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Experimental Study of Welded Connection of Three Steel Beams to Lateral Reinforced Concrete Column

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Abstract

This paper presents the results of an experimental investigation in to the seismic performance of a composite moment resisting frame system that consists of reinforced concrete columns and steel beams. The type of RCS joint developed in this study is called "column penetration joint" which could improve its strength, deformation,and energy dissipation capacities compared to existing composite joints. A static reversed cyclic loading was performed on three specimens. Various detailing options were evaluated to provide full moment connection in both orthogonal framing directions at the beam-column joints. With appropriate joint detailing, specimens exhibited a desirable beam plastic hinge mechanism with stable hysteretic response to cyclic hysteresis loading. They were able to maintain their strength, with little or no deterioration of stiffness during repeated cycles at the same drift. Increasing the thickness of steel cover plates significantly increased the strength and enhanced the stiffness retention capacity of RCS joints.

Keywords: Composite connection, Failure mechanism, Seismic behavior, RCS frames, Coverplate

1. INTRODUCTION

RCS composite moment resisting frames that consist of reinforced concrete (RC) columns and steel (S) beams have gained increasing interest in the past 40 years due to their efficiency from both structural and construction viewpoints. Extensive research has been conducted in the United States and Japan to study the basic force transfer mechanisms in the connection region, as well as various joint details that could enhance the connection performance, especially under seismic excitations.

Despite the advantages offered by RCS structures, their use has been restrained primarily to low and moderate seismic risk regions because of the lack of design provisions that consider the behavior of these hybrid systems under large load reversals. In addition, the study of RCS joint behavior has been limited primarily to interior connections[2].

Therefore, an experimental and analytical program was undertaken at the University of Azarbayjan to develop information on the inelastic cyclic response of RCS joints, especially in exterior RCS connections. In this paper, the behavior of three exterior RCS joints and their failur mechanism is discussed.

2. Experimental program

The experimental program included the testing of Three exterior RCS connections subjected to cyclic loading. The specimens consisted of an RC column and three steel beams that connected to the column through the steel plates. Each specimen was subjected to twenty cycles of increasing vertical displacements from 0.5% to 5.0% story drift. Each cycle to a higher story drift level was performed twice to evaluate the stiffness retention capacity of the specimens during repeated cycles.

Three specimens S1, S2, S3 was designed and built in the laboratory, each specimen consisted of concrete columns with dimensions 20 × 20 cm and three IPE12 steel beams that connect to the columns with steel plates around it. Also stiffners has been used in order to achieve a stable cycle behavior and All parameters including beams and columns dimensions, column bars and plates of steel were used in