Sborník vědeckých prací Vysoké školy báňské – Technické univerzity Ostrava
číslo 1, rok 2009, ročník LII, řada hutnická
článek č. 1460

MECHANICAL PROPERTIES OF 60MPA STRENGTH CONCRETE

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ABSTRACT: The paper describes the testing of mechanical properties of the concrete. Mechanical properties of concrete are used for design of constructions. Strength in compression and tension, Modulus of elasticity, stress-strain curve are very important. High performance concretes are modern and often used in constructions nowadays. Concrete with cement ratio of 0.35 was tested in compression and in the Brazilian test. Superplasticizer was used for concreting. Evolutions of properties in the time were observed. Concrete specimens were tested in 7, 14 and 28 days. Prism specimens 400 mm tall were used for testing in compression were and for the Brazilian tests were used cubes with edge of 100 mm. Strength in compression after 28 days was 58.8 MPa and strength in lateral tension was 5.34 MPa. Curves of evolution of the strength in compression and tension, Modulus of elasticity were created from data of measuring. Slump test was modelled by OOFEM software. Rise of concrete flow, height of cone and diameter of concrete cake were measured.

KEY WORDS: concrete, strength, slump test, Brazilian test, Modulus of Elasticity

1. INTRODUCTION

Goal of suggestion of properties of higher strength concrete is to gain the adequate base and information about designed concrete. Suitable design method for acquisition of material properties of concrete is passing adequate quantity of information for verification of theoretical design of construction. Simultaneous results give control pieces of information about quality, method of concrete processing and its final properties. Problem in giving the valuable material properties lies in different approach in observing of parameters of concrete. It is possible to obtain different results by different methodology, and it is necessary to interperet them correctly. For example, compression strength can be higher for cubic specimen and lower for tall prism specimens.

Properties of high strength concrete are determined by testing equipment which is able to test great specimen adequately. Specimen, which is too strong and big, cannot be tested in a low capacity testing machine. And it is impossible to test too small specimen in a high load capacity testing machine. Testing of material properties of specimen is suitable in equipment with strength capacity from 2 to 5 times higher than specimen's strength.

2. PREPARING THE TESTS

Specimens with strength of 60 MPa were tested in compression tests and Brazilian tests. We used equipment DSM 2500. This is hydraulic testing machine with maximal compress capacity of 2500 kN. In order to obtain post peak curve we need following parts of machine:

- Stiff machine frame
- Electronic and fast control system
- Hydraulic load system
- Control the test by deformation of specimens

Specimen was stuffed with 2 external strain gauges which are placed on the surface of specimen. Measuring length is chosen by depth of specimen. For specimen which is 400 mm tall we need measuring length of 150 mm. Measuring length of tensometric gauges is for Brazilian test 50 mm. Deformation of pecimen is measured by 4 strain gauges which are placed between loading plates of testing equipment.

Concrete mixture was designed with water cement ratio 0.35 (tab. 1). Superplasticizer in content of 1.5 % of weight of cement was added for better processability of concrete. Height of prism was 400 mm and cross section was 100 x 100 mm.

Tab. 1: Mixture of concrete

Component	Concrete (kg/m^3)
Sand 0-4	778
Aggregate 4-8	605
Aggregate 8-16	345
Cement CEM I 42,5 R	460
Water	161
Superplasticizer	6.9

During the preparation of concrete we performed slump test by steel cone. Results of slump test are presented in fig. 1. On the left side is the graph of evolution of the radius of slumped concrete in time. On the right side is the graph of slump of cone in time. Slump of cone was finished on 150 mm of its height.

Concreted specimens were placed into the water basin with 20 °C water. Their specimens were placed to the time of testing.

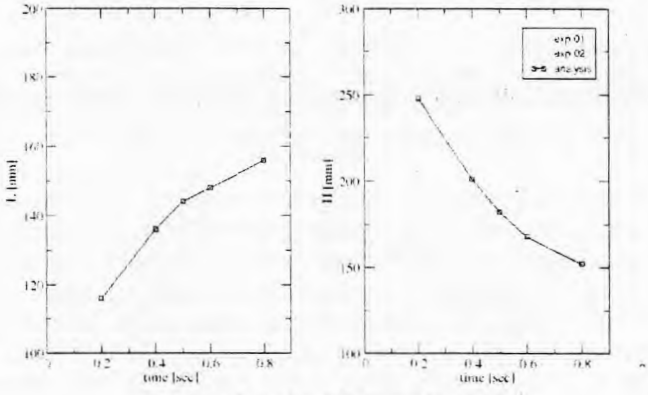

Fig. 1: Results of slump tests

3. RESULTS

Research was focused on measuring mechanical properties for 28 days in compression, lateral tension (Brazilian test). The evolution of strength and modulus of elasticity were investigated at time of 7th, 14th and 30th day of concreting of the specimens. During the testing day we tested 4 specimens in compression and 2 specimens in Brazilian test.

Fig. 2 presents the diagrams of specimens which have been in Brazilian test and in compression test for 14 days.

Fig. 3 shows the diagrams of evolution of mechanical properties in time. Points in the graphs label values measured by testing on 7th, 14th and 28th day. Horizontal axe presents time in days. Vertical axes show strength in MPa and strength in GPa.

Like diagrams in fig. 3, diagram in fig. 4 describes the evolution of tensile strength of concrete. By these tests we achieved tensile strength of 5.4 MPa. Increase of strength is steeper in first days. Strength in compression on 28th day was 60 MPa and Modulus of Elasticity achieved 40 GPa.

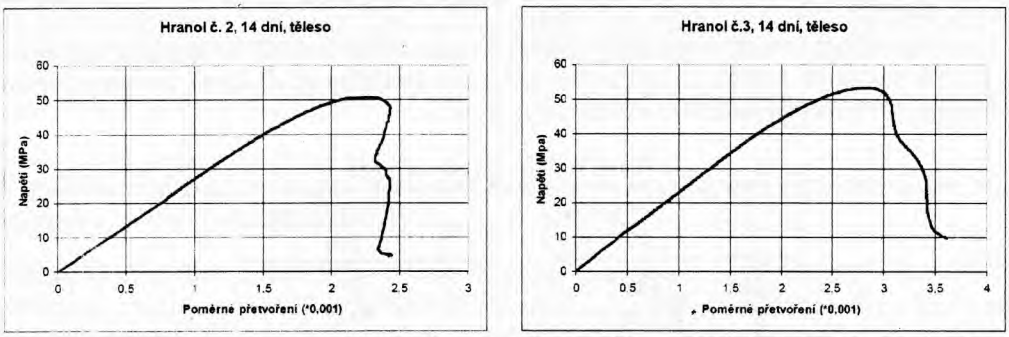

Fig. 2: Left side stress-strain diagram of cube tested in Brazilian test, right side stress-strain diagram of prism specimen in compression

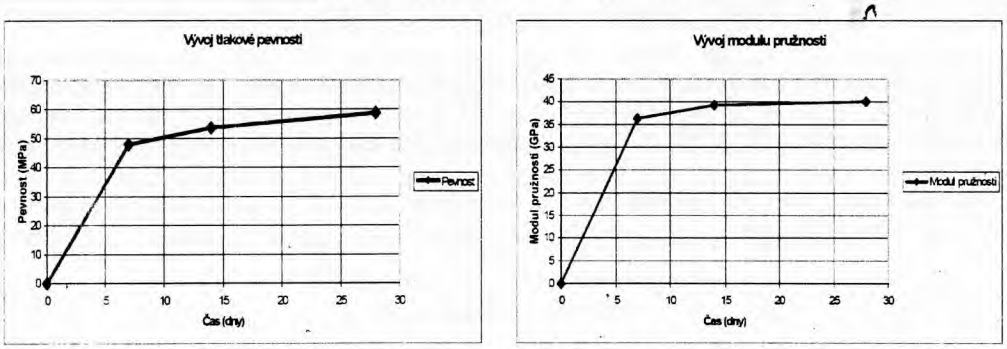

Fig. 3: Left side evolution of strength in compression, right side evolution of Modulus of Elasticity

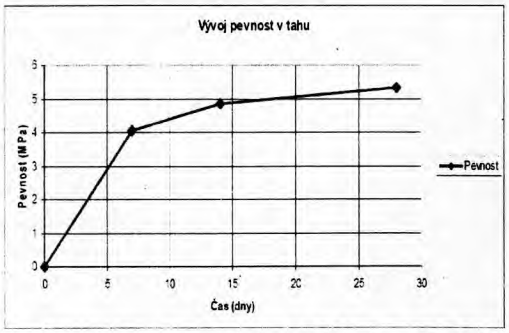

Fig. 4: Evolution of strength in tension from Brazilian test

Acknowledgement: This outcome has been achieved with financial support of the Ministry of Education, Youth and Sports of the Czech Republic, project No. 1M0579, within activities of CIDEAS research centre.

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