TOOL / Novel tools

● Challenges for the use of piezoresistive adhesives in anisotropic materials like timber

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Abstract content

In the last years, we applied the concept of electrically conductive nanocomposites [1] by addition of nanofillers to adhesives for engineered timber. It has been shown that stress and moisture can be recorded in laboratory scale [2]. The typical loss in strength for these composites, when nano-sized powder is integrated, is negligible for dry bonding strength (EN 302-1) in engineered timber [3]. These multifunctional adhesives (usable as sensor and for joining) open a new horizon for adhered products, especially in timber engineering. Public buildings as schools, multi-storey buildings, large span halls and bridges have to be assessed regularly. Integrated sensing layers are providing the possibility to monitor the structure with regarding high stress or elevated moisture content Ongoing research treats the upscaling of laboratory tests to real size specimen. From the early stage research, new challenges and research questions emerged for the application of piezoresistive adhesives in anisotropic and moisture-sensitive materials under structural conditions. Those are: (1) detection of singular and multiple stress constellations depending on the anisotropic mechanical properties and transverse deformation in wood, (2) the differentiation of moisture sensing from the mechanical strain and the piezoresistive effect in the glue line, (3) the reproducibility and the reliability of the signal in real conditions, (4) differentiating measurement parameter from disturbances, scaling issues, the long-term and variable load behaviour of the material wood and the multifunctional bond line.
Further application related focus will be on the development of different adhesives and application technologies for production or repair of glulam. The principle relationships of mechanical stress and moisture on the hygroscopic fiber composite wood and nanoparticle-filled adhesive are graphically visualized on the poster and a research roadmap is presented.

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References

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