An Example of Article Design

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Abstract. The paper presents experimental and computer researches of ferroconcrete beams at high-temperature influences. There were conducted the experimental fire tests of ferroconcrete beams. The most promising way of verifying these experimental research data is computer simulation of structures, also during a fire. In order to evaluate the quality of the experiment and the reliability of the received temperature distribution.

1 Introduction

In 2018, in Ukraine there have been registered 78 608 fires. Material losses from fires amounted to 8 billion 279 million 119 thousand UAH. On average, there were 215 fires every day, 70 buildings and structures were destroyed or damaged by fire [1, 2]. Daily material losses from fires amounted to 22.7 million UAH. Each fire caused the country direct losses of 28.0 thousand UAH.

2 Main part

There was investigated the ferroconcrete beam-wall of a rectangular section 600x700 mm. The definition of the limit of fire resistance of beams is carried out according to DSTU B B.1.1-4-98 * [11] and DSTU B 13.1.1-13: 2007 [12].

Materials. The combined fire-retardant material was prepared using two components: (a) premium class magnesite plates (LLC NPP Ukrmagnesit, Sumy, Ukraine) 12 mm thick, characterized by fire resistance up to 1200 °C, water absorption of no more than 18 %, density in the range of 950-1100 $kg \cdot m^{-3}$, thermal conductivity from 0.58 to 0.69 $W \cdot m^{-1} \cdot K^{-1}$ [13, 14].

The obtained data on the studied materials are given in Table 1.

Table 1. Products of pyrolysis and combustion of polymers

Product name, polymer	Ignition temperature, t_i [°C]	Self-ignition temperature, t_{si} [°C]	Flame spreading speed, v [mm/min]	Pyrolysis products	Combustion products
Water pipes based on PE	341	349	90	Paraffins, olefins, cycloaliphatic hydrocarbons	CO, CO_2
Tarkett linoleum (PVC)	391	454	30 - 40	Aromatic hydrocarbons,	HCl, CO, CO_2, $COCl_2$

The limit of fire resistance of a ferroconcrete beam-wall of a rectangular section of 600×700 mm was not less than 62 minutes. Fire class R60. The results of experimental studies in the future allowed to check the main principles of the developed calculation methods.

Tests. In order to evaluate the quality of the experiment and the reliability of the temperature distribution obtained during its conduction, it was made a computer simulation of the beam-wall in the ANSYS R17.1 software system (Fig. 1). …

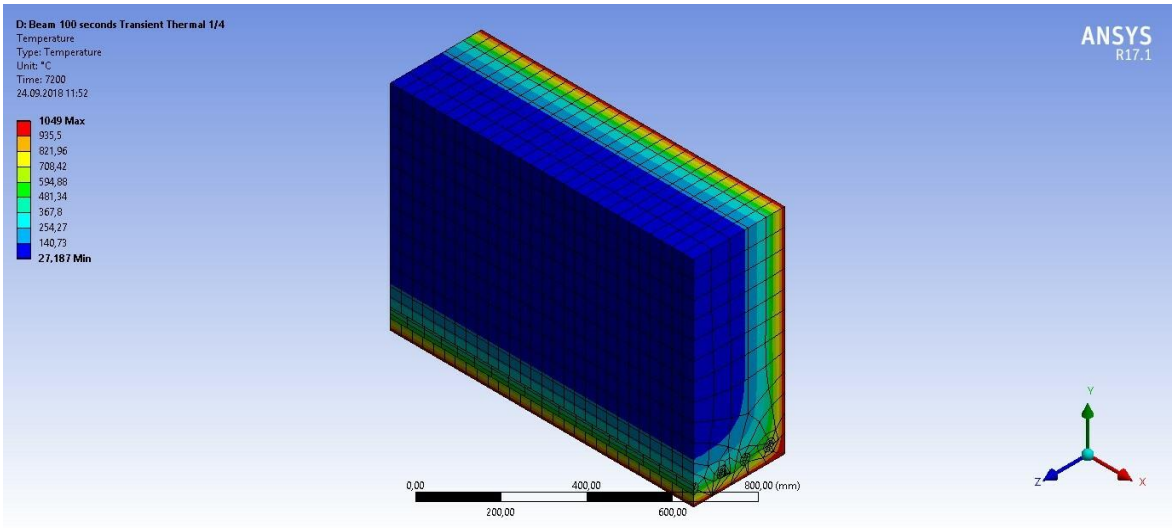

Fig. 1. Temperature distribution in the ANSYS beam-wall model. Experiment and the reliability of the temperature distribution obtained during its conduction

Two samples of the construction are subjected to the test. According to [11, 12], …
From Fig. 2 shows that the heat resistance of samples that were in the flame for 3...6 s, drops sharply by 20 %. From Fig. 3 shows that the most durable was the Ondex roofing material. However, when exposed to a flame for 3...6 s, the impact toughness of all test materials are reduced by 45-50 %. …

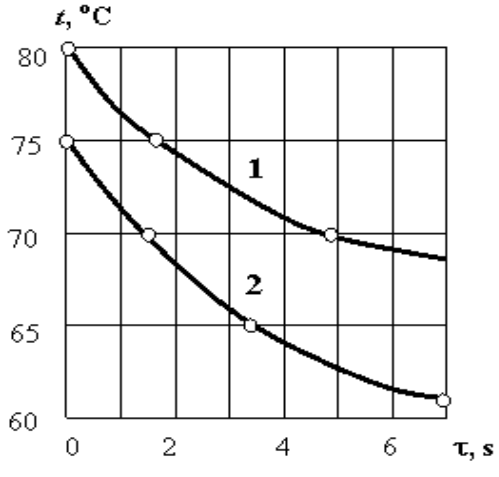

Fig. 2. The dependence of the heat resistance of PVC on the exposure time of the flame: 1 – Ondex roof; 2 – Rolvaplast panels

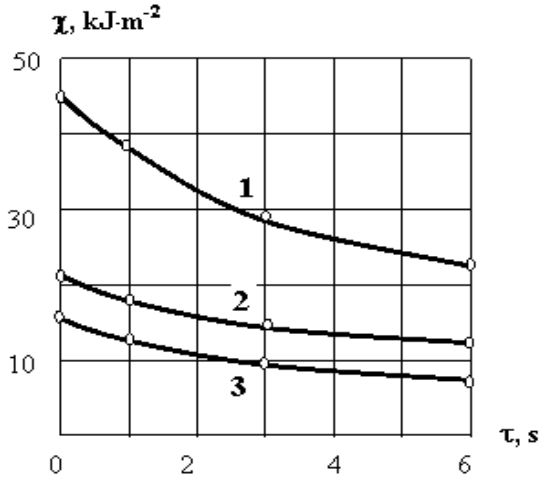

Fig. 3. The dependence of impact toughness on the exposure time of the flame: 1 – PVC-based plastics; 2 – plastics based on PFO; 3 – PC-based plastics

When determining the bending strength on the Dinstat device, only a sample of the facing tile was chosen. …

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$$c^2 = a^2 + b^2. \quad (1)$$

When solving a thermal problem, we determined the dependence of the temperature of the steel on the time of fire exposure

$$c_p \rho_p \frac{\partial \theta_p}{\partial t} = \frac{\partial}{\partial x}\left(\lambda_p \frac{\partial \theta_p}{\partial x}\right), \quad (2)$$

were Θ_g – temperature of the gas environment near the structure, ^{o}C; t – time, minutes.

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4 Conclusion

Table 1 analysis shows that the results of experimental studies of beam-wall and its numerical analysis in the ANSYS program for the first 10 minutes are quite different at all control points. However, further this difference is stabilized and, until the end of the experiment, does not exceed 10.0 %. …

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