CHARACTERISATION OF GREEN-GLUED
WOOD Adhesive BONDS

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ABSTRACT


The gluing of unseasoned wood, called green gluing, is a relatively new sawmill process, implying a radically changed order of material flow in the production of value-added wood-based products. It facilitates the enhancement of raw material recovery and value yield by integrating defect elimination and gluing already before kiln drying. The present study evaluates green glued adhesive bonds in flatwise glued beams and finger joints. The main part of this work deals with green gluing using a moisture curing polyurethane adhesive (PUR). Standardised test methods and specially designed, small scale, specimens were used for the determination of the strength, fracture energy and the ductility of both dry- and green glued bonds in tension and in shear. Using the small scale specimens it was possible to capture the complete stress versus deformation curves, including also their unloading part. An optical system for deformation measurement was used for the analysis of bond behaviour. The influence of moisture content during curing and temperature after curing on the adhesive chemical composition and on the mechanical properties was investigated. Furthermore, the moisture transport through the adhesive bond during curing was tested. Finally, microscopy studies were performed for analysis of bond morphology and fracture. The results show that two significant factors influence the shear strength of green glued bonds: wood density and adhesive spread rate. Bonds which fulfil the requirements according to EN 386 could be obtained within a wide range of process parameters. The small specimen tests showed that green glued PUR bonds can reach the same strength and fracture energy, both in shear and in tension, as dry glued bonds with the same adhesive amount. The local material properties of the bonds could be determined, thanks to the failure in the tests taking place within the adhesive bond itself and not in the wood. Following process factors were shown to cause lower bond strength: a) a low adhesive spread rate, b) high pressure and c) short pressing time in combination with low wood density and high moisture content. Moreover, the heat treatment of the cured PUR adhesive during drying influenced the chemical composition of the adhesive, providing for higher strength, stiffness and Tg of the adhesive, caused by an increased amount of highly ordered bidentate urea.

Key words: green gluing, finger jointing, durability, shear strength, wood failure percentage, fracture energy, tensile strength, PUR adhesive.