

RESEARCH OF DIFFERENT TYPES OF FIBRE REINFORCED POLYMER (FRP) REINFORCED CONCRETE BEAMS



August, 2016

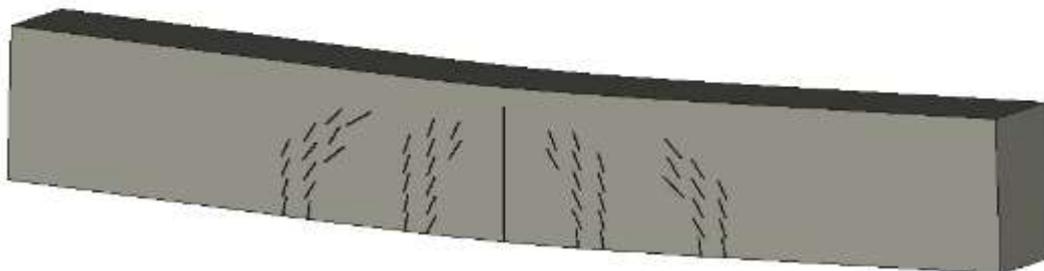
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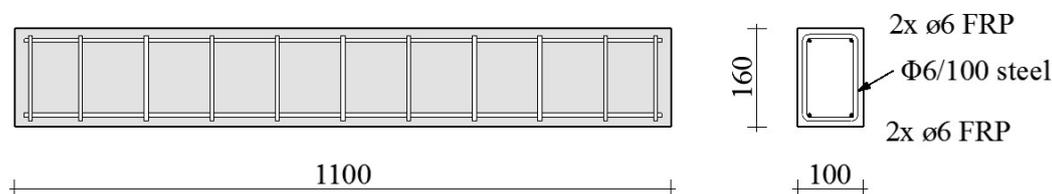
1. Preliminaries

The purpose of the experiment was to investigate the effect of the different internationally recognized Fibre Reinforced Polymer (FRP) rebars in concrete beams. The research contains laboratory experiment and Finite Element Analysis (FEA). The final goal was to compare the bending capacity of different FRP rebars in concrete beams.

After the preliminary laboratory tests finite element material models were developed for each bar, which follow exactly the behavior of the noticed bar in concrete. To produce the bending failure (which causes the rupture of the FRP bars) in the concrete beams steel stirrups were applied to bear the shear stresses.

2. Test specimens

Tested beams: 1100 mm long, 160 mm high, 100 mm wide concrete beams as shown in Pic.1.



Pic. 1. Geometry of the beams

Concrete strength class: C50/60 according to Eurocode 1992-1-1.

Concrete mix proportions:

Component	Type	[kg/m ³]
Cement	CEM I 52.5 N	400
Water content		160
Aggregate 0/4		921
Aggregate 4/8		921
Superplasticizer	Mapei Dynamon NRG 1012	3,2
w/c	0,400	

Table 1. Concrete mix proportions

FRP reinforcement: 2Φ6 at tension and compression side, with 15 mm concrete covering. In the experiment two kinds of FRP material were tested: glass and basalt.

Steel stirrups: Φ6/100 bended steel bar reinforcement

Number of beams: 3 pieces with all FRP rebars

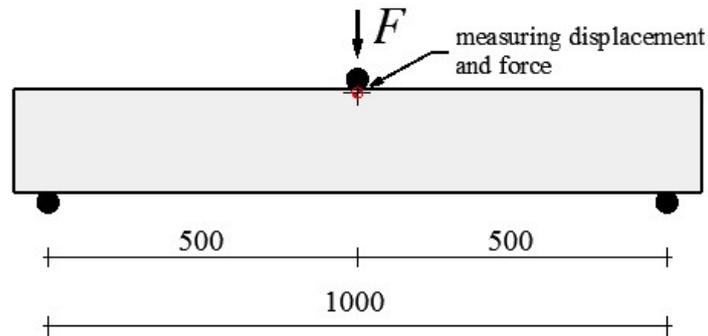
Specimen production: Technical University of Budapest, Czako Adolf laboratory.

Specimen casting date: 18.05.2016 – 26.05.2016

Specimen testing date: at the age of 28 days

Specimen storage: at 25 °C and 55-60% relative humidity

3. Test description



Pic. 2. Details of the test

A three-point bending beam test was carried out to investigate the capacity of different FRP bars.

For the test a ZWICK-ROELL Z150 Universal Testing Machine was applied.

The span was 1000 mm, and the force was added on the middle of the beam as shown in Pic.2.

During the test the applied force and the current displacement were measured.

For all beams video was recorded during the test, and photos were taken during and after the test to recognize the failure mode and the crack development during the loading.



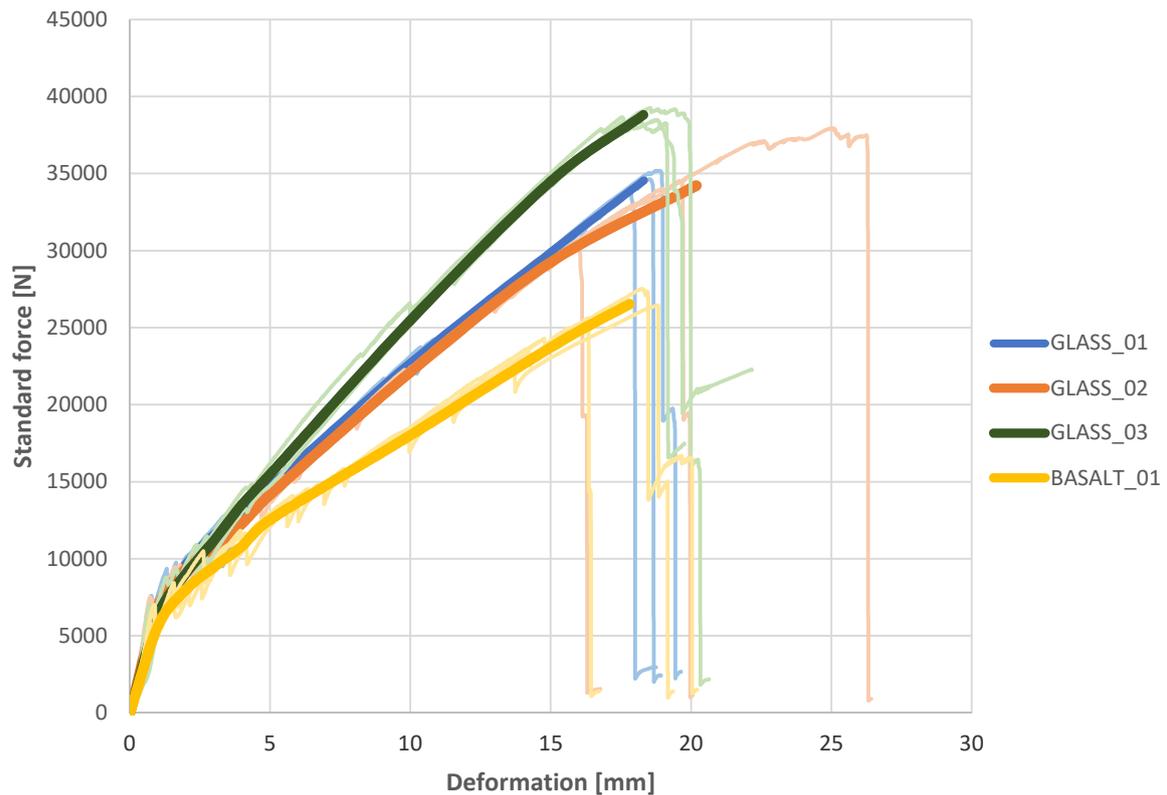
Pic. 3. Beam before and after testing

4. Results

After the tests the Load – Deflection diagram was determined for all beams, and the average value was calculated as well.

The first Appendix contains every Load – Deflection diagrams, and the second one contains some photos of the different behaviors of concrete beams with crack propagation.

The summarized diagram can be seen below in Pic.4.



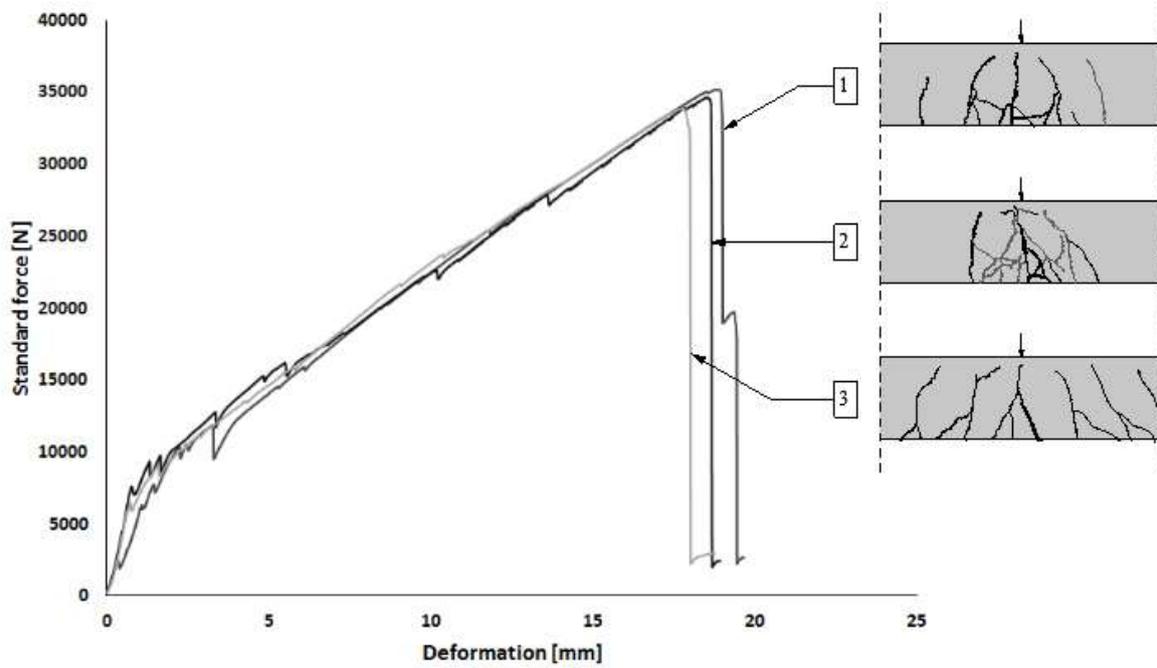
Pic. 4. Summarized results

On the Horizontal axis the Deformation in [mm], and on the Vertical axis the Force in [N] can be seen. The thin lines are the different beams, and the thick are the average values.

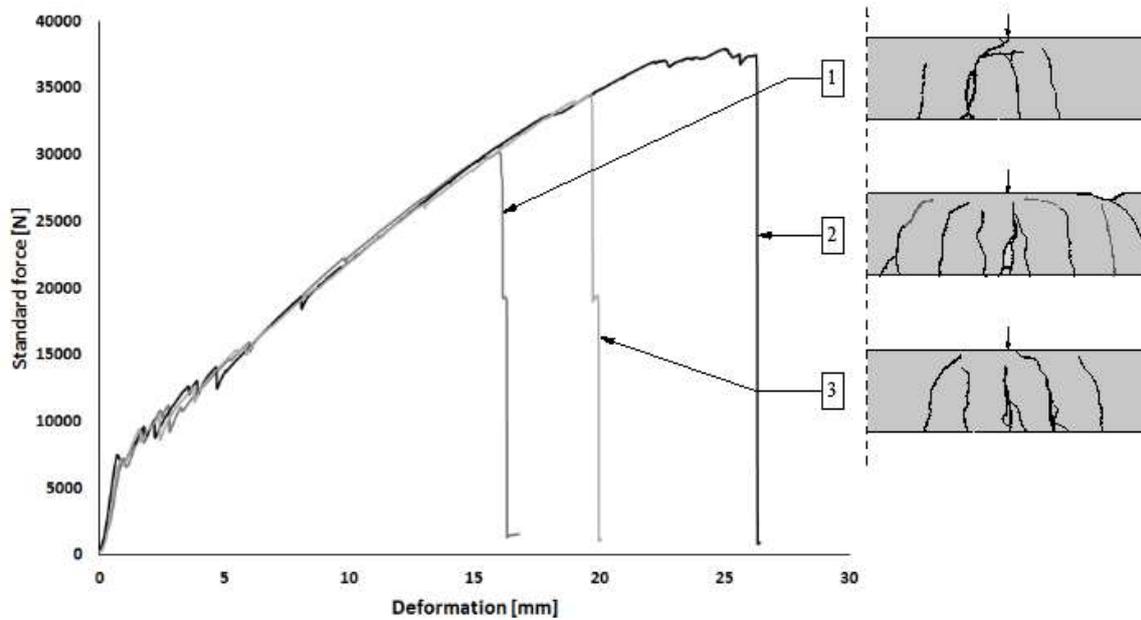
The best performance belongs to Glass_03 bar, marked with green line.

1. Appendix – Crack propagation and moment capacity of the beams

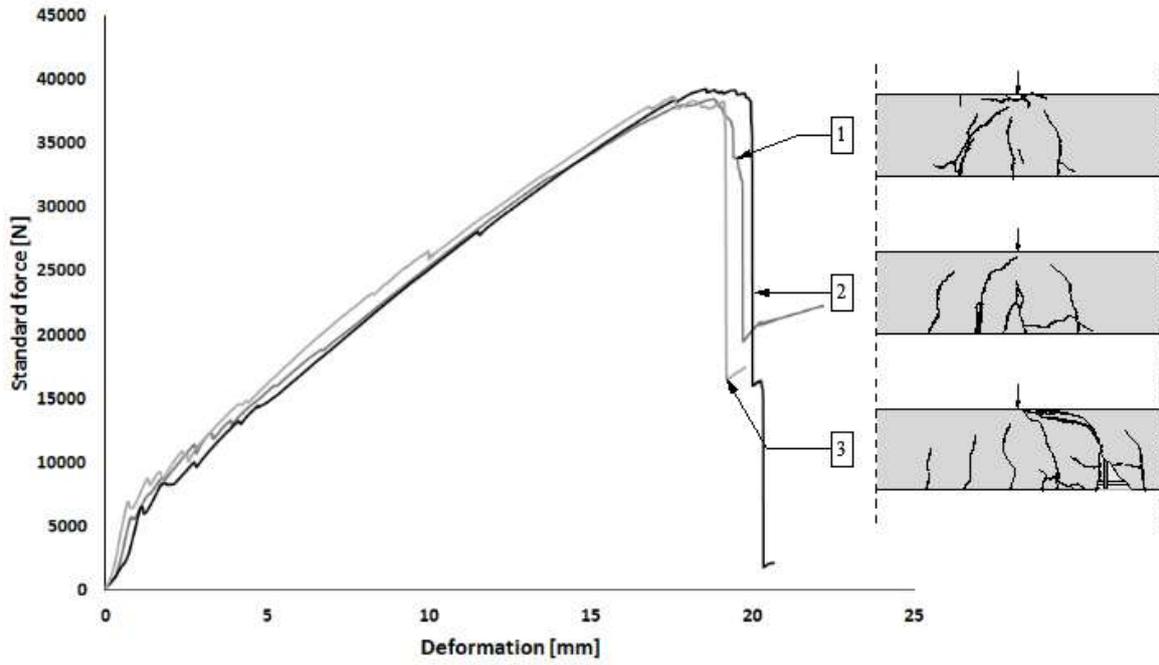
Class 01



Class 02



Glass 03



Basalt 01

