REINFORCEMENT OF SHEAR FAILURE WITH LONG SCREW IN MOMENT-RESISTING JOINT

Makoto Nakatani¹, Hideki Morita², Takuro Mori³

ABSTRACT: Moment resisting joint with lagscrewbolts shows good mechanical performance and aesthetic. However, beam and column joints rarely showed a brittle shear failure in a panel zone of a column in previous studies. Therefore, a joint system reinforced by long screws was developed to prevent from the failure in this research. The maximum shear strength of the joint increased with increasing the number of long screws. However, the average of six screws specimens was lower than that of four screws, because the glulam and some of the screws were damaged due to the narrow space between the screws during an inserting process of the screws.

KEYWORDS: Long Screw, Lagscrewbolt, Shear Failure, Panel Zone

1 INTRODUCTION

The number of middle and large scale timber public building is recently increasing in Japan. Also, the number of houses constructed using timber portal frames is increasing due to demand from customers to have wider rooms. A moment-resisting joint by using Lagscrewbolt (LSB) was developed and confirmed the performance in a previous research [1]. The LSB joints showed good mechanical performances and aesthetic. However, the beam-column joints rarely showed brittle failures which were shear failure of the column in the panel zone surrounded by LSBs. Therefore, a cross LSB joint was developed and confirmed good reinforcing performance in a previous study [2]. However, it was not easy to drill oblique lead wholes for cross LSBs. Therefore, in this research, an improved joint was developed by using long screws which does not need a lead hole and were used instead of the cross LSBs prevented the joint from the brittle shear failure.

2 EXPERIMENT

The specimens imagined an actual beam and column joint with LSBs. Fig.1 shows geometry of the actual joint, and the red area shows a panel zone. The column and beam sizes were 120mm x 300mm and 120mm x 390mm, respectively. Specimens were made of Japanese cedar glulam, and the grade was E65-F225 in accordance with

¹ Makoto Nakatani, Miyazaki Prefectural Research Institute, 20-2 Hanaguri Miyakonojo, Miyazaki, Japan.
Email: nakatani-makoto@pref.miyazaki.lg.jp
² Hideki Morita, Miyazaki Prefectural Research Institute, Japan
³ Takuro Mori, Kyoto University, Japan
the Japan Agricultural Standard (JAS). The diameter of LSB was 25 mm, the length was 300mm and the lead hole was 22 mm. The long screws shown in photo 1 were used to reinforce the panel zone. The diameter was 8 mm and the length was 320 mm. In order to accurately investigate the reinforced effect of the screws on shear strength of the column, the tests were conducted based on an asymmetric four-point bending tests shown in Fig. 2. Fig. 3 shows the details of reinforcing conditions of specimens. There were four conditions, no reinforcement, (i) two long screws, (ii) four long screws and (iii) six long screws. The total number of specimens was 20. The failure phenomena of all specimens were shear failure around the centre of specimens same as shown in photo 2. Fig. 4 shows a relationship between the number of long screws and maximum shear strength. The shear strength increased with increasing the number of long screws. However, the results of the six long screws specimens were varied, and the average was lower than that of four screws. Because some of the six screws were scratched by the next long screw, and the glulam were also damaged due to the narrow space during the inserting process of the screws. The maximum shear strength of the four screws increased by 17% compared with that of non-reinforced specimens. The shear modulus of four screws increased by 55% compared with non-reinforced specimens.

![Figure 3: Details of reinforced specimens](image1)

**Figure 3: Details of reinforced specimens**

![Figure 4: Shear strength vs. the number of long screws](image2)

**Figure 4: Shear strength vs. the number of long screws**

### 3 CONCLUSION

The reinforced effect of the long screws on shear strength in the panel zone was confirmed. The shear strength and modulus were increased with increasing the number of the long screws. However, they were not increased and varied over four long screws specimens in this test conditions, because the glulam and some screws were damaged due to the narrow space between the screws during the inserting process. The future problem is to propose an optimal reinforcement method with long screws.

### REFERENCES
