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Pretensioned, Rocking Bridge Columns for Accelerated Construction and Enhanced Seismic Performance

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Abstract

A new precast bridge bent system has been developed that accelerates on-site construction activities, minimizes residual displacements even after large seismic events and reduces post-earthquake damage. The connections are the key to the system's seismic performance. They were tested under quasi-static conditions and found to perform exceptionally well with nearly zero strength degradation and little concrete damage, even after being loaded cyclically up to drift ratios of 10%. The restoring properties of the system were evaluated through multi-shaking table tests conducted on a quarter-scale, two-span bridge specimen. The maximum residual drift ratio during testing was 0.4%, even after excursions to drift ratios exceeding 13%. This paper describes the new system, compares its performance to that of more conventional cast-in-place construction, and describes key aspects of its design philosophy.

Keywords: bridges, rapid construction, shake-table, pretensioned concrete, connection, precast concrete, seismic, residual displacements, low-damage, rocking structures

1 Introduction

Given the increasing demands on transportation networks, new bridges must be constructed rapidly, reducing the need for bridge closures and re-routing. Transportation agencies are actively developing and implementing new methods for accelerating the on-site construction of bridges. These efforts are intended to reduce negative construction impacts; especially in densely urbanized, remote or ecologically sensitive areas. Accelerated bridge construction (ABC) has the additional benefits of higher construction quality and greater work-zone safety [1].

Additionally, bridges in seismically active regions must be able to withstand shaking without significant damage, residual deformations or interruptions to service. Bridge closures for inspection, repair or demolition after an earthquake can significantly impact the resilience of the communities they serve. Conventional

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