EXPERIMENTAL STUDY OF COMPOSITE COLD-FORMED STEEL C-SECTION CONNECTED BACK-TO-BACK

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ABSTRACT

This thesis describes the results of an experimental investigation involving the testing of push out specimens. This study was aimed to develop a new type of shear connector that is easy to construct for a composite beam. The test specimens were designed to study the effect on the different shapes of shear connectors that have been applied for cold-formed steel lipped C-sections connected back-to-back. The test specimens have been categorized into two series which are four numbers of specimens for the first series and two numbers of specimens for the second series. For the first series variations of shear transfer mechanisms were tested, where prefabricated bent-up tabs of square shape and prefabricated bent-up tabs of triangular shape were employed at the surface of the flanges embedded in the concrete to provide shear transfer capacity. Second series of specimens were selected based on the results from the first series. The primary differences between the specimens are the shapes of the shear connectors and angles of bent-up. Failure mechanisms also were observed during testing. In this study, longitudinal cracks were observed from most of the specimens that were tested. Results show that the shear capacities of specimens with proposed type of shear connectors increase and the slips reduce compare to control specimen that only relies on natural bond (i.e. without shear connector) between steel and concrete to resist shear. Between the two types of shear connectors used, prefabricated bent-up tab (square shape) provides better performance in-term of strength, compare to the prefabricated bent-up tab (triangular shape). Concerning the angle of bent-up tab, higher degree of bent-up gives better performance.

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays cold-formed steel sections are widely used in a light-gauge construction that requires a large space. Fast speed erection and light structural weight are the major benefits of using cold-formed steel sections in the construction as they can minimize the equipments demand, thus reducing the cost of construction. Cold-formed steel sections have been utilized and started in the United States for at least a century, but mainly for only non-structural purposes (Hancock *et al.*, 2001). However, as load carrying structural members, the cold-formed steel sections started to become popular in the 20th century especially for use in the industrial and commercial buildings.

Cold-formed steel sections are made by bending a flat sheet of steel at room temperature. They can be seen in many different shapes, as shown in Figure 1.1 and in any forms stated in the code of practice BS5950-Part 5 (1998). Normally, cold-formed steel sections are used in the roof and wall system for industrial, commercial and agricultural building as purlins and truss members in the shapes of "Z" and "C" section.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The most important encountered combination of construction materials is that of steel and concrete, with applications in multi-storey commercial buildings and factories, as well as in bridges. These materials can be used in mixed structural systems, for example concrete cores encircled by steel tubes, as well as in composite structures where members consisting of steel and concrete act together compositely. These essentially different materials are completely compatible and complementary to each other. They have almost the same thermal expansion, an ideal combination of strengths with the concrete efficient in compression and the steel in tension. Concrete also gives corrosion protection and thermal insulation to the steel at elevated temperatures and additionally can restrain slender steel sections from local or lateral-torsional buckling.

In composite construction, the most commonly used composite member is steel-concrete composite beams. Composite beam is defined as element resisting only flexural and shear that comprises of two longitudinal components connected together either continuously or by a series of discrete connectors (Lawson, and Wickens, 2000). The earliest known forms of steel-concrete composite beam comprised of a steel beam encased in concrete and had been used from the early 1900 until the development of lightweight materials for fire protection in the past 25 years (Nethercot, 2003). It was then has become generally accepted by engineers for bridges during the 1950s and for buildings during 1960s. Consequently, this has resulted to the introduction of another form of composite beam where the steel beam is connected to the concrete slab using shear connectors. Application of composite beams increase with the availability of thin cold-formed steel sections like profiled sheeting together with new slab systems like pre-cast hollow core slab and pre-cast slab with concrete topping (Figure 2.1).