XV WORLD FORESTRY CONGRESS
Building a Green, Healthy and Resilient Future with Forests
2–6 May 2022 | Coex, Seoul, Republic of Korea

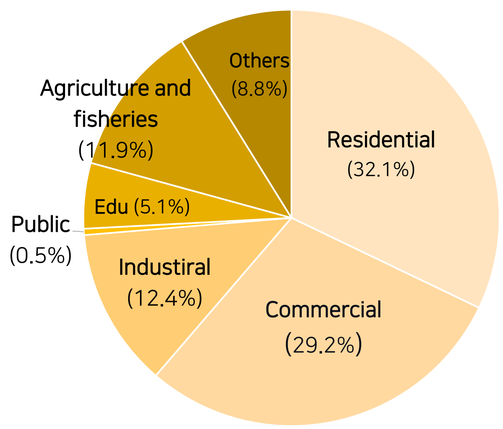
Evaluation of Novel Plywood Shear Connector in Timber-Concrete Composite Slab

Kyung-sun, Ahn[1], Ji-yong Kim[2], Sung-jun Pang[3], Jung-Kwon Oh[4]

[1]Department of Agriculture, Forestry, and Bioresource, Seoul National University, rudtjs6339@snu.ac.kr
[2]Department of Agriculture, Forestry, and Bioresource, Seoul National University, led_zep@snu.ac.kr
[3]Department of Agriculture, Forestry, and Bioresource, Seoul National University, pangsungjun@snu.ac.kr
[4]Department of Agriculture, Forestry, and Bioresource, Seoul National University, jungoh@snu.ac.kr

Introduction

● Research Background and Objective



Status of the domestic construction market
(Ministry of Land, Infrastructure and Transport, 2018)

- As demand of non-residential building has been increased, the **high-performance slab is needed.**
- Timber has lower stiffness than other building material, so it is not enough to use for long span building.

● Conceptual design

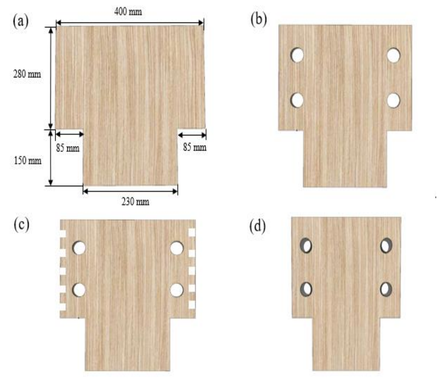
Timber-concrete composite

Plywood shear connector

- To improve effective bending stiffness of timber slab, timber concrete-composite (TCC) system was used.
- Since the performance of TCC is decided by the stiffness of shear connector, the novel plywood shear connector was developed and its stiffness was evaluated in this study.

Material & Methods

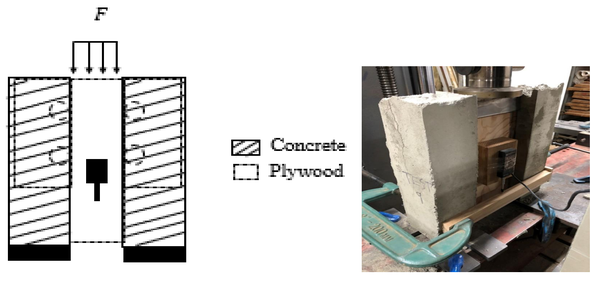
● Material



Specimen	Component	
Type a	×	
Type b	Holes	Ø25mm
Type c	Small grooves	24mm (depth) 24mm (length)
Type d	Steel tube	1.5 (thickness) 72 (length)

- Timber
  - Species : Larch (*Larix Kaempferi*)
  - Oven-dried density (kg/m^3) : 456
  - Moisture contents (%) : 12
- Concrete
  - Compressive strength (MPa) : 27
- Plywood
  - Species : Larch (*Larix Kaempferi*)
  - Oven-dried density (kg/m^3) : 549
  - Moisture contents (%) : 8
  - Adhesive : Phenolic resin
  - Thickness (mm) : 24

● Methods

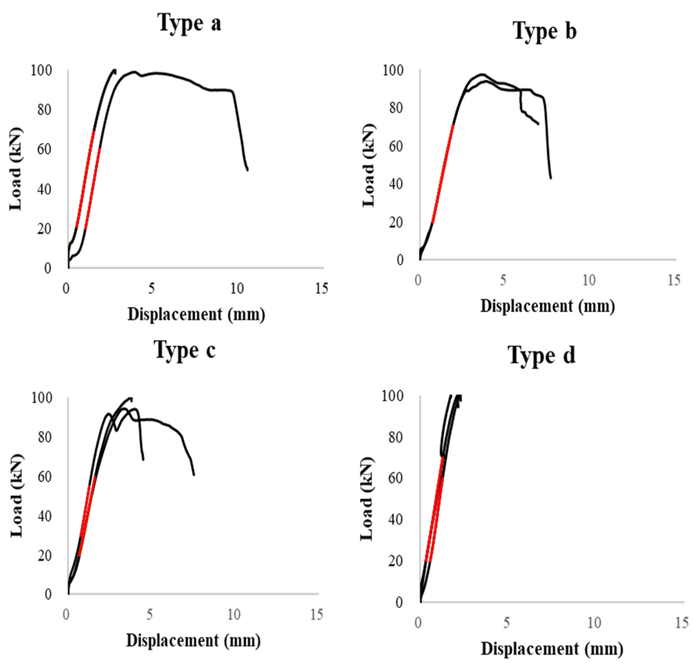


Test specimen – schematic (left), photo (right)

- Test Procedure : ASTM D 5652
- Loading rate : 1.5 mm/min
- Measuring equipment : Universal test machine (UTM)

Results and Discussion

● Test results



Compression failure (type a)

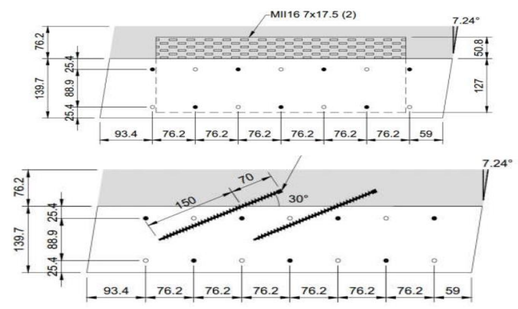
shear failure (type c,d)

Specimen	Repetition	F_{max}(kN)	K_s (kN/mm)
Type a	2	99.5	49.57
Type b	2	95.5	43.56
Type c	3	96.16	44.74
Type d	3	100*	52.99

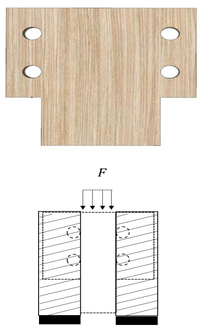
* Over capacity

- The compression failure was prevailing in type a
- In type b, c, the shear failure was occurred because of the hole to prevent disassembling of concrete layer.
- Type d which was reinforced by additional steel tube in hole showed the highest slip modulus

● Comparison



Metal plate, STS (Hong ,2017)



Plywood Type b

Connector	K_s(kN/mm)	L_{ef}* (mm)	K_s/L_{ef}
Metal plate	114.41	609.6	0.09
STS (30°)	101.15	150	0.17
Plywood (Type b)	43.56	430	0.10

* L_{ef} = effective length

Conclusion

- In comparison, slip modulus of the plywood shear connector was similar with metal plate, so plywood shear connector can substitute with metal connectors, considering the energy consumption in manufacturing phase.
- Slip modulus of the plywood shear connector was lower than self-tapping screw.