Concrete Structural Element Reinforced by Glass Fiber Fabric

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Interest to concrete, reinforced by glass fibers knitted fabrics, is increased in recent years. Such materials are exhibiting attractive mechanical properties. In woven fabric, threads traditionally are running horizontally and vertically. Contrary, in the case of knitted fabric, strands are forming loops. A knitted fabric is highly deformable in all directions. Depending on fibers are used, some of them are more deformable than others. The reason is – yarns are not making any straight line anywhere in the knitted fabric, leading to technological advantage – excellent deformability, shape forming ability and flexibility, which allows it to be used in any complex shape mould without folds. In this project glass fiber yarns were investigated. Glass fiber knitted fabric was prepared using knitting machine Neva-5 (see Fig.1). Fabrics were used for concrete beam reinforcement. Fabrics were placed inside the mould during beam preparation at the equal distance from the top and bottom each prism surfaces and at equal distance one from another separating prism thickness to 4 or 5 layers (in the case of 3 or 4 embedded fabrics). Ruptured sample reinforced by 4 fabrics is shown in the figure 2. Simultaneously, mechanical performance of the beam reinforced by 3 or 4 fabrics under 4-point bending was numerically simulated. Glass fibers yarn loop in concrete matrix was modeled using FEM. It was intended that knitted fabric composite would consist of multiple plain weft knitted fabric laminas. The 3D geometrical model of the knitted fabric was accepted. Model predictions were validated by experiments. Three groups of 10x10x40 cm concrete prisms were prepared. First group was without reinforcement. Second group was reinforced by 3 fabrics each prism. Third group has 4 reinforcing fabrics inside each prism.

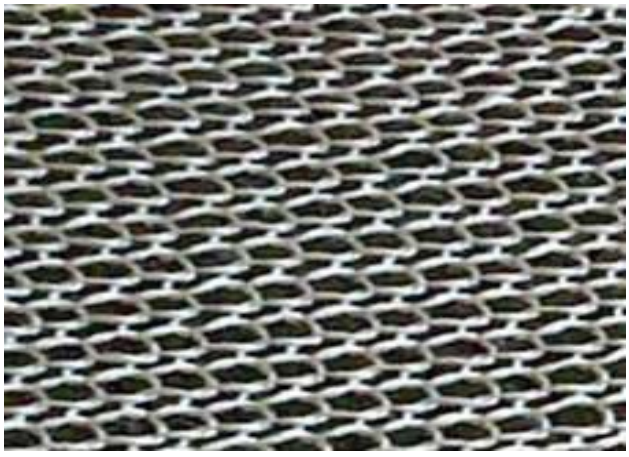

Fig.1. Glass fibers knitted fabric.

All prisms were loaded by 4-point bending till rupture. Applied load displacement curves were obtained experimentally and were compared with numerical simulation results. Results comparison showed good coincidence at starting part of non-linear applied force- beam midpoint deflection curve and was allowed to recognize mechanical picture of fracture for such materials.

Fig.2. Concrete prisms reinforced by four glass fiber knitted fabrics. One half of the beam was broken under 4 –point bending.