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Experimental Stress Analysis

Material Properties of a Gypsum Block Exposed to Influence of Weather

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Abstract: Paper present material properties like a strength and Modulus of elasticity. Gypsum blocks were sawed on the small specimens with dimensions 40×40×160 mm. Research was focused on the change of properties with dependence on the exterior and interior side of the gypsum blocks. The blocks were exposed to the influence of weather during the 5 years.

Keywords: Gypsum, Fire test, Gypsum block, Weather

1. Introduction

On of our parts of gypsum research was an experiment in real-life conditions, which was performed at Faculty of Civil Engineering, CTU in Prague. The advantage of this test is mainly in the fact that, unlike the "semi-scale" experiment where the simulation only includes the temperature and the relative moisture content, while all the other effects are neglected for operating and economic reasons, here the effects of wind, rain and solar radiation may apply.

The bottom part of the outer shell glazing was removed, and the gypsum block from material S0, were inserted in this space. Material S0 was non-modified by additions and was made only from FGD-gypsum (Flue gas desulphurisation gypsum) [1] with the water gypsum ratio 0.627. FGD-gypsum was produced in the Počerady Power Plant (ČEZ Company), in rotary calciners at temperatures of 110 to 160 °C, for more information about this gypsum see [2].

The blocks were cast in wooden moulds with dimensions of 350×250×600 mm. The free space between the block and the load-bearing structure of the outer shell was filled with thermal insulation. The block was placed so that its exterior edge would be aligned with the glazing. Sensors for reading temperature and relative moisture contents were mounted inside the block. The block or its interior and exterior surfaces respectively, were further fitted with thermal elements for temperature reading. Exterior conditions – temperature, relative humidity, rainfall

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intensity, wind direction and velocity – as well as interior conditions – temperature, relative humidity and atmospheric pressure – were read using a small meteorological station. All data were recorded in a digital form by means of the central measuring unit and transferred to PC. The arrangement of the experiment shows Fig. 1.

The results of this experiment still have not been processed in their complexity, this experiment started 20. 12. 2005 and the block was removed 25. 2. 2010.

For example in first year of this experiment the minimum values of exterior temperature, which were measured at 5 a.m. during a period from 23. 12. 2005 to 12.5. 2006. The lowest temperature of -14.1 °C was measured on January the 23rd, 2006. The highest day-time exterior temperatures measured at 3 p.m. for the same period. The highest day-time temperature for the monitored period was measured on May the 11th, 2006, amounting to 30.1 °C. This temperature pattern implies that the blocks were exposed to exterior temperatures ranging from -14 to 30.1 °C. This picture, of course, is further complemented by the changes in relative humidity, the effects of rain, wind and solar radiation. The condition of the gypsum blocks after an annual exposure to real conditions during five years of duration of this experiment shows no visible damage being in an absolutely identical state as the interior surface; see Fig. 2.

Fig. 1. A view on the experiment from a exterior side.

Fig. 2. The outdoor side of gypsum block after five year of exposition to Prague exterior weather conditions.

2. Preparing of specimens

Specimens for testing the material properties were prepared from gypsum block. Block was sawed on the specimens for testing (Fig 3). Lengths of the specimens were 160mm and cross sections were dimensions 40 mm height and 40mm width. Specimens were sawed by circular with help the hydrocooling. Water saturated into the specimen during the sawing was evaporated one week. Specimens were used for testing after the process evaporation of water.

Tests of specimens were realized in testing equipment Alliance MTS 30kN. Firstly were tested specimens in the bend tests. Detritus were used for compression

test. In the compression test were measured testing load, deformation and axial strain on the all specimens. Tensile strength was determinate by the flexural three point test. Distance between the supports was 120mm.

Exterior

I1	II1	III1	IV1	V1	VI1
I2	II2	III2	IV2	V2	VI2
I3	II3	III3	IV3	V3	VI3
I4	II4	III4	IV4	V4	VI4

Interior

Fig. 3. Describing of the specimens for testing from gypsum block.

3. Material properties

Firstly were tested two (course). First one was contact course with exterior during the 4 years. Second one was by interior side of block.

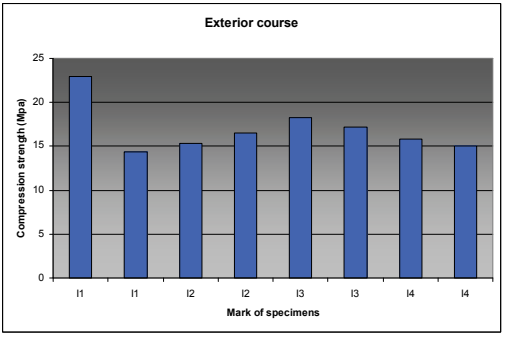

Fig. 4. Layer (course) **I** – compression tests.

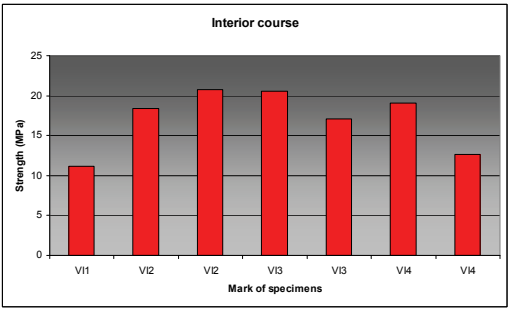

Fig. 5. Layer (course) **VI** – compression tests.

Average compression strength of course I was 16.94 MPa. Average compression strength of course VI was 17,08MPa. This result is predicating that 4 years influence of exterior weather don't increased the compression strength. Finally in the flexural test achieved the course I 4.84 MPa and course VI value 5.27MPa. Values of tensile strength are very close.

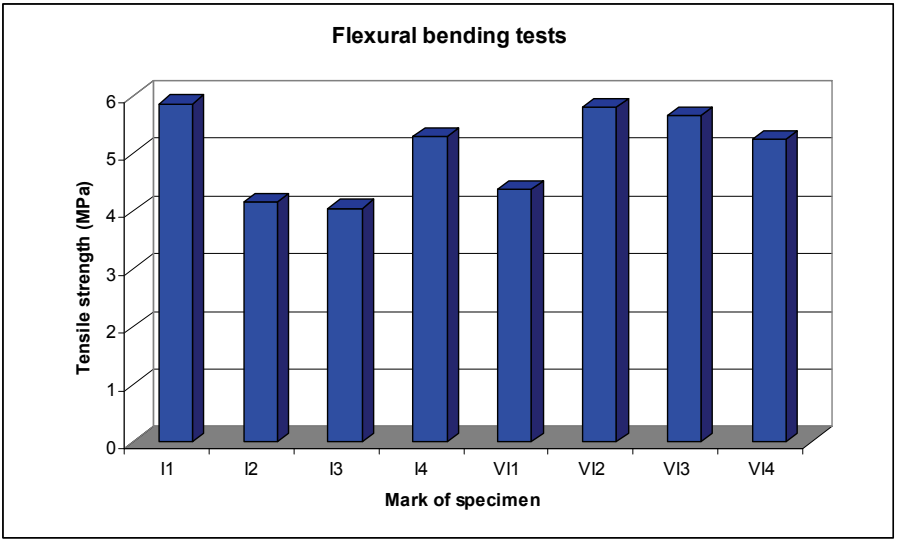

Fig. 6. Three points bend test - results.

4. Conclusions

Effect of weather influence of long time on the mechanical properties of gypsum block wasn't prove. Compression strength and tensile strength is very similar for exterior and interior side of specimen. Values of the mass density are similar for both sides of the block and achieve of the value 1192 kg/m^3. Gypsum block is appear like a suitable and stationary building material.

Acknowledgements

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