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Creep Behaviour of Cement-based Composites

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Keywords – FRCC, PVA fibers, creep, compression strength, modulus of elasticity.

I. INTRODUCTION

Scientists and concrete technologists have been working on the development of new types of concrete. Newly elaborated material provides improved mechanical and physical properties. The deformation characteristics of concrete are important in the design of sustainable structures [1]. This paper introduces the recent state of research on elastic and time-dependent deformations of new high performance cement composite materials (FRCC) that are reinforced with polyvinyl alcohol (PVA) fibres and subjected to long-term, uniform, constant compressive load. In these composites, part of the cement has been replaced with micro- and nano-fillers. The experimental studies of creep in compression were performed. The concrete specimens were tested in a controlled constant temperature and with a constant level of moisture. This study was carried out on two different extreme cases of environment: the case with 100% moisture of specimens obtained by protecting to desiccation of this one and the case of air-dried specimens. Specimens were tested at age of 28 days. The compression strength and modulus of elasticity of HPFRC concrete specimens were determined. The results of the experiments permit the prediction of long-term deformations of the concrete.

II. MATERIALS AND METHODS

The experimental work included the preparation of two fiber-reinforced high performance concrete (FRHPC) compositions with polyvinyl alcohol (PVA) fibers with and without nano silica. The mix compositions are given in Table 1. PVA fiber properties are listed in Table 2.

TABLE I
CONCRETE MIX COMPOSITION

Component [kg/m ³]	SF	NN
Cement Aalborg white CEM I 52,5 N	1000	1000
Quartz sand 0-1mm	260	260
Quartz sand 0.3-0.8mm	400	400
Quartz sand 0-0.3mm	300	300
Silica fume Elkem 971 U	150	150
Plasticizer Sikament 56	30	30
Nano silica	0	20
Water	195	195
PVA fibers MC 40/8	10	10
PVA fibers MC 200/12	10	10
W/C	0.19	0.19

TABLE II
PROPERTIES OF PVA FIBRES

Fiber type	Ø [µm]	L [mm]	f _t [GPa]	E [GPa]
MC 40/8	40	8	1.6	42
MC 200/12	200	12	1.0	30

Standard sample cubes 100x100x100 mm and cylinders 47x190 mm were produced in order to investigate the mechanical characteristics of the material. The tests were performed after 28 days of concrete hardening in standard conditions (temperature 20±2°C, RH > 95±5%). The creep was measured for hardened concrete specimens subjected to a uniform compressive load which equal to 25% of the characteristic compressive strength of concrete and which was kept constant over a long period of time [2, 3]. The tests were conducted in two extreme conditions – moist and drying. Specimens were kept under a constant load for 90 days, and for recoverable creep they were kept without load for 30 days. All specimens were kept in a dry atmosphere of controlled relative humidity in standard conditions: temperature 20±2°C and relative humidity 40±2%.

III. RESULTS

The highest deformation response was exhibited by the compositions without nano silica. At moist conditions this difference is 20%, while for specimens which were tested in dry conditions it is 7.7%.

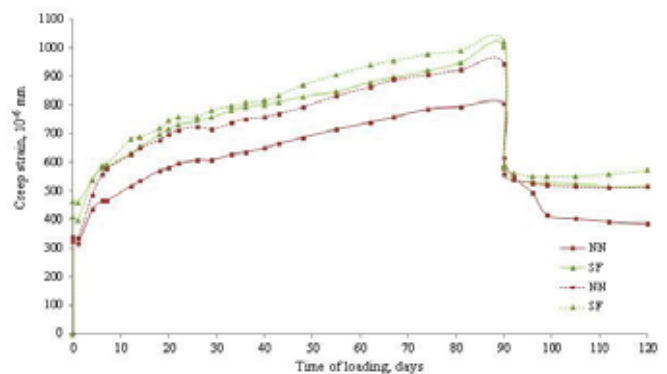


Fig.1. Creep Strain of FRHPC Compositions.

IV. CONCLUSION

The experimental study indicates that in the polyvinyl alcohol fibers (PVA) don't have significant influence on the high performance concrete creep in the compression properties.

V. ACKNOWLEDGEMENT

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