

# CONSTRUCTION DEFECTS IN THE SUBSEQUENT INSULATION OF PANEL BUILDINGS

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**Abstract**—This article is intended to highlight elementary construction defects occurring during subsequent thermal insulation which would considerably improve the energy properties of buildings. The previously planned fifty-year life cycle of large-panel building structures may significantly improve after the insulation of the facade. Therefore, it is desirable to observe the regulations in every detail and execute the renovation in a professional manner.

**Keywords**—Panel buildings, insulation, construction, defects

## I. INTRODUCTION

Energy consumption has increased in both the industrial and residential segments in the past few decades. As a result, the subsequent insulation of buildings has also increased all around Europe and Hungary. It is also thanks to the realization that it is better to hold warm and cold air within the building to maintain thermal comfort. The wide range of innovative possibilities offered by modern technological means and manufacturers provides a solution to almost every problem (except for historical buildings). The insulation wave of flats found in panel buildings of the socialist era has reached residents, professionals as well as laymen. It may not be so well-known that, contrary to popular belief, these buildings are not the products of a Soviet socialist ideology. The first method of using large prefabricated concrete blocks, which could be called a factory-built house, had been developed in France in the early 1950's, which was borrowed by the Soviet Union and improved upon by the Danish. The initial system for building prefabricated five-storey houses, in France (CIGNET, CAMU), the Soviet Union (Domostroitel'nyj Kombinat House-building Factory) as well as Denmark (Larsen-Nielsen factory), was improved to allow for the construction of ten-storey buildings. In Hungary, in the late 1950's, several large companies experimented (relying on their experience with the application of block technology) with the production and construction of buildings of large prefabricated concrete blocks based on (mainly Soviet) examples abroad. The first house factory

in Hungary started production in 1965, while the last one, the tenth, in Kecskemét, started in 1976. Their capacity for producing flats reached 25,000-30,000 flats per year with an average flat area of 35 square meters. Unfortunately, it is also mistaken to think that these buildings were arranged into housing developments as a result of certain political views. The main idea of placing buildings separated from each other by a large air-filled space in a park area and the separation of functions based on a regional basis are generally associated with the principles of the Athens Charter (as presented by the CIAM), Le Corbusier, and, especially, the notion of "Unité d' Habitation" and the plan of a city housing three million inhabitants, [1], [2].

## II. THE CHARACTERISTICS OF PANEL BUILDING

Panel buildings consist of sheet-like frameworks, which are normally a storey high and the size of a room. These modules may be turned into a supporting frame by pouring concrete into them along the edges at the construction site.

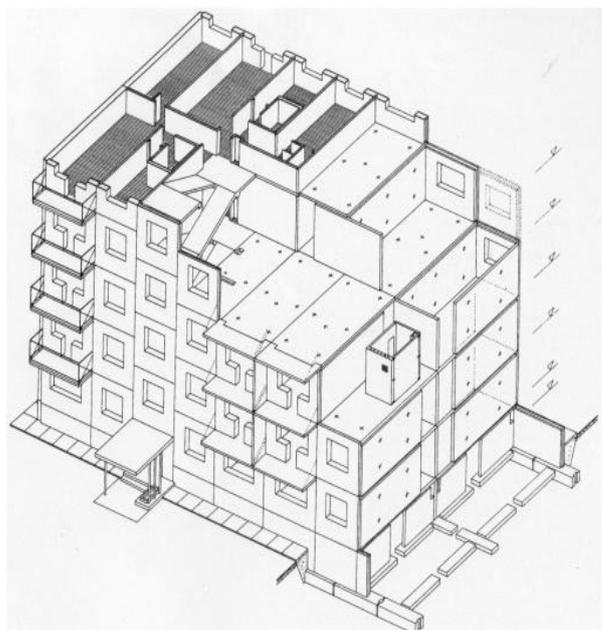


Fig.1 Panel building  
(Source: [5])

Further characteristics of the panel structure are:

- 1) modules generally weigh 1-7 tonnes;
- 2) gaps between the joints are filled with concrete; the joining of modules is done with the help of steel reinforcement and bracing along the edges;
- 3) the building is reinforced with two-way walls (the connection between the floorspace and walls does not provide enough firmness);
- 4) panels on the facade are sandwich-structured; panels on the inside are of concrete; while the floorspace is made of reinforced concrete,[3], [4].

### II.1 Typical defects in panel buildings

Defects in panel buildings may be traced back to deficiencies in design, production and construction as well. The most common defects are the followings:

- 1) there may often be differences of the order of centimeters between the sizes of prefabricated modules and planned sizes because of inaccurate production templates or their premature wearing;
- 2) the insulation layer is damaged during heat treatment;
- 3) cracking may occur in the modules, especially in winter, as a result of disregarding prescribed curing times;
- 4) the insulation layer was left out of the panel occasionally, although not often;
- 5) the edges of the panels were damaged during shipping, lifting or installing;
- 6) the installation of the insulation layer to be placed during construction and designed to fit between the inner supporting walls and facade elements was sometimes omitted [5].

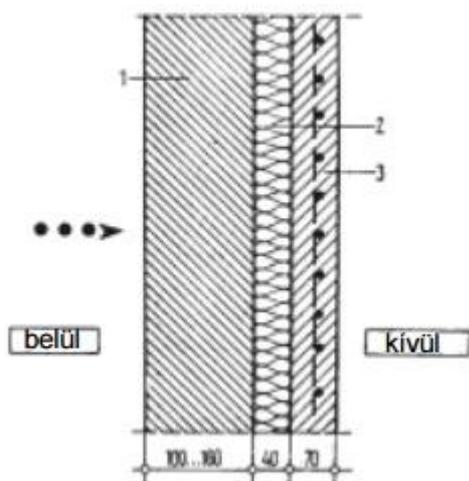


Fig 2 Basic conception of panel buildings  
 (Source: [6.]

### III. THE INSULATION OF PANEL BUILDINGS

Most of the buildings are in a really bad condition because of poor construction standards and are in need of fundamental (**non-static**) renovation. Energy loss is quite high in the case of panel buildings. This is well-

illustrated by the thermal image in Fig.3.



Fig.3 Thermal image of a panel building  
 (Source: [6.]

As far as energy and heating costs are concerned, the followings are of vital importance:

- 1) in terms of building structure, especially:
  - a) doors and windows of the facade
  - b) the roofs
  - c) the walls of the facade
  - d) floorspace above the basement
  - e) proper insulation of the walls of the stairways
  - f) the installation of windbreaks in the stairways
- 2) in terms of building engineering systems:
  - a) heating and utility warm water supply
  - b) the importance of ventilation (mold problems, hygiene)

TABLE 1 shows the loss in percentage in terms of these factors.

TABLE 1  
 Heat LOSS (Source: [7])

Heat loss of buildings as shown by experience in Hungary	
Heat loss of blocks of flats (panel buildings)	
Windows, doors	50-60%
Facade, gaps in structure (drafts)	25-30%
Roof, ceiling	5-10%
Ground floor, basement	3-8%

During the construction (1950-1978), such buildings were built, as a result of unrealistically low energy prices and the lack of adequate materials, which lack low level heating control, or it is rudimentary, and where billing or the measuring of consumption was not based on individual consumption, and, what is more, it is still not. Especially in the case of panel buildings, this results in a huge waste of energy. A certain wave of insulating buildings started in Hungary to insulate the corners, decrease the impact of thermal bridges and to help improve low thermal comfort. The insulation of the facade of a building is like football in Hungary – everybody seems to be an expert at it. Without the professional background and knowledge such solutions came to exist, which we can come across every day. Fig.4 shows such solutions very well.



Fig. 4 Custom subsequent facade insulation  
(Source: press photo)

The tenants and contractors who use such solutions may not even suspect that, as a result of their work, they cause further problems to the neighbors and even themselves. Sooner or later problems generated and accumulated by thermal bridges will begin to occur even on walls that had no mold problems before.

The insulation of the facade of these buildings is not standard procedure. Often, the tenants, or their representative, choose such cheap professionals/non-professionals who have no references and may make such basic mistakes that might even lead to life-threatening situations or have serious financial implications.

#### IV. CONSTRUCTION DEFECTS IN THE SUBSEQUENT INSULATION OF PANEL BUILDINGS

In my article, I shed light on four such basic mistakes which may occur during the subsequent insulation of panel buildings.

#### IV.1. SCAFFOLDING AND THE USE OF A SUSPENSION BRIDGE

The construction of the scaffolding may only be done by professionals, carpenter scaffold builders, as they used to be called, or, currently, industrial and building scaffolders. It is a trade. For scaffolds higher than 24 meters (a 10-storey building is 30 meters high), a statics plan needs to be prepared. In lack of MSZ, TÜV and other authorizations, materials not measured and qualified beforehand must not be built in at such heights. Construction can not begin while the protection protocol and the OSH protocol (delivery receipt) are missing.

The other solution is the application of a suspension bridge, which admittedly was not intended for this purpose, but contractors often tend to choose this option still for its easy rentability. It must be noted though that only personnel who have the required licenses may operate it. Experience has shown that it doesn't allow for accurate work. Dust and the formation of stains on the facade show this. In order for workers to be able to keep within the vertical and horizontal planes, it must be continually checked and evenness must be provided. In this case, this is always limited to the size of the basket/bridge. Working on it is like working on a moving swing. Fig.5 shows working levels used during construction and the stains and sediment which have appeared on the barely half-year old facade.

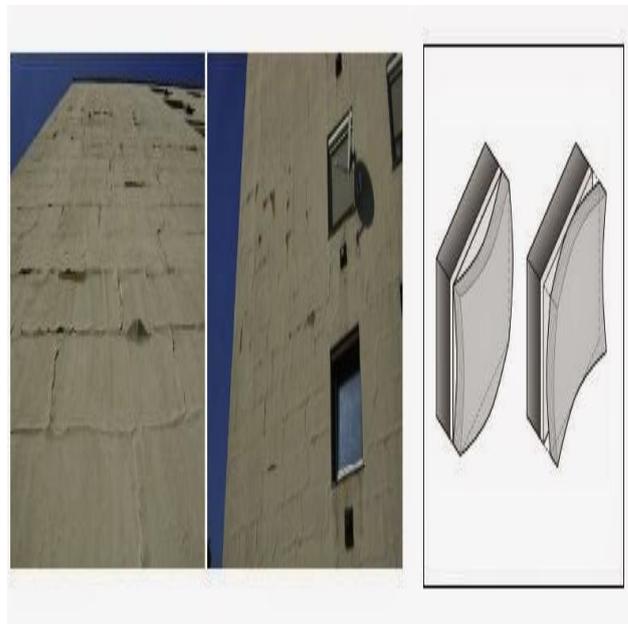


Fig. 5 Working levels

#### IV.2. ADHESIVE BONDING OF THE FACADE MATERIAL AND ITS METHOD

In contrast to common adhesive bonding methods (scones), the "point-edge" bonding method must be used to avoid the "mattress effect". It must be added that it is also important to use it for fire safety reasons because, in the case of regular scones, air may freely circulate after

placing one pane over the other, which may cause a chimney effect. The result of this is best proved by the fire in Miskolc (Although, it must be noted, this was not the cause of the fire but it accelerated its spreading). Due to the incorrect adhesive bonding, panes of insulation show fast and flexible deformation as a result of rising morning temperatures which follow the drop in temperature at dawn. The mattress effect is shown in Fig.5. The real-life effect can be seen. [4]

#### IV.3. THE METHOD OF PHYSICAL BONDING (ANCHORING) AND THEIR NUMBER IN RELATION TO HEIGHT

This is one of the most important aspects of facade insulation. The physical bonding of insulation panes was and unfortunately sometimes still is carried out by the rule of thumb. This important step is often skipped to save money. On surfaces where there has been no anchoring, nature and the laws of physics can cause havoc. In terms of anchoring, panel buildings differ from normal buildings in that, with the change of height, the usual number per square meter cannot be used but, instead, an exact number of anchors must be used to fix the insulation material in the exact spots. Many does not take into account the suction effect of the wind and the effect of mechanical effects on each other, which always affects surfaces on the edge. In each and every such case, an anchoring plan must be obtained from the manufacturer along with an offer based on quality and quantity factors after the examining of the surface built. After the anchors of the right size and quality have been chosen, have some characteristic measurements made on each type of wall. The measuring is scalable and applicable based on the results of the drawing out of anchors. The practical length in the case of anchors belonging to thermal insulation systems is defined by the anchor itself. For calculating the necessary length, the thickness of the insulation material, the adhesive layer and concessional non-supporting layers (old plaster-work and insulation, etc.) must be taken into account. In the case of anchorage through a net support, the thickness of the primary plaster-work must not be forgotten [3].

#### IV.4. USING NETS AND PATCHING SYSTEMS

Adhesive materials needed for the bedding layer are neglected or used overly sparingly because of the great surface area of panel buildings. Embedding, leveling and smoothing a fiber glass net in a precise, professional manner is always of secondary importance due to a lack of time and money. The lack of this may cause the colored plaster-work to simply fall off the surface in palm-sized flakes. As a result of the height of the building the facade is subject to such mechanical effects which make the use of diagonal netting, edge protection, droppers and dilations essential [3].

#### V. CONCLUSION

Research shows that only 25 percent of households have had their buildings insulated and their windows and doors changed and only 16 percent have upgraded their heating systems. Our residential buildings are mostly old; 61 percent of them were built before 1980 and only 10 percent in the past 15 years. This data indicates that there is a big task ahead of us since the European Union will be tightening its energy efficiency requirements till 2020. Basically, the maximum energy consumption of new and refurbished buildings has to meet the levels of today's passive houses. Unfortunately, prices decide who the successful contractors will be as there are no laws in Hungary yet defining who can carry out the subsequent insulation of panel buildings with a permit. As a solution to the construction defects occurring during subsequent thermal insulation, I recommend the introduction of continuous education for contractors and even representatives of the residents of a block of flats possibly. New technology and information must be presented to the residents, companies and representatives so that when time comes for renovation they know the pros and cons of the proper way of construction of the system to be applied. The owners of flats refurbished already are pleased with their current energy consumption compared to consumption before. The role of technical inspectors and responsible technical managers is not to be undervalued either in proper construction, [1], [2].

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