鋼I桁高力ボルト摩擦接合継手のすべり・変形支圧限界に着目した限界状態設計法に関する研究

Study on Limit State Design Method of High Strength Bolted Frictional Joints for Steel I Girders Focusing on Slip/Deformed Bearing Limit States

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Proposing slip resistance functions of bolted girder connections. Clarifying the relationship between bearing resistance and full plastic moment

BACKGROUND

Purposes

①Proposing slip resistance functions of steel I girder connections

②Clarifying the relationship between bolt hole deformation and full plastic moment

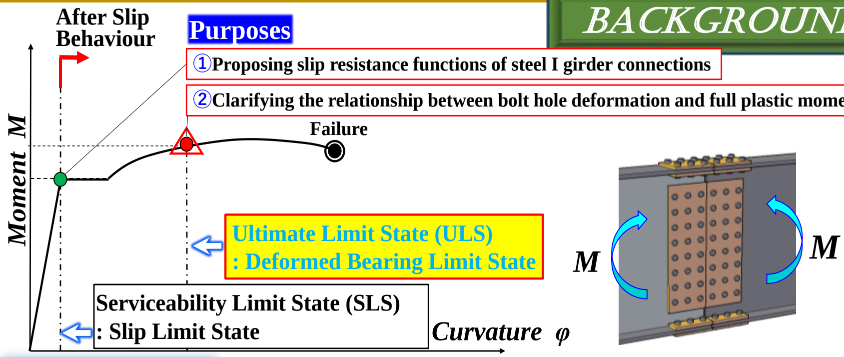

Fig. 1 Limit states of frictional joints for steel I girders

Slip Behaviour

Flange and web splices of girder connections are designed individually in general design codes. However, actual girder connections resist the applied bending moment through the cooperation of flange and web resistances.

Proposing slip resistance functions of steel I girder connections.

After Slip Behaviour

To utilize the bending plastic capacity of the girder connection at the ultimate limit state, the bearing capacity of the girder connection should be defined by the ductility of bolt hole deformation.

Clarifying the relationship between bearing resistance and full plastic moment.

keywords：
frictional bolted joint,
cooperative resistance,
after slip behaviour

METHODS

① The influence of shape and bolt arrangement of web joint on slip strength of girder connection

FE analysis was conducted to evaluate the effect of the structural parameter（as shown Fig.2）on the slip strength / bolt hole deformation.

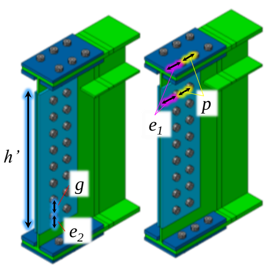

Fig. 2 Parameters of FEA

②Checking the versatility of slip and bearing resistance functions

Evaluate the effects of combined sectional forces and different cross-sectional geometries on the slip and bearing resistance.

Viewpoints

- Effect of the slip resistance ratio of flange / web splices on the slip and bearing resistance.
- Load transfer mechanism of web joints at after slip bearing status.
- Effect of combined sectional forces.

RESULTS

①Estimating the web slip resistances

Fig.3 shows the slip strength of web splices $M^*_{fric\_web}$ vs. the structural parameter ξ. the structural parameter ξ is obtained by Eq. (1) considering the frictional moment and internal force of the web splice.

$$\xi = M_{we} \times (H_{we}/2) \times (6/H_w) \quad (1)$$

Where M_{we} is the slip moment resistance of the farthest web part bolts, H_{we} is the distance of each farthest web part bolts, H_w is the height of web.

Fig.4 includes a variety of joint shapes and girder cross-section configurations, but $M^*_{fric\_web}$ and ξ are positively correlated. Thus, $M^*_{fric\_web}$ has affected the slip resistance, the number of bolts of web splices and the height of the web.

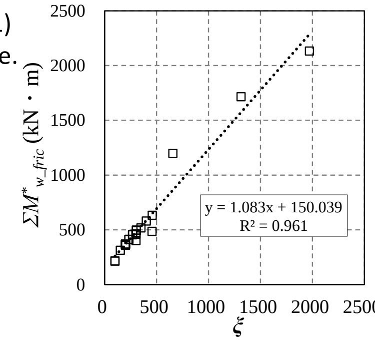

Fig. 3 Evaluation of the slip strength of web splices

②Effect of combined sectional forces

Fig.4 shows the slip strength of the girder connections subjected the bending moment M and shear force Q. Even though the ratio of the shear force Q increased, the slip strength did not decrease significantly from the design resistance.

In the after slip bearing behavior, it was found that the bearing force exerted by the web splices was almost insignificant and that there was no cooperative resistance at the bearing state.

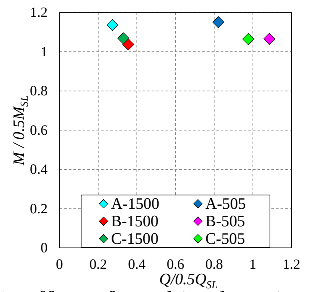

Fig. 4 Effect of combined sectional forces.

SUMMARY

① The slip strength of web splices $M^*_{fric\_web}$ and the structural parameter ξ considered the frictional moment and internal moment of the web splice, are positively correlated.

②Combined sectional forces have little effect on slip resistance of the girder connections.

③There was no cooperative resistance of the flange and web splices at the bearing state.