THESIS INFORMATION

INTRODUCTION

Official thesis title:	**Punching shear behavior of RC flat slab – CFT column connection using improved details**
Major:	Civil & Industrial Construction
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ABSTRACT

Reinforced concrete (RC)/ unbonded prestressed concrete (UPC) flat slab – concrete-filled steel tube (CFT) column joints possess many outstanding features in terms of structure, construction and architecture. RC/UPC slab – CFT column joints are, thus, widely used in civil and industrial projects. However, since the RC/UPC slabs are directly connected to the CFT columns, the slabs also face the same brittle and dangerous type of punching shear failure as the traditional slab – RC column joint. In addition, the inherent weak bond between the concrete slab and the smooth surface of the CFT steel column strongly affects the integrity of the connection, which can reduce the stiffness, punching shear resistance and effectiveness of this delicate structure - RC/UPC slab – CFT column joints. Clarifying the punching shear behavior of this delicate and promising structure as well as searching for new types of connection elements that can ensure the continuity, punching shear resistance, ease of construction and ductility of this structure are of crucial importance. This thesis investigates the punching shear behavior of RC/UPC slab – CFT column joints using proposed innovative connections in the form of steel plates and proposes a semi-empirical model to predict the punching shear resistance of RC/UPC slab – CFT column joints using steel plate connections. The experimental program was carried out on 12 large-scale RC/UPC slab – CFT column joints using four types of innovative connections with various configurations including full connection (having both horizontal bearing plates and vertical ribs) and reduced connection (only vertical ribs), and with different shapes of horizontal bearing plates (continuous annular and discrete rectangular).

The experimental results showed that the proposed full connection helped the /UPC slab – CFT column joints maintain good rigidity, have a significantly greater punching shear resistance (up to 25%), outstanding deformability (up to 123%) and good ductility (up to 91%) as well as a very high energy absorption capacity (up to 216%) compared to the traditional slab-RC column joint. Meanwhile, the reduced connection also greatly improved the deformability (29%), ductility (4%) and energy absorption capacity (18%) but slightly reduced the punching shear resistance (about 7%) and significantly reduced the post-cracking stiffness (about 50%) of the slab-CFT column joint compared to the traditional slab-RC column joint. The obtained test results also showed that the effectiveness in improving the structural response of all the proposed connections for the UPC slab-CFT column joint was significantly smaller than that for the RC slab – CFT column joint, especially in terms of punching shear resistance (smaller than 213%), ductility and energy absorption (smaller than 264% and 232%, respectively). This means that more research is needed to improve the steel plate connections proposed in this thesis to increase further their effectiveness in the case of UPC slab-CFT column joints. There was a clear difference in the punching shear behavior between the UPC UPC slab-CFT column and RC slab – CFT column joints. The prestressing tendons effectively reduced the rate of stiffness deterioration of the slab – CFT column joints. That is, the degree of stiffness reduction (after cracking compared to before cracking) of the UPC slab-CFT column samples was significantly smaller (up to 2.1 times) than that of the RC slab-CFT column samples. This result means that the tendons, on the one hand, helped control the slab displacement well (reduced by up to 58%) and ensure the serviceability of the structure. However, on the other hand, the tendons increased the brittleness and reduced the deformability (final displacement) of the slab (up to 51%). This resulted in the ductility and energy absorption indexes of the UPC slab – CFT column samples being significantly smaller than the RC slab-CFT column samples (up to 44% and 41%, respectively).

In the context that most of the existing models to calculate the structural strength are empirically based, the formulas proposed in this thesis, which are built by the analytical method combined with the experiment, have been more closely reflected the physical nature of the punching shear failure. The proposed model incorporates in it the material model, the conditions of equilibrium and the strain compatibility, while at the same time, taking advantage of the simplicity of the traditional superposition method. The verification results showed that the proposed formulas were able to predict the punching shear resistance of

RC/UPC slab – CFT column joints using steel plate connection slab with good accuracy and low variation compared with the experimental results. Therefore, the proposed formulas can be used to facilitate the design of RC/UPC slab – CFT column joints.

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