

# Sustainable retrofitting solutions for precast concrete residential buildings

A. Botici, R. Zaharia, V. Ungureanu, A. Botici & D.Dubina

*Department of Steel Structures and Structural Mechanics, Civil Engineering Faculty, "Politehnica" University of Timisoara, Timisoara, Romania*

## ABSTRACT:

In the present context, the Romanian population, as like that of Eastern Europe, lives in collective residential buildings with concrete structure and large prefabricated panels. The official census made and published on March 18th 2002, in Romania, highlighted that at that time there were 4.234.173 households built in the urban area from which 3.021.122 were buildings made of large reinforced concrete and precast panels, that represents approximately 71% of the existing urban housing. Most of these buildings are over 30 years old, and the materials used for thermal insulation are already outdated. The existing building stock poses a special challenge since the current energy policy and climate mitigation goals require distinct reductions of the primary energy demand and greenhouse gas emissions in the building sector.

In the period 2000-2011 a series of these buildings have been rehabilitated, but without having or following specific guidelines concerning energy savings, architectural impact and sociological aspects. Most of these interventions are made punctually, using simple technical solutions, and were executed in different manners that resulted in a degrading effect on the neighbourhood's image. The major problems that concern these neighbourhoods regard less the structural and energy consumption capacity of the concrete blocks and refer more to their lack of retrofit for urban image, the interior space, the public green areas and public space. During the past 10 years the facades of these units have been improperly contoured to a mix of shapes, materials, and colours, an image similar to the one of a ghetto. The urban space was diminished by inhabitants that turned large green areas into parking lots and garbage disposal zones. Nevertheless the interior reduced surfaces of these flats drove the inhabitants to create enlargements in the structural partition walls in order to re-design the interior space and also to extend their living area by closing their balconies. Another major intervention that was applied to these units frequently is over roofing. In approximately 30 % of the units executed during '62 to '89 over roofing were realised. Most of these interventions took place without concerning the visual impact and also the densification impact for these neighbourhoods.

Starting from the representative typologies of executed buildings, the context when they appeared, their evolution in time, and their current and actual problems, the paper presents some directions, modalities, intervention methods and their implementation for rehabilitation.

The study refers to a set of solutions for these concrete blocks that implies:

- Retrofitting the exterior envelope to the aim of improving the overall energy efficiency of the existing building stock ;
- Solutions for balcony enclosures (technical and energy efficient envelope);
- structural reconfiguration for interior structural partition concrete diaphragms;

- possible interior reconfiguration of apartments by pairing flats occurring on the same storey by creating enlargements in the structural partition concrete diaphragms;
- possible interior reconfiguration of apartments by pairing flats occurring at different storeys and creating an interior stair by creating enlargements in the structural partition concrete diaphragms and in the concrete slab;
- retrofitting the roof surface by creating new apartments or penthouse - over roofing -with or without creating an elevator ;
- retrofitting the urban area, green space, alleys, entrance, parking area, etc;

These sets of architectural and structural solutions have to include fire protection measures according to relevant fire scenarios and refer to :

- Fire protection for the new envelope – new materials and systems;
- Fire based design for balcony enclosure (new materials and engineering solutions)
- Fire protection for the steel profiles used to consolidate the enlargements created in the interior structural partition concrete diaphragms;
- Fire design regulations for the over roofing of these units – fire design, new materials, new systems for fire protection regarding over roofing.

An inventory of potential fire protection solutions will be presented.