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NUMERICAL SIMULATION OF MECHANICAL PROPERTIES FOR COMPOSITE REINFORCED BY KNITTED FABRIC

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Polymer and concrete matrix composites reinforced by knitted fabric were investigated. Such materials are mechanically non-linear with a high dynamic energy absorption possibility. Precise mechanical properties appreciation and prediction are important for materials use in novel structures. Two different approaches were executed for mechanical properties evaluation - numerical (FEM) structural modeling, based on reinforcement and matrix mechanical and geometrical properties (were measured experimentally) and direct experimental mechanical properties measurements. Similarly numerical probabilistic structural modeling results were compared with material direct experimental strength measurements. Both approaches were compared and comparison results were discussed.
Glass fibers yarns were used for knitted fabric preparation. Knitted fabric was prepared experimentally. Prepared sample of the knitted glass fiber fabric is shown in the Fig.1.

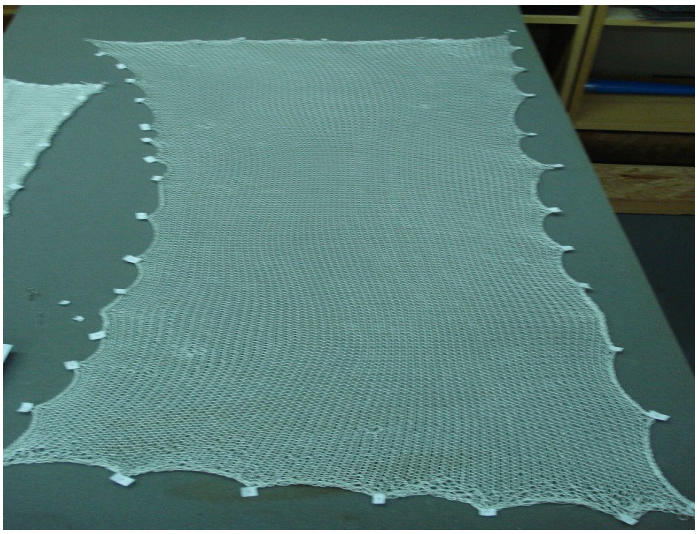

Fig. 1. Glass fiber knitted fabric sample.

Thermoset matrix composite plates (5 layers, 2.2 x 10–3 m thick), reinforced by the glass fabric, were manufactured using acrylic resin. Rectangular specimens 25 × 250 mm were cut out of the plates for tensile tests under different directions to knitted fabric orientation (angles 0°, 45°, 90°).
The 3D geometrical modeling of the knitted fabric was based on the Leaf and Glaskin approach, FEM 3D unit cell (of the glass fabric reinforced composite) model was elaborated (see Fig. 2) and materials elastic properties were numerically calculated on the base of yarn's and matrix experimentally measured mechanical properties data.

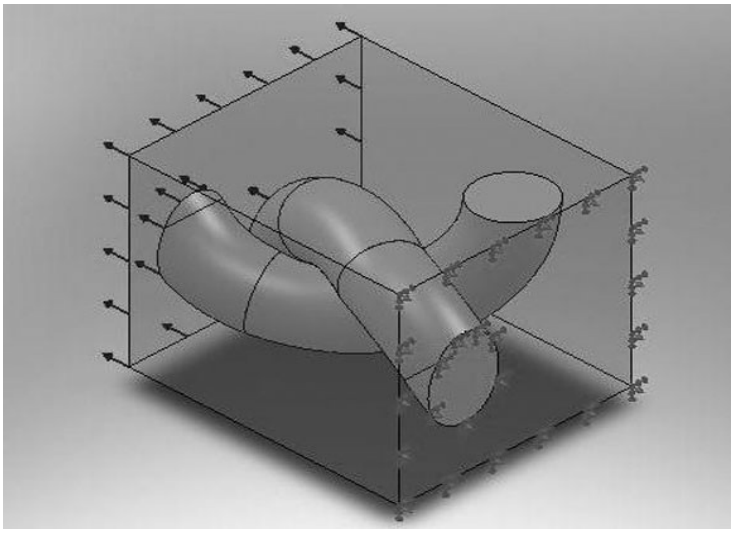

Fig. 2. Composite material unit cell.

The numerical method [1] was used for material elastic properties prediction. Probabilistic structural model was elaborated for material strength prediction. Similar ways were elaborated knitted fabric reinforced composites with concrete matrix. Three different strength and elastic properties concrete matrix were investigated. Thin (1.5 cm, 3 layers) plates as well as 10cmx10cmx40cm prisms (with 5 layers) were elaborated and experimentally investigated. Experimental results were compared with performed numerical simulations.

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