Analysis of technical state of timber structural elements in Wrocław 19th and 20th century historical buildings

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Abstract A great part of Wrocław downtown development, i.e. dwelling houses, office, commercial and industrial buildings, was built about 100 years ago, so these objects already reached their expected mean time of service life. These buildings, despite their functional assignment, have typical construction with foundations and walls made of burnt brick, ceramic floors over cellars and timber structural elements used for higher storey floors and roofs. These latter elements are the ones that suffered most the lack of repair and conservation. This paper is an attempt to summarize the results of technical condition assessments of these buildings and to present methodology used in determination of timber elements technical wear and ways of partial or complete repair or strengthening of their wooden structural elements.

Keywords historical buildings, timber structural elements, technical state, destruction, repair

1. INTRODUCTION

The great part of the Wrocław city centre buildings, i.e. dwelling houses and also office, commercial and industrial ones, were built towards the end of the 19th or at the beginning of the 20th century (Berkowski et al 2004). These buildings generally have typical construction with foundations and bearing walls made of brick masonry, ceramic floors over cellars and wooden structural elements used for storey floors and roofs. Until the last years major repairs generally were not conducted in these buildings, because it was assumed that they would be demolished and replaced by new ones when they became too dilapidated. This mean that during nearly the whole century these buildings were very often left without proper technical care and many of them achieved their expected mean time of service life as a whole structure, i.e. 100 years. Now lots of these buildings are in a very poor technical condition and need a realisation of serious repairs.

Presented work contains an attempt to summarize the results of those assessments and to describe of the methodology used in determination of timber elements technical condition and wear level, and ways of partial or complete repair or strengthening of these structural elements.

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2. CONSTRUCTION OF TIMBER STRUCTURAL ELEMENTS IN OLD BUILDINGS

2.1. Floors between storeys

Wooden floors between storeys were mainly constructed in dwelling houses. Rectangular wooden beams are their primary bearing elements on which there are directly based wooden floor boards. On the mid boards there is an acoustic insulation, generally made of clay with chaff or slag backfill.

2.2. Roof rafter framings

There are many types of rafter framing structures that can be found in old buildings, some of them typical, but some having very unique static scheme and construction. Timber roof structures are generally built of rafters and purlins, sometimes connected using roof ties or collar beams. Loads from roof are passed through pillars with angle ties (and sometimes sleepers) directly on floor beams.

3. METHODOLOGY OF DIAGNOSIS OF TECHNICAL CONDITION OF TIMBER STRUCTURAL ELEMENTS

From structural engineer point of view, basing on the detailed information contained in ISCARSAH Recommendations ... (ICOMOS 2001), one of the most important elements of the old building reconstruction process is the evaluation of its technical state. Simplifying, it should be executed in the following way: analysis of archival documentation (historical research), architectural and structural survey, conservatory opinion, geotechnical study, material examination, constructional expertise (loads, structural and strength calculations, cause of damage), definition of the level of technical deterioration, definition of repair technologies, definition of structural safety during repair, monitoring of structure during repair.

4. METHODS OF REPAIR AND STRENGTHENING

Methods of repair and strengthening of the damaged wooden floor beams in old buildings can be divided into two main groups. Methods of the first group are based on introduction of additional structural elements as: independent strengthening, suspended structural system and strengthening that co-operates with existing structure. The second group includes structural treatment that leads to improvement of technical and operating properties of damaged elements properties.

5. CONCLUSIONS

To the present day in Wrocław city centre buildings there are lots of timber structural elements that were constructed even more than 100 hundred years ago. First of all, there are among them beam floors between storeys and roof rafter framings. These elements withstood nearly twice a time of their service life without being properly conservated. All types of the structural repair techniques are used in rehabilitation of timber elements, starting from local strengthening using wooden elements, passing through new composite materials and finishing with complete replacement with new bearing structures.

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