

論文 / 著書情報
Article / Book Information

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Title(English)	Low-Cycle Fatigue Performance Evaluation of Beam-to-Column Connection in High-Rise Steel Moment Resisting Frames
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種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

専攻 : Department of	環境理工学創造	専攻	申請学位 (専攻分野) : Academic Degree Requested	博士 (工学)	Doctor of
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

In recent years, low cycle fatigue (LCF) behavior of beam-to-column connection during the massive earthquake, which have long-duration and long-period ground motion are causing great concern. So, the safety and cumulative damage of beam-to-column connections subjected large number of cycles deformation is highlighted as a problem. However, existing knowledge and data with which to evaluate the cumulative damage and LCF performance of beam-to-column connection that experienced cyclic deformation under many cycles are insufficient. Most of investigation on the behavior of beam-to-column connection is either from testing under load of large deformation, or from analytical studies. In addition, deformation capacity of beam-to-column connection depends on the variables such as material's properties, moment gradient of beam, beam-end geometry and loading history, and the effect on these variables are not quantitatively evaluated.

This dissertation aims to propose LCF performance evaluation method of beam-to-column connection in high-rise steel moment resisting frames. An experimental and analytical investigation is presented focusing on the Japanese connection details. First, the welded flange-bolted web (WFBW) connection, which is commonly used in high-rise steel moment resisting frames considering slip behavior is elaborated through cyclic loading tests with different bolt configuration. The slip behavior of bolted web connection was different under minor inelastic deformation according to the bolt configuration, and LCF performance of WFBW connection depends on the slip behavior. Slip behavior is evaluated from the slip moment defined from the test, and it was found that the minimum value between the slip-critical strength and the yield bending strength of the shear plate can be evaluated as an index of slip behavior. Furthermore, it is also confirmed that if the strength of bolted web connection of the WFBW connection is equal to yield strength of the welded web connection, the LCF capacity is the same. After a methodology for LCF performance assessment of beam-to-column connection is proposed considering beam-end geometry based on the database of cyclic loading test results. The database includes two types of beam-end connection details: bolted and welded web connections. In case of these connection type, the moment transfer efficiency at the web connection could be decreased due to slip behavior at the bolted web connection, out-of-plane deformation of

column flange as well as loss of the web section by weld access hole. In order to consider these decreasing the moment transfer efficiency at the web connection according to the beam-end geometry, the coefficient, J_b , which is strength ratio of beam member to beam-end connection is proposed. The proposed coefficients were examined and verified using the different beam-end geometry details of the database. If the coefficient, J_b , is determined almost the same, the fatigue curves are identical regardless of the mechanism of moment transfer even moment transfer mechanism is different which is bolted connection and welded connection. Furthermore, a coefficient, J_b , is reflected in the fatigue curve based on the relationship between the number of cycles to failure and the constant beam rotation amplitude obtained from cyclic loading tests. Here, the relationship between the number of cycles to failure and the constant beam rotation amplitude can be evaluated regardless of the yield strength of the beam steel. In other words, the LCF evaluation Eq. is proposed reflecting coefficient, J_b , in the relationship between the number of cycles to failure and the constant beam rotation amplitude, it mean proposed evaluation eq. considering yield strength of steel grade and beam-end geometry. Analytical approaches are also introduced to clarify the scope of the proposed methodology. The range of the beam rotation amplitude for LCF performance assessment is specified and calibrated considering the material's characteristics and shear span ratio. In the analytical approach, a hysteresis model considering Bauschinger effect was proposed to consider the material characteristics under cyclic loading, and analysis model considering slip behavior was introduced and verification based on the experimental results. In the analysis, it was confirmed that the effect of different steel material and shear span ratio can be equally evaluated up to the 0.02rad of beam rotation amplitude. In design criteria, the beam-to-column connection in high-rise SMRFs is limited up to 1/100 inter-storey drift under Level 2. It means, in high-rise SMRFs, the 0.02rad beam rotation amplitude is sufficiently large amplitude, and the proposed methodology is sufficiently covered the LCF evaluation range. As the results, the proposed approach is applicable to evaluating the comprehensive fatigue performance of beam-to-column connections, considering the material characteristics, moment gradient of beam and beam-end geometry.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).