Master's Thesis Engineering Technology

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SHEAR REINFORCEMENT OF LONGITUDINAL CRACKED GLUED LAMINATED TIMBER BEAMS USING CARBON FIBRE REINFORCED POLYMERS

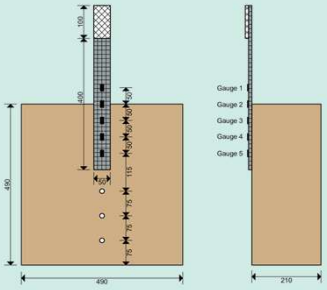
Steven Liberloo

Master of Civil Engineering Technology

Due to aging or errors during calculation or execution, strength of buildings can become insufficient. Rehabilitation using FRPs can restore these buildings with a reduction in cost, waste and destruction of historical heritage compared to demolition and rebuilding. However, a lack of research for FRP application with timber prevents engineers from accurately predicting strength.

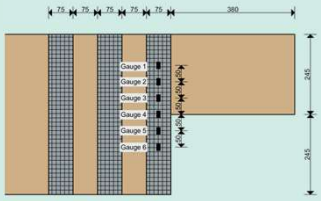
METHOD AND MATERIALS

SINGLE LAP SHEAR TEST



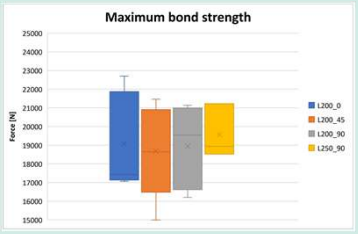
- 3 different angles between timber fibres and CFRP (0°, 45° and 90°)
- 200 or 250 mm bond length
- 18 test pieces total

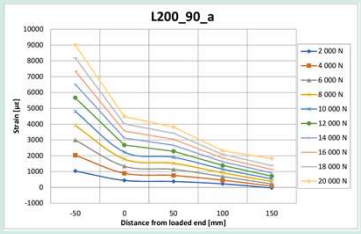
3-POINT BENDING TEST

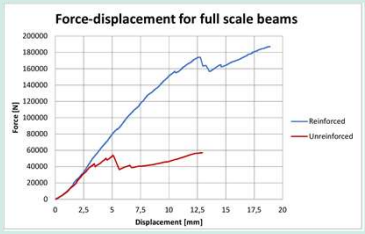


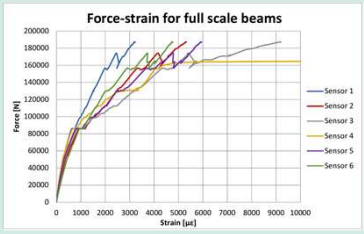
- Beam dimensions: 3000 x 490 x 210 mm
- U-jacketed reinforcement
- One reinforced and one unreinforced beam tested

RESULTS









DISCUSSION

- No significant difference between 0°, 45° and 90°
- Although strain gauges suggest that effective bond length is not reached, no significant difference between 2 bond length configurations could be measured
- Failure of the bond in surface of the timber or resin
- Results from testing do not fit existing equations, possibly due to limited tested configurations or lack of appropriate coefficient for glulam

- Reinforced beam shows significant increase in strength
- Failure due to debonding of FRP reinforcement
- Similar failure modes as observed during single lap shear tests
- Existing equations do not fit results obtained from testing

CONCLUSION

While the 3-point bending test proves that CFRP reinforcement against shear can greatly improve a beam's strength, existing research cannot accurately predict failure strength. Future research could test more configurations with different dimensions, FRP types and timber types to reach an accurate numerical model.

Supervisors / Cosupervisors: Prof. Emmanuel Ferrier
Prof. dr. Ir. Jose Alexandre Gouveia Henriques
Associate Prof. Cecile Grazide