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A Concrete Attic for Prefabricated Panel Blocks

Catalina Bocan[*1],

[1] *Faculty of Architecture,"Politehnica"University of Timisoara, 2A Traian Lalescu Str., 300223, Timisoara, Romania*

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Abstract

Romania, along with the other five states (Hungary, Czechoslovakia, Poland, Bulgaria and Eastern Germany – as Russian socialism' satellites) that were under the communist regime until 1989, is populated with lots of prefab concrete housing blocks, low or high rise, almost in every city, small or big. After 1990, the people started to develop different kind of construction works for comfort improvements: at a smaller scale, (inside their newly bought apartments or outside with closed balconies or HVAC units), or at a larger scale with thermal rehabilitation and pitched roof / attic solutions (partially for their own housing unit or for the whole building). This paper propose a concrete attic solution, completely different from the actual offers, with a large scale applicability due to prefabricated elements for structure and enclosing parts, with light weight. The structural novelty is given by a prefabricated concrete frame, with small trapeze section elements, together with a special detail connecting the new frame with the old building structural parts.

Keywords: prefabricated panel block, light concrete structural attic

1. Introduction

The 1989 Revolution meant a big change in people's mentality over life: a political switch from communism to liberalism was a challenge for everyone – social, economical and ideological freedom. But over the next twenty years, this lack of control in almost every industry field had a bad management. Especially in construction (and architectural) works, the interventions on existing building stock reflected the absence of know-how – contemporary trends, techniques, materials, practical applications – combined with personal interests above the community / public benefit.
The housing concrete blocks, as the most representative living units from the communism era, became the best support for all kinds of comfort interventions. They reflected first of all the social status of the new owners (former tenants) and only after that, the cultural education (or its absence).
These are the main reasons why all grey and monotonous "matchboxes" started to look more like a patched pattern on different stories or same level but different apartments – colors, materials – for facades' panels, exterior windows and doors, closing balconies, pitched roof with all kinds of forms.

The interior changes were not so obvious from an outside / urban point of view, but some of them were quite important. The exterior aspect was changed permanently with personal works as those

[*] Corresponding author: Tel.: + 40720060397; fax: +40256228717
E-mail address: catalina.bocan@arh.upt.ro

mentioned above. Only in the last 10 years, the tenants associations started to develop some collective projects considering the whole building, or at least one staircase. Even in these interventions, the lack of coordination between staircases from the same block led to a vertical separation and a strange image of the whole. The implication of a third party (a real estate agency or a mixed company – builder and seller) guided the interventions to a new direction – the market.
All construction works on existing buildings were developed by the different parts involved, strongly connected with personal interests. The exterior rehabilitations and new pitched roofs were built by contractors with no concern for good design or an overall image for the whole ensemble (Fig.1).

Figure 1. Existing "attics".

Whenever an attic was involved, the interest was only in maximum for sale area, transposed in a complete new story with the same area as the beneath levels. The usual materials used for the new roof level were masonry, steel and wood / combination of these. Due to the financial problems and real estate market, the interventions were always made with minimum costs and cheap materials.
The idea of a general study and possible application on a large scale for so many existing building came from the architectural / urban chaos created all around the collective living' districts in Romanian cities.

Other countries (as those mentioned at the beginning of the paper) had a quicker reaction and a better control over the proposed /realized intervention. At a European scale, there were very good programs developed and some even applied on these "historic" buildings. These studies (from IEE – Intelligent Europe Energy – with ROSH, InoFIN, Factor 4 programs, TREES - training for renovated energy efficient social housing, CONCERTO, SureFIT - Sustainable Roof Extesion Retrofit for High Rise Social Housing in Europe) together with other programs / institutes (BPIE – Buildings Performance Institute Europe, CASH – Cities Action for Sustainable Housing, ASIEPI – assessment and improvement of the EPBD impact, BUILD UP portal – energy solutions for better buildings) and national applications (Germany, The Netherlands, Poland, The Czech Republic, Slovakia, Hungary) [1] created a precedent that shows the great opportunity for an improved solution and a sustainable project. (Fig.2, 3)

Figure 2. Application of SureFIT program.

Figure 3. Application of SureFIT program.

In Romania, because most of these blocks are prefabricated, they usually have the same openings, together with the same structural elements: prefabricated concrete panels. The idea of prefabrication, as it was understood at the beginning of communist period, can be applied to create a unique structural system, usable for as many buildings as possible. The use of repetitive and light structural elements, together with light closing elements, also prefabricated, could be a perfect financial solution for so many "commieblocks". Our country has a distinct characteristic – the seismic movements – that implies some other / extra issues to be taken into consideration on each project.

2. Case study

The studied building proposed for a "new" image of roof retrofit, type 770, has (probably) the largest spreading of all standardized constructions in Romania. With a rectangular form and three main subtypes (Pa, Pb and Pc – each of this with 4 versions) – [2], it presents small structural cells (2.4m, 3.0m, 3.3m, 3.6m and 5.4m) and standard width for connection of different types (11.2m). With 5 levels of 2.7m height and a technical basement with only 1.7m height, it accommodates 6 types of apartments (2, 3 or 4 rooms, type I or II), different ending block panels(opening on long / short side) offering 88 sections of buildings and 72 types of concrete panels, with 1 to 4 staircases. Structural and architectural elements were uniformly used for each of these constructions (Fig. 4).

Figure 4. Block 770 subtypes.

The choice for a hypothetical building made of 3 different sections (Pa1 +Pb3 + Pc1) is motivated by the challenge to show a capacity for large scale usage design concerning the great amount of identical constructions. The 3 staircases / accesses, each section having its own, are also distinct, as shown in the image below (Fig. 5).

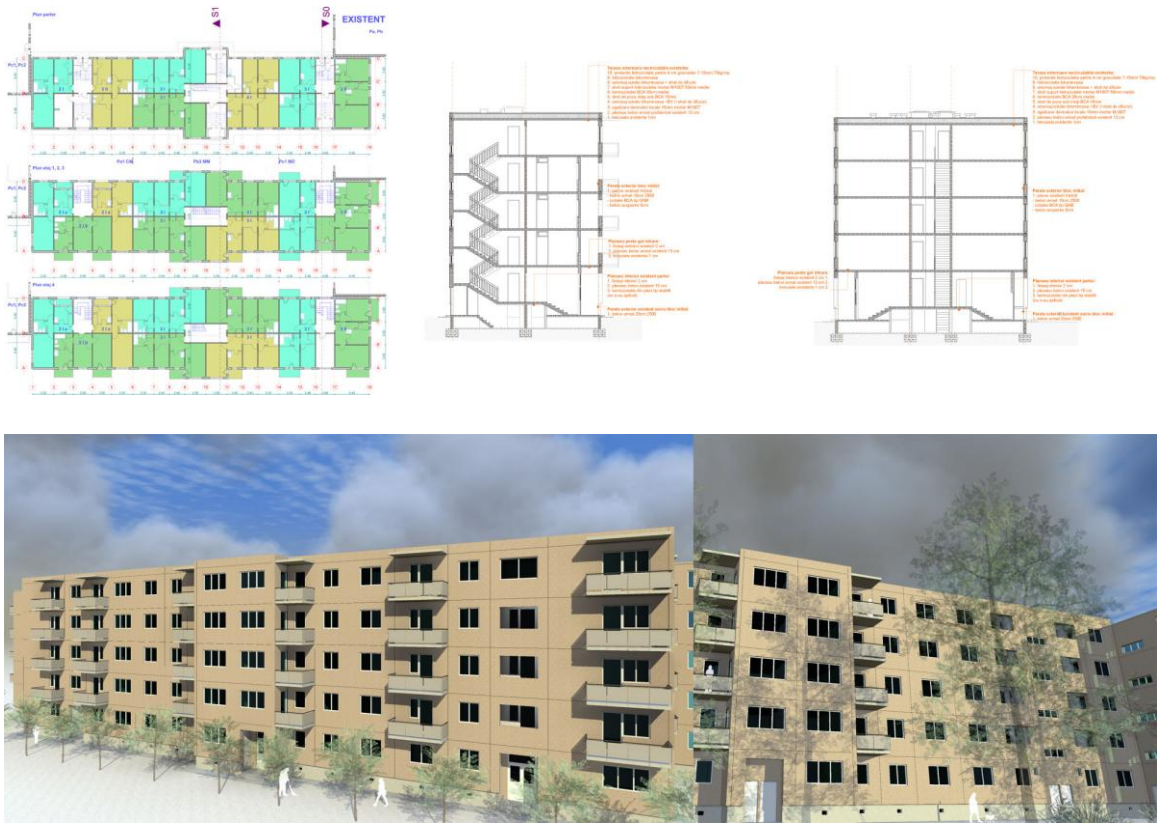

Figure 5. Case study building.

3. Proposed solution

For the new level, called "attic" according to our national norms, there were several self-imposed conditions: double orientation for apartments with open spaces; continuity for mechanical features, simple and quickly assembled structure, placed on the same structural grid as the panels below; horizontal and vertical closing elements light and also with quick execution; modulated new openings according to the dimensions of closing walls; exterior aspect that integrates the traditional image of a cubic volume (Fig.6).

Figure 6. Proposed building for intervention.

There were also studied the many possibilities of an exterior elevator position, due to the difficulties

of integrating it inside the existing structure: near the main access, with small distance or attached to the exterior panel or near the secondary (backyard access) detached from the building (in order to avoid the disturbance of existing apartments) (Fig. 7).

Figure 7. Possibilities for elevators (on main façade).

Between the two options for a new level (the more real-estate oriented with exterior walls placed exactly over the panels underneath and maximum saleable area and a penthouse solution with a continuous terrace enclosing the inner space), the choice was simple and architectural motivated: a recessed volume to articulate the big volume from beneath and with more quality spaces than existing ones, and exterior elevators detached placed on the long secondary facade.

The urban approach was made considering that the long facades offer the only socializing and interacting spaces, with a demi-basement car parking under a big playground field and all ages park area (benches, trees) organized instead of the actual improvised garages and the neglected zone surrounded on four sides by the multi-level dwellings (Fig. 8).

Figure 8. Ensemble 3D images.

4. Structural innovation

The usual accepted and used solutions for these kind of interventions are with masonry, metal and especially wood elements, with less concrete, because of: loading considerations, cheap and not so qualified workforce, use of small elements, a psychological factor related to pitched roof instead of bad executed flat roof, greatest saleable area. The biggest disadvantages are: the small fire degree resistance and the most important, the aesthetics of the whole ensemble (a big volume with a “hat”). The structural novelty is given by a prefabricated concrete frame, with small trapeze section elements, together with a special detail connecting the new frame with the old building structural parts. This new structure is independent from the envelope, the columns being left visible and

outside of the recessed walls in order to give a fresh aspect to the whole construction and new usable outside space for the penthouse apartments (Fig. 9).

Figure 9. Structural frames of the "attic".

The position of frames, placed on the existing structural grid of concrete panels below, gives a dynamic rhythm on the upper part of the monotonous "commieblock". The envelope elements (walls and roofs) are also prefabricated and energy efficient composites, with light weight and quick process of assembling [3, 4, 5]. There are three columns, two exterior ("L" shaped) and one interior (central) and two horizontal beams, as showed in the next figure (Fig.10). All of them are prefabricated, made out of reinforced concrete. Because of their small sections and of a large scale production (same section can be used for so many buildings). The exterior columns and the beams have a trapeze section and the central column has just a trapeze capital for a good connection with the other new elements. The exterior horizontal part of the columns is protected with a light canopy that offers shadows to the surrounding terrace.

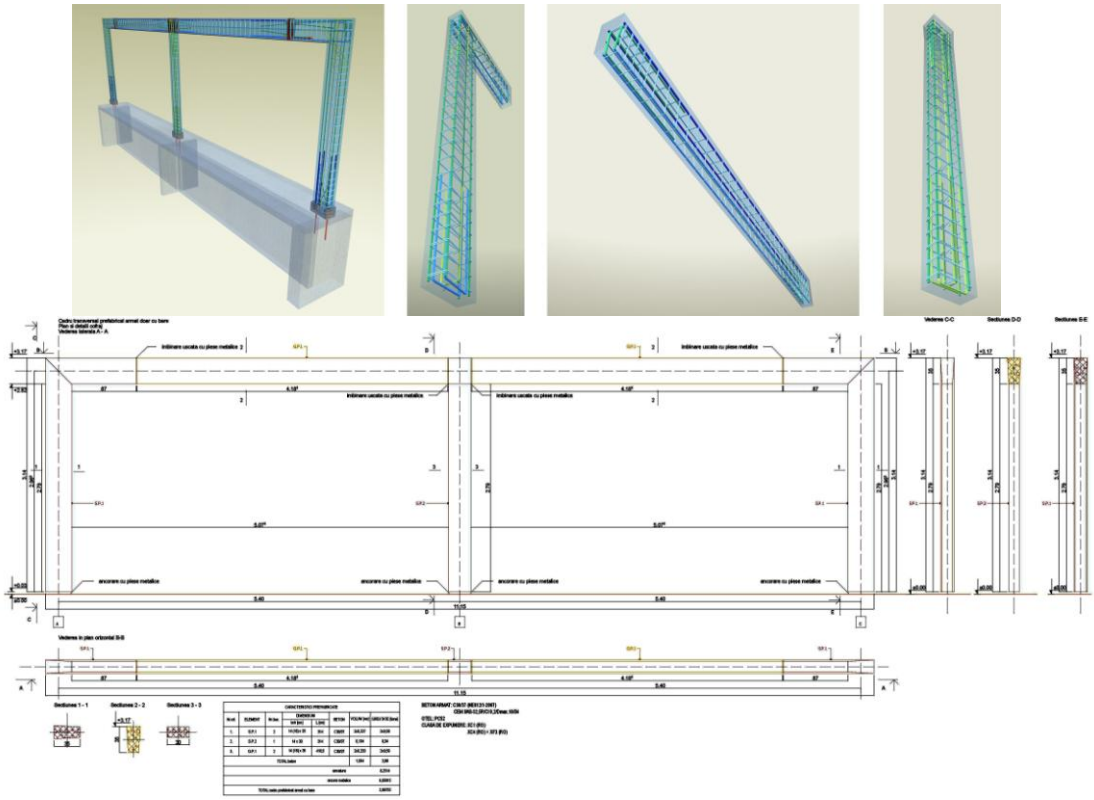

Figure 10. Detailed elements of the structural frame.

The joint between the original structure and the new one consists of an original made of steel element, with columns shoes and chemically anchored bolts (for 45cm length) to the interior structural walls underneath. The column base connection is a rigid node, non-monolith and the gaps

are filled with a special effusive cement from Sika producer and all metal components (screws, nuts, washers, etc.) have to have a special strength (at least 8.8 or 10.9). The same element, weighting 22kg/piece is used for all the same columns and inside the section together with the metal reinforcements (Fig. 11).

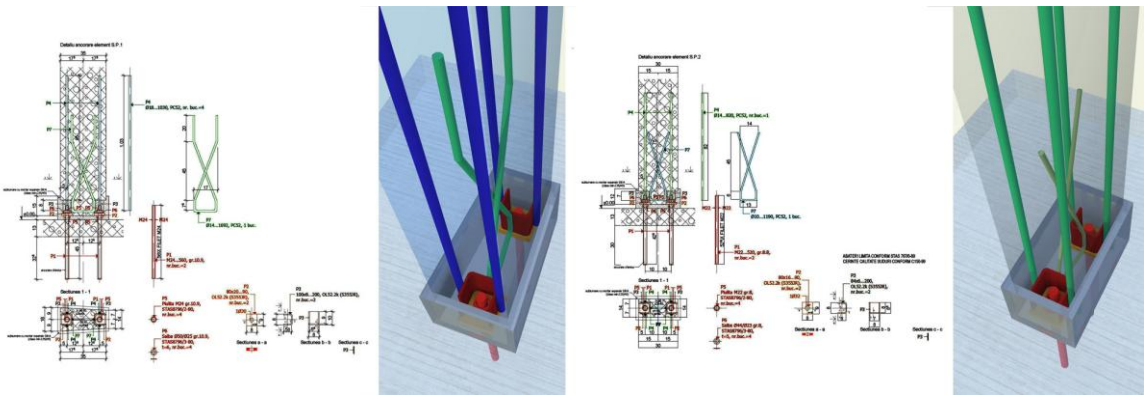

Figure 11. Detailed connection with the existing structure.

A similar connection is used between the three columns and the two beams, also with metal pieces and bolts (Fig. 12). All these joints allow a quick assembly and a shortage of the execution period.

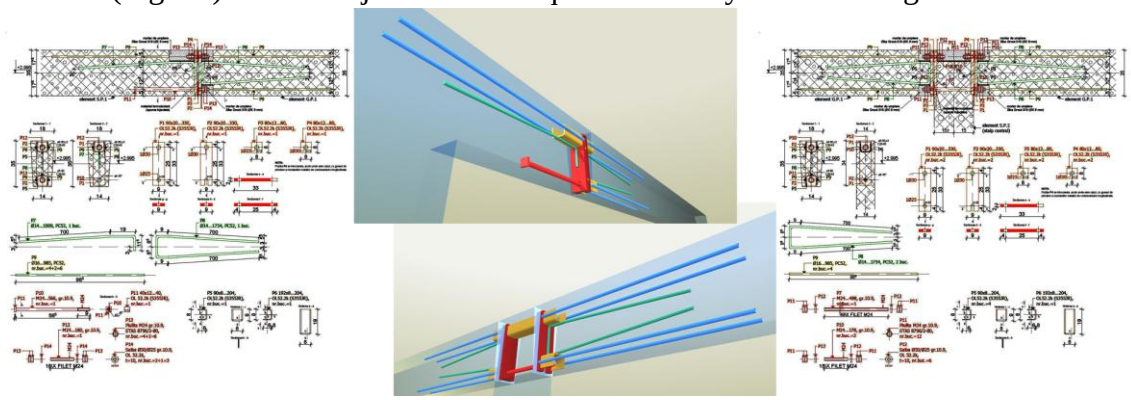

Figure 12. Detailed connections between columns and beams.

5. Conclusions

The innovation of the proposed solution is a combination between a flat roof penthouse, use of prefabricates concrete for structural elements, special joint between the panel concrete walls and the new frame plus a whole different approach concerning architectural design for a “matchbox” with a cap. All these represent an opposed point of view to the current pitched roofs, maximum saleable area of new apartments, no exterior spaces for the new story, painted design for facades. The use of prefabricated elements, made of concrete (with a very good fire behavior), allows a contemporary roof retrofit, architectural and sustainable.
This paper presents a thorough solution, from an architectural and structural point of view, as an extract from my PhD Thesis.

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6. References

[1] ***, ec.europa.eu/energy/intelligent/ , www.**buildup**.eu , www.**sure-fit**.eu

[2] ***, 1983. Large panels living units P+4. *Project 770 – 83 Short description Brochure.*

[3] ***, 2009. Thermal Insulation Panel Glupan. *Glulam Company Presentation Brochure*.

[4] ***, 2010. Kingspan X-dek KS1000 XD − Longspan Roofpanel. *Kingspan Company Brochure.*

[5] Hegger, M. & Auch-Schwelk, V. & Fuchs, M. & Rosenkranz, T. Insulating and sealing. In Edition DETAIL. *Construction Materials Manual*. Munich: Birkhauser; pp.132-141, 2005.