



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

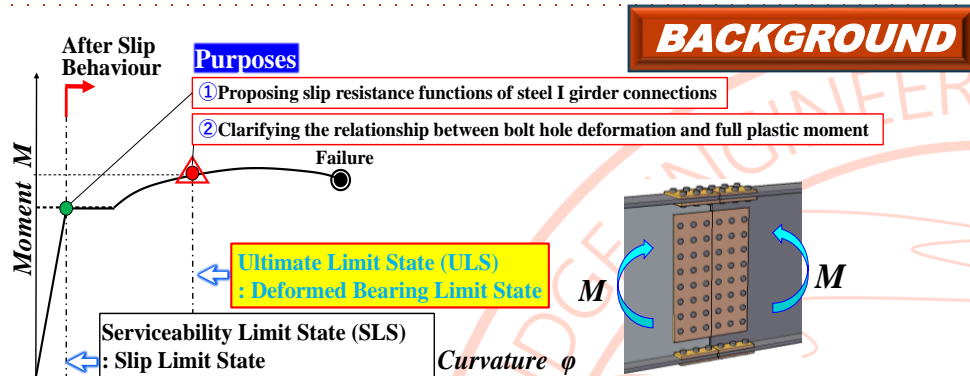


Fig. 1 Limit states of frictional joints for steel I girders

#### After Slip Behavior of bolted girder connections

To utilize the bending plastic capacity of the members at the ultimate limit state, the strength relationship between the member and the bolted connection should be considered such that the connection failure occurs after the member reaches the full plastic.

However, the relationship between the deformation - bearing force relationship of the coupon joints and that of the bolted girder connections, which is the actual structure, is unclear.

**Purpose** Clarifying the relationship between bearing resistance and full plastic moment.

#### KEYWORDS

frictional bolted joint, after slip behavior, bolt hole deformation

#### METHOD

##### 1. The influence of the geometrical configurations of the girder on bearing strength of girder connection

FE analysis was conducted to evaluate the effect of the structural parameters (as shown Fig.2) on the bearing behavior of the girder connection.

##### 2. Evaluation of the bearing strength of the girder connection

###### Viewpoints

- Difference between nominal bearing stress of the girder connection and that of coupon joint.
- Effect of the bearing behavior of girder connection on the bearing strength of web splice

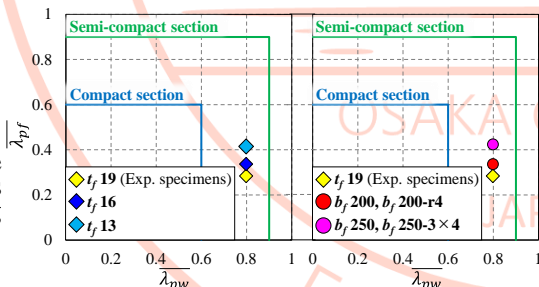


Fig. 2 Normalized plate slenderness of specimens

#### RESULT

##### 1. Bearing strength of girder connection

As shown in Fig. 3 and 4, the difference in the ultimate and yielding modes and bearing behavior of the flange and web splice affected the overall after slip behavior and increased strength between the  $M_p$  and the  $M_{max}^*$ .

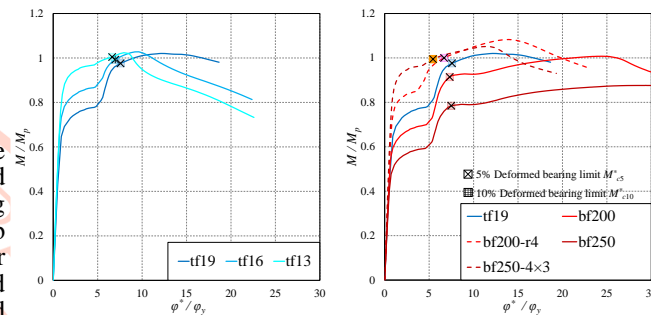


Fig. 3 Moment-connection curvature curves

##### 2. Effect of the bearing strength of web splice bolt

The slope of the moment vs. connection curvature curves increased again after the 10% deformed bearing limit strength  $M_{c10}$  at  $b_{f250}$  and  $b_{f200}$  because the bearing force of web farthest bolts (web Row No. 8) started increasing (see in Fig. 5).

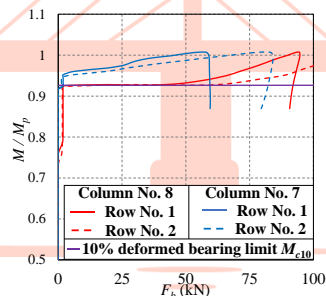


Fig. 5 Bearing force of web farthest bolts

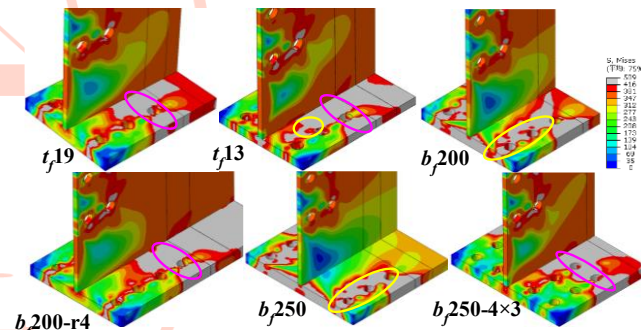


Fig. 4 Mises stress at 5% deformed bearing limit

#### SUMMARY

1. The ultimate and yielding modes of girder connection were influenced by the relationship between the shear and tensile yield of the main plate due to the varying structural parameters. Even for the bolted girder connections, It is also conjectured that that relationship could be evaluated by the design failure resistance ratio of the shear to the net cross-section failure.
2. The bearing state of the web splice started when the curvature of the girder connection reached the state in which the bolt hole deformation of the flange reached the 10% nominal bolt diameter  $d$ .