Cyclic Load Behavior of Self-Centering Hammer-Head Bridge Piers

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Abstract

This paper presents an experimental investigation in the cyclic load response of hammer-head
bridge piers. The paper investigates the response of piers made of precast elements assembled with unbonded
prestressing to provide self-centering capabilities under extreme lateral loading. This technique is beneficial in
terms of limiting the expected residual deformations after major seismic events.
Five one-fifth scale pier prototypes were designed, fabricated and tested under both gravity and lateral cyclic
loading in displacement control. The test matrix was designed to investigate the effect of the construction method
(monolithic versus precast), level of initial prestressing in the unbonded tendons and the use of energy dissipation
rebar to result in fatter hysteresis loops.
Experimental results showed that the proposed construction method is indeed capable of enhancing the cyclic
load response characteristics in terms of increased ultimate lateral load capacity, reduced residual
displacements, delayed damage states and reasonable energy dissipation capacity. The paper serves as a
foundation for the next phase of the research program in which a detailed numerical simulation study will be
developed to examine various design considerations related to the seismic behavior of such construction method.

American Journal of Engineering Research (AJER) 2018, January