Investigation on the reasonable area of energy-dissipation bars for hybrid rocking columns

Zehua Bao, Xueqi Zhong, Jianzhong Li

Tongji University, Shanghai, CHINA

Contact: 1810739@tongji.edu.cn

Abstract

In recent years, hybrid rocking columns have drawn more and more interests from researchers, due to their self-centering capacity. The energy-dissipation bars, which are generally applied at the rocking joints of hybrid rocking columns, could improve their energy dissipation capacities. Thus, the reasonable reinforcement ratio of energy-dissipation bars is much required for engineering applications. To determine the reasonable reinforcement ratio of energy-dissipation bars, a numerical investigation is conducted in this paper based on nonlinear time-history analysis. The analysis results show that a reasonable reinforcement ratio of energy-dissipation bars can effectively reduce seismic displacements of the hybrid rocking columns, without excessive residual deformations. Further, the reasonable reinforcement ratio of energy-dissipation bars for hybrid rocking columns with different periods is proposed in this paper.

Keywords: hybrid rocking columns; unbonded prestressed steel; energy-dissipation bars; reinforcement ratio; equal displacement; residual displacement

1 Introduction

China is in the junction of plates, which leads to frequent earthquakes[1]. Traditional reinforced concrete piers will be damaged during earthquakes, and long-term maintenance or complete replacement of the piers will be required. Therefore, an attractive solution is to develop a system that can be quickly repaired after an earthquake. This goal can be achieved by hybrid rocking columns, which are the combination of traditional piers and unbonded post-tensioned prestressed steel[2].

In fact, the energy dissipation capacity of the rocking structure with unbonded post-tensioned prestressed steel is insufficient[3,4,5,6], which will generate a large amount of displacement demand[7].In order to improve the energy dissipation capacity, the application of energy dissipation devices[8,9,10,11] (such as metal dampers, energy dissipation steel bars, buckling restraints, shape memory alloys) has been proven to be an effective method.

Beginning in the 1990s, foreign scholars have linked prestress and energy dissipation structure together and proposed the concept of hybrid rocking structures[4,5,12,13]. In 2002, Christopoulos[14] and others extended the concept of hybrid rocking structures to steel frame structures. In 2014, Bao Longsheng[15] and others explored the influence of parameters such as reinforcement ratio of energy-dissipation bars on the seismic performance of segmental precast unbonded post-tensioned ring-shaped piers. In 2017, Roh[16] made new self-centering bridge piers using shape memory alloy as

https://doi.org/10.2749/ghent.2021.1407
Distributed by structurae