

Application of Performance Based Design to Highway and Transit Structures

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Abstract

The latest Canadian Highway Bridge Design Code, S6-14, now requires Performance Based Design (PBD) for certain bridges. For engineers comfortable with the previous force based design approach, PBD appears to require additional, and more complicated non-linear analysis, to satisfy multiple performance objectives. A review of a displacement based design approach indicates that simple, existing tools can be used to implement PBD for a majority of highway bridges and transit structures. A parametric study is used to demonstrate that the minimal damage performance level will generally govern; thus the other levels only need to be verified after initial conceptual design is completed. The study also indicates that different strain limits can lead to different column designs for the same performance level.

Keywords: Performance Based Design; Displacement Based Design; Performance Criteria; Pushover Analysis; Concrete Columns.

1 Introduction

The latest Canadian Highway Bridge Design Code, CAN/CSA-S6-14 (S6-14) [1], requires Performance Based Design (PBD) for more important or irregular bridges. PBD is also typically required for new light rail transit projects in Canada. For engineers comfortable with the previous force based design approach, PBD appears to require additional analysis, and more complicated non-linear analysis, to satisfy the multiple performance objectives specified. These concerns can be addressed by reviewing the basic principles behind the displacement based approach that can be used to implement PBD for a majority of

highway bridges and transit structures. Additionally a parametric study is used to evaluate which of the multiple performance objectives is likely to govern. This can help focus initial design efforts and make the analysis and design tasks more manageable.

Although PBD is now implemented as a code requirement, there is still some debate over strain limits used to define damage levels. This issue is examined by comparing the strain limits for concrete and reinforcement specified in S6-14 with those specified in the British Columbia Ministry of Transportation and Infrastructure (BC-MoTI) Supplement to S6-14 [2].