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IN CO-OPERATION WITH:

Energy efficient roofs retrofit for communist prefab concrete blocks

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Introduction

- During Communist regime, Romania had an important soviet influence in construction field
- Projects designed by the National Institute of Standardized Buildings
- There were few types with many subtypes.
- Because of seismic movements, great openings were not available.
- Norms together with maximum usable areas and price limitations lead to improvements of same type of concrete blocks.
- As general features, 30 cm modulation and maximum weight of panels limited to 5.5 tons were used everywhere.

Introduction

- Specific local details enriched the usually "grey" and monotonous facades
- These buildings are used at their full capacity even today
- The infrastructure and facilities are inadequate to such big number of cars (with not enough socializing or playground areas nearby).

Project type 770

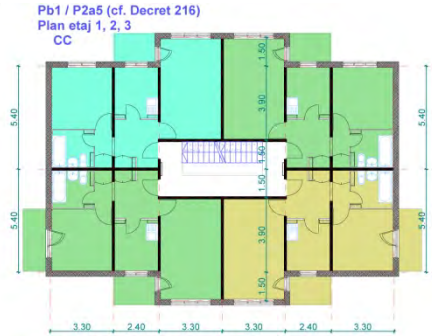
Communist existing buildings

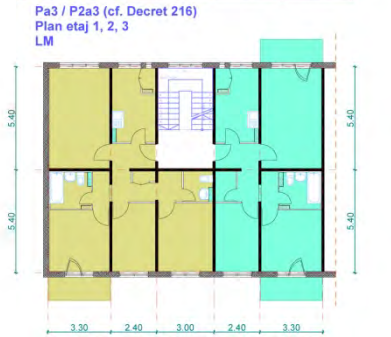
One of the most extensively used projects, called 770, with its twelve subtypes (Pa1, Pa2, Pa3, Pa4, Pb1, Pb2, Pb3, Pb4, Pc1, Pc2, Pc3 and Pc4), can be found all around the country.

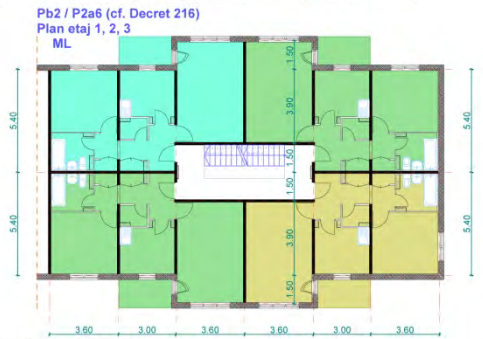
Project type 770

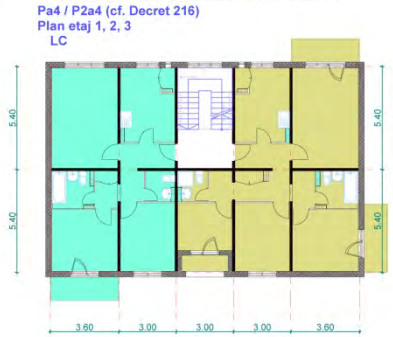
Communist existing buildings

- The last variant designed in 1983 – rectangular "matchboxes" – with 6 types of apartments (with 2, 3 or 4 rooms), small structural cells (2.4 m, 3.0 m, 3.3 m, 3.6 m or 5.4 m) and a standard coupling width of 11.2 m.
- Five levels of apartments with same height (2.7 m) while the technical basement has just 1.7 m.





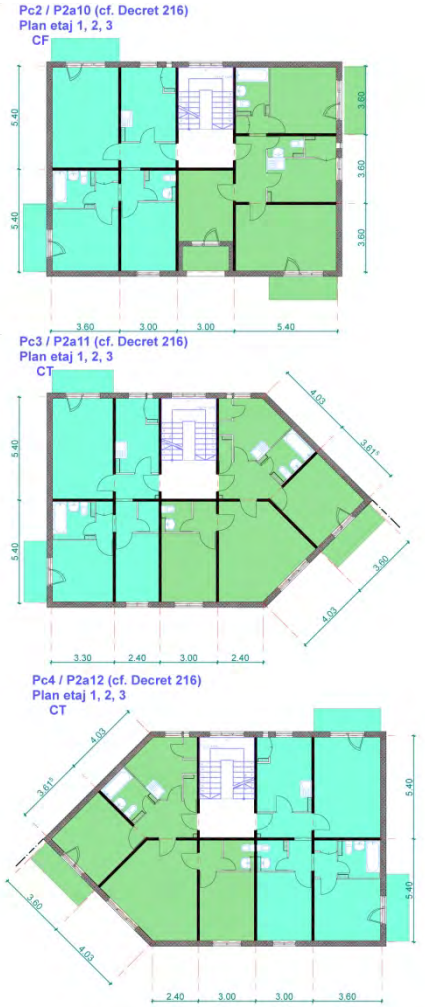




Project type 770

Communist existing buildings

- The different ending block panels (opening on long / short side) offer 88 sections of buildings and 72 types of concrete panels, with 1 to 4 staircases.
- Prefabricated construction elements, with structure made out of concrete
- Exterior panels made out of three layers and 30 cm thickness, interior walls and slabs also from reinforced concrete.
- Flat roof with thick thermal insulation (expanded clay or autoclaved aerated concrete), usually deteriorated by the poorly executed waterproofing works and many uncontrolled leaking.
- Prefabricated plumbing features and carpentry elements (apartment windows and doors), the common spaces having metal doors.



Post revolutionary small scale interventions

- After 1989's Revolution, the new owners (former tenants) improved their own comfort through small scale interventions, interior and also exterior.
- Different construction works – replacement of wood fenestration with white PVC double glazing, closing balconies, exterior units of HVAC, outside enlarging ground floor apartments, single apartment exterior insulation, change of thermal system (district heating to individual unit)
- The financial power and knowledge of each occupant was reflected in these small scale interventions, especially those regarding exterior aspect of the entire building.

Post revolutionary small scale interventions

- General alterations were developed for each staircase's apartments or Owner's Associations by changing the roof
- The need to have a traditional aspect with small price and no concern for the whole building image, along with a general rejection for flat roofs
- Sometimes, the result was worse than the primary conformation
- Each staircases could receive a local and different "hat" (form, material, colour, etc.)

National Rehabilitation Program

- Since 2002, the National Program for Thermal Rehabilitation of collective dwellings reached its peak in 2009.
- The whole program included for 2004-2014 25.000 multi-storey buildings and 0.8 million apartments. (Later 3 million apartments and the need of 11 billion euro).
- Selection criteria: older buildings, greater number of apartments, construction envelope type (preference for concrete prefabricated panels), technical conditions, mildew or dampness, climatic area. (no urban reasons and other exterior / social / public works).

National Rehabilitation Program

- For housing rehabilitation measures: thermal insulation, pitched roof (no attics), replacement of exterior doors and windows, replacement of common mechanical features.
- Costs shared between the state, the local authorities and the owners' association; from 2010, the State switched to bank credit with governmental guarantee.
- Architecturally, the final "product" doesn't show a contemporary aesthetic attitude, just vivid colours on facades, white PVC windows and improved comfort inside - less money for energy costs with individual heating system.
- Cheap materials + lack of specialists' involvement (financial constraints), small interest for a unitary district aspect → erratic and colourful ensembles

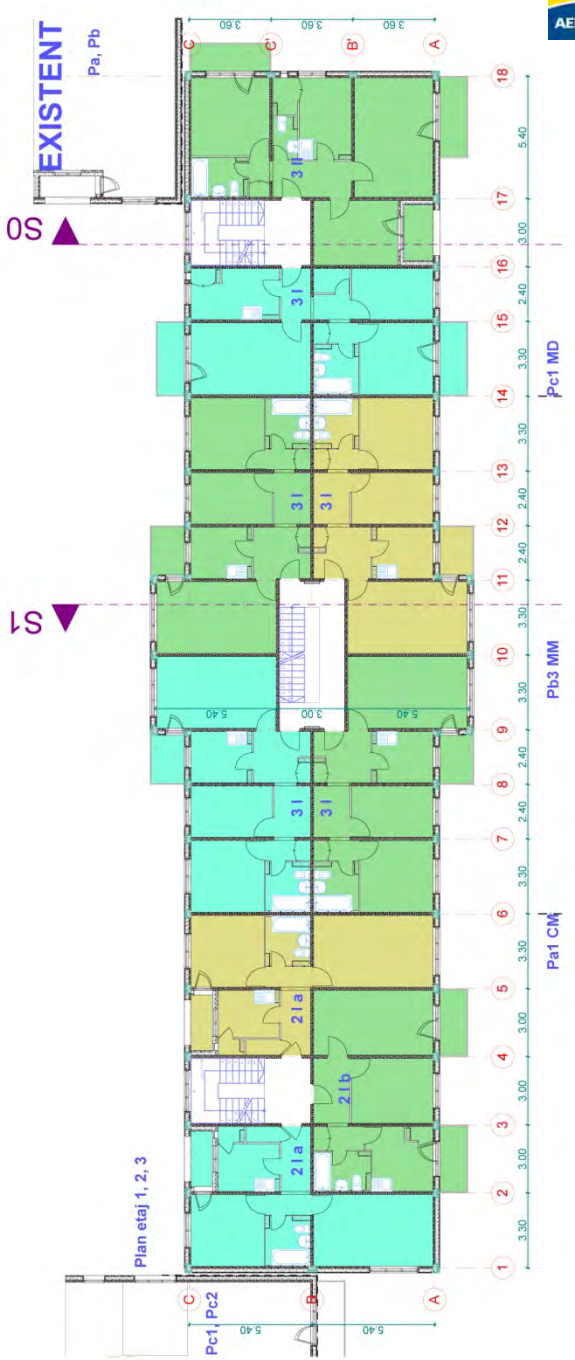
Attics and real estate market

- Combination between thermal exterior insulation and pitched roof developed by real estate agencies or contractors in exchange of new attic apartments with maximum saleable area
- A whole new level, without elevator (according to nowadays legislation) - extra housing units in the same urban area, suffocated by cars.
- Highly appreciated on real estate market.
- Problems: legal aspects concerning private and collective property, same fire and structural resistance, insufficient mechanical features, more parking spaces needed.
- Architectural aspect: different solutions applied on the same building, each staircase (sometimes equivalent with the owners' association) having a distinct look.

Proposed roof retrofit

Description of selected building

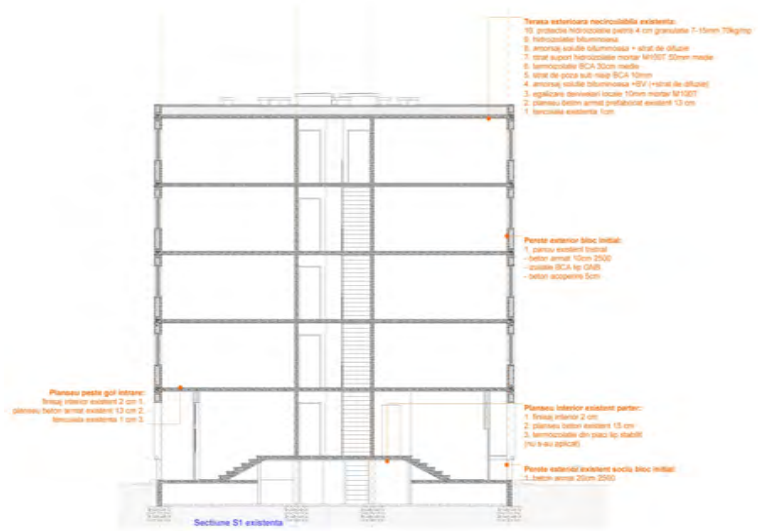
- A great opportunity of applicability all over Romania is a sustainable solution for this prefabricated “commieblocks”
- The choice of a widespread building type and uniform intervention treating problems like comfort, social all ages areas and even parking.
- The use of energy efficient composite materials and a complete approach of exterior design to provide contemporary comfortable new plus old apartments
- The study case considers a building with three staircases, no settlement joint and three different subtypes (Pa1, Pb3 and Pc1); the hypothetical building allows similar blocks to be urban related with the studied one

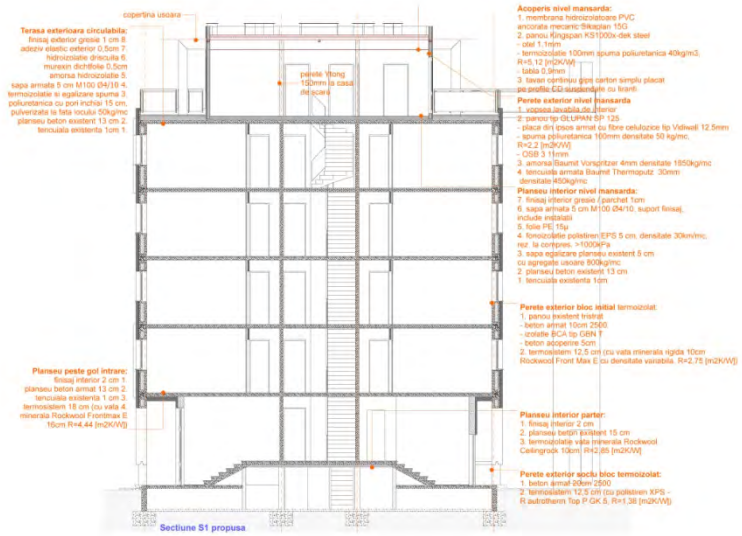


Proposed roof retrofit

Self imposed constraints

- A reaction to actual interventions: less interference with the residents during construction works through a quick execution, respect for actual legal constraints, a new and aesthetical image for old blocks.
- The legal constraint of an elevator: an exterior position, detached from the façade, private windows or balconies.
- Fire resistance: the existing concrete building have a very good fire behavior. Any addition should maintain the same degree of fire resistance – most of the existing interventions don't comply with this rule.
- Weight of new attic construction has to be similar with the removed components of the former flat roof.

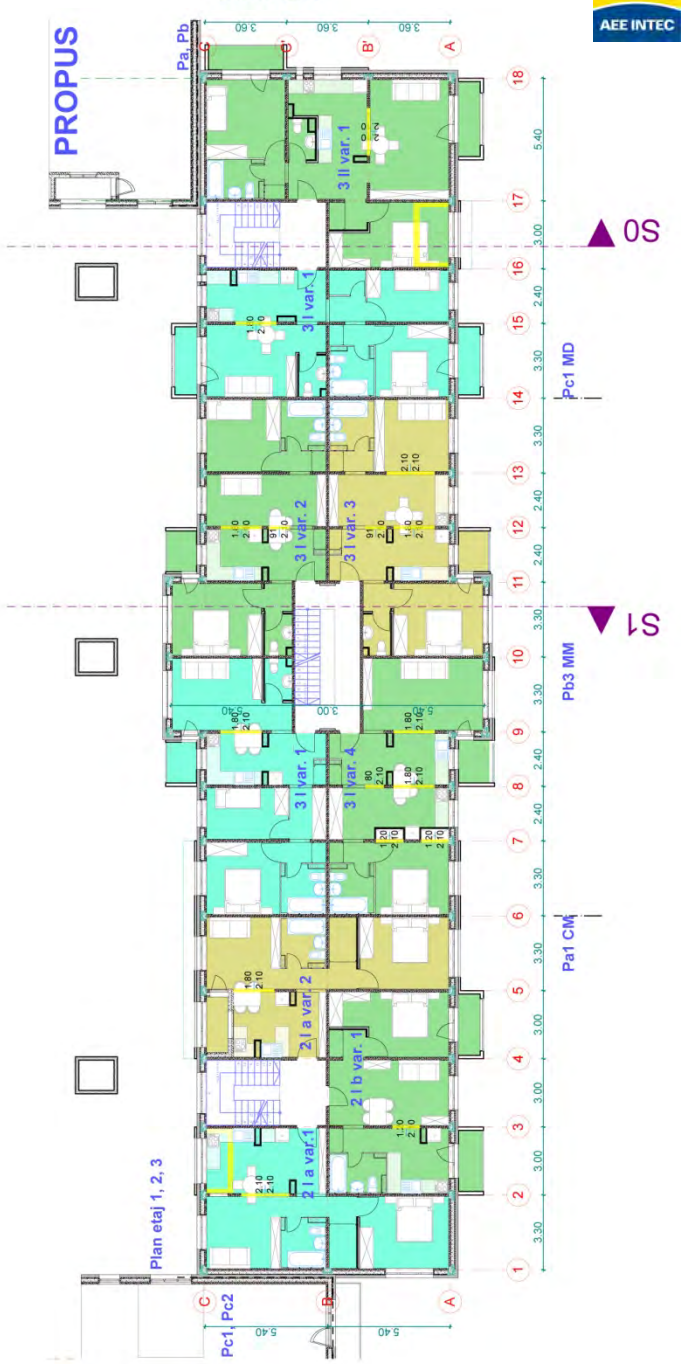




Proposed roof retrofit

Architectural innovative solution

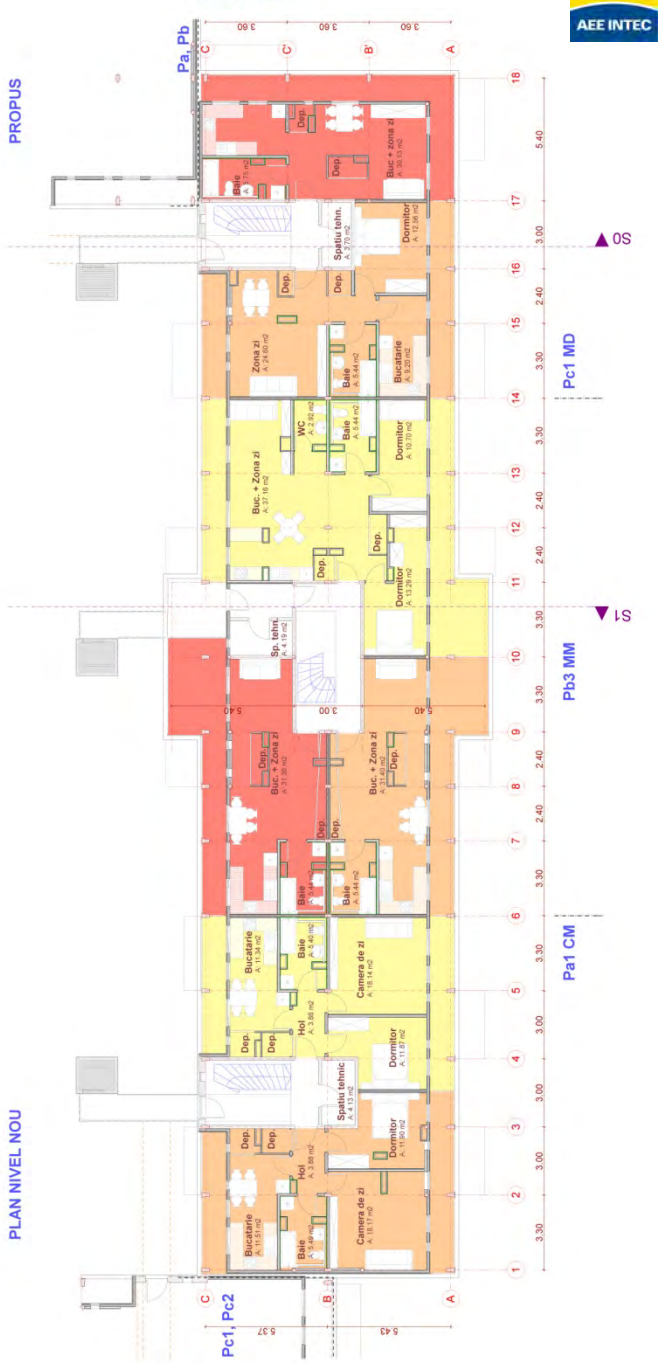
- Old apartments: respect of private property, with some variants – very small structural but controlled damages.
- Exterior thermal insulation with mineral wool, changing of wood windows with efficient double glazing together with controlled
-ventilation, along with new outside image.
- Extra measures – insulations of basement ceiling and flat roof insulation (thermal and hydro) + new plumbing features
- Different treatment of balconies (open, partially or completely closed) means diversity, but still unanimous treatment of exterior architectural elements



Proposed roof retrofit

Architectural innovative solution

The new level uses an existing infrastructure, so there is no need for foundations, utilities and accesses.
- Same staircase space + exterior detached elevator (also used for last upper floors); at the corner of two buildings, a single elevator can serve the both accesses.
- Interior open space design with no structural barriers, with identical and repeated light concrete frames consisting of 3 columns (2 exterior and one interior – in the middle) and 2 beams.
- Recessed closing vertical elements, completely separated from the structural frames, with a continuous terrace for the new apartments



Proposed roof retrofit

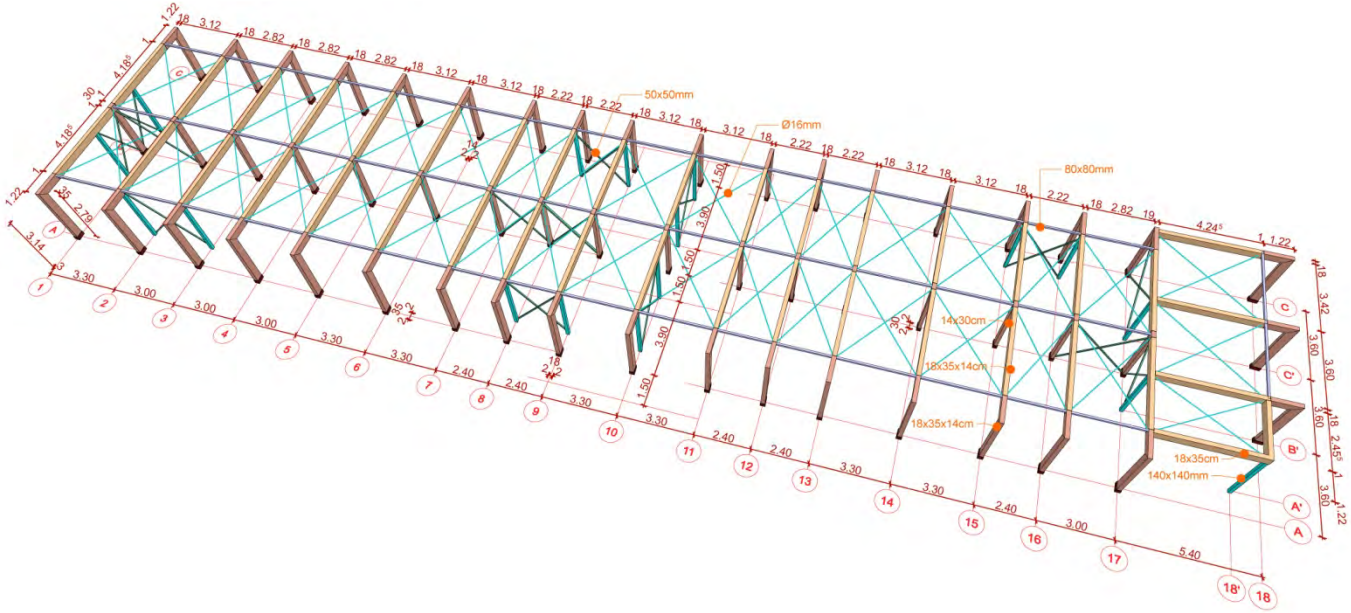
Architectural innovative solution

The facades are an urban image, being very important in rehabilitation process.
- The image of urban vicinity is completely changed through a square proposal, regarding parking places and playing / socializing spaces, all together in the middle of the plot, surrounded by the “back” facades and new erected elevators.
- A demi-basement parking with social areas above replace the nowadays concrete panels garages randomly erected
- The pedestrian area, a combination between parking alleys with sitting areas and playground equipments

Proposed roof retrofit

Energy efficient measures and EPC

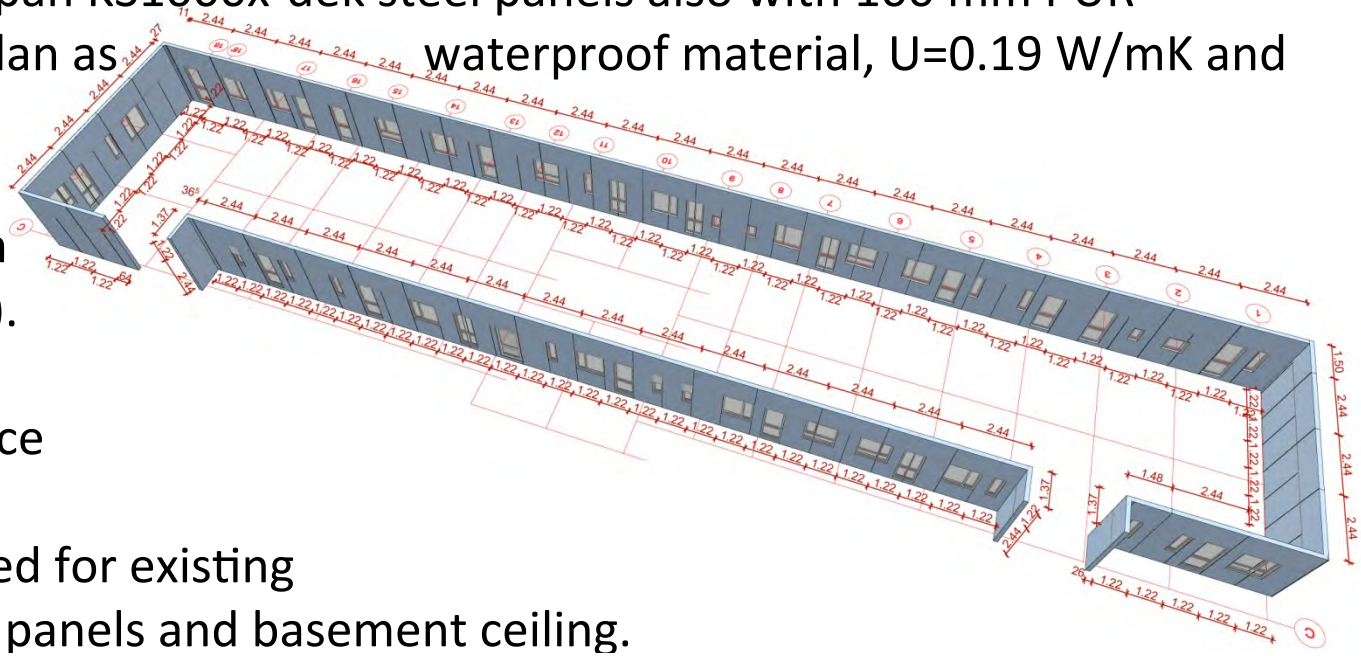
- Only energy efficient composite materials, light, good fire behaviour and quickly erected
- Only prefabricated elements to reduce execution time and to minimize the interference with occupants beneath
- Light prefabricated frames made out of reinforced concrete as a structural solution (with trapeze section, overlapped exactly above the existing structural grid)



Proposed roof retrofit

Energy efficient measures and EPC

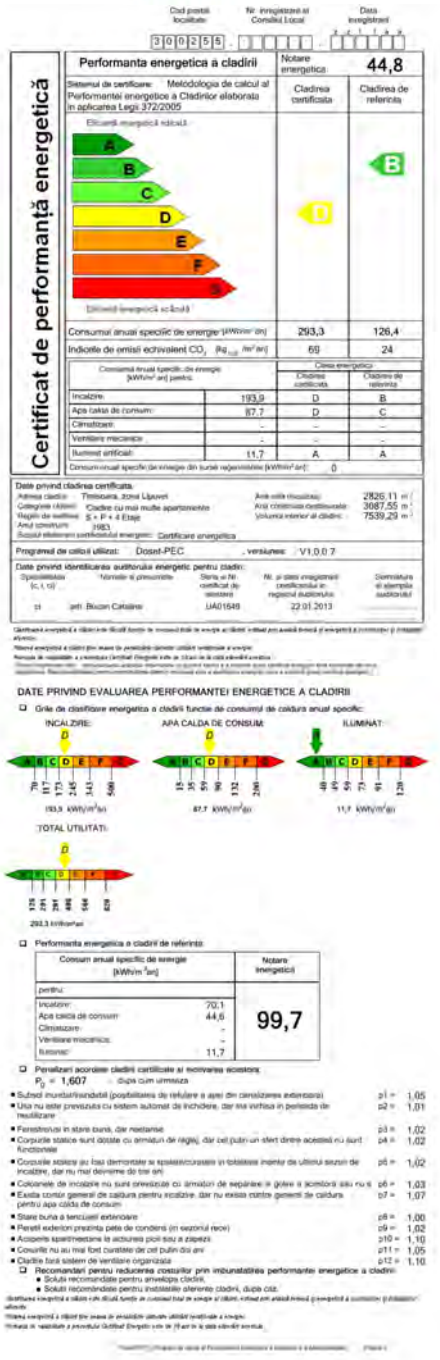
- Light triple layer walls called Glupan 125 with Vidiwal fibre reinforced interior gypsum board, rigid polyurethane foam (PUR) in the middle and OSB board outside has 125 mm width, U=0.022 W/mK, 27.55 kg/sqm and vertical elements (including openings) modelled after its dimensions (outside protection made with Baumit Thermoputz plaster).
- The flat roof uses Kingspan KS1000x-dek steel panels also with 100 mm PUR insulation and PVC Sikaplan as waterproof material, U=0.19 W/mK and 24.6 kg/sqm
- New PVC doors and windows from Internorm (Kunstoff Passion 4-16-4).
- PUR insulation, in situ applied for existing terrace new insulation
- Rockwool insulation used for existing exterior prefab concrete panels and basement ceiling.



Proposed roof retrofit

Energy efficient measures and EPC

- A thermal and energetic expertise was done (for existing and rehabilitaed building), concluded with an Energy Performance Certificate (EPC)
- The old block (1983), the minimum thermal resistance corrected (R'M) with thermal bridges of envelopes' each element is lower than the admissible values (sanitary – R'nec and energy efficiency conditions – R'min) and condense appears inside exterior panels and flat roof (table 1).



Thermal resistance for each envelope element on existing building

Construction element	Area	R'M	R'nec	R'min
	[m²]	[m²K/W]	[m²K/W]	[m²K/W]
Exterior wall	1465.87	0.606	1.188	1.4
Flat roof terrace	570.06	1.132	1.583	3
Slab over basement	560.36	0.244	1.416	1.65
Exterior fenestration	352.31	0.369	0.39	0.4

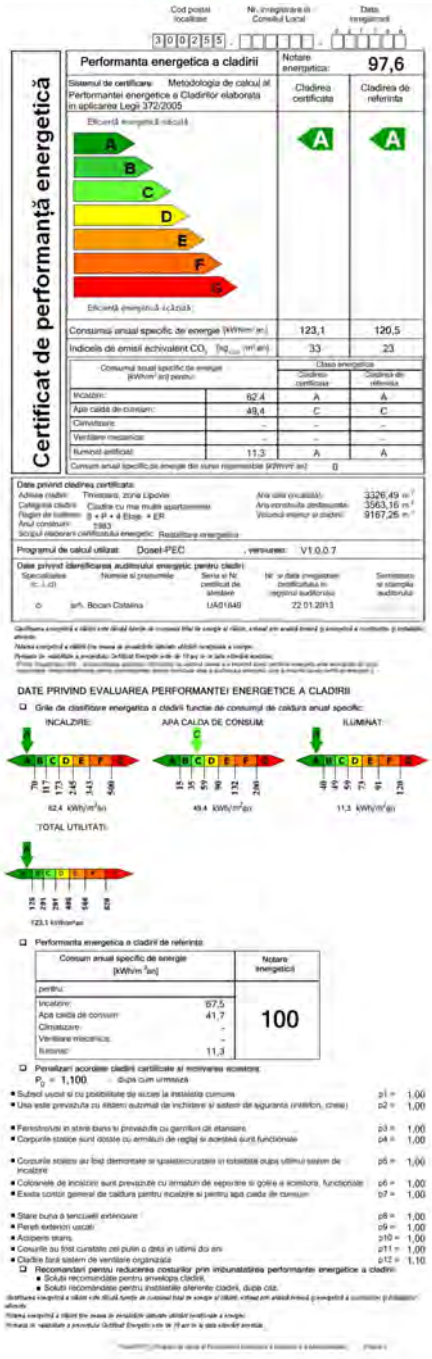
Proposed roof retrofit

Energy efficient measures and EPC

- The extended and rehabilitated block, with all new materials enumerated above, exceeds the admissible values and there is no mildew
- The use of mineral wool instead of polystyrene is recommended (fire safety, sustainability).
- The use of PUR insulation allows minimal width when is needed (existing terrace – new attic floor).
- The use of concrete as main structural material has never been used in this manner before because of a psychological rejection for prefabrication and flat roofs.

Thermal resistance for each envelope element on rehabilitated building

Construction element	A	R'M	R'nec	R'min
	[m²]	[m²K/W]	[m²K/W]	[m²K/W]
Exterior wall	1732.39	2.619	1.188	1.8
Flat roof terrace	577.54	5.146	1.583	5.0
Slab over basement	560.36	3.045	1.416	2.9
Exterior fenestration	448.48	0.833	0.39	0.77



CONCLUSIONS

- A roof retrofit by creating an attic, combined with a thermal retrofit = a challenge for Romanian people, running away from flat roof, prefab concrete structures and small spaces.
- Sustainable arguments: the reuse of existing infrastructure, good energy quality prefabricated materials, quickly erected design solution and smaller disturbance, opportunity for large scale applicability.
- The actual apartments' inhabitants pay less money for building rehabilitation and the energetic performance of the whole construction is much better than without the new attic

CONCLUSIONS

Innovation of this solution given by a mixture of:
- new attic / penthouse design adverse to general adopted solution with pitch roof;
- new prefabricated materials used for structural and enclosing part, opposite to wood / masonry/ metal/small tiles;
- little structural elements inside the new apartments;
- large covered terraces for the penthouse apartments;
- new elevator used as a dynamic element for the back/inner court facade (with less balconies).

The relocation is not a viable solution and construction works with residents in the building can be very difficult.

THANK YOU FOR YOUR ATTENTION

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