CIVIL AND ENVIRONMENTAL ENGINEERING REPORTS

No. 9 2012

TECHNICAL MISHANDLES OCCURRING IN BUILDING RENOVATION AND MODERNIZATION

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The paper presents current technical requirements related to adaptations, extentions and modernizations of building facilities according to the binding legal and technical documents. It also presents the technical reasons that affect the reliability and durability of repairs and modernizations which occur at the designing and the execution stages. The most common errors and deviations from the accepted principles are listed. At the end, some examples from the practice both in design and in execution are discussed, referring to all types of buildings. Also some proposals were formulated. They related to the elimination of technical errors and improvement of the quality of realized repairs, strengthening and modernizations.

Keywords: repairs, refurbishments, modernizations, adaptations

1. INTRODUCTION

Contemporary products, materials and technologies for the repair, strengthening, adaptation and modernization of buildings are based on the modern achievements in chemistry and technology.

They should have formal certifications in terms of safety, durability, health, acoustics, heat, performance requirements, environmental protection and sustainable development [1÷6].

Contemporary materials engineering as well as a wide range of polymers, offer increasing opportunities for repair and modernization of buildings. Polymeric and polymer-mineral materials allow repairs and reinforcements, both inside and outside buildings. Materials used for exteriors need to meet higher standards since, apart from the physical-mechanical parameters, they need to be resistant to harsh weather conditions. Whilst, the interiors of a building are

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exposed to the following destructive factors: mechanical, chemical, thermal, dynamic, etc., depending on the type of a building element.

Optimal selection of the technology of repairs and reinforcements should always be adapted to the user's requirements. Their diverse and effective properties are conditioned by a proper design is implementation within the conducted renovation, adaptation, extension and modernization works.

2. TECHNICAL REQUIREMENTS FOR ADAPTATIONS, EXPANSIONS, MODERNISATIONS

The adaptations and expansions as well as the renovation and modernization of buildings must follow some basic technical requirements that are specified for newly-implemented objects.

Safety requirements for the adapted and extended structures refer to the general principle of ensuring adequate reliability and stability of components or entire buildings, for the period of intended use.

Fire safety in renovated and modernised buildings primarily consists in meeting the emergency evacuation requirements, ensuring appropriate ventilation, stairways and zone lifts.

In terms of health and environmental protection, the adaptations and building extensions should prevent any gas emissions from the used materials, dangerous radiation, dangerous particles or gases in the air, moisture or improper waste disposal.

The safety of the adapted and modernized buildings involves the prevention of accidents such as slippings, collisions, burns, electrocution, etc.

Whereas, issues of protection against noise and vibrations are the ones which are most essential for the building use, especially historic ones or situated in densely built-up areas.

Repairs, adaptations, expansions or modernizations of buildings should be considered in the two following aspects:

- to ensure the acoustic quality of the object and its partitions determined by the users' needs
- to improve the acoustic performance as one of the goals of modernization.

In both cases, it is necessary to determine the acoustic requirements to be met by buildings being renovated and modernized.

Thermal insulation of partitions in modernised buildings includes the implementation of, inter alia, the following issues:

- the assessment of the suitability of various insulation methods depending on the type of construction of partitions,
- elaboration of new improved methods of insulation and energy saving.

3. TECHNICAL REASONS AFFECTING THE QUALITY OF RENOVATION AND MODERNIZATION OF STRUCTURES

Errors or poor quality of repairs and modernization of buildings result mainly from the erroneous design and inaccurate construction works.

The most common technical and organizational causes influencing the poor quality of repairs and buildings include:

designing and programming stage:

- inadequate and erroneous diagnosis of the ground and the water-ground conditions under the modernised facilities or infill buildings especially in densely built-up areas,
- erroneous determination of the ultimate loads for the grounds and the acceptable settlements for the specific type of a construction before and after modernisation,
- inappropriate foundation and its improper design without taking into account its interaction with subsoil,
- the assumed types of construction and foundation of a modernized facility are inappropriate for applied technologies or requirements imposed by its specific uses,
- non-compliance with or incorrect interpretations of standards, technical approvals and recommended instructions for renovation and modernization of buildings,
- unjustified deviations from the standard, technical approvals and guidelines for renovation and modernization of structures in special conditions,
- erroneous diagnosis of the behaviour of the structure under unusual loads, such as para-seismic loads and loads from wind, snow, dust, ice, etc.,
- engineering and technical errors while designing such elements as ties, joints, connectors, as well as whole structures,
- inappropriate or incorrectly selected technologies, types of materials, structural and finishing components,
- insufficient attention paid to investors' and users' opinions and remarks, especially in repeated implementations,

the performance stage included the following errors:

- changed conditions and types of foundation during renovation and modernization,
- lack of sufficient subsoil tests before the commence of renovation and modernization,
- poor quality of concrete, materials and other construction products used in the processes,
- usage of damaged and incorrectly selected materials and elements,
- poor performance of joining and connecting construction elements,

- applying construction materials and products which are unapproved or which do not possess necessary certifications,
- inadequate supervision of quality of used materials and products, and inadequate progress supervision,
- insufficient knowledge of the properties of new materials, products and construction systems,
- failing to meet the construction standards and inadequate technical supervision,
- insufficient understanding of the work by contractors renovating the structures, as well as the conditions of their use, which may result in improper changes introduced into the project during the realisation process,
- effects of weather factors during the renovation and modernization of buildings,
- insufficient co-operation between designers and contractors.

Long-term analyses indicate that hazards, breakdowns and construction disasters affecting, inter alia, poor quality of renovated and modernized buildings have been caused, apart from random factors, by human errors made at the design and execution stages. The reasons are shown in Figures 1 and 2.

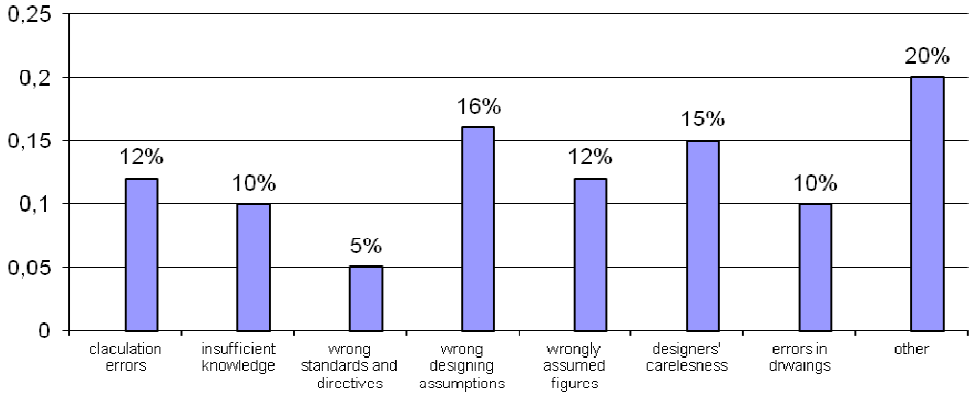

Fig. 1. Long-term design reasons affecting, inter alia, the quality of repairs and modernization of buildings.

The most common design reasons influencing the poor quality of repairs and modernization were generally wrong design assumptions, negligent design, insufficient knowledge and calculation errors.

The most common reasons of poor performance were: generally negligent contractors, insufficient qualifications, insufficient knowledge, deviations from the design and poor quality of joining elements.

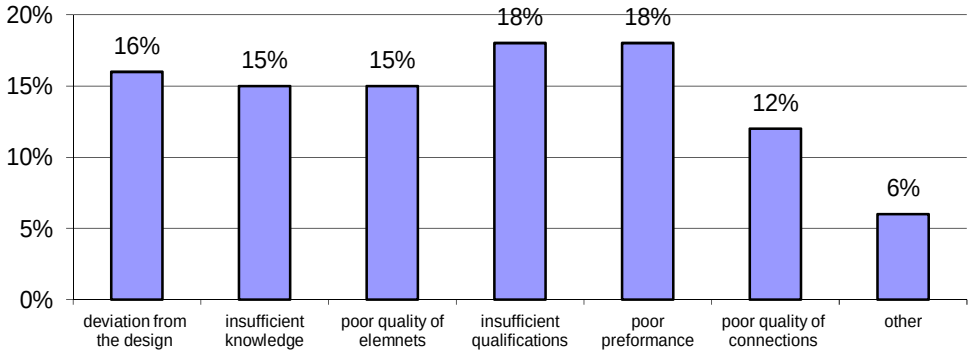

Fig. 2. Causes of poor performance which affect the quality of repairs and modernization of buildings

4. EXAMPLES

Examples of the most common reasons contributing to the poor quality of the renovation and modernization of buildings dependant on the participants of the investment process included:

- **Improper design of** elements of ceilings and floors, massive concrete elements, layered walls in buildings, elements fastening façade to the structure and connections, expansion joints of large-size structures, as part of the modernization of buildings, superstructures, repairs and reinforcements, as well as assuming wrong loads and static charts.
  These related in particular:
  - ceilings and reinforced concrete and steel columns, especially in commercial and storage facilities,
  - foundation slabs especially for infill buildings erected in densely built-up areas,
  - reinforced concrete diaphragm walls for deep foundations,
  - commercial buildings, warehouses and storage rooms,
  - suspended ceilings in buildings designed for various purposes,
  - internal walls and claddings of buildings,
  - entertainment and multi-purpose auditoriums,
  - water, thermal and acoustic insulation of facilities designed for various purposes,
  - trim elements such as plasters, linings, floors, joinery, etc.
- **Inadequate performance** of concrete work, connections between reinforced concrete and timber elements, bonding and connections of steel elements, scaffolding and operation stiffeners, water and acoustic insulation,

trim and auxiliary elements, infill buildings, demolitions and additions, superstructures, floors, light partition walls, window and door elements, etc.
These related in particular:

- reinforced concrete diaphragm walls and foundations, most frequently in infill buildings,
- tower structures, reinforced concrete and masonry structures,
- walls, columns and ceilings made of concrete blocks or similar materials,
- skeletal structures and reinforced concrete multi-storey garages, both underground and free-standing,
- infill buildings in towns,
- multi-purpose pre-stressed structures
- roofs of various roof structures,
- water, thermal and acoustic insulation in buildings,
- balconies and trim elements of buildings
- outbuildings and single-family houses;

5. SUMMARY AND CONCLUSIONS

The presented technical reasons elaborated on the basis of the long-term analysis of errors resulting from the analysis of risks, breakdowns and disasters of buildings allow for an overall assessment of the influence of the design solutions and execution at various stages of the investment process (including the renovation and modernization) on the safety, reliability, durability and the rate of failure of buildings.

They show that the existing risks, failures and disasters of renovated and modernized facilities are due to specific technical, organizational, legal, administrative, financial, social and other reasons.

Since the analysis included objects of a very different character, in terms of technical, economic and organizational aspects, the presented errors reveal a wide range of problems in the field of engineering, economics, organization and management.

At all stages of the investment process, there is still too much negligence, poor organization, lack of adequate technical supervision, insufficient knowledge of contractors and users, as well as other characteristic errors of renovation and modernization.

They affect, to the greatest extent, the quality and maintenance of the renovated and modernized buildings.

Without a critical assessment of the existing resources and the principles of their collection and use, it is impossible to think of making positive changes in both the investment and operational processes.

Information on threats, emergencies, failures and construction catastrophes should be used to improve the quality of renovated and modernized buildings. They should also be used in determining the technical, organizational and administrative regulations.

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BŁĘDY TECHNICZNE WYSTĘPUJĄCE PRZY REMONTACH
I MODERNIZACJACH OBIEKTÓW BUDOWLANYCH

Streszczenie

W artykule przedstawiono aktualne wymagania techniczne związane z adaptacją, rozbudową i modernizacją obiektów budowlanych zgodnie z odpowiednimi dokumentami prawnymi i technicznymi. Przedstawiono również przyczyny techniczne wpływające na trwałość i niezawodność remontów i modernizacje występujące w procesie projektowania i programowania oraz w wykonawstwie. Wymieniono najczęściej występujące błędy i odstępstwa od przyjętych zasad. Na zakończenie przedstawiono niektóre przykłady z praktyki zarówno w projektowaniu jak i w wykonawstwie, dotyczące wszystkich rodzajów obiektów budowlanych. Sformułowano też wnioski w zakresie eliminowania błędów technicznych i polepszania jakości realizowanych remontów, wzmocnień i modernizacji obiektów budowlanych.