



## Concepts for Durable Post-Tensioned Bridges over Highways in Ontario, Canada

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### Abstract

Cast-in-place post-tensioned concrete bridges present certain advantages over slab-on-girder bridges and they make up 20% of the Ontario Ministry of Transportation's bridge inventory. Despite their excellent performance, relatively few are currently built. This paper presents two concepts for cast-in-place post-tensioned concrete bridge replacements over existing highways which overcome some perceived shortcomings. The first concept is two-span cast-in-place voided slab underpass with monolithic pier columns and integral abutments on caissons. The superstructure is cast 1.2 m above the final profile to allow for falsework clearance over three lanes of highway in each direction, and jacked down to the final alignment. The second concept is a single-cell box girder underpass with two spans of 37.5 m, monolithic pier column, and integral abutments.

**Keywords:** prestressed concrete; post-tensioning; integral abutments; bridge aesthetics; jacking; sustainability; cast-in-place concrete.

### 1 Introduction

Cast-in-place post-tensioned concrete bridges present specific advantages over slab-on-girder bridges. They are robust owing to an integrated superstructure, resilient due to internal redundancy, and attractive owing to smooth texture and few horizontal lines. They are minimalist bridges. They are durable owing to their relatively low exposed surface area, they feature few bearings and joints, and can be detailed with a shallow superstructure depth (historically, span-to-depth ratios of 30 to 35 were common in Ontario). The construction of cast-in-place post-tensioned concrete bridges in Ontario was pervasive from the 1960s through the 1980s. Today, they make up 20% of the Ontario Ministry of Transportation's (MTO) bridge inventory.

In many ways, the MTO's cast-in-place post-tensioned bridges have performed comparatively better than slab-on-girder bridges of the same age.

Few have required strengthening, and none have exhibited sufficient damage of post-tensioning strands to be of any structural concern, despite the fact that most of these bridges were built with exposed concrete decks and low cover. A concrete overlay, waterproofing, and asphalt were added starting in the late 1970s.

Despite their excellent performance, relatively few cast-in-place post-tensioned are currently built in Ontario. Reasons include perceived complexity in their detailing, falsework clearance over existing traffic, potential complications for future widening, and lack of standard details for integral and semi-integral abutments. Since the early 1990s, precast concrete girders of up to 45 m are available and routinely shipped in Ontario. Due to the standardised nature of their design and construction, the slab-on-girder bridge type dominates new bridge construction in Ontario. However, in many respects the durability of precast girder bridges falls short of cast-in-place post-