steel, Stability, Asymmetric, Buckling, Approximate Analysis

1 Introduction

The Port Lands Bridges are a part of a larger project by Waterfront Toronto known as the Port Lands Flood Protection (PLFP) Project in Toronto, Canada. The purpose of the PLFP is to re-naturalize and create a new river outlet for the Don River, which will help remove the risk of flooding to approximately 230 hectares of urban land in Toronto. The new outlet for the Don River along with the existing Keating Channel will form a new island, to be known as Villiers Island, in the Port Lands. The four new Port Lands Bridges were designed as a family of bridges (Figure 1), required to span the Keating Channel and the new extension of the Don River to Villiers Island. The bridges

include: the Cherry Street North Road and Light Rapid Transit (LRT) Bridges over the Keating Channel; and the Cherry Street South and Commissioners Street Bridges over the new extension of the Don River. The Cherry Street North bridges have a 56.1 m span with three (3) lanes and two (2) lanes on the Road and LRT structures respectively; the Cherry Street South bridge is three (3) spans (20 m – 70 m – 20 m) with three (3) lanes; and, the Commissioners Street bridge is four (4) spans (19.8 m – 56.1 m – 56.1 m – 19.8 m) with three (3) lanes. The bridges were designed in accordance with the requirements of the Canadian Highway Bridge Design Code CAN/CSA S6-14 (CHBDC) [1].