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The Existing Champlain Bridge – Assessment Using Refined Analyses

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Abstract

In order to evaluate the performance of the post-tensioned I-girders and diaphragms in the existing Champlain Bridge, a combination of 3D linear and 2D non-linear finite element analyses were carried out. After 55 years in service, many girders are experiencing deterioration. The results from the 3D analyses enabled the determination of the loads applied to individual girders and diaphragms for the non-linear analyses. The 3D analyses also enabled the determination of the redistribution of forces in the structure due to different degrees of corrosion of the tendons in the girders. The 2D non-linear finite element analyses captured the responses of the girders and diaphragms and enabled an assessment of the performance under service and factored loads. The degrees of corrosion of the tendons and the stirrups were estimated from inspection results. The effects of different strengthening measures were also assessed using this approach.

Keywords: bridge girders; post-tensioning; deterioration; corrosion; evaluation; strengthening; finite element analysis; non-linear analysis.

1 Introduction

The concrete portion of the existing Champlain Bridge in Montreal has 50 spans, with each span consisting of seven 3.1 m deep precast post-tensioned I-girders. After 55 years in service, many of these girders are experiencing significant deterioration. In order to gain a better understanding of the performance of the deteriorated prestressed concrete girders and the diaphragms, a combination of 3D linear and 2D non-linear finite element analyses were carried out. The results from the 3D analyses enabled the determination of the loads applied to individual girders for the non-linear analyses. The 3D analyses also enabled the determination of the redistribution of forces in the structure due to different degrees of corrosion of the post-tensioned tendons in the girders. The 2D non-linear finite element analyses captured the non-linear flexural and shear response of each girder and enabled an assessment of the likely

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