39th IABSE Symposium – *Engineering the Future*
September 21-23 2017, Vancouver, Canada

# A Case Study on Evaluating the Performance Criteria of the 2014 Canadian Highway Bridge Design Code

**Sepideh Ashtari, Carlos Ventura, W.D. Liam Finn**

*Department of Civil Engineering, University of British Columbia, Vancouver, BC, Canada*

**Don Kennedy**

*Associated Engineering, Burnaby, BC, Canada*

**Contact:** sepideh.ashtari@gmail.com

## Abstract

The performance based design provisions of the 2014 Canadian Highway Bridge Design Code (CSA S6-14) have been applied to assess the seismic design of a three-span prestressed reinforced concrete bridge in Vancouver Island, British Columbia. Response spectrum and nonlinear time-history analyses of the bridge at 10%, 5%, and 2% probabilities of exceedance in 50 years hazard levels, and a static pushover analysis were carried out. Soil-structure interaction was considered assuming two soil conditions, corresponding to site classes C and D of CSA S6-14. The seismic performance of the bridge was also evaluated using the recently updated performance criteria in the 2016 BC MoTI Supplement to CSA S6-14. It was observed that the bridge design satisfied all of the performance criteria in both documents at all hazard levels and for both soil conditions, except for the CSA S6-14 criteria at 10% in 50 years probability of exceedance hazard level on site class D.

**Keywords:** concrete bridges; performance criteria; performance-based design; force-based design; Canadian Highway Bridge Design Code, BC MoTI Supplement.

## 1 Introduction

The 2014 edition of the Canadian Highway Bridge Design Code [1] introduced performance-based design (PBD) as an alternative seismic design approach to the traditional force-based design (FBD). The code mandates using PBD for the seismic design of life-line and major-route bridges in high seismic zones. PBD requires bridges to meet certain performance criteria defined in terms of tolerated structural damage, repair, and serviceability objectives, at three hazard levels of 10%, 5%, and 2% in 50 years probabilities of exceedance. For brevity we will refer to these by 10%/50, 5%/50, and 2%/50. The performance criteria include quantitative strain limits of concrete and reinforcing steel, and qualitative damage, repair, and return to service durations. Goals of CSA S6-14 were to allow owner and user-based objectives to drive the seismic design, rather than prescriptive component-based measures. However, owing to the fundamental shift in design philosophy, some prescriptive damage measures were retained within the body of the code, rather than in the commentary, to assist engineers in transitioning from FBD to PBD.

https://doi.org/10.2749/vancouver.2017.3159
Distributed by structurae