SEISMIC SHEAR STRENGTH OF REINFORCED CONCRETE BRIDGE COLUMNS

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Abstract

This paper presents a design method for the seismic shear strength of RC bridge columns. The design approach is based on the principle tensile stress for the diagonally-cracked concrete column with empirical modifications. The proposed method accounts for the effects of concrete compressive strength, axial load level, shear span to depth ratio, longitudinal reinforcement ratio, and displacement ductility ratio. The analytical predicted results of shear strength for forty seven rectangular columns and thirty eight circular columns are in a good agreement with the experimental results. The average ratio between experimental shear strength to predicted strength is 1.21 for circular columns and 1.25 for rectangular columns. The proposed model is compared with the ACI 318-11 and ECP-203 codes, as well as the design approaches of the Caltrans SDC and modified UCSD model. Also, the parametric studies show the reliability of the method for calculating shear strength of bridge columns with different geometrical and material parameters.

Key words: Concrete bridge columns; RC design; cyclic loads; seismic; shear strength.

1. Introduction

Due to its brittle nature, shear is regarded as a mode of failure that should be avoided in reinforced concrete bridge column design [1]. To provide a reinforced concrete bridge column with sufficient shear strength, it is domineering that the shear strength be predicted in an accurate and dependable manner. The available experimental results, e.g. [2-9] indicate that the column shear strength is influenced by several variables, such as the concrete compressive strength, axial load level, shear span to depth ratio, longitudinal steel ratio and transverse reinforcement content and yield strength. Various existing shear strength models such as the ACI 318-11 [10], ECP-203 [11] Caltrans SDC [12], and Modified UCSD model [1] incorporate some of these variables. Hence, there is a need for development of a new model that consider most of the noticeable shear strength variables.

The objective of this paper is to develop a simple design model for seismic shear strength of concrete columns. The proposed design approach is developed by revising and modifying Sezen and Moehle model [14]. The proposed design method account for the effects of concrete compressive strength, shear span to depth ratio, longitudinal steel ratio, compression load level, and displacement ductility on shear strength of bridge columns.