The Load Transfer Mechanism Between the Reinforced Concrete Ribbed Slabs and Their Supporting Columns

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Aims and objectives

- To study experimentally the shear failure mechanism between the reinforced concrete ribbed slabs and their supporting column.
- To develop a mathematical model to simulate the shear failure mechanism and to predict the shear carrying capacity of the connection.
- To develop a simple shear capacity design procedure for design purposes.

Background

Reinforced concrete slabs are relatively thin, flat, structural element whose main function is to transmit the vertical loading to their supports. Building slabs are constructed in great variety of structural forms; e.g., solid, voided, ribbed, and waffles. They can be supported either on beams or columns. The slab column structure began to emerge in the structural design since early nineteen century. Since then extensive research had been made to understand the punching behaviour of flat slab column structure. However no research had been made to aid the understanding of the load transfer mechanism between the reinforced concrete ribbed slabs and their supporting columns. Consequently the design procedure for the shear transfer mechanism on such connection is not cover adequately in the present codes of practice.

Introduction

In general slabs are susceptible to a type of local failure known as the 'punching shear failure' under concentrated loads or over the supporting columns. That is a small portion of the slab is to be separated or punched out from the main slab with the rest of the slab remain rigid (as shown in figure 1). Punching failure is a sudden rupture shear failure; if occurred at column-slab connection, after punching the connection could lose its shear and bending capacity, and consequently leads to a total collapse of the structure. The design against punching failure is therefore a predominant factor in structural designs.

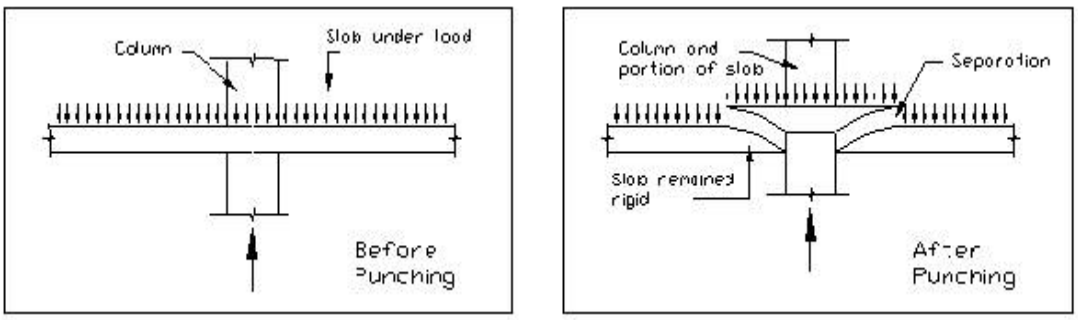

Figure1: Punching mechanism of column-slab connection

Problems arose with the inadequacy of the use of the present design codes and the lack of information available for the punching shear behaviour on the ribbed slab-column connections (as shown in figure 2). Consequently the need to carry out a research on the load transfer mechanism on such connection is predominance.

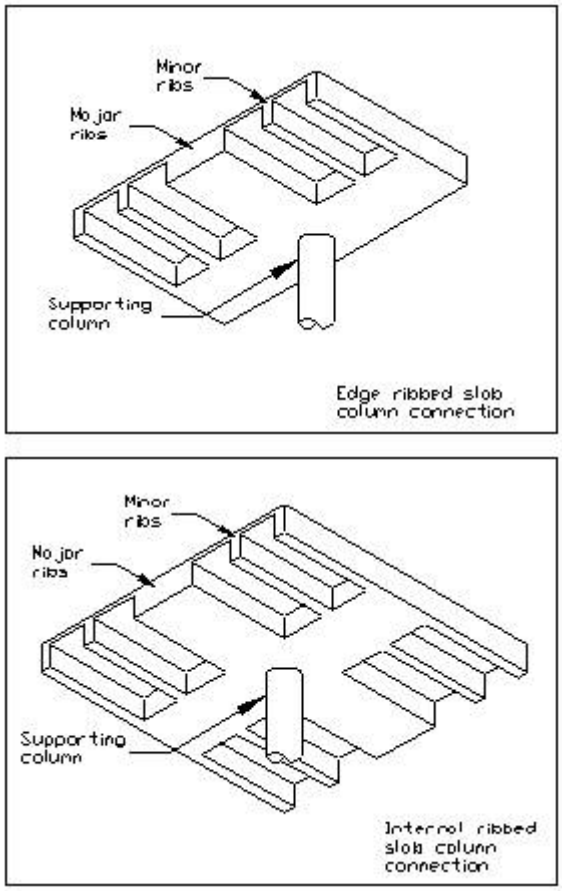

Figure 2: Typical ribbed slab-column connections

Methodology

This research began by making and destructive testing of small-scale models to study the shear failure mechanism, followed by the development of the theoretical models that was based upon the shear theory of plasticity. It is intended to verify the theoretical models by means of limited number of large-scale models testing at a later of the research. Finally it is also intended to propose a punching shear design procedure for the ribbed slab-column connection.

Conclusions

The punching shear mechanism for the internal ribbed slab-column connection has been studied experimentally and acknowledged that it is a two dimensional analogue to shear in beam problems. The mechanism observed from test consists of an incomplete solid revolution (as shown in figure 3) separated from the main slab leaving the rest of the slab rigid. The mathematical model for the internal ribbed slab-column connection had been developed and good correlation with tests was found.

Figure 3: Incomplete solid revolution punched out from main slab.