

## CREEP OF CEMENT PASTE WITH W/C RATIO 0.5

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**Abstract:** The paper present methods for measuring of the creep of cement paste and results of measuring of creep of cement paste with water-cement ratio 0,5. Basic creep is one of major value used for computer simulation of the creep of cement paste. Incremental linear optoelectronic probe is used for long time measuring of change of specimen length under constant load. Deformation of the specimens is measured by 3 probes and calculated like a average value from measurements. Small specimens made from cement paste are tested in the loading equipment for compression. Specimen is cylinder with diameter 10mm and height 70mm.

### 1. Introduction

For the mathematical simulations [3] of the concretes creep are important material properties of cement paste. Strength of cement paste and Modulus of elasticity are basic material properties for simulations. Strengths of cement pastes are tested in compression tests in the MTS Alliance RT 30 equipment. Modulus of Elasticity is tested in MTS equipment too.

Other properties for simulations of the concrete creep are: mass, specific humidity of specimens and curves of the creep of cement paste. Mass is calculated from specimen's volume and its weight. Specific humidity is calculated from volume of specimen and a change of weight the specimen.

Finally, curves of creep are measured by lever mechanisms.

### 2. Specimens

#### 2.1 Type of specimens

For compression tests are used specimen with diameter 1cm (made into same forms like a specimens for measuring of the creep). Height of the specimen for compression test is 2cm. The length of specimens in the mould is 120mm. All specimens were made from Portland cement and water, without plasticizer. Water – cement ratio was used 0.5. Cement mixture was sufficiently liquid and was it possible pour to moulds. Portland cement CEM I 42,5 R was used [1].

Specimens are made in the plastic mould equipment (Figure 1). Cement paste is after filling the moulds vibrated by knocking the mould. Specimens are taken from the mould out and sawed on the length necessary for testing. 3 short specimens are sawed from one original specimen for material testing. One specimen is sawed from original specimen for creep test.

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*Figure 1: Plastic mould with specimen.*

## **2.2 Specimens for creep measuring**

All specimens for test have a cylindrical shape, with 10mm in diameter and 70mm in length. Each mould contains 7 cylindrical specimens (original specimens). Length of the specimens for shrinkage test is 70mm, and length of the specimens for material testing is 20mm.

## **3. Testing equipment**

### **3.1 Material testing**

Measuring of the material properties are realized in the MTS Alliance RT 30 equipment. By MTS Alliance are tested: strength, Modulus of elasticity. By continuous loading are measured parameters of material and is possible acquire the stress-strain diagram of the cement specimen.

### **3.2 Lever mechanism**

Lever mechanism (Figure 2) is equipment for measuring of creep of cement paste [2]. Specimens are loaded by constant loads. Sizes of the load depend on the weight of plumb and location of plumb at the lever. For used specimens with diameter 10mm are applicable loads approximately from 760N to 1000N. In the case specimens made from Portland cement with diameters 10mm were applied loads 760N. Applied load on each specimen is constant for whole time of the loading.

Specimens are firstly placed into the lever mechanism and after then is system loaded by plumb. Measuring of the deformation was start when specimen is placed into the lever mechanism.

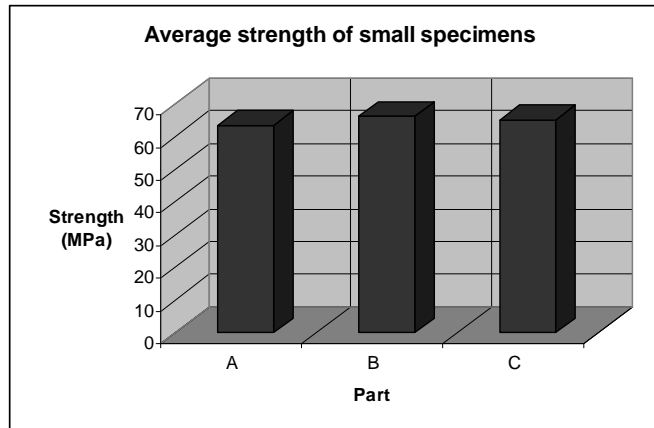


*Figure 2: Lever mechanism.*

## 4. Results

### 4.1 Deformation of specimens

Material properties were tested on the 120mm length specimens. Every specimen was



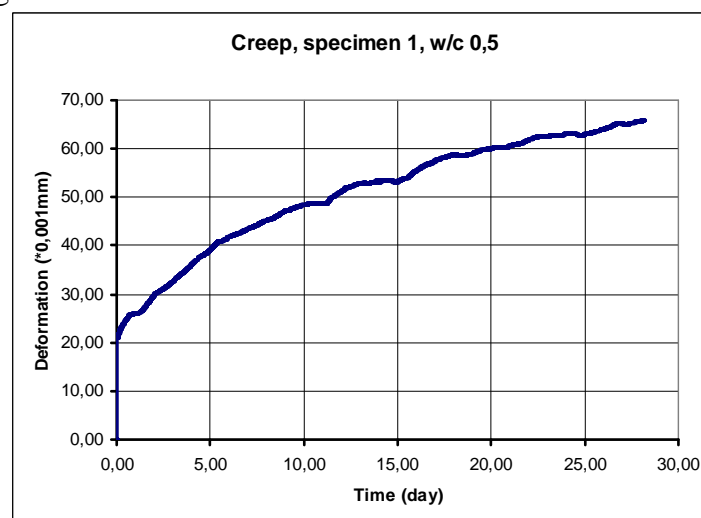
*Figure 3: Lever mechanism.*

sawed to 3 small specimens with depth 20mm. From compression tests were measured results: Average strength of the top parts of 120mm length specimens was 63,4MPa. From central parts of specimens was achieve average strength 66,2MPa. Finally, bottom part of the specimens was characterized by average strength 65,1MPa (Figure 3).

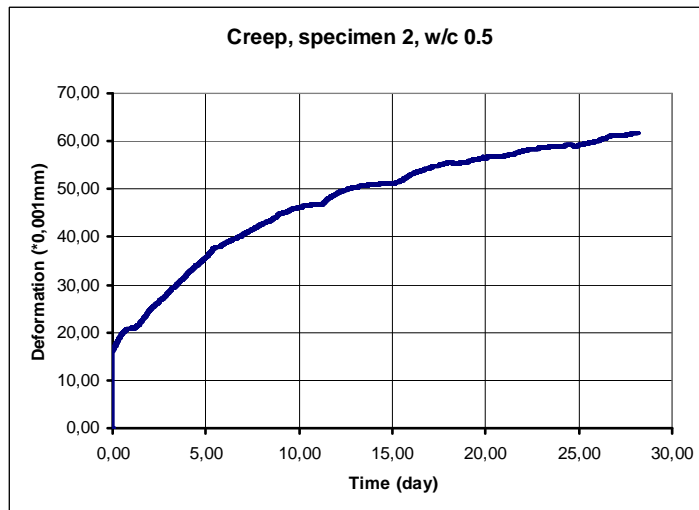
### 4.2 Results from lever mechanisms

In the lever mechanisms were tested 4 specimens 70mm length. Two specimens were loaded by plumbs and with full saturation of water. During the testing specimens were covered by plastic wrap. Before covering were specimens placed into the water basin.

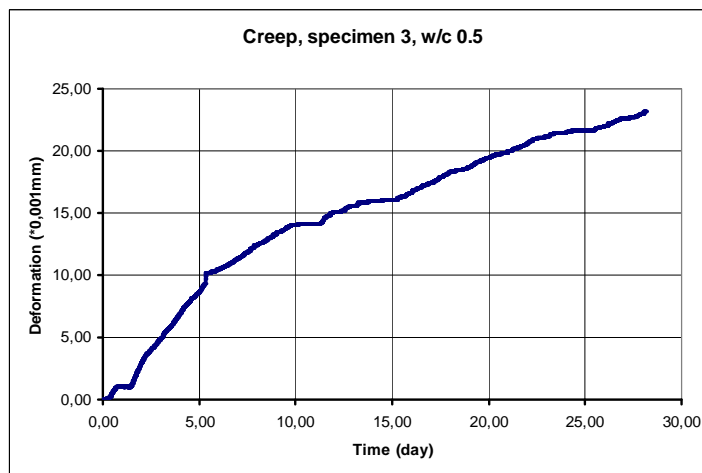
Third specimen was covered by plastic wrap like a first two specimens. But this specimen was not loaded by 760N loads. It was only placed into lever mechanism and measured self shrinkage (autogenous shrinkage). Fourth specimen was placed into the lever mechanism covered to plastic wrap too, but without humidity. Specimen was not placed into the water basin before testing.



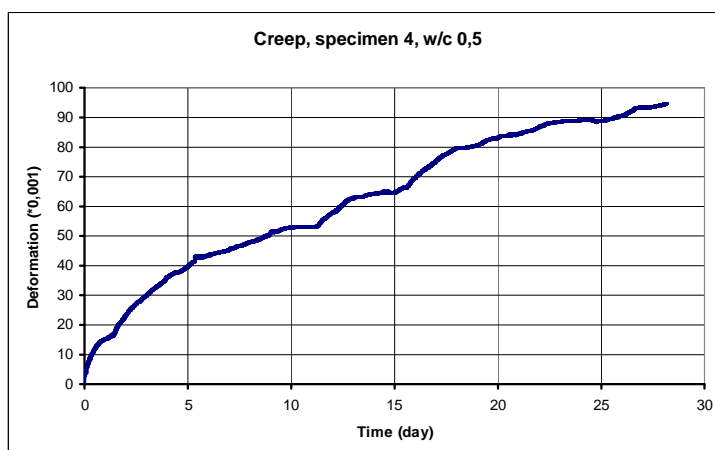
*Figure 4: Specimen No. 1 - creep.*



*Figure 5: Specimen No. 2 - creep.*

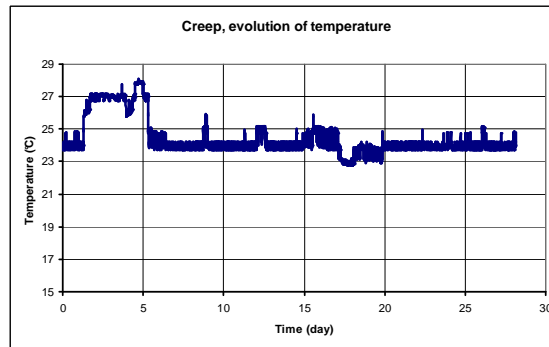


*Figure 6: Specimen No. 3 - shrinkage.*



*Figure 7: Specimen No. 4 - drying shrinkage.*

Specimens were tested 28day old. During testing was check temperature (Figure 7). During first 4 day temperature achieve 27°C. After 5<sup>th</sup> day temperature was stable at 23°C. Weights of the specimens after 28 day testing were same like a on start of the measuring.



**Figure 8:** Evolution of the temperature during the test.

## 5. Conclusions

For test was used cement paste made from Portland cement CEM I 42,5 R with water cement ratio  $w/c = 0.5$ . Average strength of the specimens in the compression tests was 64,9MPa.

Lengths of the specimens for creep tests were 70mm.

Deformation of the water saturated specimens was 45 microns after 28day in the creep test.

Deformation (shrinkage) of the unloaded specimen was 22,5microns after 28day.

Deformation of the specimen without physical fixed water was 85microns after 28day in the creep test.

## Acknowledgement

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## References

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