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（博士課程）
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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 ）

As the beam-to-column connection is a critical component for absorbing seismic energy, its damage and fracture have always been focused as important topics for research. In recent years, due to advancements in building design and functional requirements, the shapes of beam-to-column connections have become more complicated to accommodate these developments. One of the commonly seen forms of beam-to-column connections involves the connection with oblique angles. However, in existing studies on the behavior of these connections, the seismic performance and the effect of oblique angles have not been thoroughly investigated. This dissertation as a fundamental study on beam-to-column connections with horizontal and vertical oblique angles, focusing on the beam-end connection, which has the most significant shape changes. This dissertation investigates the cyclic behavior, failure sections, and effects of steel beam-end connections with horizontal or vertical oblique angles through full-scale experiments and finite element (FE) analysis.

In the study of beam-end connections with horizontal oblique angle, the effects of horizontal oblique angles on the elastoplastic behavior of beam-end connections under cyclic loading were investigated. The von Mises criterion was employed to predict the failure sections of beam flange. An element test validated these predictions and demonstrated that horizontal oblique angles significantly influence the strain distribution at the obtuse angle zone and plastic deformation capacity. Subsequently, a full-scale experiment was conducted to confirm the conclusions from the element test. In the full-scale experiments, the beam-to-column connections with oblique angles exhibited stable hysteretic behavior and same behavior in elastic and plastic state, indicating that the oblique angle had little effect on the overall cyclic behavior of the connections. Additionally, the strain concentration was also observed at the obtuse angle zone. The failure section of the connection was perpendicular to the beam's axis. As a result, to avoid premature failure caused by strain concentration, it is recommended to use an extended diaphragm method for the connections with horizontal oblique angles greater than 15 degree.

In the study of beam-end connections with vertical oblique angle, the effects of vertical oblique angles on the elastoplastic behavior of beam-end connections under cyclic loading were investigated, and a mechanism analysis for beam-to-column connections was proposed. In the mechanism analysis, the internal forces in the upper and lower flanges were calculated, and the failure section from the upper flange to the lower flange was identified. Additionally, a method for defining beam span in beam-to-column connections with vertical oblique angles was presented. To validate the results of the mechanism analysis, a full-scale experiment was conducted. The full-scale experimental results showed that beam-to-column connections with vertical oblique angles exhibited stable hysteretic behavior and almost the same elastic and plastic behavior under cyclic loading. The analysis of failure modes and the number of cycles to failure showed that as the vertical oblique angle increased, the plastic deformation capacity of the connections noticeably decreased. These results consistent with the results of the mechanism analysis.

In the study of FE analysis, FE analysis using ABAQUS was conducted to study the behavior of beam-end connections with vertical or horizontal oblique angles. For the vertical oblique angles, the FE analysis accurately reproduced the experimental results by providing internal forces at the failure section, thereby confirming the effectiveness of the mechanism analysis. The results showed that the internal force in the upper flange increased linearly with increasing vertical oblique angle. Moreover, the effects of loading direction, beam depth, and span were analyzed to further understand their impact on the behavior of connection. Similarly, for horizontal oblique angles, the FE analysis successfully reproduced the hysteretic behavior observed in the experiments and analyzed plastic strain changes at the beam end. The numerical analysis revealed strain concentration changes in the obtuse angle zone under varying horizontal oblique angles, beam widths, and spans. Based on these

deformation conditions, a strain analysis was conducted, and an equation for predicting the strain concentration was derived.
In the Chapter of conclusions, the experimental and FE results from the previous chapters are summarized. Based on these findings, recommendations are provided for the design of beam-to-column connections with horizontal or vertical oblique angles, suggesting reinforcement methods or strategies to mitigate the impact of the oblique angle on beam-end connections. Additionally, as this dissertation serves as a fundamental study on beam-to-column connections with oblique angles, the issues identified in the experiments and analyses, as well as related research topics on such connections, are also summarized as future works.

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