



Machine learning-based failure mode identification of RCSPSW

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Abstract

Reinforced concrete – steel plate composite shear walls (RCSPSW) have attracted great interests in the construction of tall buildings. From the perspective of life-cycle maintenance, the failure mode recognition is critical in determining the post-earthquake recovery strategies. This paper presents a comprehensive study on a wide range of existing experimental tests and develops a unique library of 17 parameters that affects RCSPSW's failure modes. A total of 127 specimens are compiled and three types of failure modes are considered: flexure, shear and flexure-shear failure modes. Various machine learning (ML) techniques such as decision trees, random forests (RF), *K*-nearest neighbours and artificial neural network (ANN) are adopted to identify the failure mode of RCSPSW. RF and ANN algorithm show superior performance as compared to other ML approaches. In Particular, ANN model with one hidden layer and 10 neurons is sufficient for failure mode recognition of RCSPSW.

Keywords: failure mode recognition; composite shear walls; machine learning; ANN.

1 Introduction

Reinforced concrete shear walls (RCSW) are considered to be one of the most effective structural components to resist lateral load and maintain structural integrity in high-rise buildings in seismic regions. In past decades, ever-increasing building height associated with greater vertical axial load demands calls for thicker RCSW to meet axial compression ratio limits specified by design codes worldwide [1-2], leading to an increased gravity load intensity and severer damage states in

seismic events. Under such circumstance, composite steel-concrete wall systems with various section forms have been extensively investigated by researchers to explore viable solutions with good seismic behaviour [3–4]. Specifically, Zhao [5] first proposed to add the steel plate in the concrete wall panel to improve the lateral load performance, forming a new composite shear wall system, named as reinforced concrete-steel plate shear walls (RCSPSW). According to the steel plate location, RCSPSW can be categorized into two types: steel-plate-embedded concrete shear walls