39th IABSE Symposium – *Engineering the Future*
September 21-23 2017, Vancouver, Canada

Key Techniques for Performance-based design of metro depot covered structure

Jian Jia, Chuanping Liu, Xiaobing Xu, Zhibin Zhang, Xiaolin Xie ,Kai Liu

TJAD Co., Ltd. Shanghai, China

Contact: liuchuanping@126.com

Abstract

The challenges of developing superstructures on metro train depots include abrupt changes of structural stiffness, discontinuities of vertical structural elements, out-of-current codes, different architectural types, and different construction sequences. This study analyses design process of superstructures on a metro train depot in Shanghai area. The performance-based seismic design is used to design the key structural components. The laboratory shaking table tests are used to simulate seismic responses of depot and superstructure subject to earthquakes. The theoretical analysis and shaking table simulations show the superstructure and depot deformed elastically in moderate earthquakes and will not fail in strong earthquakes. The main factors affecting development of superstructure above metro train depot are analysed. The paper provides useful insights to similar projects.

Keywords: Metro train depot; superstructure above depot; performance-based design, shaking table tests

1 Introduction

During development of metro systems in cities, the metro train depots are important for storage and maintenance of trains. A metro train depot usually includes garage, maintenance workshop, material storage, and other live/work facilities. The train depot is usually a single-story building with a large plane area. Therefore, the roof of depot can be used for real estate development. The building on the roof of depot is termed as superstructure in this paper.

Several challenges may be encountered in development of superstructures above metro train depots. The height of depot is usually 8~10 m while average story height of superstructure is about 3 m. The lateral stiffness of depot is significantly smaller than the lateral stiffness of superstructure.

The depots usually use frame structures with large space between columns. The superstructures usually use frame-shear wall structures with small space between columns and shear walls. Therefore, the loads of superstructure must transfer to the roof of depot firstly and then distribute on the columns of depot.

The spaces between train tracks are usually restricted, which confines the cross-section of columns of depot.

The architectural types of depot and superstructure are different. The depot is an industrial building while the superstructure is a civil building. Current codes used for either industrial or civil buildings may not applicable to the combination of two types. Additionally,

https://doi.org/10.2749/vancouver.2017.1592
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