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Investigation on Effects of Concrete Properties on Seismic Behavior of Composite Steel Plate Shear Walls

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Abstract

Appropriate performance of composite section, and design codes approach to expand the utilization of this type of construction has led to increasing research on advantages of using composite steel plate shear walls as a lateral load resisting system and its adequate design criteria. The current research was carried out to investigate the effects of increasing concrete compressive strength of composite columns on seismic behavior of composite steel plate shear walls by developing numerical models based on finite element method. For this purpose, several models of steel plate shear walls with composite columns, with the same geometry were analyzed under seismic loading. Two different types of vertical boundary elements were considered : (1) H-shaped steel section , (2) H-shaped steel section with concrete cast between the flanges. Beam to column joints were assumed as moment connections. The results were illustrated and compared in parameters such as : stiffness, load carrying capacity, energy dissipation capability, stress distribution pattern in steel plate shear walls.

Keywords: Composite steel plate shear walls, Boundary elements, Non-linear analysis, Seismic behavior, Finite element Method.

1. INTRODUCTION

Researches, both experimental and analytical, in the past four decades indicate that the Steel Plate Shear Wall (SPSW) system can act as an economical and effective lateral load resisting system against wind and earthquake.

A typical SPSW consisting of vertical infill panel connected to the surrounding boundary elements, exhibit high initial stiffness, behave in a very ductile manner and dissipate significant amounts of hysteretic energy, which make it a suitable lateral load resisting system for the design of new buildings as well as for the retrofit of existing constructions.

The tension field action of SPSW, as a basic concept of performance of SPSW, would increase the demand on boundary elements of this system. In addition to gravity load, the vertical boundary elements (VBE) resist the bulk of overturning moments. They also provide an anchor for tension field action of the infill panel. Therefore SPSW system requires enough stiffness of VBEs and it often leads to use large sections. Steel-Concrete composite columns can replace the use of steel-only columns to improve the behavior and cost efficiency of the structure significantly. Concrete increases the axial capacity of the columns and their flexural stiffness, thereby providing good anchorage for the development of the post-buckling capacity of the infill panel without requiring overly deep members. Steel-Concrete composite columns offer high stiffness, high strength, high ductility and large energy dissipation capacity.

A new type of steel-concrete composite column composed of H-shaped steel section figures the partially encased composite (PEC) section with concrete cast between the flanges of the steel section has recently been developed by Canam Manac Group [3].

This paper investigates the effect of increasing concrete compressive strength on seismic behavior of a system combining PEC columns and SPSW.