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Zaporozhye State Engineering Academy, Zaporozhye

FORECASTING OF THE INTENSE - DEFORMED CONDITIONS OF BUILDINGS AT THEIR RECONSTRUCTION

In this article results of inspection and numerical experiment connected with definition of intense-deformed conditions of constructive elements of frameless buildings after its partial reconstruction and repair, an opportunity of forecasting of the further work of buildings and the constructions maintained in complex earth conditions. Settlement models of interaction of buildings with non-uniformly deformable bases are analyzed.

Numerical experiment has consisted in an estimation and the analysis of intense - deformed conditions (IDC) of designs frameless building undergoing influence of non-uniformly deformable basis. Works on inspection of a technical condition of a building of a hostel of Hydropower technical school of the Zaporozhye state engineering academy (HTS ZSEA) have been carried out.

The purpose of work was, that on the basis of the carried out works on measurements and inspection, the analysis of engineering - geological conditions of a platform, actual high-altitude position of building constructions and verifying calculations to define the IDC of designs and elements of a building, to analyse a technical condition and bearing ability of building constructions of a building of hostel HTS ZSEA and to compare these data for conformity of settlement model to physical object, and also to make the forecast of change of the IDC of elements of a building in case of the further development of sink deformations.

For achievement of this purpose the following works have been executed:

- Engineering - geological conditions of a platform are analysed;
- Bearing{Carrying} and protecting constructions of a building are surveyed;
- Are executed strength calculations in view of re-planning premises as a result of reconstruction;
- Reliability of the basic bearing constructions is determined;
- Comparison of results of strength calculations with the actual IDC of constructions of a building is made;
- Strength calculations on predicted deposits of the basis of a building are executed.

Thus materials of the design documentation on reconstruction of a building of a hostel, inspection of a condition of the basis and the conclusion about results of fastening of soil are used.

The building of a hostel - five-floor, frameless, brick, with longitudinal bearing walls, was constructed in 1967 on standard project I-300-II of Glavstroiproect, rectangular in the plan, with the sizes in axes 71.9 x 12.6 m. The building has the temperature seam dividing{sharing} left (east) wing of a building in length of 19.9 m (in axes) and right - 51.8 m (fig. 1). The building has been maintained since 1967.

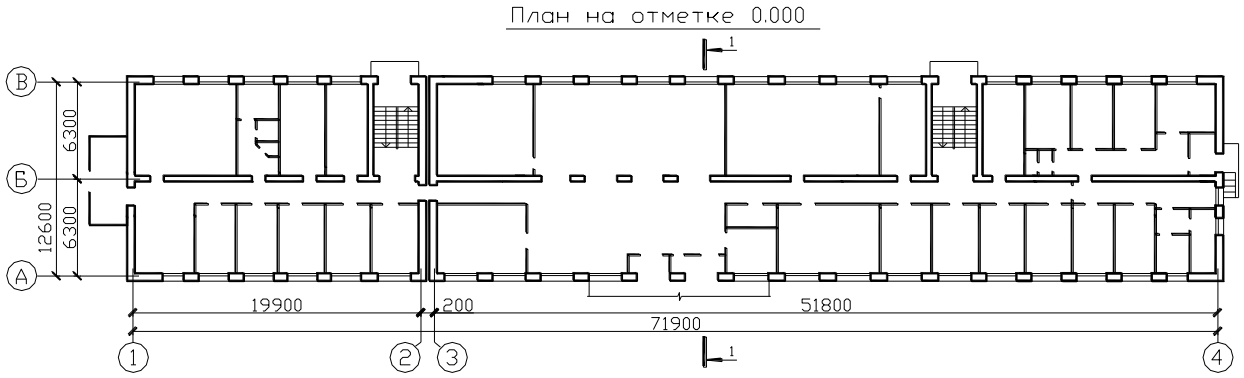


Fig. 1.

At reconstruction of a building under the project of the special design office " Zaporozhhydrostal " in 1990 re-planning of internal premises has been made. For the period of operation the building was exposed to deformation influences of sink soils of the bases that has led to the damages of walls and partitions, disclosing of a temperature seam and a roll of a part of a building. In this connection engineering - geological researches on a platform of building with definition of physical and mechanical properties of soils of the bases have been carried out and the way of fastening of the basis is chosen. In 1993 fastening of soils by electrothermal way under a part of a building in axes 1 … 2, which received a roll, was lead.

For definition of the deformed condition of a building determination of high-altitude position of the bases of a building by a method of levelling on the fixed points of a building is lead{carried out}.

The greatest relative settlings take place on the face sides of a building and make on an axis 1 - 195 … 345 mm, on an axis 4 - 252 … 364 mm. On character of deformation in a longitudinal direction the building has received a curve with maximal arrow of a curve on a number A - 223.5 mm, on a number B - 212.5 mm (accordingly, relative curves - 0.0031 on a number A and 0.0029 on a number B, that in 3.1 … 2.9 times exceed maximum permissible norms value 0.001).

Non-uniformity of the settling of the next bases reaches the greatest value on a number B in axes 1 … 2 and makes 0.0132. On relative non-uniformity the settling of the next bases the received values exceed extremely admitted norms 0.002 at 1.35 … 6.60 times in more than 63 % from total of the measured points.

In a cross-section direction the building has received non-uniform settlings from 0.006 up to 0.0119, that in 3 … 5.95 times exceeds the values admitted by norms.

The width of disclosing of cracks makes in the base on a number A 80 … 130 mm, in the base on a number B - 7 … 60 mm (see fig. 3). Development of cracks - from below upwards, that confirms deformation of a building in a longitudinal direction under the form "curve". Such deformation has led to disclosing of a temperature seam from below upwards on all longitudinal walls of a building. The width of disclosing has made: on mark +/-0.000 m - 4 … 6 sm, at parapet plates - ~ 60 … 80 sm (fig. 2).

Fig. 2.

The basic kind of damages to external walls is formation of vertical and inclined cracks in width of disclosing 1 … 10 mm (fig. 3).

Fig. 3.

Taking into account, that as a result of non-uniform settling of the bases, caused by sink of soils of the basis, a building has received deformations as a curve and a roll, verifying calculations for revealing the IDC of the basic constructive elements have been made.

For finding-out of the condition of constructions of a building current tensely - deformed calculation of spatial model of a building on influence sink deformations is executed. Thus with the maximal detail it was taken into account as the constructive circuit of a building (physicomechanical characteristics of materials of constructions, interface of elements, apertures in bearing walls, presence of a temperature seam, etc.), and force and deformation influences on a building.

Calculation is executed with use of a program complex "LYRE - WINDOWS" of version 5.03. The settlement model of a building is made of final elements in the size 0.5*0.5 by m. Because of the big dimension of a problem{task} the superelement approach of a method of final elements is used. Blocks of final elements in the size of 3.0 * 3.0 m are incorporated into superelements , 22 kinds of superelements are used. The settlement model of a building of a hostel is resulted on fig. 4.

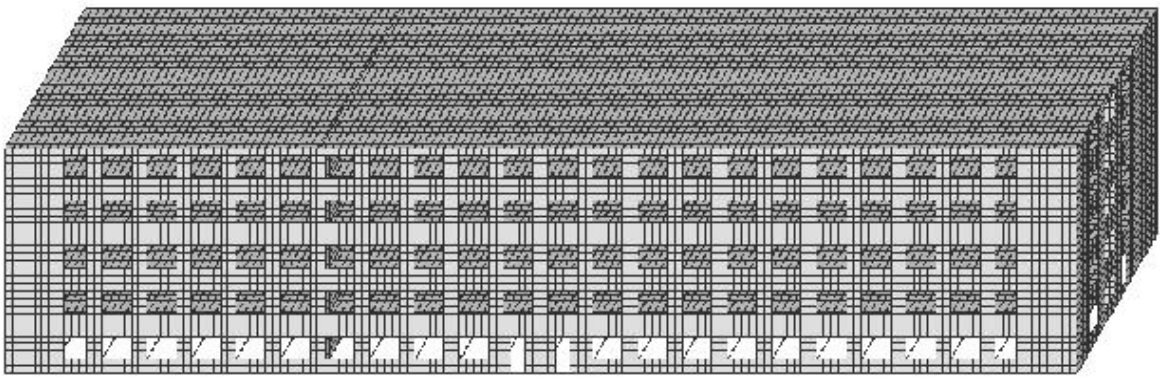
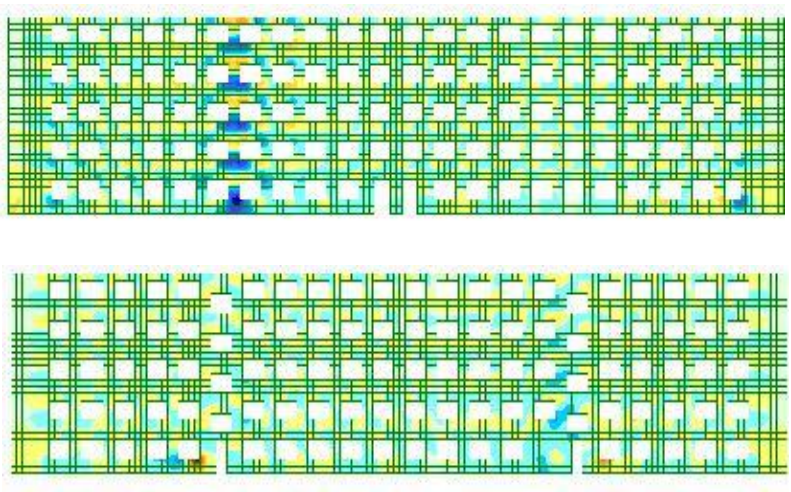


Fig. 4.

Settlings of the basis were modelled by displacement of the fixed points of a bottom of settlement model according to results of levelling of a socle of a building. As a result of the analysis of results of the calculation, received for external walls, zones of the maximal pressure which have coincided with zones of the maximal deformations in brick walls of a building are revealed (see fig. 5), that speaks about correctness of the chosen settlement model and its adequacy to real object. In figures it is visible, that the most loaded are sites of walls about a temperature seam, a site with the incorporated window, a site of top of a wall, and also angular sites of apertures and piers in zones of staircases. Efforts in these elements of a brick wall reach 1700 t/m2, that exceeds bearing ability of a bricklaying and, accordingly, causes their destruction. In an internal bearing wall there is a loading less than a dangerous limit except for the zones adjoining to a temperature seam and staircases.



Above the calculation of a building on actual deposits, calculation on expected sink deformations, determined earlier, in the assumption of the further development of revealed sink craters is executed By a Fig. 5.

As the results of calculation show, in case of the further increase of sink deformations, in view of an arrangement of the formed craters, it is possible to predict formation of through cracks in piers, increase of width of their disclosing, and at the further increase in a curve and a roll of a building – possible destruction of piers of a ground floor at ladder marches, an eaves at a temperature seam, and also angular sites of apertures of a ground floor in face walls.

Thus, results of detailed inspection of buildings and constructions can form a basis for formation of adequate settlement models and statement of numerical experiments. Thus criterion of adequacy of settlement model is concurrence of a picture of the IDC of real object and received as a result of calculation. Carrying out of the numerical experiments basing detailed spatial settlement models of buildings and constructions, enables not only to define the actual IDC of constructions, but also to make the forecast of its change at the further operation or at reconstruction.