

SOME ASPECTS OF ANTISEISMIC STRENGTHENING IMPLEMENTATION FOR HISTORICAL BUILDINGS IN TASHKENT

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SUMMARY

In difference from buildings of mass scale construction, the reinforcement of buildings presenting architectural-historical value connected with limitations and specific constraints. In Tashkent were implemented rehabilitation and reinforcement of few buildings, constructed more than 50 years ago – hotels, restaurants. The main condition is the necessity to preserve exterior view of building or some internal historical elements. At the first time were developed methods of provision of seismic safety of buildings with minimal impact to architecture of building and use of traditional construction materials.

INTRODUCTION

Antiseismic strengthening of historical buildings differs from approaches used for traditional constructive systems by some limitations due to necessity to preserve exterior view of building or some internal historical elements.

In the paper are presented results obtained during implementation of rehabilitation and strengthening of some old buildings of Tashkent city (50-70 years old): Hotel "Tashkent',

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concert hall "Bakhor' and restaurant –cafe buildings. Historical heritage is presented by elements of oriental architecture and existence of ornaments interior. The buildings were designed for seismic intensity 7-8 MSK scale units. At present buildings site design intensity is 9. Buildings were exposed to soil subsidence due to unproper exploitation and watering of foundation soils and experienced earthquakes with M up to 5.3. Construction materials used are bricks with internal bearing RC frame. For the hotel Tashkent building most important is preservation of exterior, while for others is interior – gypsum ornaments, planning, decorative paintings.

Building of hotel "Tashkent".

As a construction the building of hotel 'Tashkent' consists of 5 objects, separated by deformation junctions. Main part of building has 6 storey, including technical floor and roof used as restaurant. Other parts are 4 storey. Buildings were designed as combined construction. External walls are masonry with vertical RC inclusions with step 4m. Internal bearing elements are columns with cross-bars in longitudinal direction. Ceilings are ribbed reinforced concrete plates with bottom flange, supported at longitudinal walls and cross-bars by beam scheme. Part of ceilings are assembled, other part are monolith. In fig. 1 is presented general view of hotel "Tashkent". In some cross-sections of building in transversal direction of axes there are RC shear walls with wire mesh reinforcement. Shear walls by the height discontinuous for example at level of first floor. The walls of first floor are sparse with purpose to provide freedom for planning. Partition walls with thickness 20 cm from slag blocks are bearing; they have horizontal reinforcing fabric and vertical RC inclusions, connected with ceilings and vertical bearing elements. Foundation under columns is monolith RC and under external walls - strip RC or rubble concrete. The height of underground floor is 2.6m, first floor – 4.6m, typical floors -3.3m, technical floor -2 m. step of columns -4m. Technical inspection showed the state of building: compression strength of columns concrete is varied between 100-200kg/cm²; normal cohesion of brick with mortar -0.6 - 0.9 kg/cm² that is less than minimal requested by building codes (1.2 kg/cm^2) . In some cross sections the vertical inclusion are absent. According to acting building codes in earthquake prone areas permitted to construct buildings with discontinuous frame such as hotel "Tashkent" only in regions with expected intensity 7 with height not higher than 3 floors. By conditions of customer request we are not permitted to provide reinforcement from external side.



Fig. 1 General view of hotel Tashkent building under reinforcement.

Based on results of our preliminary investigations and our calculation for earthquake impact we have had tasks as following:

- to increase design earthquake resistance up to 9 MSK intensity units;

- to decrease negative influence of existing flexible floor;

- to equalize main own resonance frequencies of building in orthogonal direction, which are differ in 2 times;

- to increase rigidity of ceiling slabs discs;

- to develop measures to reduce soil subsidence and strengthen foundations.

Following methods of reinforcement and rehabilitation were adopted for hotel "Tashkent" building:

The walls were reinforced by plastering by cement mortar grade M100 by reinforcing fabric from internal side; to provide better cohesion of mortar layer used reinforced connectors in the walls; reinforcing fabrics anchored in walls by inclined on angle 30-45 ° steel bars with diameter 8mm driven into holes with diameter 7mm (fig.2).



Fig.2 Reinforcement of wall by reinforcing fabric.

Window and door openings were framed by reinforcing bars with anchoring in the walls. Reinforcing by the building height is continuous – parts of wall within ceiling were framed by short steel bars. Reinforcing fabric in underground part anchored into foundation and in upper floor to the ceiling.

Columns in underground and first flexible floor covered by concrete jacket which anchored in underground floor to monolith foundation, at first floor to newly implemented monolith RC spanner (fig.3). Columns of other floor reinforced by angle bars with following plastering by reinforcing fabric.



Fig.3 Columns covered by concrete jacket

For increasing of rigidity of ceiling slabs discs were used monolith RC slabs by metal platform with anchoring in ribs of existing ceiling and also by perimeter of walls.

For reinforcement of foundation at level of underground floor was implemented ribbed monolith RC curtain with anchoring in existing walls and columns. It permitted two times decrease pressure to the ground.

Heavy slag block partition walls were substituted for asbestos board; some partition walls changed to shear walls;

Water carrying systems with purpose of effective control for leakage were moved to level of top floor of underground;

Existing cracks in the walls were injected by polymer cement mortar and plastered by reinforcing fabric.

Any of reinforcement measures not reached the external edge of the walls. Every type of reinforcement has original details, different from traditional.

Buildings of restaurant café and concert hall "Bahor".

Customer requested to preserve interior of buildings, decorated by gypsum modeling and painting. Technical inspection showed the state of building materials less than minimal requested by building codes. With purpose to provide spatial rigidity of existing construction were implemented following technical solutions:

By perimeter of external walls were used metal or RC applications, presenting horizontal and vertical bars with discrete reinforced connectors with bearing walls. For provision of ties with existing walls the elements of joints have free ends in internal walls. Vertical cross - bars were anchored in foundation, and by perimeter of building were connected by metal insertion pieces (fig.4).



Fig.4 Building of concert hall "Bahor" under reinforcement.

CONCLUSION

Seismic response calculations were provided by spectral method and also using real and synthetic accelerograms of expected earthquakes with probabilistic recurrence and intensity parameters. Elasto-plastic deformations of reinforcement constructive elements were maximally taken into account. Results of calculation confirmed high efficiency of implemented reinforcement.

As a result of implementation of rehabilitation works were developed recommendations, album of technical solutions and produced educational video, created in process of strengthening works on mentioned above objects.

Technical –economical calculations established that cost of antiseismic reinforcement of building not exceed 10-20 % of new construction.