

## **Reinforcement of glulam beams with basalt- and glass fibre sheets**

Wood is one of the oldest building material's men have utilized. The strength of the timber depends on the natural characteristics of the timber, such as knots, cracks, slope of grain and many other things. By choosing together and combining timber with few flaws, it's possible to produce stronger combined section of wood that is called glulam beams (glued laminated timber beams). By strengthening glulam beams with material who has more tensile strength than the glulam beams themselves, it distributes the load from defected areas to areas with higher strength. With an effective reinforcement ratio, it is possible that it leads to plastic behavior on the compression side of the timber, which is very seldom in unreinforced glulam beams.

The objective of this research is to investigate the reinforcement of glulam beams with fibre reinforced polymers (FRP). The reinforcement used was basalt fibre reinforced polymers (BFRP), and glass fibre reinforced polymers (GFRP). The beams were reinforced in the tensile zone. The result of the experiment was compared to calculated predictions of the strengthened beam but there has not been issued a standard code for the Reinforcement of glulam beams with FRP material. The experiment involves a two point breaking test of twelve GL-32h glulam beams that where 3,2 meters at length, 65 mm in width and the height of 165 mm. Five beams were reinforced with BFRP and four with GFRP. The reinforcement ratio of both BFRP and GFRP was 0,5% of the cross section area of the beam. For comparison, three unreinforced beams were also broken. Those glulam beams that were reinforced with either BFRP or GFRP was randomly selected from the lot of the twelve glulam beams.

The results demonstrated that by reinforcing glulam beams with either BFRP or GFRP plates it is possible significantly increase the ultimate moment capacity of the beams, and increase the elastic modulus of the beams in moderation. Comparison of results from the experiments and the considered code values, showed calculated values at average 17 – 33% lower than experimental values. The reinforced glulam beam's failure in a more ductile manner than the unreinforced glulam beams.



**Picture showing glued laminated timber beams strengthened with GFRP (four beams to the left) and with BFRP (five beams to the right)**