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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This dissertation focuses on the performance evaluation of box column connections with internal diaphragms in steel frames. For a box moment frame, the performance of the connections can be improved by using continuity plates, known as internal diaphragms. The study aims to propose a comprehensive and alternative design approach for the internal diaphragm and to evaluate the performance of the internal diaphragm connections between plates and box columns, and wide flange (WF) beam and box columns. Thereafter, the study is further expanded to a prediction of stress due to shear lag and its design parameters for the internal diaphragm connections between box beams and box columns (T-joints) with beam under a point and uniformly distributed loads. The dissertation is arranged into seven chapters and one appendix and can be summarized as follows.

Chapter 1 describes the introduction of the dissertation, which contains the research overview, purpose and objectives, frameworks and scope of the study, and organization of the dissertation. The research overview provides a brief background of the application of steel box column systems and their connections in steel frames. The related problems and solutions on the box column connections with internal diaphragm have also been discussed.

Chapter 2 presents a review of the related studies. The review discussed a set of existing studies which related to and facilitated this current research topic, including the design and performance of the box column connections with and without diaphragms, method of predicting the strength of the box column connections, load-deformation characteristics of the plate-to-box column connections, shear lag phenomenon and stress prediction method in the box connections, and deflection of the plate. Static behaviors, such as strength and its prediction method (Yield line), and load-deformation relations for the box column connection were attentively reviewed. The shear lag phenomenon in box connections was subsequently discussed, including a method (Least-work solution) to predict the stress distribution in the cross section of the box members.

Chapter 3 provides the performance evaluation of the plate-to-box column connections, in which static behavior, such as strength, load-deformation relations, and mechanism of the connection was discussed using theoretical and numerical approaches. The investigation focused on parametric effects, such as diaphragm parameters, plate-to-column width ratio, column width-to-thickness ratio, and concrete on the performance of the study connections. The numerical assessment required to utilize finite element method (FEM) which assisted by a computer software Abaqus. Consequently, the strength and

load-deformation characteristics of the connection can be analytically evaluated.

Chapter 4 comprises of testing of plate-to-box column connections with internal diaphragms. The study discussed the confirmation of the static behavior considering the parametric effects, such as plate-to-column width and column width-to-thickness ratios, and concrete filling on the strength of the connections. The testing contained six connections with two box columns with nominal thickness of 8 mm and 12 mm, plate width of 100 mm and 150 mm, and diaphragm thickness and hole of 12 mm and 125 mm, respectively. The strength and yield mechanism including failure formations of the connections have been confirmed.

Chapter 5 presents the numerical performance evaluation of the WF-beam-to-box column connections with and without concrete using the designed diaphragms as proposed earlier in Chapter 3. The connections' sizes were selected to satisfy the seismic design requirement given by AISC 341-10. Static and cyclic results showed that the designed diaphragms provided a very remarkable strength contribution to WF-beam-to-box column connections, which are able to ensure the target performance of the connections, as required by AISC connection pre-qualification criteria.

Chapter 6 discusses the theoretical and numerical evaluations of stress distribution due to shear lag in the box T-joints with beam subjected to a point and uniformly distributed loads. Using a method so-called "Least-work solution" with the assumed longitudinal displacement function of the beam flange and web, the stress due to shear lag can analytically be predicted. The evaluation process considered particularly the effects of column flange flexibility, depth of the beam web, and their relations on the stress distribution and resulted in stress equations with a complicated form. Therefore, a simplified method was proposed to facilitate the calculation procedure by modifying the shear lag stress to a factor β_s, which represents the shear lag in the beam web. The FEM was carried out to provide the validation of the stress equations. Further empirically simplified method for the evaluation of shear lag stress (peak stress) was developed in order to serve for rapid preliminary design.

Chapter 7 concludes the results and main findings of this study, such as; strength, load-deformation characteristics, and failure mechanism of the plat-to-box column connections; performance evaluation of the WF-beam-to-box column connections; and shear lag stress prediction in the box T-joints. The chapter also provides recommendations and further studies.

Appendix A provides an evaluation of shear stress in the box T-joints using least-work solution method.