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INFLUENCE OF NEW APERTURES AND ELEMENTS OF  
AMPLIFICATION{STRENGTHENING} ON INTENSE – DEFORMED CONDITION OF  
ELEMENTS OF BUILDINGS AT THEIR RECONSTRUCTION

In article results of numerical researches of tensely - deformed conditions of external and internal bearing walls of a building after its partial reconstruction with the device of new apertures in internal walls and strengthening of piers and existing apertures in external walls are analyzed.

The volumes of reconstruction which have increased recently and re-planning of residential buildings with change of purpose of maintained premises demand the considered approach to the analysis tensely - deformed conditions (IDC) of constructive elements of these buildings, that considerably increases required amount of calculations. In case of influence on a building of non-uniform deformations of the basis under complex earth conditions, the responsible design decisions supported by numerical researches of change of the IDC of bearing elements of a building at their reconstruction are required. Thus not always there is an opportunity of calculation of all building on detailed spatial model, taking into account besides, that such calculations considerably increase cost of designing.

With the purpose of simplification of carried out calculations in Zaporozhye State Engineering Academy (ZSEA) researches are lead and recommendations on drawing up of the simplified settlement models of frameless buildings and their elements are developed. Thus influence of the accepted simplifications and changes of various parameters of settlement models on IDC of bearing elements of so-called "buildings - representatives" which are characteristic buildings under constructive characteristics, time of construction, to conditions and features of operation among the most widespread series or types was investigated.

As an example of object of researches we shall result five-floor brick block of flats with constructive decisions, characteristic for residential buildings of the period up to mass prefabrication constructions (fig. 1).

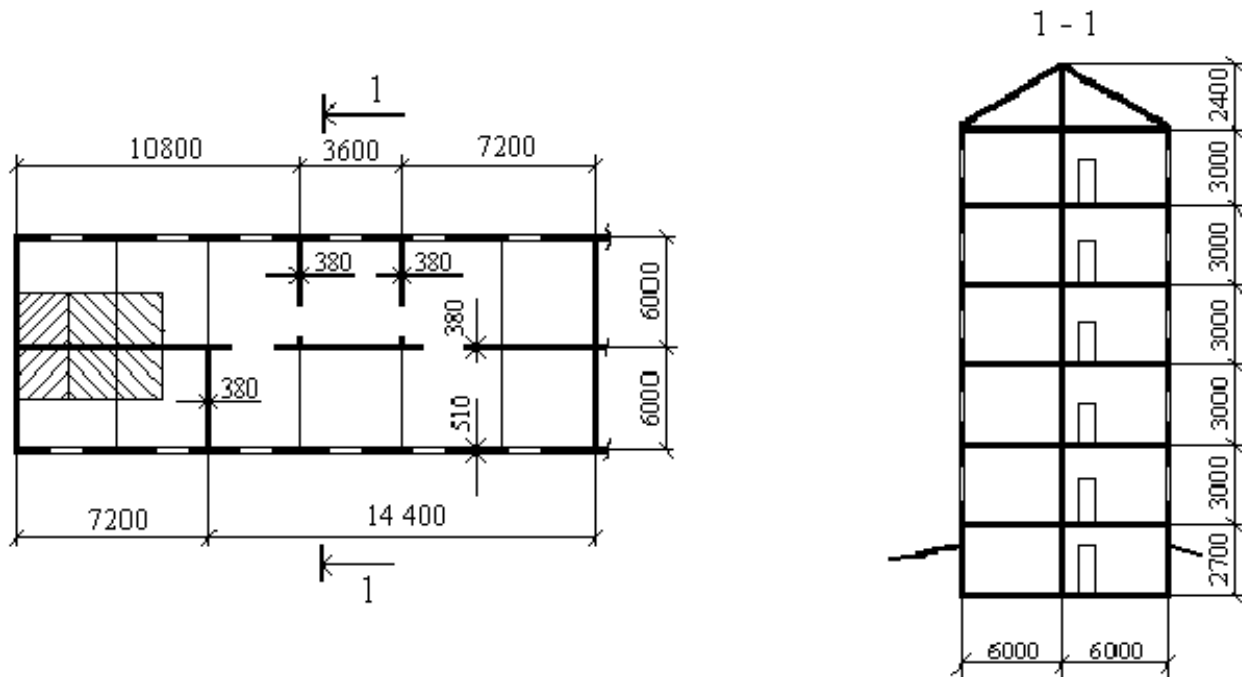


Fig. 1. The circuit of the plan and a cut of a part of the building - representative

For a material of bearing walls of the given building - representative value of the module of deformations was accepted equal to 915 MPa, that corresponds to its average value from the apartment houses of this type received at inspections. Calculations were carried out on the combination of loadings including, according to Norms, a body weight of elements of the building, the useful in regular intervals distributed loading and loading from a snow with corresponding factors of reliability on loading. Thus constant loadings have been accepted proceeding from the constructive decisions revealed during inspection of apartment houses of this type. Wind loading was taken into account simultaneously from two sides of a house as active and passive pressure.

Numerical researches were carried out by a program complex the "LYRE - WINDOWS", realizing MFE. As a result of the carried out researches influence of various factors, such as quantity of overlying floors, the account of cross-section walls, overlappings, cross-pieces above the apertures, the size of used FE, the longitudinal size of a fragment of a wall considered, elements of strengthening, non-uniform settling of the basis, defects of bearing elements, has been established for values of characteristics of the IDC of overlappings of calculations, external and internal walls received as a result.

Using the developed technique, the proved simplified calculations of elements of buildings now are carried out at their reconstruction, strengthening, punching holes of new apertures and

closing up those ones existing earlier. Thus calculations are carried out in two stages: before strengthening - in view of existing defects (through cracks in bearing elements, split-offs with the area more than 15 % of the area of section of an element, etc.), and after strengthening- in view of liquidation of defects (injecting of cracks of astringently-glutinous structure, restoration of split-offs).

As an example we shall consider influence of elements of strengthening of a pier with a crack between the apertures of a ground floor framed by a rigid contour on the IDC of an external wall of a building. The crack was modelled by exception of final elements (fig. 2).

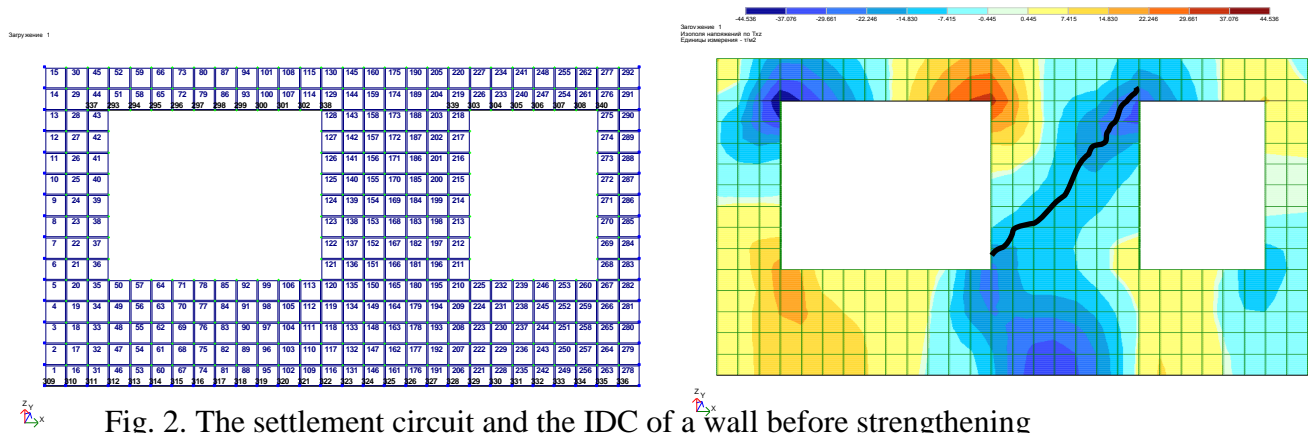


Fig. 2. The settlement circuit and the IDC of a wall before strengthening

At the analysis of results of calculations it has been established, that overwhelming majority of FE undergoes compressing pressure. Thus the maximal values are marked at normal pressure on a direction of a vertical axis, and in majority of FE they considerably exceed values of other pressure. Besides it is established, that approach of a limiting condition in some elements of a wall at reconstruction has been caused by excess of limiting values by pressure of compression. An arrangement of the maximal shifting efforts at the account of deformations of the basis coincide with an arrangement of a crack in a pier that speaks about adequacy of used settlement model.

At introduction of elements of strengthening and increase in an aperture into the settlement model character of distribution of the IDC of a wall changes, and efforts in a bricklaying of a pier increase in 2.2 ... 2.8 times (fig. 3).

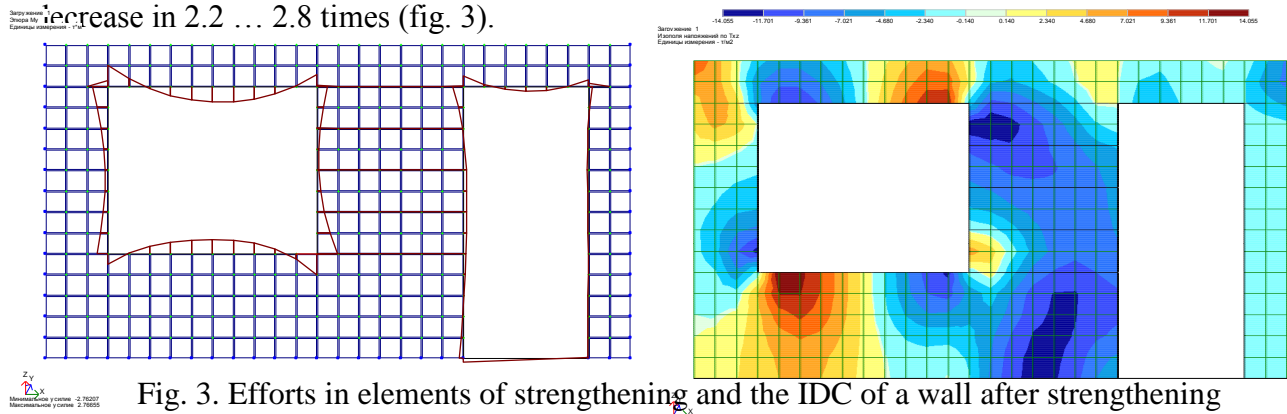


Fig. 3. Efforts in elements of strengthening and the IDC of a wall after strengthening

Similar calculations have been executed while making a new aperture in an internal wall of a ground floor of the same part of a building. Thus a wall was strengthened by an arch element above an aperture. The IDC of an internal wall before making of an aperture was basically characterized by the compressing pressure far from limiting values for a bricklaying. After making of an aperture character of distribution of the IDC of a wall has changed, pressure of compression in a place of fastening to a wall of an arch element of strengthening (fig. 4) have appeared.

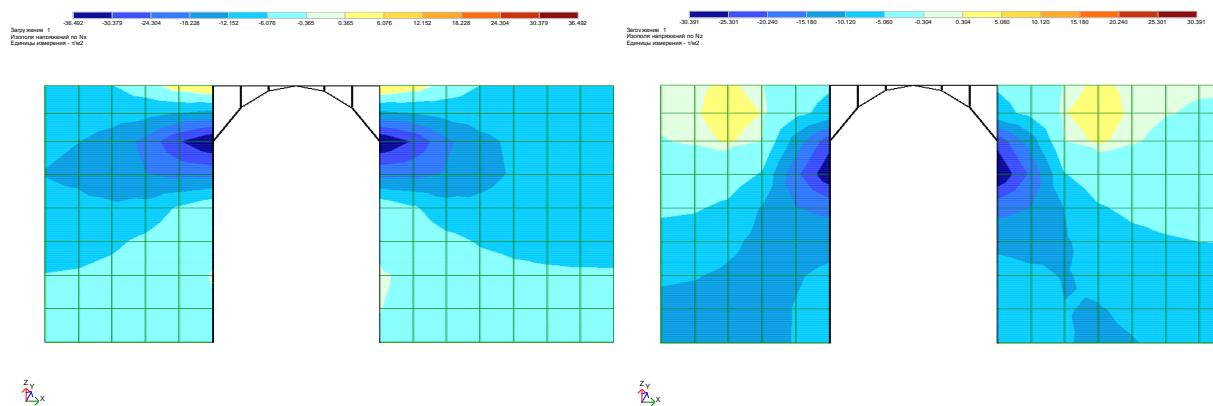


Fig. 4. IDC of an internal wall after making of an aperture

For defining the actual deformations of elements of the wall caused by increase of an aperture in an external wall and making of an aperture in internal, and their comparison to settlement values, received according to an offered technique, natural experiments and additional comparative calculations have been carried out. At vertical sides of prospective apertures pairs of angles, anchored in preliminary drilled apertures, average distance between which made 400 mm, have been established. Measurements of deformations were carried out by standard portable indicators of clock-work type with the value of division of 0,001 mm and a limit of measurements 0 ... 4 mm, corresponding to requirements of State Standard 9696-82. For initial readout distances between angles, measured before expansion of an aperture, and for final - distances between angles, measured through 14 days after expansion of an aperture, after stabilization of deformations were accepted. Thus with the help of the comparator influence of temperature deformations was taken into account.

The size of a deviation concerning settlement values has made from 11.5 up to 17.6 %. The maximal deviations in a range from 15.7 up to 17.6 % are marked as a result of the researches spent at the device of a new aperture in an internal wall. At the analysis of results of calculations pressure of compression along a vertical axis of some sites of the wall adjoining to a prospective aperture

have been established. This pressure has exceeded maximum permissible values that has caused of strengthening of a wall by metal elements. Thus calculation with inclusion in the settlement circuit of a wall of elements of strengthening has been executed in addition . The maximal deviation between the values of relative deformations received as a result of calculation by the offered technique, and experimental values, has made 17,6 % at an average deviation on all measurements of 11,2 %.

Settlement values of relative deformations in the same FE walls in all cases exceed the values received as a result of natural experiments. These deviations, obviously, are caused by overestimate of settlement values of the useful in regular intervals distributed loading accepted on norms, obviously exceeding actual values. Besides at strengthening of a wall probably additional divergence due to discrepancy of actual and settlement influence of elements of strengthening on change of the IDC of a wall.

Generalizing results of the resulted researches, it is possible to draw the following conclusions:

1. At performance of reconstruction of buildings with change of constructive characteristics and purposes of premises, it is especial in conditions of non-uniform deformations of the basis, detailed calculation is necessary for definition of the authentic IDC of elements of a building after reconstruction.
2. Taking into account complexity of spatial calculations, carrying out of numerical researches on settlement models of so-called "buildings - representatives" of typical series or groups of constructions is expedient with the purpose of the subsequent simplification of settlement models for engineering calculations.
3. Use of an offered technique allows at smaller expenses for preparation and calculation of models to receive an authentic picture of the IDC of elements of buildings at their reconstruction.