



Effect of Corrugation Angle and Direction on the Performance of Corrugated Steel Plate Shear Walls

Hayder Fadhil ^a, Amer Ibrahim ^a, Mohammed Mahmood ^{a*}

^a Department of Civil Engineering, University of Diyala, Iraq.

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Abstract

Corrugated steel plate shear wall (CSPSW) is one of the lateral resistance systems which consists mainly of steel frame (beam and column) with vertical or horizontal corrugated steel plate connected to the frame by weld, bolts or both. This type of steel shear wall characterized by low cost and short construction time with high strength, ductility, initial stiffness and excellent ability to dissipate energy. The aim of this paper is to evaluate the effect of corrugation angle and its direction on the performance of CSPSW under cyclic loading. The Finite element analysis was employed to achieve the research aim. The FE models were validated with experimental data available in the literature. Results reveal that the corrugation angle has a clear influence on initial stiffness, strength, ductility, and energy dissipation of CSPSW. The optimum performance of CSPSW can be obtained with angles of 30° for CSPSW with vertical corrugation and 20° for CSPSW with horizontal corrugation. The use of CSPSW with vertical corrugation provides higher strength, stiffness, and ductility compared to CSPSW with horizontal corrugation. Therefore, it is recommended to use CSPSW with vertical corrugation.

Keywords: Corrugated Shear Wall; Corrugation Angle; FEM Analysis; Cyclic Loading; AC154 Protocol; Energy Dissipation.

1. Introduction

Steel plate shear walls (SPSWs) are lateral force resisting system. They have seen increased in usage over the last thirty years. They provide significant strength, ductility and initial stiffness at relatively low cost and short construction time [1]. SPSWs always show early elastic buckling in the wall panels under gravity loads transferred from the boundary frame and floor during construction, or even under low lateral load unless they strengthened by stiffeners or concrete encasement. Therefore, there is a need for another type of shear wall that could be a viable and convenient solution without the need for welding stiffeners or casting concrete. Corrugated Steel Plate Shear Wall (CSPSW) is one of the best alternatives. CSPSW is a new type of lateral load resisting system within the family of steel plate shear walls, which consists of a steel boundary frame and a corrugated steel plate wall panel. The corrugated plate categorized by three aspects: angle of corrugation, horizontal side, and the inclined side, which are forming the ribs (Figure 1). The ribs are one of the advantages of the geometric shape of the corrugated plate. They act as stiffeners to the plate and they proved to improve ductility, initial stiffness, energy dissipation, and the ability to oppose the gravity loads compared with SPSW. In addition, CSPSWs have lower construction cost because there is no need for stiffening the plate [2]. CSPSWs can be divided according to the direction of corrugation to the vertical corrugated and horizontal corrugated steel plate shear wall.

In recent years several studies have investigated the behaviour of corrugated steel plate shear walls. Easley and McFarland [3] was the early research that conducted for studying the global shear buckling equation of corrugated plates. Mo and Perng [4] tested five specimens of the reinforced concrete frame and corrugated steel plate. The specimens tested

* Corresponding author: mohammed.mahmood@uodiyala.edu.iq

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