Organization of restoration and repair works

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Abstract. Housing stock and the objects of industrial production of our country are represented by constructions, which were erected in the XX century, XIX century and pre-revolutionary time. Among them there are constructions built with using of natural stone and brick. The service time of this constructions is several decades or hundreds of years. Considerable amount of this value are constructions of the first industrial generation and objects of cultural heritage under the state protection. Nowadays, because of untimely overhaul and restoration, it is very complicated to bring masonry cultural heritage objects in normal technical state, accounting the negative effect of natural climatic factors. Monitoring of technical state of this objects is quite important for timely carrying out the overhaul, restoration and reconstruction. This government-controlled task has actual significance. Preservation of this objects in good technical state is important in general for the Russian Federation. Domestic researchers developed effective method for the monitoring of technical state of masonry architecture structures. It takes to the account the main natural climatic factors as the influence of solar radiation, wind load, freezing and defrosting of building materials. This article describes a method which considers the restoration works on the example of brick building according to order of Moscow City department of non-residential premises is given to AK "Mosagropromstroy". The restoration works is made with preliminary deterioration assessment.

1 Introduction

The issue of overhaul and restoration of masonry constructions, which main load-carrying and enclosing structures made from stone or brick masonry has centuries-old history.
Publications and papers of by P.P. Oleynik, V.A. Chulkov, A.A. Lapidus , V.I. Telichenko , V.N. Kabanov , M.A. Fakhratov, M.N. Ershov, T.K. Kuz'mina, V.E. Bazanov, A.G. Tamrazyan, O.A. Simakov, S.I. Ekba et al. [1-6] in MGSU were dedicated to the issues of construction production, issues of technology and organization of special works, including restoration.

The research of ecological and geoecological issues, the theory basics of the engineering, the methods of construction calculation, systems engineering, structural mechanics, the architecture of residential and public buildings, heat insulation and acoustic insulation materials, masonry and reinforced masonry structures, engineering survey, assessment of natural and natural-technogenic processes, architectural design in building complex of Russia is conducted by V.A. Kucherenko, A.A. Gvozdev, B.G. Skromtaev, V.I. Svetlichnyy, B.G.

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For building recovering it is necessary to carry out a complex of repair and restoration works, namely:

- strengthening of the foundations along the perimeter of the building;
- repairing the white stone basement along the perimeter of Southern, Eastern and a part of the Northern housing of the building;
- brickwork restoration with partial replacement of spans of walls and storey;
- replacement of the wood ceilings to new one (on three storey of Southern and Eastern housings);
- front elevation recovering of the Southern, Eastern and Northern housing of the building;
- constructing roofing from galvanized iron and glazing;
- repairing galleries with construction of the fencing and glazing;
- replacement internal and external engineering services, conversion of electrical voltage in building from 127 to 220 Volts and replacement of the equipment in city transforming station, installation of new transformators, re-laying of 2.8 km long external power supply networks in micro-district;
- partial accomplishment of courtyard;
- construction of the blind area and asphalt surface along the perimeter of Southern and Eastern housings of the building.

Fig. 1. General view of the brickwork of the external walls.

2 Materials and methods

Choosing of rational ways and methods of repair and restoring works implementation as in Russia so in developed foreign countries connected with the preliminary survey of the object [4, 6, 8, 9]. The first step of the works is visual survey with fixing of all types of violations of the normal technical condition of building materials and structures.

The next step of surveying is connected with the application of destructive and non-destructive methods of assessment of technical characteristics which based on using of instruments and devices certified or considered in GOST.

As a one of the typical examples of rational organization and technology of building object surveying with load-bearing and enclosing structures from bricks was chosen the building in Moscow, which has lost its architectural attraction and become obsolescent as a result of many years of operating.

Part of the building with an area of 2221 sq. m, due to order of the Moscow city department of non-residential premises, was leased out to AK "Mosagropromstroy", who carried out the works using design and budget documentation developed by the Institute "Spetsproektrestavratsiya" and own expense.

The most expensive and laborious process was restoration of the eastern housing of the building because of the foundation, walls, ceilings and roof recovering.

The building was partially operated while the restoration.

3 Results of the research

3.1 Sounding of the external walls

Sounding in restoration is the limited disclosure of the coating, which covers up the masonry. It is produced to solve local research task. Depending of the producing way and level of introduction in the structure of architectural monument, sounding is divided into:

— sounding of paint coating;
— sounding with removing of plaster or wood boarding;
— sounding with the masonry removing and etc.

In this case, all three types of sounding were used in the northern part of the building (Fig. 2).

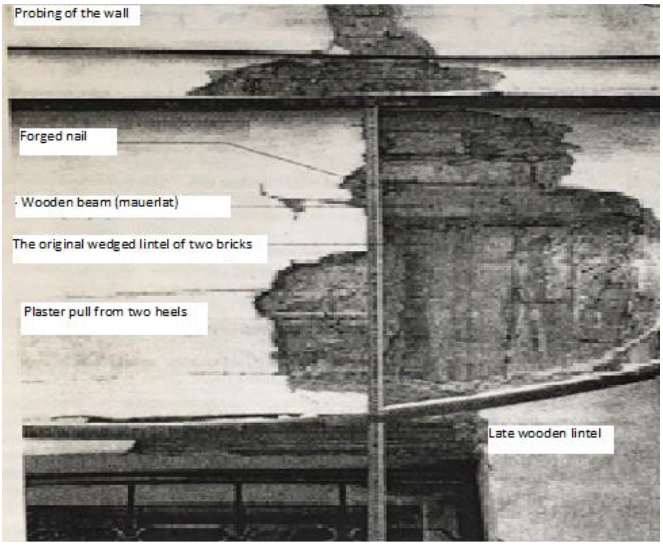

Fig. 2. Example of sounding.

There wasn't necessity of top coating removing in southern and eastern parts of the building, because brickwork there was in open form (Fig. 1). The condition of walls in

southern, northern and eastern parts of the building varied so it was important to assess the level of walls deterioration.

3.2 The assessment of walls deterioration level

The level of masonry walls deterioration is assess by the closing of the load-bearing capability. It, conditionally, is divided into low, medium and high.

Low deterioration (less 15%) is caused by the defrosting, weathering and fire damages of walls material to depth no more than 5 mm, vertical and oblique cracks, crossing no more than two masonry rows (Fig. 3).

Fig. 3. Example of masonry destruction.

Medium deterioration (up to 25%) is caused by the defrosting and weathering of masonry, detachment of coating to depth up to 25% of thickness, fire damages of wall materials to depth up to 20 mm, vertical and oblique cracks, crossing no more than four masonry rows, slope and bulging of the walls within the storey no more than 1/5 of wall thickness, vertical and oblique cracks appearance in the places of longitudinal and lateral wall connections, local masonry violations under the beam and window lintel bearings, displacing of ceiling plates no more than 20 mm.

High deterioration (up to 50%) is the result of walls collapse, defrosting and weathering of masonry up to 40% of its thickness, fire damages of wall materials up to 60 mm in depth, vertical and oblique cracks (despite the temperature and sedimentary cracks), crossing no more than eight masonry rows, slope and bulging of the walls within the storey to 1/3 of wall height, displacing of walls and pillars along the horizontal brick joints or oblique indents, losing connection between longitudinal and lateral walls, masonry damages under the beam and window lintel bearings more than 20 mm in depth, displacing of ceiling plates in pillar places more than 1/5 of bearing depth [2, 4, 5, 7, 10, 11].

Walls are considered as destructed, when they lost more than 50% of its strength. The most part of the walls had low and medium deterioration level. But also there was high level deterioration areas (eastern housing of the building), where walls were had to be re-laid partially.

3.3 The Sequence of wall recovery and strengthening works

Repair and wall strengthening includes:

—re-laying of wall sections;
—crack repairing;
—strengthening of the masonry by the way of injection;
—repairing and strengthening of the window lintels;
—strengthening of the pillars and piers;
—providing the spatial rigidity of the constructions.

The walls were fully cleared from the old covering, bricks, which were weakly connected – are fixed by the way of pouring the solution in cracks. Highly damaged elements were extracted using the hammer and chisel and replaced using the solution to new one, which are similar in color and texture. Replacement of dropped out and weakened stones were held from top to bottom direction. The disordered stones in old brickwork were extracted and replaced to new ones, the solution was removed about 0,5 in depth by the chisel and angle grinder, the cracks were occluded by the troweling.

Some sections of the eastern housing of the building had to be re-laid. At the same time, measures were taken to ensure the safety and stability of position of overlying wall areas and structures, which are supported by them. While the disassembling of old masonry, works were carried out from top to bottom. And while the carrying out the new masonry—from bottom to top. The disassembling of old masonry and carrying out the new one starts after the installation of temporary fastenings, which remains for the whole time of the works. For the replacement of narrow piers (up to 1 m), temporary fastenings are made from single pillars, which are rested on the bottom of window openings or doorways and supports the elements of lintels. For the replacement of wide piers (more than 1 m), temporary fastenings are made from double pillars, which installed on both sides of the opening. While the installing of the temporary fastenings, tight adjoin of the top and bottom of the pillars, as well as the including them into work with help of wedges should be ensured. In especially crucial cases, the inclusion of temporary fasteners pillars to the work is controlled by the measuring of pillar deformation in the process of tamping the wedges. Unloaded beams used for the unloading of the distorted section, which are disposing on both sides of the wall into previously punched ruts. First of all, the beam is brought to the most weakened side of the wall. For this, a rut should be marked and punched in the wall. The rut height must be 40...60 mm higher than the height of the unloading beam. Next, the platform supporting the beam on the masonry is prepared. It should be at least 250 mm. After that, the beam is installed. The gap between the upper surface of the beam and the masonry is filling with a hard cement mortar.

On the other side of the wall, these operations are performed after 2 ... 3 days after the first beam installation and fixation. Simultaneous re-laying of walls in several tiers vertically and access of people to the underlying premises is forbidden. The sizes of stones used for repairing should correspond to the sizes of stones of the repaired masonry. They should be close in their physical and mechanical properties. For the construction of new piers, materials such as brick and concrete are used.

4 Discussion

The results of surveying, analysis of laboratory and in-situ researches had great importance for the further repair and restoring works, which became the basis for the conclusions and rational and economically sound recommendations.

The issue of a specific overhaul and restoration of constructions, with main load-bearing and enclosing structures made by brickwork, despite of centuries-old history and practical results, has its own nuances in each specific cases because architectural and constructional solutions of building materials depends on operating conditions and regional conditions [2, 4, 7, 9].

The issue of repair and restoration works, especially in the unique buildings and structures, has considerable difficulties and should be solved with the usage of annually appearing instruments and equipment for an objective assessment of the technical condition of building structures of a particular restoration object.

5 Conclusions

1.Methodological recommendations and results, which were got on the object, are recommended to usage based on analysis of natural climatic conditions, time and quality of operation.

2.During the overhaul and restoration of cultural heritage sites protected by the state, investors, developers and contractors should develop and use individual repair and restoration projects.

3.Organizational technical documentation for the works production in work execution programme, flowsheet of operational sequence, regulations should be developed accounting the requirements of standard documentation and local conditions.

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