Analysis of the Use of Frame Construction and Modular Additions in City Centre

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Abstract. The living urban fabric can be characterized by the continuous introduction of changes and additions. The city centre is subject to specific restrictions due to the conservation protection and high demand on aesthetics aspect, thermal insulation, construction cost and the ratio of usable area of the building area. This article presents a comparative analysis of traditional construction with light frame and modular construction for the above-mentioned issues. Timber frame structure technology was suggested as effective, economic and innovative solutions for modular additions on buildings in city centres.

1. Introduction
The issue of additions in the city centres in recent years is a very important subject; the main reason is the persistent price of the property after 2006 (Figure 1) and heightened interest in the observance of the nature of space, work-related conservator. Multithreading these issues gives great opportunities at the same time it poses a large number of problems. Above new additions that involve a variety of issues in the area of both buildings, architecture, maintenance, and new technologies should work with multidisciplinary teams. We are dealing with the delicate matter of downtown, where some changes are irreversible, and the attention to it is our common duty, after all, is our national heritage.

Figure 1. Flat price changes in Poland [4]
2. **The growing importance of frame construction**
Frame construction in the past few years significantly increased its market share in housing construction. In Germany, the share of prefabricated construction in the market is about 20%, in Poland makes about 3-5%. However, one can see the dynamic development of the importance of this type of construction. The most important applications include the construction of timber frame houses. However, with the popularization of the method market can found more and more opportunities for the application of the technology. A very interesting and important use of frame construction is the possibility of application in downtown development.

3. **Downtown buildings- new additions**
Modern complement buildings in city centres are very sensitive subject. At the junction of the historic body formed object bearing the hallmarks of the modern times and so very different in style from neighbouring buildings.

Architect on the one hand is required to create the architecture compatible with the spirit of the time, on the other hand has over one another rigorous supervision of the conservator to supplement did not affect the development of a coherent piece. Interdisciplinary nature of the team and ripped cooperation architect and conservator has positive effects, otherwise the chaos appears in the urban landscape. Treasures of historical architecture could be suppressed by contemporary, often aggressive form of expression, and sometimes simply irreparably damaged. It should be emphasized that protection is often subject to not only a monument, at the junction of the new object is created, but the whole quarter or frontage.

Valorisation of cultural heritage resources is a historic value evaluative analysis, dividing the two main groups: retrospective (socio-economic) and prospective (cultural). They cover both aspects of uniqueness, authenticity, but also the economic potential and value of social utility, translating into attractive cultural landscape [6]. An attempt to meet as many aspects can be Monopol hotel in Wroclaw (Figure 2).

![Figure 2. Monopol Hotel in Wroclaw: a) before addition, b) after addition [5]](image)

Topics discussed are regularly undertaken by specialists at conferences both Polish and international, who are trying to adapt them best to rapidly changing conditions. Their work is reflected in the documents of ICOMOS, the Athens Charter [7], the Venice Charter [8], the Krakow Charter [9], and many others. They define as far as possible, the characteristics of which should be characterized by the newly formed building and descriptive way explain what the correct supplement building.
However, these are not precise instructions, because each object is different and requires an individual approach, so important in this process is the role of the conservator. Among the many features one can try to distinguish the main aspects. On the basis of studies, they have been shown in the following table (Table 1). Divided into those which are characterized by the correct supplement and those that disqualify them from this group.

Table 1. Key features of the additions in the city centres based on documents

| Good implementation should consist of min. 3 aspects | Good implementation should not consist of any of the mentioned aspects |
|-----------------------------------------------------|---------------------------------------------------------------|
| 1. Modern architectural form                         | 1. Historical styling                                      |
| 2. Individuality                                      | 2. Incorrect object scale                                   |
| 3. Integrity                                         | 3. Incorrect object colour                                   |
| 4. Harmonious incorporation                          | 4. Improper facade divisions                                |
| 5. Authenticity                                       | 5. Facade leaving                                           |
| 6. Conservancy of functional system                  | 6. Rebuilding-incomplete documentation                      |
| 7. Rebuilding - complete documentation               |                                                               |

Undertaken attempts in order to systematize the subject are not simple, although experimentally observed that the correct supplement must have at least 3 of the characteristics of the left side of table 1 and any of the features on the right. It should be noted that this is an oversimplification, so the design should always be supervised prepared for the task of architects, with the additional knowledge of the theory and Monuments conservation and conservation services.

4. Frame construction in city centres

This kind of technology is used mainly for extensions to existing buildings and superstructures. Frame construction technology seems to perfectly respond to market demand. Rising prices of flats in the centre of prompt investors to exploit every opportunity to maximize profits. The main problems during expansion include incomplete project documentation of existing buildings, which affects the difficulty of the assessment capacity of the main components. In many cases, due to the low capacity of the investor must choose between costly reinforcement of the structure or frame construction using much less incriminating existing structure. Very often, the use of lightweight frame is the only possibility of constituting the profitability of the investment. Wall made in the technology of light frame is filled with mineral wool, which provides thermal and acoustic insulation [2]. This allows obtaining the required parameters of the heat transfer partition of the smaller section. The wall thickness of frame technology is 18 - 22 cm whereas the wall layer in a traditional brick has a thickness of 34 - 40 cm. This difference, with unchanged surface of the building, allows to increase the usable area of a few square meters, which translates into increased profits developer. Example of an expansion in a lightweight steel frame is presented in Figure 3.

During restorations in city centres, special attention should be focus on the construction process. Frame construction allows to work in low temperatures and to speed up the construction phase on site. A special case of frame construction is a prefabricated frame construction. Investment process is largely transferred to the prefabrication plant. Switching time of building elements in situ can be reduced...
dramatically, up to several days [1]. Carrying out construction in the city centre should be as short as possible due to traffic problems.

![Figure 3. Superstructure of the object in lightweight steel frame technology [3]](image)

The disadvantages of frame construction include primarily sensitivity performance mistakes, leading to faster degradation of the structure and reduction of operational object parameters. The performance of the objects in the timber frame technology depends on usage of high quality wood of proper humidity and four-planed sides. Failure to follow these guidelines may result in premature destruction of the structure.

5. Summary
The issue of additions in the city centres can pose many problems. Presented in the article the benefits flowing from the use of frame construction are:

- lightweight construction,
- increase of the usable space by reducing the cross section of the outer wall,
- shortening the time of construction phase

Listed properties of timber frame technology suggest that this technology offers interesting and effective solutions. It should be remembered, however, that erected building should respect the past, where eventually it will be found too.

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