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Environmental and Social Aspects of Large-Panel Technology in Housing

Aspects sociaux et d'environment de la technologie dans le bâtiment

Ökologische und soziale Probleme der Grossplattenbauweise im Wohnungsbau

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SUMMARY
The paper deals with non-structural problems arising in large-panel dwelling houses in Poland during the past 25 years. Many unfavourable consequences in technical, environmental and social aspects have already occurred. The state of the art, measures of prevention and concepts of improvements being applied nowadays in Poland are reported.

RÉSUMÉ
Le rapport traite des problèmes non structuraux apparus en Pologne pendant les 25 dernières années dans les maisons d'habitation préfabriquées. Un grand nombre de conséquences néfastes s'est déjà manifesté dans le domaine technique, d'environnement et social. L'état de la science, les mesures de précaution et les concepts d'amélioration appliques à présent en Pologne, sont présentés.

ZUSAMMENFASSUNG
In dem Beitrage wird über die nicht-konstruktiven Probleme der Grossplattenbauweise im Wohnungsbau Polens der letzten 25 Jahre berichtet. Dazu gehören zahlreiche ungünstige Folgen von technischer, ökologischer und sozialer Bedeutung. Der aktuelle Stand dieser Probleme sowie die Konzepte der in Polen bisher vorgenommenen Verbesserungsmassnahmen werden dargestellt.

1. INTRODUCTION

Severe destruction of housing substance in Poland during World War Two as well as mass migration of people from the countryside into towns necessitated building many dwelling houses as quickly as possible. In Poland and most other east-European countries the large-panel technology of construction has been developed on a very large scale. This technology seemed to be very promising for solution of housing problems with respect to:

- location of most of building operations in factories and making them irrespective of weather conditions,
- assurance of higher quality in industrial processes,
- stable and regular supply of structural components partially stored in buffer stores.

On the basis of these assumptions the large-panel system has become very widespread and nearly the sole technology in Poland for dwelling houses. About 200 industrial plants for prefabrication of large-panel buildings have been assembled and from their production about 100 000 flats are constructe every year.
Such monoculture of building technology has been found to cause many unfavourable consequences in technical, environmental and social aspects that deeply influence the life conditions of inhabitants. Particular aspects of such influence are discussed below.
The illustrations /drawing, photos/ will be shown during presentation of the paper.

2. SOCIAL AND ENVIRONMENTAL ASPECTS

2.1. Social and family life aspects

In multi-storey dwelling houses being erected nowadays in Poland the area of individual flats is subject to limitations defined in administrative rules and depends upon number of inhabitants. On the other hand the time of expectation for a flat extends up to 15...20 years and tends to prolong. Therefore many families live in flats much too small for their needs /two or three generations instead of one/ whereas some old people can not afford to pay the rents for their relatively too big flats. An exchange of flats is often hampered by bureaucracy. In the mid 70-ties the attempts of seeking the technical solutions of division or joining of flats were made with practically no success.
Too small area of most dwellings and needs for privacy in overcrowded flats do not contribute to looking for the adjustment of lay-out by demolishing or replacement of partitions within flats. Even light-weight honey-comb gypsum boards used instead of concrete slabs or masonry walls do not tempt the residents to change the lay-out; they are often replaced by masonry partitions as giving better acoustical and functional solutions.
The problem of inflexibility of large panel buildings arises too in the scale of town planning. The use of heavy cranes for erection of large-panel buildings tends to limit location of new settlements on open grounds outside the existing town. The unified dimensions of panels and differences of desired room heights do not allow to accomodate the dwelling and the shops in the same building. Dwelling houses spread out for better exposure to Sun as well for location of parking places and children playing grounds do not form streets or squares attracting people to walk or to gather.

The disappearance of traditional streets, alleys and squares makes the social contacts and bonds poorer and brings the feeling of isolation and depression. As the new residential areas are poorly equipped with kindergartens, schools, shops, cultural centers and hospitals, the whole productive and cultural activity of inhabitants is performed in the city. The humanisation of new building areas can be achieved only by differented architecture and "saturation" of new districts with social and cultural facilities making them vivid and attractive. Few attempts have been hitherto succesful.
In many small towns new large-panels blocks do not harmonise with existing architecture and social tissue; they dominate the town and destroy social bonds. Deformation of a landscape by heavy large-panel buildings is a special form of architectural pollution, especially in small towns with their graceful old architecture or in a health resort situated in a beautiful landscape.

2.2. Acoustical aspects

The level of acoustical requirements in the relevant Polish Standard conforms to mean world standards. Characteristic features of dwelling houses erected in Poland after World War Two /multi-family houses prevailing, large-panel buildings, small area and overcrowding of flats/ create however special problems. Despite of sufficient thickness of heavy concrete walls /14...15 cm/ and floors /14...16 cm/ about 30...50% of inhabitants complain of noise from upper stories and about 10...20% complain of noise from neighbouring flats on the same storey. The main reasons of this state are:

- good transmission of noise through concrete,
- acoustical bridges in places of joints and openings in concrete slabs,
- poor insulation of service pipes,
- no possibility of proper insulation and dilatation of technical rooms in large-panel buildings,
- poor quality of construction,
- poor acoustical quality of installation equipment.

A separate problem is the traffic noise as the density of traffic increases. The noise protection should be achieved by:

- proper town planning,
- proper lay-out of the building itself,
- sufficient acoustical insulation of external walls including windows.

Two first means are very rarely respected in town-planning and architectural design. Windows of increased acoustical insulation are not always used according to the need. There are not windows available of high acoustical insulation and of controlled air input rate.
Generally there is no technical supervision and inspection of completed buildings from the acoustical point of view. Nobody checks the conformance of buildings with acoustical requirements prescribed by relevant standard. The measurements are conducted sporadically, only in cases of frequent complaints.

2.3. Heat and moisture aspects

Heat insulation requirements were introduced to the relevant Polish Standard since 1957 /for outer walls k-value below 1 kcal/ m^2h^oC, for flat roofs below 0,75 kcal/m^2h^oC/ on the basis of long-term previous experience with masonry walls. This coresponded with

red brick wall, two bricks thick, both sides plastered /total thickness approx. 55 cm/. Long-term experience has shown quite good performance of such walls in the moderately-cold climate of Poland.

The same requirements applied to the multi-layered walls of large concrete panels have proved to be unsatisfactory. There are many cases of condensation on the cold bridges /insulation voids, corners of walls, horizontal joints/, combined sometimes with rain water leaks through the joints or cracks in outer cladding. Due to cold bridges caused by improper design or fabrication faults usually real k-value exceeds by 20...40% the nominal k-value. Up to now this effect is not taken into consideration in design practice and in Polish Standards. It results in too small area of radiators installed.

Almost all dwelling houses with large pan ls have heat supply from heating plants or district power plants. No local thermostats are used, there is only central regulation of heating medium according to the outside air temperature. Distant heating lines are usually in bad condition due to corrosion; heat losses including the hot water leaks reach up to 18...20%. Failures in heat supply concerning single houses or even whole districts occur relatively often. As a result a large portion of dwelling houses are temporarily or permanently poorly heated, while some of the others are over-heated.

Natural ventilation is a prevailing system in dwelling houses up to 12 storeys with its efficiency time and place dependent. The residents of poorly heated dwellings often close the inlets to the ventilation flues in order to diminish the heat losses, increasing in such a manner the relative humidity of air. The increase of relative humidity is often caused by the overcrowding of dwellings /e.g. small flats occupied by people with small children/. The lack of space and sometimes architectural solutions often force people to place the pieces of furniture /beds, cupboards, bookshelves/ at the outer walls, stopping the convective streams. It results in a surface condensation.

Since 1982 the house owners /building co-operatives/ can get remitted credit for execution of additional cladding or additional insulation of outer walls if technological faults occur. At the same time heat insulation requirements for new buildings were heightened /k-value for outer walls should not exceed 0,75 W/m^2K/.

Some thousands of houses have been already additionally insulated either with glued expanded polistyrene or with mechanically fixed mineral wool slabs. It resulted in improving the comfort conditions with no heat saving effect as no regulation of heating system has been performed.

For the time being the complex program of energy saving is under preparation. In 1989-92 successively maximum k-value for outer walls will be changed to 0,35...0,45 W/m^2K, for windows to 2 W/m^2K. The radiators will be equipped with thermostatic valves, airtightness of windows will be improved. There is a tendency to reach zero-growth of energy consumption at about 2000...2005. It means the necessity for thermo-renovation most of the existing buildings, including the introduction of controlled mechanical ventilation.

2.4. Microbiological environment contamination

Insufficient thermal insulation of external envelope, the faults

of central regulation and heat supply, random efficiency of natural ventilation, over-crowding of dwellings - form beneficial conditions for the growth of micro-flora. The problem has been extensively studied since late 70-ties by several research centers.
In buildings of concrete panels mostly mould fungi occur as a compound of micro-flora. Such materials like floorings with base of natural fibres, wall papers, paints, glues, lignocellulose materials - are especially vulnerable to biocorrosion. The measurements performed by Building Research Institute have shown, that buildings with outer walls attacked by mould are highly polluted by fungi spores /mostly Penicillium, Aspergillus and Cladosporium/. The spores can cause allergy and different sicknesses, mostly of air passages and lungs. The best way of counter-action against micro-flora growth is to eliminate high moisture content in materials, caused mostly by condensation. The additional insulation of the external envelope, good ventilation and required heat supply eliminate the ground for fungi.
Due to the great number of buildings "waiting" for thermorenovation the chemical means of mould control have been used, too. Many of them, however, had to be withdrawn from use due to emission of toxic gases.

2.5. Chemical pollution of air

Chemical pollution of air with toxic or allergic gases occurs very often due to use in construction of such materials as: impregnates, tar, adhesives, paints and lacquers, chemo-hardening plastics, organic solvents. The most often found compounds are phenol, formaldehyde and chlorophenols. The main sources of emission are usually:

- as concerns phenol and chlorophenols - insulation hardboards used in floor layers impregnated with "Xylamite", mineral wool slabs, tar and tar roof felt, adhesives and furniture of wood particles slabs,
- as concerns formaldehyde - furniture, chemo-hardening lacquers and adhesives.

Nowadays use of many "suspected" materials is under the control of health inspection.

2.6. Natural radio-activity of building materials

The first pilot investigations were started at the end of 60-ties. Since the mid 70-ties the ground has been laid for mass control investigation of natural radiation /methods, apparatus, criteria and qualified staff/. Since 1980 the control of natural radiation of some "suspected" materials has become obligatory. On the basis of past results as such materials can be treated: aerated concretes on the basis of fly-ashes, furnace slag concrete, ceramic brick, cement with admixture of fly-ashes. The use of these materials should be permanently controlled and materials with high natural radioactivity should be mixed with neutral materials or eliminated. The Polish Standard determining allowable concentrations of radioactive elements in building materials is under preparation.

3. CONCLUSIONS

General circumstances after World War Two substantiated the large-panel technology of construction which contributed in reconstruction of destroyed towns and cities. This technology was applied on a very large scale and for a long time as the predominant system

of construction has been proved, however, to cause many unfavourable consequences for the internal as well as the external environment of buildings, resulting in a deterioration of the living conditions of inhabitants. The authors, coming to this conclusion realize that not all the problems can be attributed solely to the large-panel system of construction and they will not be solved by a simple change of construction system which is only one of many factors influencing the environment and living conditions.

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