NEW APPLITECHNOLOGY, EFFICIENCY AND LIGHTING INITIATIVE

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Design of building envelope insulation, with external appearance of the buildings

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1. Building Thermal Insulation

1.1. *General*

Soviet heritage of" Khruschev" type residential buildings is a serious burden on Energy balance of Georgia. The multi-apartment residential buildings were constructed in a hurry, without due consideration of thermal resistance of building envelope and were designed for continuous heat supply with district heating systems.

The thermal resistance of the most of the buildings is low. Starting from 1960-ies when the massive construction of residential block buildings started, the thermal resistance of building walls was gradually reduced from initial figures of about 0.7 m^2K/W for 40cm brick walls to the numbers as low as 0.5 m^2K/W and even lower when 25cm concrete panel walls were introduced. In late 1990-ies and early 2000s the construction activity in Georgia revived at accelerated pace but the quality of construction was very low and even Soviet inefficient norms were neglected this complete neglect of thermal characteristics of buildings has resulted in extremely inefficient building stock causing huge thermal

Losses. According to some estimates, up to 80% of heating energy consumption is wasted if compared to the European standards of construction[1].

The inefficient buildings are the cause either of residents' inability to heat the whole apartments or their excessive energy expenditures. This building stock constitutes the major portion (60%)[2] of urban residential space and requires some systemic solutions in order to reduce energy waste and improve the living conditions.

After initial round of Energy Audits conducted in common areas of residential buildings in Tbilisi[3] the City hall has requested pilot projects to be designed and conducted in order to demonstrate the potential of energy efficiency and renewable energy use in Tbilisi residential buildings. Thermal insulation is essential part of improving energy performance of the buildings. Therefore it was decided to examine the feasibility of thermal insulation of these buildings together with possible improvements of the exterior appearance.

Two typical buildings were selected 53/53a Saburtalo st. and Building 1, IV block, Vazha Pshavela Avenue. Both buildings have of 40cm thickness brick walls and therefore represent the better part of

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[1] Energy problems of residential housing in Georgia G.Sadagashvili – http://weg.ge/index.php?option=com_content&task=view&id=102&Itemid=55

[2] Survey of current construction practices and recommendation to building industry to improve of energy efficiency in Georgia A.Matrosov K.Melikidze, N.Verulava 2008. USAID/Winrock International.

[3] Energy Audit Report WEG/Winrock International/USAID 2010 http://weg.ge/images/stories/publications/reports/Final_Energy_Audit_Report.pdf

Khruschovka type buildings. The heat losses were studied with the help of thermography imaging, to highlight the main common problems of heat loss and identify the highest loss areas (Appendix 1).

Several key suppliers of insulation material and technology have been contacted and cost estimates together with their conceptual design solutions were requested. In order not to create the false expectations the vendors were explicitly informed that this request is not a tender announcement and does not imply the implementation of the project or their participation in the final implementation in any way. The following three vendors replied with their solutions and respective cost estimates: Caparol, Rockwool, Ergo Greece. The information on local basalt fiber wool and fabric manufacturer BPG was shared from website and energy audit conducted in the selected buildings by SDAP.

Below the suggested technologies of building thermal insulation are discussed and the results obtained from different vendors as well as *with own research* are summarized together.

1.2. Building insulation Technologies

The complex of building insulation measures consists of

a. Replacement of old wooden single glazed windows and doors with air tight PVC frame double glazing windows and doors
b. Thermal insulation of building walls with appropriate proven technology
c. Insulation of ceilings/attics
d. Necessary repairs and refurbishments

Table 1. Below summarizes the types of works included in the feedback from different vendors.

Table 1.

	Saburtalo 53	Vazha Pshavela	Wall Insulation	Attic Insulation	Window replacement	Roof repair/ replacement	Building basalt apron
Rockwool/Green build	X	X	X	X	X	X	
Caparol	X		X				
Ergo Greece	X	X	X	X	X	X	X
Energy Audit (Basalt wool)	X	X	X	X	X	X	

Caparol is a German company producing the materials for covering the wall exterior including paints, plasters and insulation materials. They have an established representation office in Tbilisi. Several new and existing buildings have been insulated in Tbilisi and other parts of Georgia with Caparol material.

Rockwool is an internationally known company with a local representation “Green Build” that has started operation in 2011. The representation is mainly selling the Rockwool insulation materials and has not conducted own installation works yet. They have outsourced the installation work to construction/repair company.

Ergo Greece is a representative/affiliate of a Greek company Isomat using the Greek technology Kelyfos for building insulation. They have a substantial experience in conducting the projects and can provide installation training and oversight along with project implementation.

BPG (used in Energy Audit) is a producer of Basalt fiber and wool material and are not involved in building insulation work. As per our knowledge their material has been applied for sound insulation and not weather proofing. The technology and probably material for building thermal insulation needs to be developed and tested.

The cost estimates and economic analyses were performed based in feedback from these vendors. The numbers may differ at the time of project implementation due to timing and marketing strategies of market participants, however we believe that the quotations obtained fairly represent the initial assessment of final cost.

The summary of feedback from different vendors is provided in the appendix 2.[4]

1.2.1. Technologies for Wall Insulation

Below we summarize the main technologies for building wall external insulation and their characteristics. Insulation is the most effective way to improve the energy efficiency of a home. Insulation of the building envelope helps keep heat in during the winter, and keeps heat out during summer to improve comfort and save energy. Once installed by a qualified thermal insulation company the amount of energy needed to keep the home at a constant temperature will be greatly reduced with the associated reduction in natural resource usage.

Benefits of insulation:

- comfort is improved year-round;
- it reduces the cost of heating and cooling by over 40%;
- there is less need for heating and cooling which saves non-renewable resources and reduces greenhouse gas emissions;
- it virtually eliminates condensation on walls and ceilings; and
- some insulation materials can also be used for sound proofing.

[4] The vendors are not explicitly quoted in the main text to avoid the potential conflict of interest with future competitive bidding.

1.2.2. *Insulation materials and technologies*

Below the technologies for wall insulation available in Georgia are briefly discussed:

Mineral Wool

Mineral (rock) wool is made by melting a combination of rock and sand and then spinning the mixture to make fibers which are formed into different shapes and sizes. The process is similar to making cotton candy.

Advantages:

- Rock wool is clean and convenient it holds together well so it can't spill. It is easy to handle and keeps evaporation to a minimum.
- Since the fibres are non-combustible and have an extreme melting point, rock wool insulation acts as a fire barrier. Its fire resistant characteristics delay the spread of fire, which could add precious minutes for escape during fire Rock wool insulation reduces energy costs and requirements in residential homes, office buildings and manufacturing plants. Rock wool insulation can reduce residential energy bills by at least 40 percent. These energy savings are not just beneficial on the finances, but also for the environment, as the dependence on energy decreases.

Though the individual fibres conduct heat very well, when pressed into rolls and sheets their ability to partition air makes them excellent heat insulators and sound absorbers. Though not immune to the effects of a sufficiently hot fire, the fire resistance of fibreglass, stone wool and ceramic fibres makes them common building materials when passive fire protection is required.

The standard technology for insulation is to attach and glue the mineral wall boards to prepared wall surface, to cover with the protective net, plaster and finish the surface with paint moisture proof paint. This technology is used by various vendors who apply the same techniques for synthetic polystyrene boards as well.

Mineral wools are unattractive to rodents but will provide a structure for bacterial growth if allowed to become wet.

The heat that the material can withstand is:

Material	Temperature
Glass wool	230 - 250 °C
Stone wool	700 - 850 °C
Ceramic fiber wool	1200 °C

Source: http://www.engineeringtoolbox.com/mineral-wool-insulation-k-values-d_815.html

Glass wool mats are mostly imported from Turkey while rock wool is imported by Rockwool and Caparol.

Basalt non-woven mats and fabric (BPG)

This material is produced in Georgia by BPG Ltd. from basalt rock. It is characterized with: high tensile strength, high elasticity module, low moisture absorption, high chemical resistance and wide temperature operating range: (-260°C)...(+850°C).

Basalt and glass fiber combined non-woven mat is efficient for acoustic insulation. Basalt Fiber is safe for human health and is an environmentally friendly product.

According to the producer, basalt fiber diameter exceeds 6 microns and does not enter the human respiration system. No chemical additives are required in the production process. Therefore unlike some fiberglass applications basalt fiber products do not emit chemical elements when heated. For the same reason the production process itself is environmentally friendly.

Basalt mat is environmentally friendly product, and does not contain with organic binders comparing with glass wool; Basalt Mat provides the same thermal insulation qualities with less thickness and specific weight than mineral wools and mats with much thickness. The quoted thermal conductance of this material is 0.031w/m.k[5]

At the same time the basalt mat as it is produced now is more appropriate for thermal insulation in high temperature industrial processes and requires development of adequate technology to be successfully applied in building insulation. The arrangements suggested by the vendor are shown below. According to BPG the most appropriate use of basalt mat is for internal insulation of the walls.

[5] Source: www.bpg.ge

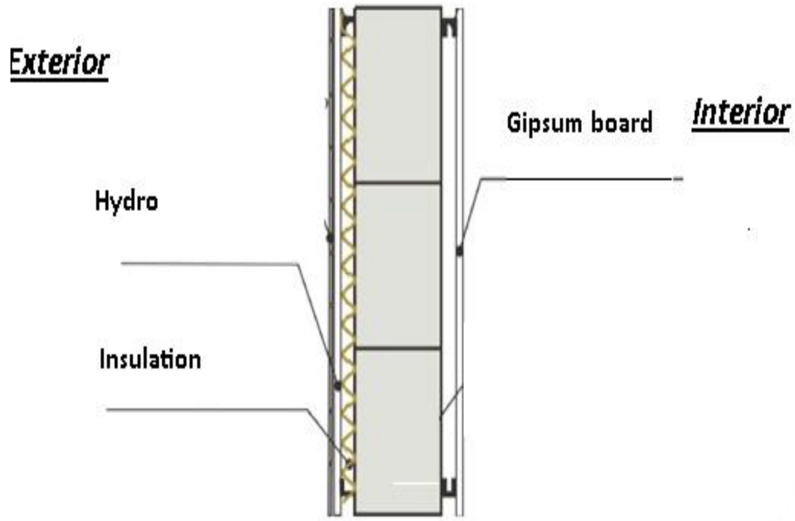


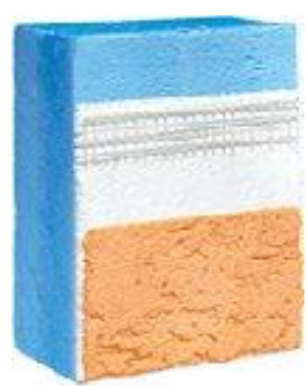
Fig 1. Suggested scheme of insulation of external walls with basalt non-woven bats.

Polystyrene

Polystyrene is a widely used effective wall and roof insulation material. Other soft forms of insulation may collapse over a period of time while polystyrene retains its shape and insulation properties for a long period. The insulation R factor can be varied dependent on the grade and thickness of the extended polystyrene (EPS) board used. In addition EPS sheet can be sandwiched between color-bond steel sheets to form an insulated wall or roof panel. Due to the strength of the steel cladding these panels have the ability to span large distances unsupported making them ideal for cool room walls and roofs where a clean internal surface is required.

Advantages:

- Easy to handle and cut
- Thinner boards
- Long lasting efficient thermal insulation which will remain effective for the life of the building.
- Simple to install without the need of special tools
- 100% homogenous closed cell structure
- Very low moisture absorption
- Excellent mechanical properties



Disadvantages:

- UV sensitive.
- Susceptible to fire unless chemically treated
- The care should be taken of the chemical content of the polystyrene inflating gas.

Source: http://styroq.com/downloads/Styrofoam(English).pdf

Polystyrene Bead Boards

Molded expanded polystyrene, also known as MEPS, EPS, or bead board, consists of many tiny foam beads molded and pressed together. EPS is manufactured in low-density and high-density versions. Low-density EPS is relatively inexpensive, resistant to the effects of moisture, and can be used underground. High-density EPS is even more moisture-resistant, and is manufactured for use on exterior foundation walls and burial against footings, if the soil is relatively dry. EPS typically uses pentane as a blowing agent, avoiding the high global warming potential as well as ozone depletion potential of CFCs, HCFCs.

Source: http://en.wikipedia.org/wiki/Rigid_panel

Advantages:

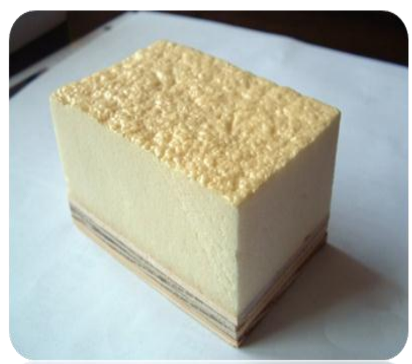
- High R-value per inch - useful where space is tight or cramped.
- Protect foundation and damp-proofing during backfilling (and, of course, insulate foundation).
- All are lightweight and strong - although EPS can be crumbly.
- Provide acoustic insulation as well as thermal.
- Most are easily cut with utility knives.
- All are water resistant, some more so than others (but none should face prolonged exposure to water).
- Will not rot.
- XPS type is highly resistant to air infiltration. Can be virtually airtight if installed without gaps between adjacent panels, with seams taped.
- Reduce heat conduction through the wall frame when used as sheathing.
- Rigid panels with a radiant heat barrier facing foil will significantly improve the insulating properties by reflecting infrared solar energy before penetrating the wall or ceiling.

Disadvantages:

- Susceptible to UV damage and solvents.
- Is flammable and produce toxic fumes when burn. It should be covered with fire-rated drywall (gypsum board) when installed in the interior of a house, unless it has a low flame-spread rating (below 25).
- Some types may be susceptible to termites using them for nesting purposes.
- May have R-values higher than that of still air, if some type of insulating gas was blown into them during manufacturing. For many years, manufacturers used CFCs or urea-formaldehyde as blowing agents. These blowing agents eventually leak out of the panels. CFCs deplete the ozone layer, and formaldehyde is toxic. Some manufacturers still use HCFCs, which are still harmful to the ozone layer, but not to the same extent as CFCs. Eventually, as the blowing agent leaks, air replaces the insulating gas, and the R-value of the panel drops.
- Most rigid panels are made from crude oil byproducts and some toxic pollution results during their manufacturing.

Example of external wall insulation with polystyrene is presented on pictures above.

Polyurethane foam



Polyurethane is an organic polymer formed by reacting a polyol (an alcohol with more than two reactive hydroxyl groups per molecule) with a diisocyanate or a polymeric isocyanate in the presence of suitable catalysts and additives.

Polyurethanes are flexible foams used in mattresses, chemical-resistant coatings, adhesives and sealants, insulation for buildings and technical applications like heat exchangers, cooling pipes and much more.

Sprayed or foamed-in-place applications of polyurethane insulation are usually cheaper than installing foam boards. These applications also usually perform better since the liquid foam molds itself to all of the surfaces.

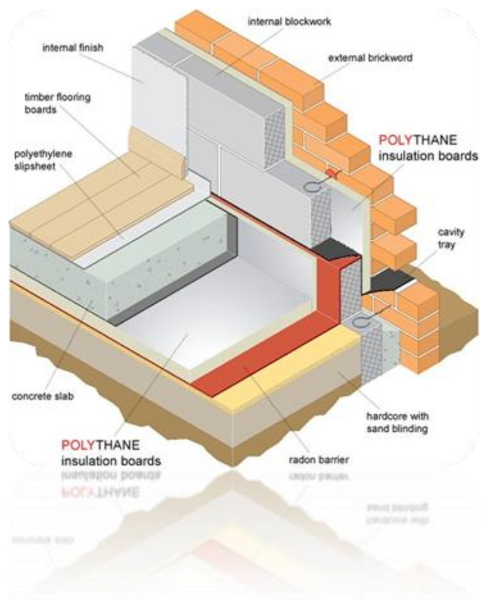
Low-density foams are sprayed into open wall cavities and rapidly expand to seal and fill the cavity. Manufacturer offers slow-expanding foam, which is intended for cavities in existing homes. The liquid foam expands very slowly and thus reduces the chance of damaging the wall from overexpansion. The foam is water-vapor permeable, remains flexible, and is resistant to wicking of moisture. It provides good air sealing and yields about R-3.6 per 2.5 cm. of thickness. It is also fire resistant and won't sustain a flame.

Rigid polyurethane foam

Foil and plastic facings on rigid, polyurethane foam panels can help stabilize the R-value, preventing thermal drift. Testing suggests that the stabilized R-value of rigid foam with metal foil facings remains unchanged after 10 years. Reflective foil, if installed correctly, can also act as a radiant barrier, which adds another R-2 to the overall thermal resistance. Panels with foil facings have stabilized R-values of R-7.1 to R-8.7 per 2.5cm.

Advantages

- Highest insulation value
- Easy handling
- Sufficient fire resistance
- Fast application (related to spray PU form)



This presentation by DOW Styrofoam Building Solutions http://besharp.archidev.org/spip.php?article136 -

Disadvantages

- Moisture absorption
- Ageing insulation
- Not 100% closed cell
- Weather and temperature dependant (related to spray PU form)
- Highly dependant on labor skill (related to spray PU form)
- Little quality control (small unit)
- Toxic fumes

Source: http://www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11600

http://www.engineeringtoolbox.com/polyurethane-insulation-k-values-d_1174.html

1.3. Building Envelope Insulation Options

The cost estimates for insulation of residential buildings are based on the feedback from vendors of insulation material in Georgia.

The information given to the vendors of insulation material (except BPG) was the same. However the feedback from vendors was not uniform. The differences were caused by differences in technologies, accounting of base costs and overheads, different experience in local market, different services provided by the vendors themselves and outsourced. These factors together with varying assumptions about the concrete insulation solutions have all contributed to wide variety of results and different rigor of calculations. As a result it was quite challenging task to bring this information to a uniform basis and it took several rounds of discussions with the vendors.

The results of comparison are as follows:

1.3.1. Window/door replacement

Window/door replacement with double glazed PVC frames is an energy efficiency measure that is already applied by the residents who can afford such an improvement to their apartments. This measure has double effect on thermal performance of building interior: It reduces the heat loss from the window panes and at the same time eliminates air infiltration from the old un-tight window/door frames. Noise reduction is one more positive effect of such a measure. In summary the comfort increases significantly while the energy use will decrease considerably. Installation of PVC double glazed windows has become a commonplace in case of new construction as well as apartment refurbishment, since these frames are also cheaper and more convenient compared to old type wooden framed windows.

The cost for such a measure can be estimated from the feedback of two the range of costs depending on vendor and window quality is: **115-215 GEL** per square meter of window/door opening. The vendors with more practical experience provide the numbers at the higher end of this price range.

The U value of windows doors is expected to be improved from 5.8W/m^{2}K to 2.5-3 W/m^{2}K after this measure.

1.3.2. External Wall Insulation

The results of are summarized in the Table 2. below.

One can see the variety of approaches and results. The lowest level of thermal insulation is provided by 3cm polystyrene (resulting R=1.5m^{2}K/W) while the highest (resulting R=3.5m^{2}K/W) by 10cm polystyrene compacted bead board insulation. This latter option also provides the lowest cost per unit of additional insulation (39GEL per 1m^{2}K/W of additional thermal resistance).

Energy audit does not include the overheads and taxes and therefore gives economic rather than financial calculation.

Summary of insulation options and their main technical and economic parameters

Table 2.

	Material	Thermal conductivity	Material thickness mm	Thermal resistance added m^2K/W	Base Cost per m^2	Total material	Overhead /taxes	Labor $/m^2$	Installed cost per m^2	Installed cost unit of R	Thermal resistance /base 0.68 m^2KW	U value /base 1.47 W/m^2K
Vendor 1	Compacted Polystyrene beadboard	0.035	60	1.71	15.7	44	40%*	30*	91.6	53.4	2.4	0.42
		0.035	100	2.86	27	58.1	40%*	30*	111.34	39.0	3.5	0.28
Vendor 2	Rockwool	0.04	50	1.25	29	56	41%	29.5	120.5	96.4	1.9	0.52
		0.04	100	2.50	58	85	41%	32.4	165.5	66.2	3.2	0.31
Vendor 3	Kelyfos white/blue Styrofoam	0.035	30	0.86	14.15	44.60	55.5%	48.0	144	168.0	1.5	0.65
		0.035	30	0.86	26.5	58.7	55.5%	47.1	164.5	191.9	1.5	0.65
Vendor 4	Basalt wool	0.031	4 layers - 32mm	1.03	28		0		44.3	42.9	1.7	0.58

*Own estimate based on other proposals

The following assumptions were used in deriving the numbers in table 2:

- The cost of material and labor calculated for Vazha Pshavela was used as basis.
- The surface area used as the basis of calculation was taken from Energy Audit data and was equal to 2050. All calculations by vendors were rescaled to this base number.
- 14% surplus of insulation material (relative to wall surface area) was used to account for leftovers and side surfaces of the window/door openings,
- The cost of window replacement and roof rehabilitation was separated from the base wall insulation estimates.

In view of various uncertainties and possible differences in assumptions the information in Table 2 shall not be used as a basis for selection between the potential vendors, but shall only serve the purpose of estimating the range of possible costs.

Having in mind the uncertainties and different approaches in calculations one can conclude that the cost of installed insulation per square meter of wall area varies between 90-165GEL/m^2.

Based on the material submitted by vendors, the calculations of saved energy were made with the help of ENSI program for each level of insulation provided by different options. A sample calculation is appended in the Appendix 3.
The results of economic assessment based on the amount of saved energy and cost of insulation are given below for Vazha-Pshavela. One has to note that the walls of Vazha-Pshavela and Saburtalo 53 buildings have the same material and thickness and are of roughly the same age. Therefore the results are applicable to both buildings.

Economic analysis of thermal insulation for Vazha Pshavela 1/IV and Saburtalo 53.

Table 3.

	Installed cost GEL/m^2	Thermal resistance /base **0.68**	U value base 1.47	Energy saving kWh/m^2/a	Cost of energy saved GEL/a	**Payback years**
Vendor 1	91.6	2.39	0.42	79.56	5.40	**16.98**
	111.34	3.54	0.28	89.29	6.06	**18.39**
Vendor 2	120.5	1.93	0.52	72.69	4.93	**24.44**
	165.5	3.18	0.31	86.71	5.88	**28.14**
Vendor 3	144	1.54	0.65	62.58	4.24	**33.93**
	164.5	1.54	0.65	62.58	4.24	**38.76**
Vendor 4	*44.3*	*1.71*	*0.58*	*67.60*	*4.58*	***9.66***

One can see that the economy of considered thermal insulation options is rather poor and provides the payback periods of 17-34 years[6].

Since the considered buildings do not represent the worst section of residential buildings in Tbilisi we have also made calculations for the buildings with thermal resistance of walls of R=0.5m^{2}K/W. The results are presented in the Table 4. below:

Economic analysis of thermal insulation for buildings with R=0.5 m^{2}K/W.

Table 4.

	Installed cost GEL/m^2	Thermal resistance /base-**0.5**	U value base 2	Energy saving kWh/m^2/a	Cost of energy saved GEL/a	**Payback years**
Vendor 1	91.60 111.34	2.21 3.36	0.45 0.30	117.8 129.5	7.99 8.78	**11.47** **12.68**
Vendor 2	120.50 165.50	1.75 3.00	0.57 0.33	108.7 126.8	7.37 8.60	**16.35** **19.25**
Vendor 3	144.00 164.50	1.36 1.93	0.74 0.52	96.1 112.7	6.52 7.64	**22.09** **25.24**
Vendor 4	*44.30*	*1.53*	*0.65*	*102.5*	*6.95*	***6.37***

In this case the cost efficiency is better however is still marginal and requires additional measures for promotion to make it realistic.

One needs to note that the cost of insulation materials is high and requires some action to make them affordable for a wider section of society and economy. The concern is being expressed by the vendors for absence of state support for the use of these materials.

Another way of increasing market is finding technological solutions that would make insulation affordable for a wider market segment.

[6] The most optimistic estimate of 10 years does not contain all the expenses and therefore is not taken into account.

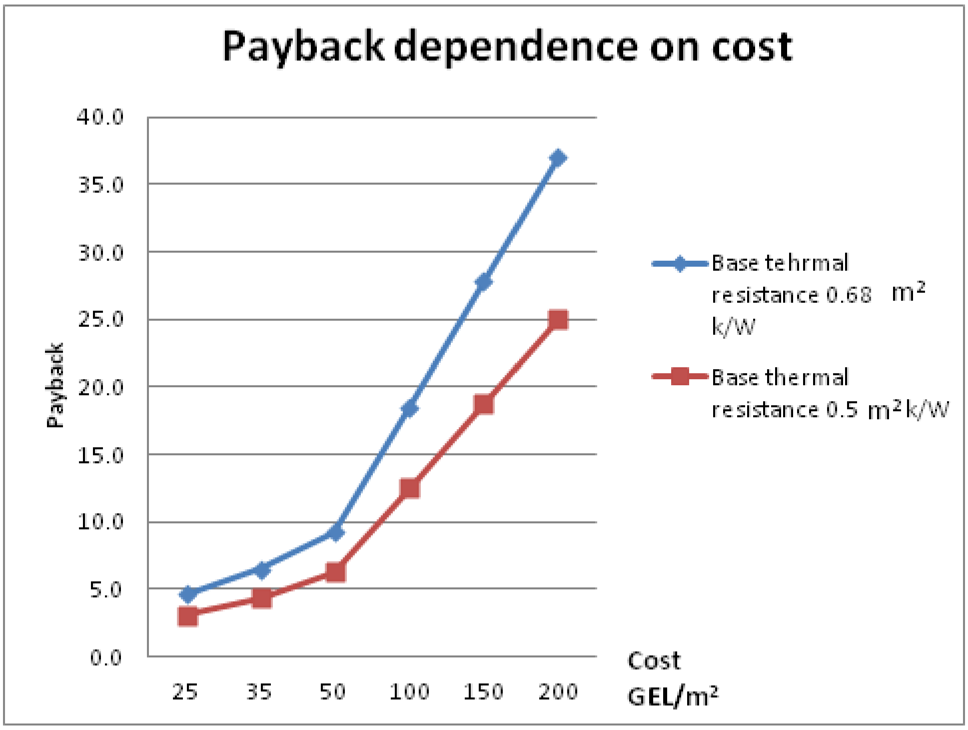


Fig. 2 Payback dependence on cost of insulation for typical buildings with two levels of wall thermal resistance

Assuming typical building with thermal resistance base 0.68 m^2K/W and 5 sm polystyrene breadboard insulation with typical energy saving one can see payback track dependence on cost (Fig.2). Initially suggested by one of the vendors price of such insulation is 92 GEL/ m^2 with corresponding payback of 17 years. By reducing price to 50 GEL /m^2 one can achieve payback of 9 years. The graph illustrates how price of insulation affects years of payback.

Similar parameters can be applied to buildings with base thermal resistance 0.5 m^2K/W. However, the main difference is that due to lower thermal resistance energy saving after insulation is higher and results in better economic performance with payback of 10 years at the cost of 80GEL/m^2. These numbers can be substantially improved for the residents with the help of co-financing from municipality or other measures for reducing the insulation material and labor costs (E.g. letter in Appendix 4).

1.4. Conclusions

Most of the measures are marginal and although economically efficient in long term, are not attractive with the account of all taxes and overheads in short term.

Technical details need to be elaborated during the tendering and implementation process. e.g. handling external existing gas and water pipes, rainwater drainage systems etc. The possibilities for cheap solutions need to be found in order to make the building insulation more affordable. e.g. one of the measures is to bring window panes close to the wall surface and thus economize on the cheap the closer to making the this can save about 10% of all insulation cost and at the same time depending on windowsill.

Some of the vendors already express their concern and desire to request government support to energy efficient material import (Cf. Appendix 4).

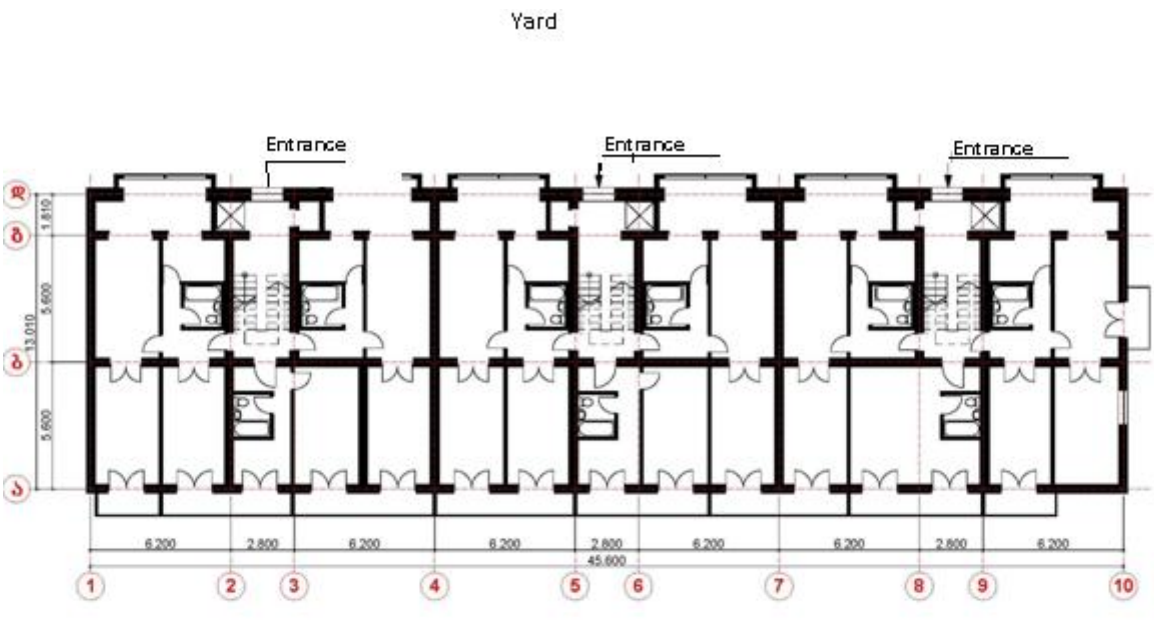
The technologies that are not proven and tested should be avoided in order to minimize the risks of the project. It is necessary to secure the residents' participation while implementing the pilot project. Participation in financing and organization of the project will develop ownership among the residents, will organize and motivate them for further successful operation and maintenance of the suggested improvements.

The estimate of material and installation costs for building thermal insulation indicate that at the current levels of electricity and gas tariffs thermal insulation of buildings is not economical compared to other options available to the consumers, specifically in the buildings with 40 cm brick walls. However in case of tax incentives and cheap financing, development of local production of insulation materials, the building insulation may become a cost effective measure.

2. Exterior Rehabilitation of Residential Block Buildings

2.1. Project Design Description
Bldg.1., IV Block, Vazha-Pshavela Avenue

The project building is located in Tbilisi Vake-Saburtalo district, Bld.1 District IV, Vaja Pshavela. This is a 8 storied 3 entrance building without basement, built and commissioned in 1966. There are three apartments on each floor with 1, 2 and 3 rooms. The total area of one room apartments is 28.8m^2, two room apartments – 50.14m^2 and three room apartments 66.7m^2. In total there are 9 apartments at each floor with the total area of 440m^2. Total living area of the building is 3155m^2.



Vaja Pshavela Avenue, IV district, I building

Fig.1. Building plan

There are commercial entities situated on the ground floor and their total floor area is 760m^2.

Ceilings are of hollow concrete slabs. The height of the floors is 3 meters with the ceiling height of 2.7m. The load bearing structures are brick walls, hollow slab floors, and prefabricated reinforced concrete belts at each floor. The main carrying structures are 4 longitudinal brick walls that are crossed by 10 transversal brick walls. The wall thickness from the basement to the 8th floor is 40cm. The wall bearing structures of the building are in good condition, without cracks and major damages.

The residential building has three entrances and is covered with a flat roof with loft. The loft is constructed of 40cm thick cold weather concrete (base) slabs. Hollow slabs and prefabricated concrete belt. The loft height is 120cm. The roof sloping is arranged with broken pumice and covered with three layers of ruberoid.

The attached photos clearly indicate that the building is not of a high artistic-architectural value, right from the beginning. Later in time its appearance has deteriorated further and now it has an unpleasant exterior that can be often seen in Vake-Saburtalo district.

Vaja Pshavela Avenue, IV district, I building

Fig.2. South façade of the building

The façade of the building from south- Vazha-Pshavela Avenue side features remodeled balconies with built masonry walls and windows that create uneven rhythm and asymmetrical composition of the façade. The general appearance of the facade is violated by brick and block masonry walls that are not plastered and finished according to façade requirements in material or color. They have the rough natural appearance of material and further aggravating the face of the building. The balcony railings are also covered with various materials of different sizes. The main decorative element of the façade, the vertical concrete gratings are also modified and deteriorated with time.

The back façade (from the yard side) is in the same poor condition as the front one. There are verandas modified with masonry walls and with window frames of varying sizes, forms, material locations and color. This is due to varying preferences and financial resources of different residents.

Fig.3. Northern façade of the building

Existing situation is quite distressing since ugly modified balconies and verandas create unpleasant and unattractive environment which in turn affects residents in a negative way. Therefore it was decided to develop a façade rehabilitation project that in its sense might be developed and replicated in other similar locations. Several main goals were set by the working group including improvement of exterior visual-esthetic appearance and also, to incorporate improved comfort requirements due to thermal insulation of the block buildings.

The current situation indicates that the residents had a necessity to cover the iron railings of balconies with cover the material (From Vaja Pshavela avenue side) among residents of the building. It is obvious as well that residents experienced lack of living space since they used the vertical concrete gratings that under initial design represent the main decoration element, by modifying them with different construction materials to have additional storing space. Moreover, some balconies are fully modified and transformed into living space. Therefore, it has been decided to take into account these residents' preferences and to accommodate the building modifications into the new design in a way that would allow simultaneously improving the appearance of the building and preserving as much as possible the modifications made by residents, without compromising the exterior view of the building. As a result, instead of demolishing the non-typical and ugly masonry walls it was decided to emphasize these asymmetric and atypical elements of the current façade which is common practice in modern architecture.

The project design also took into account the necessity to replace the existing inefficient wooden windows with the double glazed PVC windows. The sizes of window frames were preserved in original sizes to the extent possible. On the back façade of the building the windows of different sizes were painted in a way to obscure unevenness of the structures and in a way to create a relatively uniform and organized appearance.

Fig.4. South façade after rehabilitation

The iron railings of the balconies and vertical gratings of the northern façade shall be filled with partition blocks or brick peaces, putted, processed with prime coating, plastered and shall be painted with high quality façade paint. Filling up these two elements shall create a new uniform surface that shall be colored in one color. As a result the façade will acquire more uniform and attractive surface. The existing modified balcony compartment walls will be covered with thermal insulation and treated with prime coating, textured plaster and shall be painted with bright façade paint. The wood imitation shall be achieved with this paint and will become the main decorative element of the façade. These elements shall be further emphasized with plants.

Fig.5. South façade rehabilitation details

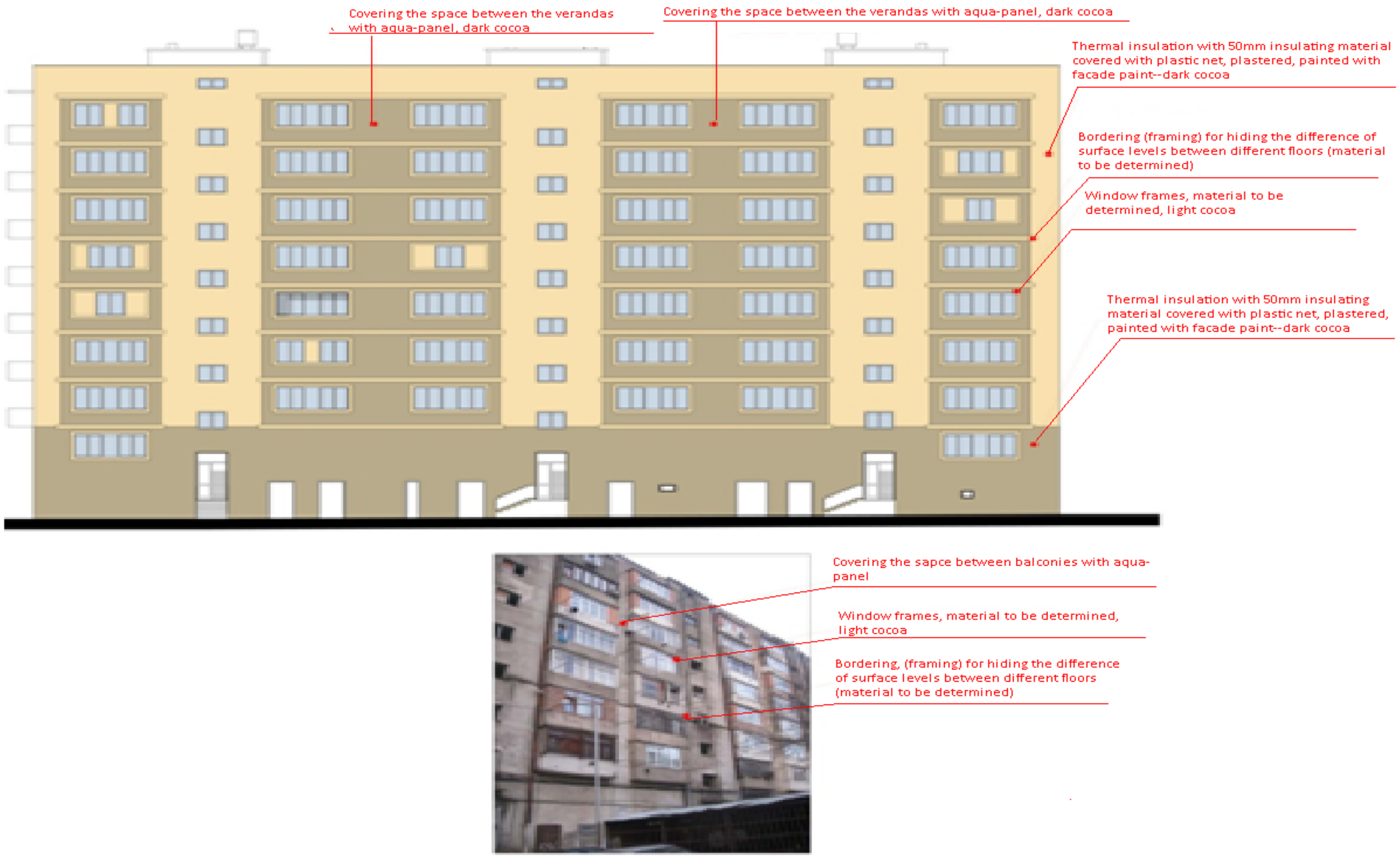
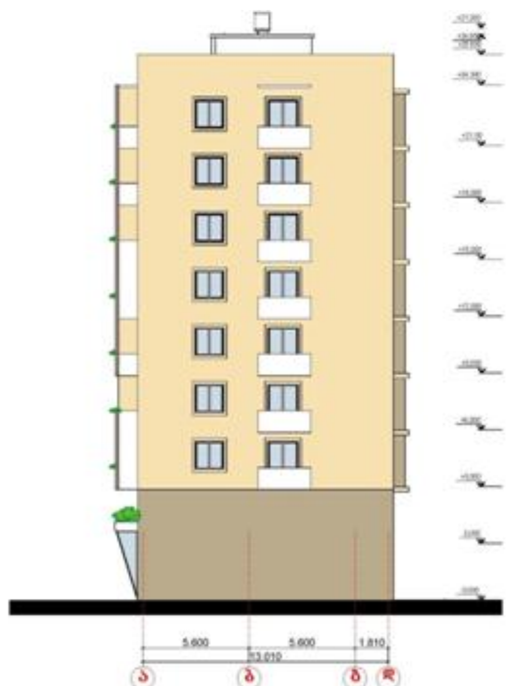


Fig.6. North façade rehabilitation details

Facade from yard side

Fig.7. North façade after rehabilitation

The space between verandas shall be covered with aqua panel and the horizontal bordering panes shall be introduced to partly conceal the difference in veranda surfaces at different floors. The differences in window sizes shall be concealed by painting the veranda surfaces into darker color.



Shavishvili street

Fig.8. East façade after rehabilitation

Special hoods shall be arranged on the top of commercial spaces on the ground floor where more decorative plants will be planted to give more lively and attractive feel to the building.

Preliminary list of materials for rehabilitation

1. Existing monolithic concrete, vertical gratings filled with brick pieces, covered with metal net, putted and plastered, covered with façade paint – $220m^2$
2. Existing metal balcony railings, filled with partition blocks, plastered and covered with façade paint – $230m^2$
3. Thermal insulation with relevant technology, covered with façade paint – $2870m^2$
4. Back façade – bordering (framing) for hiding the difference of surface levels between different floors (material to be determined) - $45m^2$
5. Back façade – window frames $80m^2$
6. Back façade – aqua panel plates for covering the openings between verandas – $75m^2$
7. Façade paint – light cocoa $1765m^2$
8. Façade paint – dark cocoa $1105m^2$
9. Textured plaster – $140m^2$
10. Façade paint – wood imitation $140m^2$

2.2. *Project Design Description*
53/53a Saburtalo street

The project building is located in Tbilisi Vake-Saburtalo district, 53 Saburtalo st. This is a 5 storied building built in 60th of XX century. The supporting structure elements of the building are brick walls. Ceilings are of hollow concrete slabs. The building consists of two residential blocks of two and three entrances and is covered with four-slope roof. The carrying structure of the roof is comprised of round wood elements. The vertical load carrying poles are of 18-20cm diameter, while the cross bars are 13-15sm. The condition of wooden parts is good. The roof was initially covered with tiles, currently part of the roof is covered with tin plate.

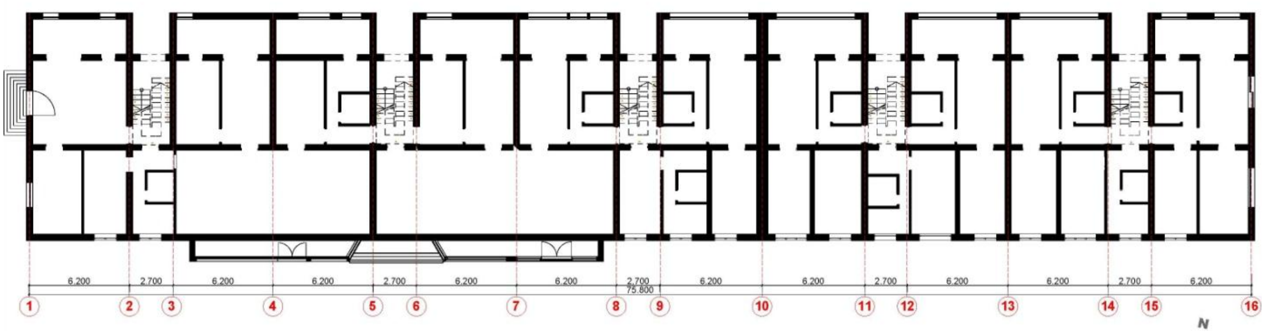


Fig 1. Building plan 53/53a Saburtalo str.

The attached photos clearly indicate that the building is not of a high artistic-architectural value, right from the beginning. With the time its appearance has deteriorated further and now it has a dull non-attractive exterior that can be often seen in Vake-Saburtalo district.

Fig 2. Southern facade

The façade of the building from south - Saburtalo Street features remodeled balconies with built masonry walls and windows that create uneven rhythm and asymmetric composition of the façade. The general appearance of the facade is violated by brick and block masonry walls that are not plastered and finished according to façade requirements in material or color. They have the rough natural appearance of material and further aggravating the face of the building. The metal railings of balconies are covered with different material in different style.

The back façade (from the yard side) is in a worse condition than the front one. There are built in structures and compartments with window frames of varying sizes, forms, material locations and color. This is due to varying tastes, preferences and financial resources of different residents.

Fig 3. North back facade

There are remodeled balconies and storage boxes and non-typical compartments built on the internal side of the house.

The existing situation is quite distressing since ugly modified balconies and verandas create unpleasant and unattractive environment which in turn affects residents in a negative way. Along with exterior appearance the poor thermal performance of the building also needs to be addressed.

Therefore it was decided to develop a façade rehabilitation project in conjunction with potential thermal insulation that in its sense might be developed and replicated in other similar locations. Several main goals were set by the working group including improvement of exterior visual-esthetic appearance and also, to incorporate improved comfort requirements due to thermal insulation of the block buildings.

The existing situation indicates that the residents had a necessity to modify the façade of the buildings in a way that would fit with their need of additional space, storage etc., but at the same time this has aggravated the appearance of the building. Therefore, it has been decided to take into account the residents' needs and to try accommodating the building modifications into the new design in a way that would allow simultaneously improving the appearance of the building and preserving as much as possible the non-rhythmic and asymmetric modifications made by residents, without compromising the exterior view. As a result, instead of demolishing the non-typical structures in building 53/53a Saburtalo str., it was decided to emphasize these asymmetric and atypical elements of the current façade which is common practice in modern architecture.

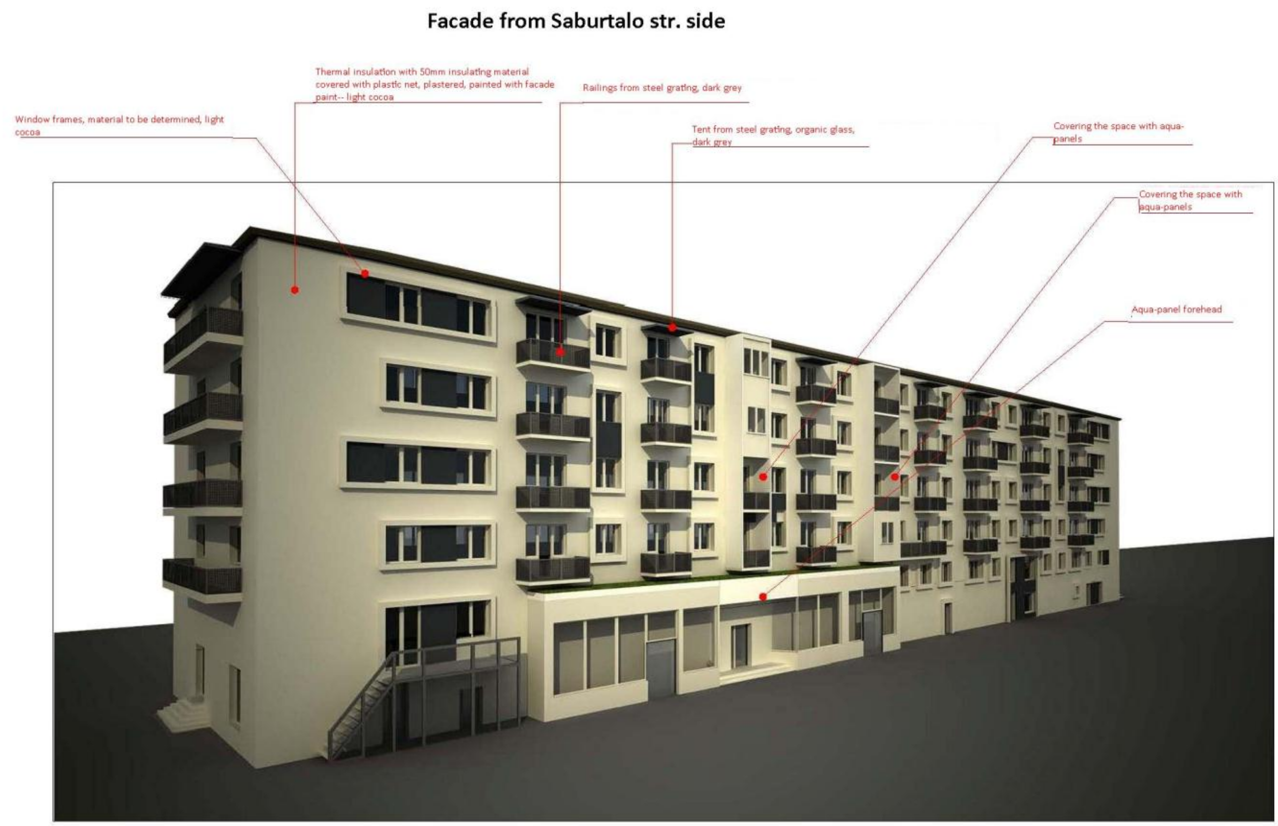


Fig 4. Façade from Saburtalo str. Side

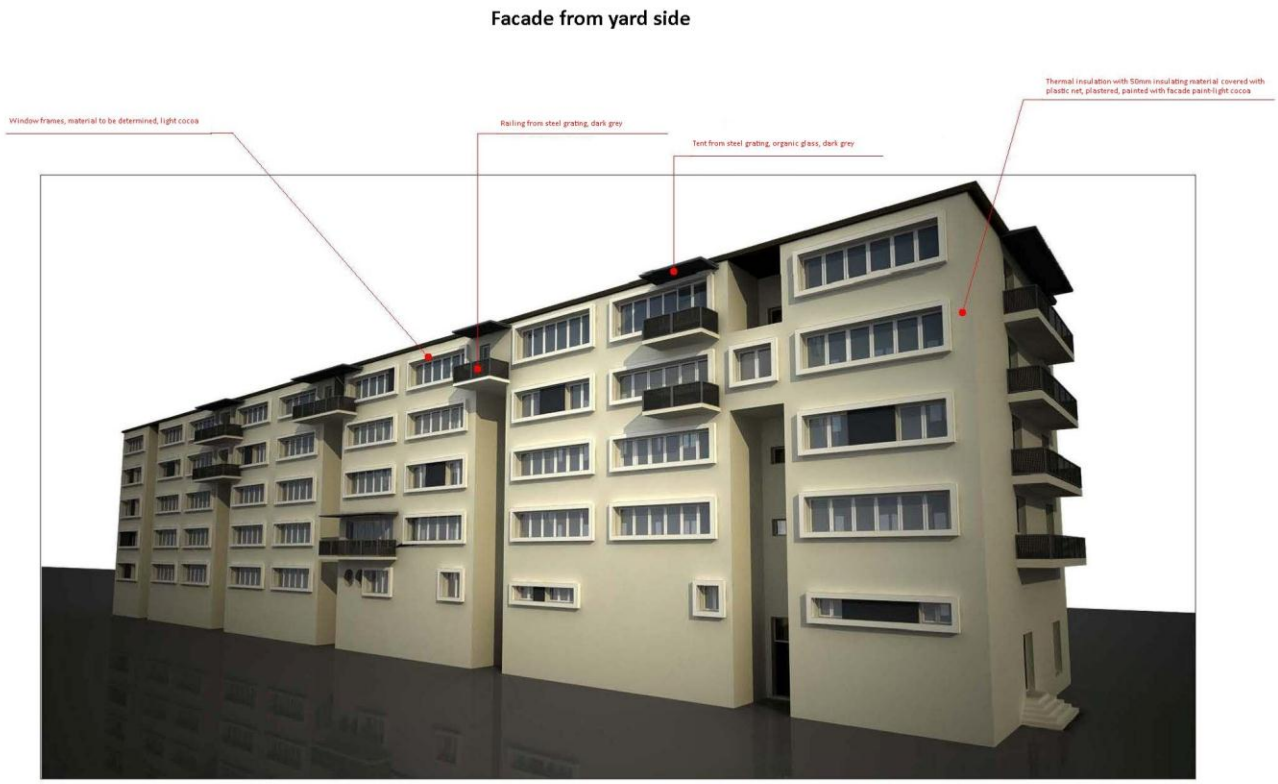


Fig 5. North façade from yard side

The three balconies built up with masonry walls were connected to other upper balconies with the side walls so that two vertical stripes were created. The windows of different sizes were grouped in a way that allowed creation of an interesting composition picture. The balconies were equipped with iron nets. The facades shall be covered with insulation material, plastic net, prime covered and painted with façade paint. A hood was created on top of commercial spaces where plants can be seeded and grown. This will add the beauty and attractiveness to the house.

The project design also took into account the necessity to replace the existing inefficient wooden windows with the double glazed PVC windows. The sizes of window frames were preserved in original sizes to the extent possible. On the back façade of the building the windows of different sizes were framed in a way to create a relatively uniform and organized appearance.

Approximate list of materials

1. Existing metal balcony railings replaced with uniform iron gratings - 216 m2
2. Thermal insulation 50mm with relevant technology, covered with façade paint – 2 590m2
3. Back façade – window frames (material to be defined) 187m2
4. Aqua-panel 85 m2

5. plastering of balconies 115 m2
6. Organic glass - 35 m2
7. Façade paint --cocoa 2 590m^2
8. Façade paint –light cocoa 447 m^2
9. Façade paint—white 575 m^2
10. Façade paint—grey 123 m^2
11. Steel paint – grey 270 m^2

APPENDIX 1: Thermography Images of Project Buildings

In order to identify and visualize the most wasteful sources of heat loss, thermal images of the buildings were taken with the help of the company NorthStar. Thermal pictures were taken on one of the last cold days of the season, on March 23, 2011 from 6-7 AM before sunrise.

Energy Audits with the use of Thermography can reveal:

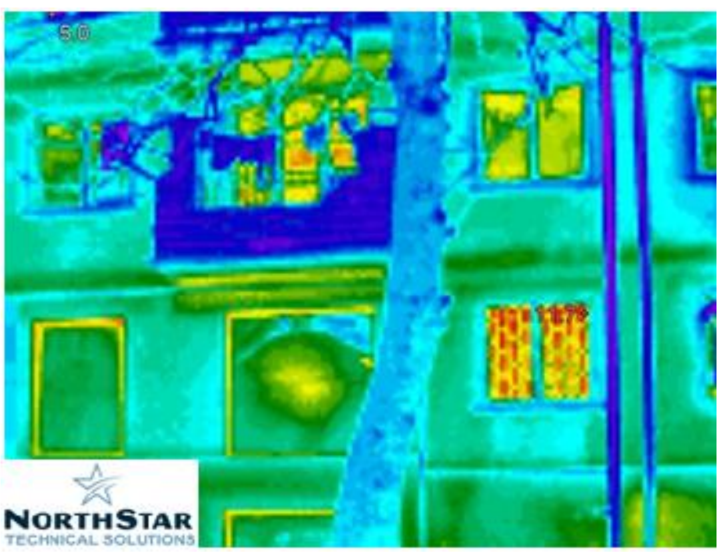
1) Excessive air leakage into and out of buildings, accounting for almost half the cost of heating, ventilation, and cooling

2) Excess moisture causing degradation of insulation material

3) Problems within the electrical systems of both buildings and individual residences resulting in losses, translating into higher power bills

4) The most cost-efficient act for initially cutting energy costs is in replacing old windows with modern vinyl double-pane glass windows

The following thermal images taken in Saburtalo by NorthStar at the end of winter 2011 show the initial findings supporting these facts.



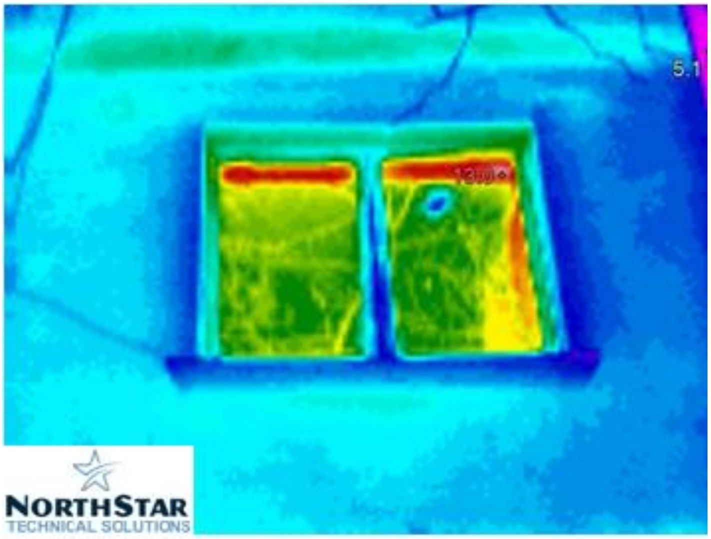
Heat energy leakage as shown through single-pane glass.

Energy leakage also depicted in typical wooden-framed glass windows.

3/23/2011 6:31 AM
Fig. 1 South façade 53/53a Saburtalo Str.

Main Image Markers

Name	Temperature
Hot Cursor	11.7°C
Cold Cursor	5.0°C



3/23/2011 7:13:31 AM
Fig. 2 Window on South façade 53/53a Saburtalo Str.

Close-up of common window. Construction of window is typically wooden-framed and also single-pane glass.

Experience has demonstated a feeling of distinct warmth on the exterior; a distinct cold from the inside.

Main Image Markers

Name	Temperature
Hot Cursor	13.0°C
Cold Cursor	5.1°C

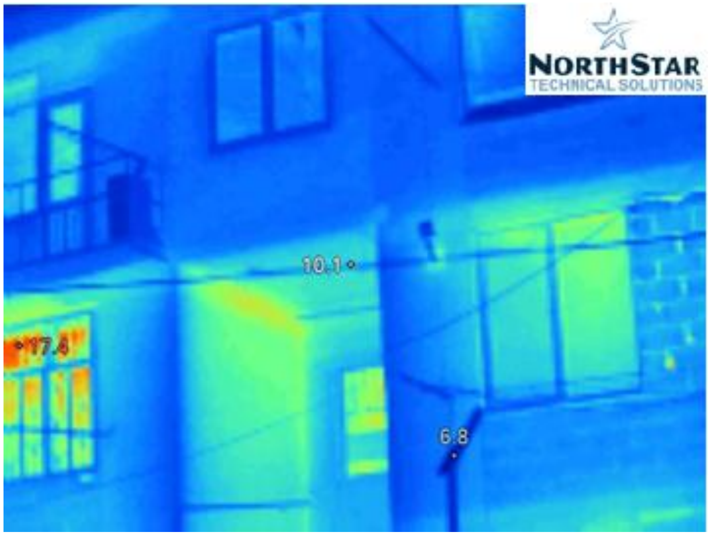
3/23/2011 7:21:50 AM
Fig.3. North façade of 53/53a Saburtalo Str.

Image depicting a typical apartment block lacking the insulating enclosure of a mid-section common area.

Also noting that the hi-temp area (17.1C) is from the surface of single-pane glass as opposed to modern double-pane window glass.

Main Image Markers

Name	Temperature
Hot Cursor	17.1°C
Cold Cursor	5.4°C



Close-up of mid-section common area.

Note that the true temperature differential is at least 7°C minimum in non-insulated areas.

3/23/2011 7:29:06 AM
Fig.4. North façade of 53/53a Saburtalo Str. (closeup)

Main Image Markers

Name	Temperature
Center Point	10.1°C
Hot Cursor	17.4°C
Cold Cursor	6.8°C

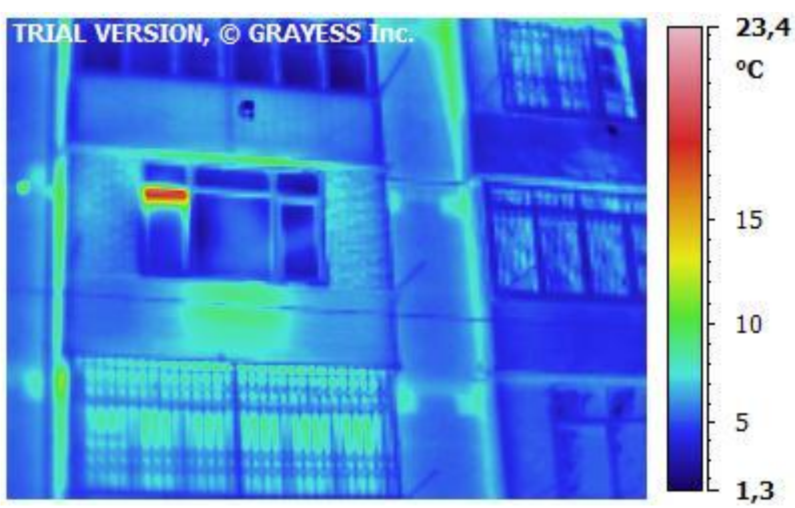


Fig.4. North façade Vazha-Pshavela Ave.

Location of heater and energy leakage from open vent can be easily identified. One can also notice that the side-walls of the verandas are the source of the highest thermal losses from the walls.

APPENDIX 2:. Thermal insulation options provided by various vendors

	Material	Thermal conductivity	Material thickness mm	Thermal resistance added m^2K/W	Base Cost per m^2	Total material	Overhead/ taxes	Labor /m^2	Installed cost per m^2	Installed cost /m^2 /unit of R	Thermal resistance /base 0.68 m^2K/W	U value base 1.47 W/m^2K
Vendor 1	Compacted Polystirene beadbord	0.035	60	1.71	15.7	44	40%	30	91.6	53.4	2.4	0.42
		0.035	100	2.86	27	58.1	40%	30	111.34	39.0	3.5	0.28
Vendor 2	Rockwool	0.04	50	1.25	29	56	0.41	29.5	120.5	96.4	1.9	0.52
		0.04	100	2.50	58	85	0.41	32.4	165.5	66.2	3.2	0.31
Vendor 3	white styrofoam	0.04	30.00	0.86	14.15	44.60	55.50%	48.0	144	168.0	1.5	0.65
		0.035	50	1.43	26.5	58.7	56%	47.1	164.5	115.2	2.1	0.47
Vendor 4	Basalt wool	0.031	4 layers - 32mm	1.03	28		0		44.3	42.9	1.7	0.58

APPENDIX 3: Sample Calculations of Energy Saving with ENSI

Option 1 Saburtalo 53

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ENSI® "EAB Software"			Building type	Userdefined - Userdefined-Userdefined-U	
Printed from ENSI® "EAB Software"			Standard Condition	Old	
Project Saburtalo 53			Climatic zone	Tbilisi	
Parameter		Standard	Actual	Baseline	Measures
1. Heating					
U - wall	W/m²K	0,60	1,47	1,47	0,62
U - window	W/m²K	3,00	5,80	5,80	3,00
U - roof	W/m²K	0,70	1,20	1,20	0,70
U - floor	W/m²K	0,65	1,10	1,10	1,10
Compactness ratio	-	0,34	0,34	0,34	0,34
Window factor	%	13,5	13,5	13,5	13,5
Total solar gain	-	0,56	0,56	0,56	0,56
Infiltration	1/h	0,50	0,50	0,50	0,30
Indoor temperature	°C	20,0	14,0	20,0	20,0
Setback temperature	°C	14,0	14,0	14,0	14,0
Contribution from					
Ventilation (heating)	kWh/m²a		0,00	0,00	0,00
Lighting	kWh/m²a		6,03	6,88	3,35
Various equipment	kWh/m²a		5,81	6,64	6,46
Energy need			51,4	103,4	42,7
Emission efficiency	%	100,0	100,0	100,0	100,0
Distribution efficiency	%	95,0	80,0	80,0	91,0
Automatic control	%	97,0	80,0	80,0	100,0
TBM/EM	%	96,0	96,0	96,0	96,0
Sum			83,7	168,3	48,9
Generation efficiency	%	100,0	100,0	100,0	100,0
Energy use			83,7	168,3	48,9
2. Ventilation (heating)					
Operation period	h/week	0,0	0,0	0,0	0,0
Ventilation rate	m³/hm²	0,00	0,00	0,00	0,00
Supply temperature	°C	19,0	20,0	20,0	20,0
Heat recovery	%	0,0	0,0	0,0	0,0
Energy need			0,0	0,0	0,0
Emission efficiency	%	100,0	100,0	100,0	100,0
Distribution efficiency	%	95,0	95,0	95,0	95,0
Automatic control	%	97,0	97,0	97,0	97,0
Humidification		No	No	No	No
TBM/EM	%	96,0	96,0	96,0	96,0
Sum			0,0	0,0	0,0
Generation efficiency	%	100,0	100,0	100,0	100,0
Energy use			0,0	0,0	0,0

tengiz jishkariani

Georgia

21.07.2011 14:23:40

ENSI® "EAB Software"		Building type	Userdefined - Userdefined-Userdefined-U
Printed from ENSI® "EAB Software"		Standard Condition	Old
Project	**Saburtalo 53**	Climatic zone	Tbilisi

Energy Budget Heating season 1.11 - 10.4

Budget item	Standard	Actual		Baseline		After Measures	
	kWh/m²	kWh/m²	kWh/a	kWh/m²	kWh/a	kWh/m²	kWh/a
1. Heating	51,8	83,7	425 218	168,3	855 492	48,9	248 331
2. Ventilation (heating)	0,0	0,0	0	0,0	0	0,0	0
3. DHW	55,0	55,0	279 791	55,0	279 791	55,0	279 791
4. Fans and pumps	2,0	0,0	0	0,0	0	0,0	0
5. Lighting	14,6	14,6	74 212	14,6	74 212	7,3	37 106
6. Various	14,5	14,5	73 947	14,5	73 947	14,5	73 947
7. Cooling	0,0	0,0	0	0,0	0	0,0	0
Total	138,0	167,8	853 167	252,5	1 283 442	125,7	639 174

8. Outdoor		0,00		0,00	0,00

Power Demand Budget Tamb -8 Climatic zone Tbilisi

Budget item	Standard	Actual		Baseline		After Measures	
	W/m²	W/m²	kW	W/m²	kW	W/m²	kW
1. Heating	40,7	53,3	271	67,8	345	37,8	192
2. Ventilation (heating)	0,0	0,0	0	0,0	0	0,0	0
3. DHW	0,0	0,0	0	0,0	0	0,0	0
4. Fans and pumps	1,3	0,0	0	0,0	0	0,0	0
5. Lighting	0,0	0,0	0	0,0	0	0,0	0
6. Various	0,0	0,0	0	0,0	0	0,0	0
7. Cooling	0,0	0,0	0	0,0	0	0,0	0

Walls	m²	2332
Windows	m²	688
Roof	m²	1016
Floor	m²	1016
Conditioned area	m²	5083
Conditioned volume	m³	14997
Heat capacity	Wh/m²K	84

Metabolic heat 3,1 W/m²

	Schedule	
	Persons	**Heating**
Weekday h/day	24	24
Saturday h/day	24	24
Sunday h/day	24	24

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Georgia

21.07.2011 14:24:25

ENSI® "EAB Software"	Building type	Userdefined - Userdefined-Userdefined-U
Printed from ENSI® "EAB Software"	Standard Condition	Old
Project **Saburtalo 53**	Climatic zone	Tbilisi

Measures	**Specific savings** kWh/m²a	**Total savings** kWh/a	**Real savings** kWh/a
1. Heating: U - wall	-29,65	-150 719	-150 719
1. Heating: U - roof	-28,82	-146 487	-146 487
5. Lighting: Average power	-7,61	-38 688	-38 688
1. Heating: Infiltration	-15,27	-77 627	-77 627
1. Heating: Distribution efficiency	-16,27	-82 721	-82 721
1. Heating: Automatic control	-26,93	-136 865	-136 865
5. Lighting: Average power	-7,30	-37 106	-11 160
Total	-131,85	-670 213	-644 267

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21.07.2011 14:26:53

Option 2 – Building with wall thermal resistance R=0.5m^2K/W

ENSI® "EAB Software"			Building type	Userdefined - Userdefined-Userdefined-U
Printed from ENSI® "EAB Software"			Standard Condition	Old
Project Saburtalo 53			Climatic zone	Tbilisi

Parameter		Standard	Actual	Baseline	Measures
1. Heating					
U - wall	W/m²K	0,60	2,00	2,00	0,62
U - window	W/m²K	3,00	5,80	5,80	3,00
U - roof	W/m²K	0,70	1,20	1,20	0,70
U - floor	W/m²K	0,65	1,10	1,10	1,10
Compactness ratio	-	0,34	0,34	0,34	0,34
Window factor	%	13,5	13,5	13,5	13,5
Total solar gain	-	0,56	0,56	0,56	0,56
Infiltration	1/h	0,50	0,50	0,50	0,30
Indoor temperature	°C	20,0	14,0	20,0	20,0
Setback temperature	°C	14,0	14,0	14,0	14,0
Contribution from					
Ventilation (heating)	kWh/m²a		0,00	0,00	0,00
Lighting	kWh/m²a		6,09	6,91	3,35
Various equipment	kWh/m²a		5,87	6,66	6,46
Energy need			60,2	118,0	42,7
Emission efficiency	%	100,0	100,0	100,0	100,0
Distribution efficiency	%	95,0	80,0	80,0	91,0
Automatic control	%	97,0	80,0	80,0	100,0
TBM/EM	%	96,0	96,0	96,0	96,0
Sum			98,0	192,1	48,9
Generation efficiency	%	100,0	100,0	100,0	100,0
Energy use			98,0	192,1	48,9
2. Ventilation (heating)					
Operation period	h/week	0,0	0,0	0,0	0,0
Ventilation rate	m³/hm²	0,00	0,00	0,00	0,00
Supply temperature	°C	19,0	20,0	20,0	20,0
Heat recovery	%	0,0	0,0	0,0	0,0
Energy need			0,0	0,0	0,0
Emission efficiency	%	100,0	100,0	100,0	100,0
Distribution efficiency	%	95,0	95,0	95,0	95,0
Automatic control	%	97,0	97,0	97,0	97,0
Humidification		No	No	No	No
TBM/EM	%	96,0	96,0	96,0	96,0
Sum			0,0	0,0	0,0
Generation efficiency	%	100,0	100,0	100,0	100,0
Energy use			0,0	0,0	0,0

tengiz jishkariani
Georgia

21.07.2011 14:32:17

ENSI® "EAB Software"	Building type	Userdefined - Userdefined-Userdefined-U
Printed from ENSI® "EAB Software"	Standard Condition	Old
Project **Saburtalo 53**	Climatic zone	Tbilisi

Energy Budget Heating season 1.11 - 10.4

Budget item	Standard	Actual		Baseline		After Measures	
	kWh/m²	kWh/m²	kWh/a	kWh/m²	kWh/a	kWh/m²	kWh/a
1. Heating	51,8	98,0	497 937	192,1	976 570	48,9	248 331
2. Ventilation (heating)	0,0	0,0	0	0,0	0	0,0	0
3. DHW	55,0	55,0	279 791	55,0	279 791	55,0	279 791
4. Fans and pumps	2,0	0,0	0	0,0	0	0,0	0
5. Lighting	14,6	14,6	74 212	14,6	74 212	7,3	37 106
6. Various	14,5	14,5	73 947	14,5	73 947	14,5	73 947
7. Cooling	0,0	0,0	0	0,0	0	0,0	0
Total	138,0	182,2	925 886	276,3	1 404 519	125,7	639 174

8. Outdoor		0,00	0,00	0,00

Power Demand Budget Tamb -8 Climatic zone Tbilisi

Budget item	Standard	Actual		Baseline		After Measures	
	W/m²	W/m²	kW	W/m²	kW	W/m²	kW
1. Heating	40,7	58,6	298	74,6	379	37,8	192
2. Ventilation (heating)	0,0	0,0	0	0,0	0	0,0	0
3. DHW	0,0	0,0	0	0,0	0	0,0	0
4. Fans and pumps	1,3	0,0	0	0,0	0	0,0	0
5. Lighting	0,0	0,0	0	0,0	0	0,0	0
6. Various	0,0	0,0	0	0,0	0	0,0	0
7. Cooling	0,0	0,0	0	0,0	0	0,0	0

Walls	m²	2332
Windows	m²	688
Roof	m²	1016
Floor	m²	1016
Conditioned area	m²	5083
Conditioned volume	m³	14997
Heat capacity	Wh/m²K	84

Metabolic heat 3,1 W/m²

	Schedule	
	Persons	**Heating**
Weekday h/day	24	24
Saturday h/day	24	24
Sunday h/day	24	24

tengiz jishkariani

Georgia

21.07.2011 14:32:52

ENSI® "EAB Software"	Building type	Userdefined - Userdefined-Userdefined-U	
Printed from ENSI® "EAB Software"	Standard Condition	Old	
Project **Saburtalo 53**	Climatic zone	Tbilisi	

Measures	**Specific savings** kWh/m²a	**Total savings** kWh/a	**Real savings** kWh/a
1. Heating: U - wall	-47,96	-243 790	-243 790
1. Heating: U - roof	-28,75	-146 116	-146 116
5. Lighting: Average power	-7,59	-38 570	-38 570
1. Heating: Infiltration	-15,23	-77 402	-77 402
1. Heating: Distribution efficiency	-18,43	-93 661	-93 661
1. Heating: Automatic control	-30,49	-154 966	-154 966
5. Lighting: Average power	-7,30	-37 106	-10 841
Total	-155,74	-791 610	-765 345

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Georgia

21.07.2011 14:33:23

Appendix 4: A Letter from Green Build on taxation of Energy Efficiency goods.

Dear Sir,

I am the director of company “Green Build”. Our company operates in Georgia, in the field of energy efficient building materials import and promotion. In the May of this year we have already imported the first party of high quality energy efficient insulation material (rock wool), which resulted in us being taxed by 12% for customs clearance, as the materials were granted the 6806 code.

In today’s environment, while both in Georgia and globally great importance is given to energy efficient material use and promotion through cheap credit lines, information campaigns carried out by different non-government organizations and a variety of other activities, it would be good if more attention were paid to the matters of taxation of this materials, since 12% customs fee increases the market price of already expensive goods even more.

To follow the upper mentioned circumstances, we ask you as a non-governmental organization, which has been playing an active role in the promotion energy efficiency, to pay attention to the taxation policy of the given type of material, and if possible, initiate the issue of cancelling the 12% customs tax.

I would like to stress, that this effort will certainly result in important outcomes and will serve as one more quite considerable stimulator, in the field of inculcating energy efficient materials in Georgia.

I am sure that this matter is one of the important issues in your work and we count on your highly qualified consultation and support in this sphere.

Looking forward to your reply,

With respect

Marika Khaliani

Green Build
Director

Appendix 5: A list of issues to be addressed during insulation works

There are a number of non-standard conditions, which, despite being discussed only on the example of two specific buildings, are typical for the housing fund.

Among them are:

	Problem		Solution	Activity	Recommendations
	Neglecting the original sizes of glazing	Geometrical dimensions are often violated as a result of remodeling the verandas, which is why we come across different sizes and configuration windows.	**WEG recommendation**	**City Hall consultation**	Resolve with the entire architectural design
	Existing effective windows	Part of the inhabitants have changed their windows and their part is of better quality and in some cases moree xpensive than what's anticipated in the pilot project.	**WEG recommendation**	Negotiations with the inhabitant	Fit with the entire design or be painted white from the outside
	Built-in compartments	There are non-typical built in compartments between the verandas and in stairwell grooves on the side of the yard in Saburtalo #53	**WEG recommendation**	**City Hall consultation** To be agreed on	Remain and fit with the design
	Partly built up balconies	From the side of the street, the Vazha-Pshavela house only has some of its balconies built	**City Hall consultation**	Decision to be made on the basis of architectural sketches	Fit with the design
	Exterior remodeling compartments	In some cases balconies are remodeled into verandas, which deteriorate the view of the outside facade.	**WEG recommendation**	**City Hall consultation**	Fit with the design
	Grating on the balcony (Vazha Pshavela)	The non-typical and ugly grating arranged on the last floor harms the appearance of the façade.	**WEG recommendation**	**City Hall consultation**	Remain and fit with the design
	Commercial buildings	Some of the commercial units are	**City Hall**		Fit with the design

	Insulation and exterior arrangement, install glazing	abandoned and of bad appearance. Non-typical and ugly iron grating	**consultation**		
	Decorative concrete vertical grating cover	Concrete grating are ugly and heterogeneous, significantly damaging the facade	**WEG recomendation with the engagement of an architect**		Address through exterior design
	Balconies which are not build-up	Single not built-up loggias, left as balconies on the side of the yard Vazha-Pshavela	**WEG recommendation - City Hall consultation**	Decision to be made on the basis of architectural sketches	Remain and fit with the design
	Electricity, telecommunication and television cables on the façade	Electricity, telecommunication, internet and other possible cables – on top or under the insulation	**Executor** Typical decision WEG consultation	To be agreed on with appropriate companies	
	Displacement of balcony lighting and electric wiring	Electric wiring should be displaced in case of such being present	**Contractor** Typical decision		
	Outdoor lighting plafonds	Combination of outside lighting and insulation on the side of the yard	**Contractor** Individual decision	The possibility of solar element lighting to be considered	To be replaced with effective lighting and solar batteries
	Wardrobes and storages arranged on the balconies	Considering the sizes there may not be space for those along with the insulation. Opening the door frequently can become problematic in case they remain.	**WEG recommendation, Consultation with the City Hall**	Consultation with insulation executors	
	General decision about the façade's architectural side	Full homogeneity Architecturally more justified, but related to a lot more communications problems in terms of payments		Inviting an architect and creating the outer view sketches for different cases	Done
	Heterogeneous nature of the façade surface	Residents of different floors have built up loggia at different times and by different decisions, which causes dissimilar surfaces between floors which typically make up 5-10 cm., but in some cases amount to 20-25 cm.	**Contractor Architectural sketches**	Negotiation with architects	Address through design
	Heterogeneity of the	We come across different types of	**Contractor**	Negotiation with	

	facade	surfaces, along with the whetted surface there are brick and sometimes block structures. Remaining railings	**Architectural sketch**	architects	
	Gas, water and drain pipes along the facade	As a result of insulation dimensions are abrogated and relocation is required	**Contractor** Individual decision	Consider while bid evaluation	
	Gas heater air intakes and exhaust pipes	Insulation protection from the temperature	**Contractor** Typical decision	Consider while bid evaluation	
	Roofing of the loggias on the last floor	The loggias on the last floor have separate roofing, which requires a separate decision	**Contractor** Typical decision	Consider while bid evaluation	
	Air Conditioners Window conditioners The distance with the walls will decrease	Split systems - wiring (inside or outside of the insulation) Outside blocks – Can the same levers be used?	**Contractor** Typical decision	Consider while bid evaluation	
	Fundamental decisions on insulation arrangement	The displacement of window frames on the surface of the facade	**Contractor**	Consider while bid evaluation	
		Insulation around the grating			
		Balcony insulation typical decisions			
	Flower-bowls, shelves, and other storages built in on the outside to the building	Flower bowls and food storage shelves built on the facade	**City Council consultation Contractor**	Coordination with architects	To offer a typical decision
	Lower floor grating on the side of the street and the yard	Grating combination with the insulation process and the outside view	**Contractor** Typical decision	Consultation with architects, tender documents	