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Diagnoses of Large Panel Buildings in the Czech Republic

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Summary

General guidance for systematic investigation on technical conditions of large panel buildings. The results of a survey that has been already performed on different types of building systems in the Czech Republic proved the necessity to solve problem of safety of large panel buildings. This problem might be common to other Central and Eastern European countries. Although there is no evidence of structural failure of the system as whole large scale field investigation is urgently needed to prevent local failures of external structures. Remedial actions to prevent concrete deterioration must be taken. Detailed assessment is recommended before any structural alterations or refurbishment projects will start.

1. Methods of diagnostics

The high number of flats located in large panel buildings establishes the importance of systematic approach to:

a) Inquiry to obtain basic information on ownership, location, number of buildings and flats, structural systems and serious faults.
b) Field investigation and visual inspection. The methodology proposes a questionnaire that is based on all six essential requirements according to Directive 89/106/EEC. [1]
c) Structural analyses when visual inspection cannot provide all information for assessment of loadbearing structures. Effective software tool is available non-linear approach can be made when necessary.
d) Collecting data on technical conditions of buildings in regions.
e) Working out a database in which all important findings and other data must be arranged.

2. Results of survey

A large scale survey has not started yet. However some findings are already available.

2.1 Main problems

The main problems that influence safety and health of inhabitants are as follows:

- inadequate structural design that does not prevent *progressive collapse* of a structure in case of accidental loading (for instance gas explosions, impact loading)
- insufficient *integrity* of structures than can cause for example separation of external layers of sandwich panels, disintegration of concrete railing elements from a structure or disintegration of other parts of external structure exposed to environmental attack

- *corrosion* of reinforcement of external concrete structures can produce falling debris (concrete cover or even parts of concrete structure at least).
- inadequate construction details and application of materials, poor technological discipline of execution together with improper system of heating, ventilation and use of a flat can create an undesirable microclimate, its consequence is *unhealthy environment* (moulds are dangerous)

2.2 Other problems

Apart from the most serious problems listed above we are faced with other problems such as *cracks* in structural elements and joints, inadmissible *deformations* of floor slabs, a wrong design with regard to *volume changes* due to thermal effects, improper *tightness* of external envelope that causes air infiltration and water leakage, too *high energy consumption*, low level of *protection against noise*, poor level by products namely *sanitary facilities*

2.3 Causes of faults

There is a complex of items that can be considered as the main causes of the faults indicated above. These causes can be summarised as follows *inadequate technical standards* and lack of knowledge of designers when the first structures of this kind were designed, *time pressure* during execution, *poor quality of products*, *poor workmanship*, insufficient *quality inspection* on building sites, insufficient *quality of maintenance*, *inadvisable utilisation* of flats, gradual worsening of *environmental* conditions until year 1990 and too small concrete covers.

3. Evaluation of large panel structures

Czech Standard [2] covers all aspects of design of large panel structures quite well.
Comparison of the archival design documentation with present requirements, shows that older panel structures do not satisfy general structural requirements. There might be doubts about proper function of joints.
However, the most structures enable wide range of alterations. For example:

- vertical extensions containing new roof apartments
- horizontal extensions, fixing of new architectural elements
- new ducts through floor slabs
- new openings in walls

4. Conclusions

According to all available findings from field investigations, non-destructive site tests, detailed numerical analysis and other assessments of different types of large panel systems it can be briefly concluded

- there is no real evidence of possible failure of any structural system as a whole
- there is potential risk of local failures
- process of ageing of large panel structures requires remedial actions
- large scale diagnostics procedure throughout the country is needed

References

[1] Council Directive 89/106/EEC Construction Products. Interpretative Documents Commission of the European Communities, Brussels 1993.

[2] ČSN 73 1211 - 2/1987 Design of concrete structures of panel buildings (in Czech).