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Analysis of mode II fracture of fibre-reinforced gypsum specimens using an anchor bolt test

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Introduction: Fibre reinforcement is not a new idea, but it has experienced a very important development in the last years. Many recent studies have analysed the effect of fibre reinforcement on fracture [1], which is of special interest in the case of concrete, given the high production of this material and its impact on the global economy and the world environment, due to the carbon footprint its production generates. Nevertheless, the use of gypsum is also widespread in the construction field and is the most used material for interior lining. Although this is not a structural material, the use of fibre reinforcement may be of interest in some cases, increasing the fracture energy of the elements and reducing tearing [2]. In the analysis of fracture of quasi-brittle materials, studies have traditionally focused on mode I. Mode I is indeed the most usual fracture mode, but in some cases Mode II has a strong influence at the onset of fracture. There is not much information about Mode II fracture in the literature and almost none about fracture of fibre-reinforced quasi-brittle materials. In this contribution mode II fracture of fibre reinforced gypsum (FRG) is studied by means of anchor bolt tests. This test was analysed in depth by RILEM [3] and consists of pulling an embedded T-shaped steel element out of a block of concrete. In the case of this study, the test is used with fibre-reinforced gypsum specimens.

Materials and methods: FRG specimens using polypropylene microfibres are tested with the experimental setup shown in Figure 1, the embedded T-shaped steel element is pulled out from the FRG specimen under quasi-static conditions. Load evolution is recorded and the strain field is analysed by means of digital image correlation (DIC).

Results: Fibre reinforcement highly increases the response of gypsum under mode II, as expected. Fracture pattern in FRG also reveals very different when compared with not reinforced gypsum. Not reinforced specimens present similar patterns as those observed in the literature for concrete [3], while FRG specimens show a different pattern, closer to a classical shear plane.

Conclusions: Results show that fibre reinforcement has a strong influence on mode II fracture of gypsum, increasing the peak load, providing a remarkable post-peak strength, thus highly increasing the energy absorbed by the material before collapse.

References:

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a) b)

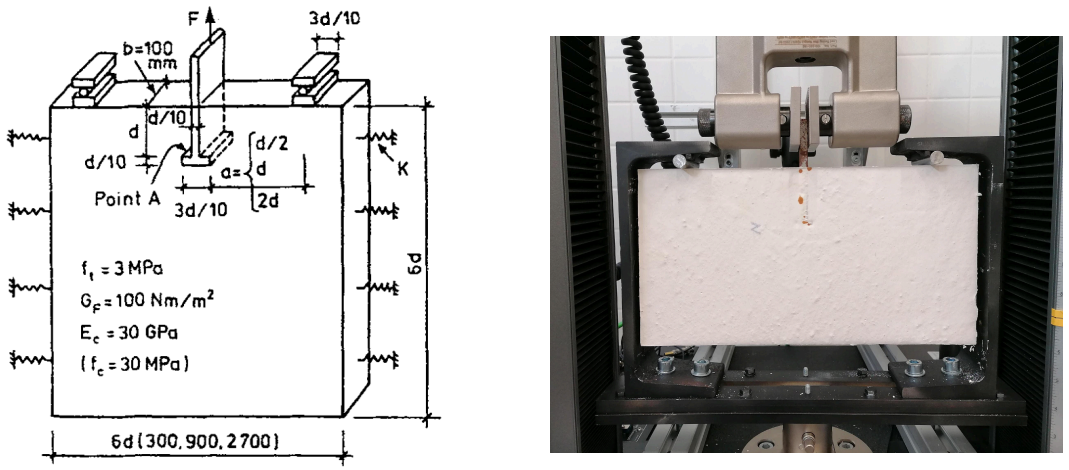

Figure 1. a) Scheme of the anchor bolt test proposed by RILEM [3], b) experimental setup used in this study.

a) b)

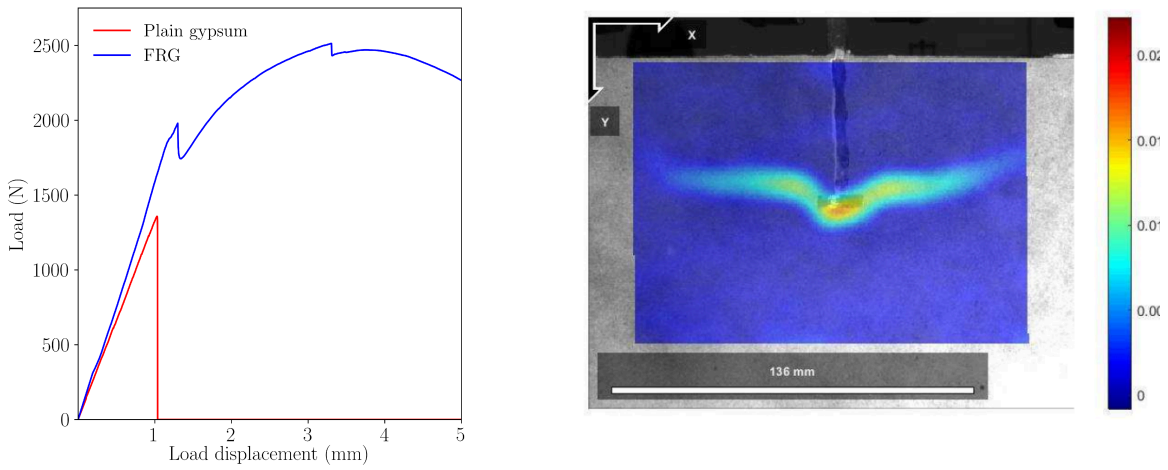

Figure 2. a) Load-displacement diagrams obtained experimentally; b) e_yy strain field obtained with FRG.