СЕКЦІЯ: НОВІ МАТЕРІАЛИ, МІЦНІСТЬ І ДОВГОВІЧНІСТЬ ЕЛЕМЕНТІВ КОНСТРУКЦІЙ

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ОЦІНКА ВОГНЕСТІЙКОСТІ ЗАЛІЗОБЕТОННИХ СТІН ВЕРТИКАЛЬНИХ КАБЕЛЬНИХ ТУНЕЛІВ ПІД ВПЛИВОМ ТЕМПЕРАТУРНОГО РЕЖИМУ, НАБЛИЖЕНОГО ДО РЕАЛЬНОГО

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EVALUATION OF FIRE RESISTANCE OF REINFORCED CONCRETE VERTICAL CABLE TUNNEL WALLS UNDER CONDITIONS SIMILAR TO REALISTIC TEMPERATURE REGIMES

For the mathematical description of the fire temperature regime on the rising branch, it is suggested to use the formula provided below, which is a modification of the formula for the standard fire temperature regime known from the standard [1] and work [2], scaled considering the results of a full factorial experiment with conducting actual fire tests.

$$\Theta_p = 20 + 345 \frac{\Theta_{e\,max} - 20}{\Theta_{max}} lg[8t + 1], \tag{1}$$

where: $\Theta_{e\,max}$ - the maximum average volumetric temperature obtained as a result of a full factorial experiment; Θ_{max} - the scaling value of the maximum average volumetric fire temperature in formula (1) is determined by the expression:

$$\Theta_{max} = 20 + 345\, lg[8\tau_{max} + 1]. \tag{2}$$

To represent the descending branch of the fire temperature regime, the formula corresponding to the linear dependence of temperature reduction can be used [3]:

$$\Theta_c = \Theta_{e\,max} - \frac{\Theta_{e\,max} - 20}{\tau_l - \tau_{max}} (t - \tau_{max}). \tag{3}$$

where: τ_{max} and τ_l - the time to reach the maximum average volumetric temperature and the duration of the fire. These parameters are calculated using regression dependencies obtained from the results of a full factorial experiment. Figure 1 shows the fire temperature regimes obtained for different data on the design and fire load of vertical cable tunnels.

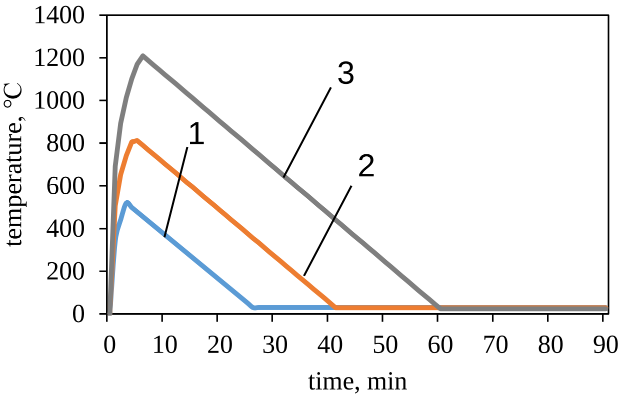

Figure. 1 - Temperature regime graphs of fires at different values of the fire load per 1 meter height of cable for constant values of the longitudinal cross-sectional area of the vertical cable tunnel S = 4.00 m^2 and horizontal air velocity component h = 6 m: 1 - m = 1 kg, 2 - m = 5 kg, 3 - m = 10 kg.

The temperature curve 2, as shown in Fig. 1, was used as the fire regime since it corresponds to the averaged characteristics of vertical cable tunnels. After conducting calculations using the Microsoft Excel spreadsheet processor, results in the form of temperature regimes, as shown in Fig. 2, were obtained.

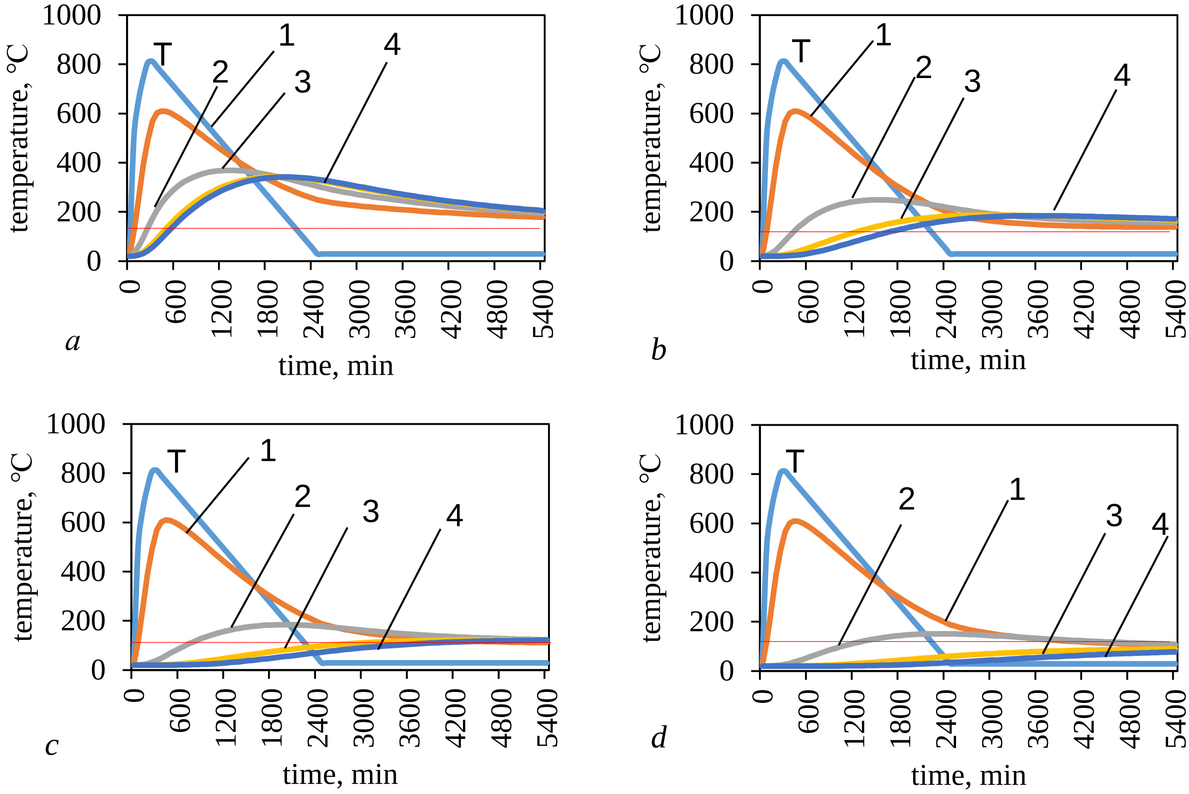

Figure. 2 - Temperature regime graphs of heating reinforced concrete barrier structures of the vertical cable tunnel at constant values of the fire load per one-meter cable height m = 5 kg, with a height of h = 6 m, and a longitudinal cross-sectional area of the vertical cable tunnel S = 4 m^2 with different thicknesses: a - 40 mm; b - 77 mm; c - 113 mm; d - 150 mm.

The analysis of the graphs in Fig. 2 shows that only the tunnel barrier walls with a thickness of 150 mm meet the requirements for all fire resistance classes EI 30, EI 45, EI 60, and EI 90. In contrast, tunnel walls with a thickness of 113 mm correspond to fire resistance classes EI 30, EI 45, and EI 60, while tunnel walls with a thickness of 77 mm only meet the fire resistance class EI 30. This demonstrates the advantages of the proposed approach as it allows for significantly higher fire resistance classes for thinner barriers.

References

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