



Experimental and Numerical Study on the Seismic Performance of Precast Bridge Column with an Improved Grouted Corrugated Duct Connection Design

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Abstract

In this paper, an improved connection design of the precast bridge column is proposed, including new design of grouted corrugated steel duct and a shallow recess pocket at the top of footing connection for the assembly of precast concrete bridge columns, which has a good seismic performance, durability and facilitate constructability. The improved grouted corrugated steel duct which can increase the bonding mechanism and facilitate constructability expected to perform better than conventional corrugated galvanized steel ducts used for post-tensioning applications. Finite element analysis is then conducted. It is found that the confining effect (support and friction force) provided by recess sidewall keeps the connection in good integrity. It also prevents early deformation and early development of transverse cracks along the connection interface, which further avoids the damage concentration at connection joint, transfers the plastic hinge region.

Keywords: prefabricated concrete bridge column; grouted corrugated duct connections; seismic performance; quasi-static cyclic test; finite element analysis.

1 Introduction

Precast bridge has attracted increasing attentions in the past decades, due to the fast construction speed, slight traffic interruption, high structural robustness, minor environmental impact, and low cost [1]. The majority of the research activities has focused on low seismic regions [2, 3], while studies on the seismic performance at medium-to-high seismic regions are limited.

The grouted ducts and sleeve couplers are favorable choices due to the construction

convenience and low cost. Grouted corrugated duct connection (GCDC) are used for the connections of column-cap and column-footing, and the performance (grout strength, embedded length and duct properties) is promising [4, 5]. Good strength and displacement capacity are found in the substructures with GCDC [1, 6-9]. It was reported that structures with these types of connections and the corresponding cast-in-place (CIP) benchmarks showed equivalent strength but lower displacement capacity [6, 10-13], which can be improved by allowing debonding of reinforcing bars [14].