



Canadian Code Framework for Performance Based Seismic Design of Bridges

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Abstract

The framework for the performance-based seismic design of bridges that was developed for the 2014 Canadian Highway Bridge Design Code (CSA S6-14) is presented. Three different earthquake return period motions are used for the analysis and the seismic hazard, site classifications and site coefficients developed for the 2015 National Building Code of Canada are used. Different seismic analysis procedures are used to predict the performance for the different levels of seismic input motions. Performance levels are prescribed to satisfy the required service states and damage states. Performance criteria, commensurate with the damage levels are given. The advantages of the performance-based design approach for the design of new bridges as well as the evaluation and retrofit of existing bridges are presented.

Keywords: seismic design; seismic hazard; performance-based design; analysis, performance criteria; importance category; evaluation; retrofit.

1 Introduction

The framework for the performance-based seismic design of bridges that was developed for the 2014 Canadian Highway Bridge Design Code (CSA S6-14) [1] is presented. The special features of this new approach for the design of new bridges include:

1. The assessment of expected performance due to three different seismic events with return periods of 2475 years, 975 years and 475 years.
2. The use of design spectral accelerations determined by multiplying the spectral response accelerations by site coefficients that are a function of period, site class, and level of ground acceleration.
3. Types of analysis include elastic static analysis, elastic dynamic analysis, inelastic static pushover analysis and non-linear time-history analyses. The required type

of analysis is dependent on the seismic performance category, importance of the bridge and whether the bridge is regular or irregular.

4. Minimum performance levels are identified and required for the three different return period events and the importance of the bridge.
5. For each performance level the required performance criteria are prescribed and these performance criteria are satisfied by meeting the damage criteria that are specified.

The framework for the performance-based design approach for new bridges is also used for the seismic evaluation and the assessment of seismic retrofits of existing bridges. For the evaluation and the design of retrofit strategies, the Regulatory Authority/Owner specifies the Importance Category and determines the performance levels