FUNDAMENTALS OF IDENTIFYING DEFORMATIONS IN BUILDINGS CONSTRUCTED FROM METAL STRUCTURES FOLLOWING A FIRE

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Abstract. *This article provides information on the specifics of post-fire inspection of buildings made of metal structures, their sequence, and the various deformations that can occur.*

Keywords: *Metal structures, deformations, fire, surveys, assessment, calculation.*

Introduction.

The main task of a post-fire inspection is to determine the current technical condition and residual load-bearing capacity of the structure, identify damaged areas, and obtain reliable information to make technical decisions on further operation, repair, reinforcement, or replacement of the structure.

Fires have a significant impact on the strength and stability of buildings, especially those made of metal structures. High temperatures that occur during combustion change the physical and mechanical properties of the metal, causing its plastic deformation, loss of load-bearing capacity and potential risk of collapse. This article discusses methods for assessing the deformations of metal structures of buildings after a fire, analyzes the effects of thermal exposure and provides recommendations for the inspection and restoration of damaged structures.

Effects of high temperatures on metal. Metal structures are usually made of steel, which has limited heat resistance. At temperatures above 500 °C, the strength and elastic modulus of steel begin to decrease significantly. At 600–700 °C, steel loses up to 50% of its strength, and at temperatures above 1000 °C, it can almost completely lose its load-bearing capacity. In addition to temporary weakening, the metal is subject to residual deformations, especially if the load on the structure was maintained during the fire.

Main types of deformations. After a fire, the following types of deformations can be observed in metal structures:

Deflections of beams and floors caused by a decrease in rigidity at high temperatures;

Bending and warping of elements due to uneven heating;

Residual plastic deformations caused by exceeding the yield strength;

Destruction of welded and bolted joints due to thermal expansion and weakening of the material.

Methods for determining deformations. Determination of deformations after a fire is carried out in a comprehensive manner, using the following methods:

1. Visual examination

An initial inspection will reveal visible signs of deformation such as deflections, cracks, peeling of protective coatings, charring and discoloration of the metal (blue/brown tint is an indicator of high temperature).

2. Geodetic methods

By means of leveling and tacheometric surveying, deviations from the design position of elements (deflections, displacements, tilts) are determined.

3. Laser scanning and photogrammetry

Allows you to obtain an accurate 3D model of the building and identify deformations with high accuracy. Particularly effective when examining large and complex objects.

4. Metallographic analysis

Steel samples are extracted for laboratory analysis. Microstructure changes are studied and physical and mechanical properties are determined, including residual strength and hardness.

5. Non-destructive testing

Ultrasonic, magnetic and X-ray diagnostic methods allow us to assess internal defects, cracks and inhomogeneities in metal.

Classification of damage levels

Based on the results of the inspection, the structures are classified as:

- Permissible for further use (minor deformations that do not affect the load-bearing capacity);
- Requiring reinforcement or partial replacement;
- Subject to complete replacement (in case of severe irreversible deformation or loss of strength).

Recommendations for recovery

- Mandatory heat treatment of deformed elements if restoration is possible;
- Reinforcement of steel elements with additional profiles or clamps;
- Replacement of damaged components and connections;
- Conducting repeated stability calculations taking into account residual deformations.

Conclusion. Assessing the deformation of metal structures after a fire is a key stage in ensuring the safety of further operation of the building. Modern survey methods allow us to accurately determine the nature and extent of damage. Based on this data, an informed decision is made on the restoration, reinforcement or dismantling of damaged structures.

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