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PRICE ANALYSIS OF DIFFERENT OPTIONS FOR THERMAL INSULATION OF VASIL LEVSKI NATIONAL MILITARY UNIVERSITY HEADQUARTERS

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ABSTRACT

The paper presents the maintenance of the buildings property of MOD and BA. In perspective, the maintenance of a building can increase the efficiency level significantly, as well as part of it being given under rent to generate income for the budget of MOD. Comparative price analysis of different options and suboptions for thermal insulation of Vasil Levski National Military University Headquarters has been made and the most cost-effective option has been determined.

KEYWORDS:

Maintenance, buildings, MOD, BA, thermal insulation

1. Introduction

As a result of the long-lasting exploitation and normal amortization of the buildings within the BA units, many of them need basic renovation and fulfillment of the requirements for energy, construction and installation efficiency. These activities could prolong buildings exploitation for period not less than 60 years. The expected savings and financial resources could be used for other purposes or for constructing new buildings for the Army (Filipov, 2016).

The purpose of this report is to make comparative price analysis of different options for thermal insulation of the façade area of Vasil Levski National Military University Headquarters and to find the most appropriate option to be applied.

2. Summary

The existing budgetary restrictions lead to problems in other functional spheres of military logistics. In this regard some researchers from the NMU "Vasil Levski" search for effective solutions for service provision (Glushkov, 2017).

The frequent amendments of the regulatory framework related to building energy efficiency create preconditions for different requirements regarding the thermophysical characteristics of newly constructed and existing buildings property of the BA and MoD. Public buildings within the category administrative buildings such as the building of the NMU "Vasil Levski" Headquarters – Veliko Tarnovo are subject to special attention under the Energy Performance of Buildings Directiv,

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which stipulates that public administration buildings shall have almost zero energy consumption level (Binev, 2015).

One of the methods for reducing the heating/cooling costs in the Headquarters building of NMU "Vasil Levski" – Veliko Tarnovo in the conditions of financial deficit is to perform energy efficiency examination of the building and to define energy efficiency measures.

The examined building was constructed in 1979 as NMU "Vasil Levski" Headquarters – Veliko Tarnovo and it has been used for this purpose until now.

According to the climate zones in the Republic of Bulgaria the town of Veliko Tarnovo pertains to Climate zone 4 Veliko Tarnovo, Pleven, which has the following climate features:

- Average altitude 280 m;
- Duration of the heating season 191 days; beginning: 16 October; end: 23 April; heating degree days (DD) – 2700 at average indoor temperature 19 °C (Ordinance 15/28.07.2005 to the Energy Act);
- Calculated outdoor temperature: –17 °C (Ordinance 15/2005)

As basic climate data are used the measured average monthly temperatures of the air in the populated area for the examined period, as well as representative average monthly temperatures of the air for climate zone 4 (National Institute of Meteorology and Hydrology, 2016).

In order to determine the most cost-effective solution for thermal insulation of the NMU "Vasil Levski" Headquarters facades, calculations have been made for applying insulation on the facade walls with regard to the different options and suboptions for renovation of facades. For this purpose it is necessary to specify definite features of the building:

The building is a massive reinforced concrete construction and the NMU "Vasil Levski" Headquarters is situated inside. It consists of three interconnected sections. Section „A" is a thirteen-floor building with basement and ground-floor. Section „B" has basement, ground-floor and one floor. Section „C" has basement and ground-floor. The outer walls are made of bricks and most of them have stone lining. The built-up area of the building is 972 sq.m. and the total built-up area is 6444 sq.m.

For the purposes of this study are accepted reconstruction values with ventilated façade system with finishing layer of HPL panels – 180 BGN/sq.m. for the façade area and also for the same system but with finishing layer of aluminum lamellas – 120 BGN/sq.m. for the facade area. For thermal insulation systems with insulation material on the basis of polystyrene and mineral wool applied directly on the walls ETICS are accepted the average costs for one packet of insulation – 60 BGN/sq.m. for polystyrene and 70 BGN/sq.m. for mineral wool. Considering the average market prices the costs are in the range of 45-55 BGN/sq.m. only for the materials. Market prices are usually determined according to the complexity and volume of the order, material costs, locality of the construction site, etc. (Mihaylova, 2015).

With a view to determine the most expedient option for renovation of the building facades we shall examine and analyze the price aspect of 4 main options with different suboptions of the thermal insulation materials used for renovation of the NMU "Vasil Levski" Headquarters facades:

- **Option I** – Renovation entirely with thermal insulation systems with insulation material applied directly on the walls, the so called ETICS systems wit two suboptions:
  - ✓ **Option IA** – Renovation entirely with ETICS thermal insulation systems with insulation material polystyrene applied directly on the walls;
  - ✓ **Option IB** – Renovation entirely with ETICS thermal insulation systems with insulation material mineral wool applied directly on the walls;

- **Option II** – Renovation entirely with a ventilated facade system with two suboptions:
  - ✓ **Option IIA** – Renovation entirely with a ventilated façade system with finishing layer of HPL panels;
  - ✓ **Option IIB** – Renovation entirely with a ventilated facade system with finishing layer of aluminum panels;
- **Option III** – Renovation with ETICS on the east, west and south facades and a ventilated façade system on the north facade, with four suboptions:
  - ✓ **Option IIIA** – Renovation with ETICS with polystyrene on the east, west and south facades and a ventilated facade system with finishing layer of aluminum panels on the north facade;
  - ✓ **Option IIIB** – Renovation with ETICS with polystyrene on the east, west and south facades and a ventilated facade system with finishing layer of HPL panels on the north facade;
  - ✓ **Option IIIC** – Renovation with ETICS with mineral wool on the east, west and south facades and a ventilated facade system with finishing layer of aluminum panels on the north facade;
  - ✓ **Option IIID** – Renovation with ETICS with mineral wool on the east, west and south facades and a ventilated facade system with finishing layer of HPL panels on the north facade;
- **Option IV** – Renovation with ETICS on the south facade and a ventilated facade system on the north, east and west facades:
  - ✓ **Option IVA** – Renovation with ETICS with polystyrene on the south facade and a ventilated facade system with finishing layer of aluminum panels on the north, east and west facades;
  - ✓ **Option IVB** – Renovtion with ETICS with polystyrene on the south facade and a ventilated facade system with finishing layer of HPL panels on the north, east and west facades;
  - ✓ **Option IVC** – Renovation with ETICS with mineral wool on the south facade and a ventilated façade system with finishing layer of aluminum panels on the north, east and west facades;
  - ✓ **Option IVD** – Renovation with ETICS with mineral wool on the south facade and a ventilated facade system with finishing layer of HPL panels on the north, east and west facades.

The above mentioned options for buildings thermal insulation are applicable for external insulation which is appropriate in this case considering the internal disposition of the building, the security zones and the specific activities of the Headquarters staff; the results of the calculations are illustrated on the diagram on Figure no. 1.

Figure no. 1 Results of the proposed options and suboptions for applying thermal insulation on the NMU "Vasil Levski" Headquarters facades and the prices for a built-up area

The following conclusions could be drawn from the calculations made for the NMU "Vasil Levski" Headquarters:

The highest price for the building façade renovation refers to the solution under II A Option, a ventilated facade system with finishing layer of HPL panels with a total price of **82,15** BGN/sq.m. which is unacceptable option.

Considering the price indicator, the most cost-effective solution is with ETICS on all the facades under I A Option using polystyrene on all the façade walls of the building where the total price is 27,84 BGN/sq.m.

With regard to the other options **IV D – 37,55 BGN/sq.m**., **IV C – 44,27 BGN/sq.m., IV B – 34,11 BGN/sq.m., IV A – 40,81 BGN/sq.m.** the prices are lower when the ventilated facade system is applied only on the north facade. Considering the fact that the operational lifetime of the ETICS systems is between 10 and 15 years and those of the ventilated facades is longer (20-25), in the long term the prices would be almost equal.

For as much as there are many buildings at the NMU "Vasil Levski" that need to be renovated, it could be taken a decision to renovate the first building using an ETICS system with polystyrene on all the facades. Using the savings from the energy-efficiency measures for the first building, the other buildings could be gradually renovated using the option to apply an ETICS system on the south, west and east facades and ventilated systems with finishing layer of aluminum panels on the north, east and west facades, which have the longest operational lifetime.

3. Conclusion

Maintenance and renovation of the military infrastructure in compliance with the requirements for good quality of life necessitates the establishment of a long-term vision for its development. Such a vision could be realized through long-term and medium-term planning of the processes and making the military infrastructure modern and mutli-functional, flexible and mobile in response to the new missions and tasks of the Armed Forces and collective responsibility (Filipov, 2010).

After renovation military buildings regain their original indicators for seismic resistance, meet the contemporary regulatory requirements for exploitation by servicemen and become energy-efficient. As to achieve high quality of military

buildings renovation, it is necessary to use only materials from proved producers and specialists with the necessary experience and qualification for the construction works (Filipov, 2016).

The choice of a solution for building renovation shall be based on the cost-analysis of the different options for activity performance and objective comparison of these options based on the reasonable balance between quality and costs (Stefanov, 2017).

Increasing the energy, construction, installation and operational efficiency of the existing military infrastructure objects calls for complete renovation and has important socio-economic and purely financial consequences.

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