

# 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



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

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

## BACKGROUND

### Purposes

- Proposing slip resistance functions of steel I girder connections
- Clarifying the relationship between bolt hole deformation and full plastic moment

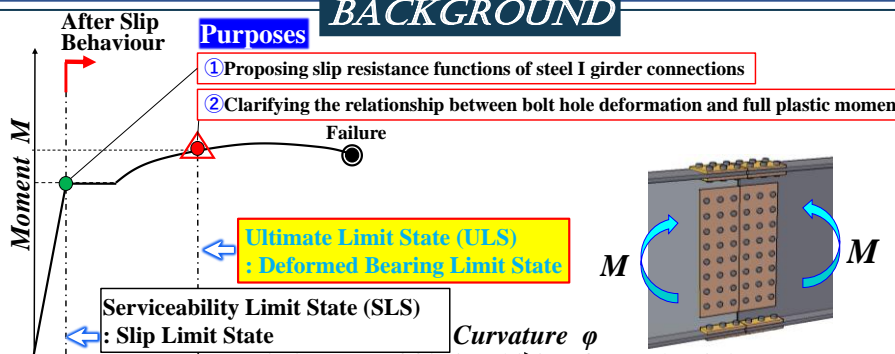


Fig. 1 Limit states of frictional joints for steel I girders

### 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 Clarifying the slip/after slip behaviour

Pure bending test of plate girders bolted connection (Fig.2) has been conducted to evaluate quantitatively the resistance and the ductility of the connection.



Fig. 2 Pure bending experiment

### ② 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 (Fig.3) on the slip strength/bolt hole deformation.

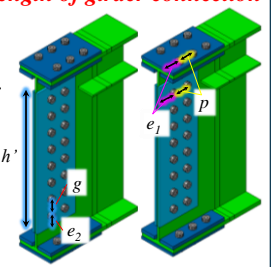


Fig. 3 Parameters of FEA

## RESULTS

As shown in Fig.4, The stiffness of the girder bolted connection starts to decrease at Initial slip strength  $P_{slip}^*$  when the flange and the farthest web part bolts reached its slip strength. The overall slip would not occur until the bolt group in the web other than around the neutral axis reaches their slip strength. the bearing resisting moment when the flange bolt hole deformation reached the bolt diameter of 5% was 1.03 times full plastic moment of the connected girder.

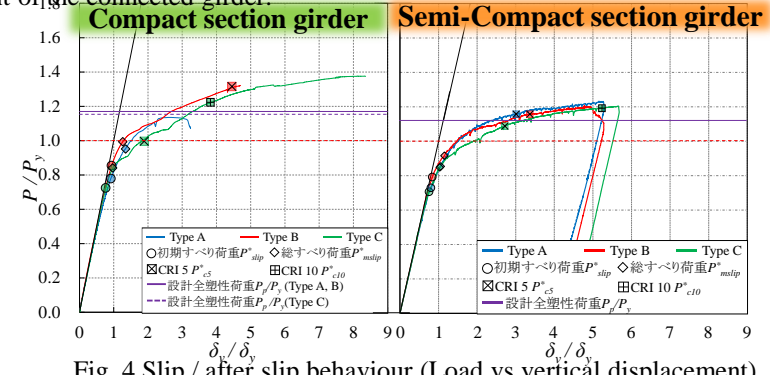


Fig. 4 Slip / after slip behaviour (Load vs vertical displacement)

As the bolt arrangements in the height direction become more extensive, the initial slip strength and all over slip strength becomes larger. This is because the contribution of web at overall slip strength was influenced by the bolt arrangements of web, as shown in Fig. 5.

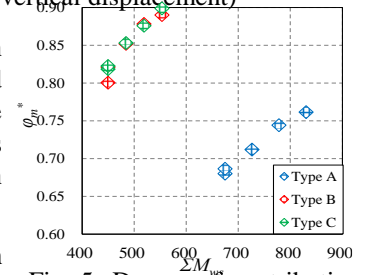


Fig. 5 Degree of contribution of web joint to major slip

The bearing deformation of the flange was varied with the number of bolts of flange and web splices.

## SUMMARY

- From experimental results, the initial slip and overall slip was defined. And the applicability of the proposed bearing limit state was confirmed.
- As the bolt arrangements in the height direction become more extensive, the initial slip strength, all over slip strength and the contribution of web become larger.