Subarea POB3: Modern materials for use in construction

Title of the presentation: Methacrylate adhesives as an alternative to welded joints in steel structures

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Abstract:

Connections in steel structures are most often made as welded joints or with the use of steel connectors. These solutions, although proven, have a number of disadvantages resulting in limited construction scenarios or reduced load-bearing capacity of the connections. An alternative are bonded joints that are applied on the surface of elements without the need to make holes in the structure and thus, without introducing additional stresses. Commonly, the bonded joints are made with the use of epoxy adhesives, which, however, have disadvantages, such as the requirement to use very thin bonds (0.1-0.2 mm), too high stiffness and brittleness, and issues with the transmission of fatigue loads. More preferred for this purposes are adhesives of medium stiffness, which with a bond thickness of 1 mm allow for effective cooperation over a long length of the joint, thus resulting in a high load-bearing capacity.

The team have conducted experiments and FE simulations of joints using methacrylate adhesives and obtained very promising results in terms of load-bearing capacity and stiffness under static and fatigue loads in a wide temperature range. The tests were carried out on full-size double-lap joints and on beams made of steel profiles, including those with a distinct notch. Advanced material tests carried out in parallel allowed for obtaining a reliable material model of the selected adhesive. Numerical models in the ABAQUS software showed very good agreement with the results of model tests. It is especially valuable in the view of absence of standard guidelines for the design of adhesive joints, as it allows to obtain reliable data regarding the load-bearing capacity of joints, their rigidity and mechanism of damage.

The team plan to extend the research in terms of the influence of aging factors (cyclic loads, variable temperatures, environmental aggression) and further thermal analyses, as well as to develop FE models and research on structural elements in a natural scale.