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Research paper

Trends of Energy Performance Certification of Buildings in Azerbaijan

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Abstract

Energy consumption by construction sector is estimated by multi- disciplinary energy auditing and results are represented in an energy performance building certificate. The building certification, which is a world trend today, is applied successfully for many buildings in Azerbaijan too. The purpose of this paper to study the current methodology of energy building certification in terms of the technological aspects of energy auditing. Many documents of the European Union directives and Russian building codes and regulations in the field of ecology and energy saving in construction sector have been revised for implementing them as base for national energy performance certification system AZERI GREEN ZOOM. The assessment categories and main requirements have been considered. The results of this overview have shown the trends and problems in this field. There are given examples of certified buildings.

Keywords: *Building life cycle; Building code; Environmental friendly building green construction; Natural resources; Rating system*

1. Introduction

Contemporary construction sector belongs to major industries with responsibility for the deterioration of environment [1]. According to the statistics, In Azerbaijan Republic construction facilities and buildings consume significant portion of the final energy balance and they account for more than 47 % of total energy amount (Figure 1). Specific heat consumption by residential stock is more than 250 kWh per one square meter of the residential area [2]. It shows that there is significant potential for energy saving and implementing eco-friendly development projects in our republic. Today there is a popular tool for energy saving and eco-development of buildings and construction facilities. It is the energy rating certification system i.e. assessment of energy and eco-rational indicators of buildings and structures at all stages of their life cycle: the production of building materials, design, construction, operation, recycling and treatment of construction trash and its reuse. Currently, there are more than thirty-five national certification systems in the world. They take into account the social, economic, climatic, natural and other resources of each country in varying combinations and degrees [3].

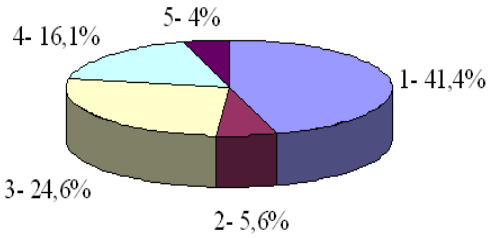

Fig. 1: Structure of the final energy consumption by sectors in %: 1- household; 2- commercial and public buildings; 3-transport; 4- industry, 5-others

2. Building Certification System in Azerbaijan

The national certification process depends on many factors, but primarily is determined by the accepted state construction standards, norms and codes. At the same time it may be adaptable to specific generally recognized world rating systems. Although in Azerbaijan more and more buildings and facilities are constructing in accordance with the latest innovation and construction achievements with using advanced engineering solutions, renewable energy sources but it still exists several problems and obstacles. Building energy consumption refers to buildings under indoor environmental conditions required to meet the rational use of energy, constantly improve energy efficiency, and reduce energy consumption as much as possible [4], for example, insufficiency of regulation of requirements of HVAC systems, that slows down the overall process of certification of buildings and constructions. One of the most significant issue is preparing and implementing legal, normative and technical acts/documents, introduce methods, tools and software for energy auditing and certification of buildings [5]. By local experts main Russian and European building certification systems have been revised and proposed tailored schemes and procedures for national building certification system.

2.1. Supporting Directives and Standards

At the present time, the following documents mainly are used in Azerbaijan as a normative base for solving issues of energy performance certification of buildings:

− EN 15217: Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings, 2005;

− Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings (recast). Official Journal of the European Union L153/13,

18.6.2010:
- SNIP 23-02-2003 "Thermal performance of the buildings", Moscow, 2012;
- EN ISO 13790: Energy performance of buildings – Calculation of energy use for space heating and cooling;
- EN 16247:2014 European Standard Energy audits - Part 2: Buildings. European Committee for Standardization and etc.

By local experts next international systems for environmental and energy certification of buildings were studied: LEED, USA, evolved since 1998, BREEAM, UK, evolved since 1990 and GREEN ZOOM, Russia, evolved since 2011[6]. As result in 2014 the State Committee of Azerbaijan for Standardization, Metrology and Patent approved the state standard AZS 759 "Environmental Requirements for Conformity Assessment of Real Estate Objects" and first national certification system AZERI GREEN ZOOM.

2.2.Buildings Certification Systems

Why was the Russian standard used in the basis of the national standard AZERI GREEN ZOOM? In Azerbaijan, approximately 77% of buildings are built according to the norms based on Russian building codes and the following stages of the building life cycle of are also basically based on the same standards, therefore AZERI GREEN ZOOM is a logical embodiment of the Russian GREEN ZOOM. AZERI GREEN ZOOM contains acceptable construction rules and norms for Azerbaijan. In turn, GREEN ZOOM is a prototype of BREEAM and LEED. Currently, the country is adapting to many European Union norms, directives, their compatibility with local and Russian ones, so the choice of GREEN ZOOM as a starting point for the national certification system. According opinion of local and foreign experts AZERI GREEN ZOOM is optimally possible, taking into account local economic, natural, geographical and climatic features of our republic.

2.3. Azeri Green Zoom

On figure 2 there are nine categories of AZERI GREEN ZOOM certification system, their maximum scores and weights[7]:1- Indoor Environment Quality, 2- GHG emission control and Energy efficiency, 3- Water efficiency, 4- Site Ecology, 5- Linkages, Transportation and Site Location, 6- Materials, Resources and Waste, 7- Innovations, 8- Local issues, 9- Analysis of the project on design level.

Table 1 explains requirements of categories, Figure 3 shows Workflow of AZERI GREEN ZOOM building certification. Points of the certain certificate are done on Table 2.

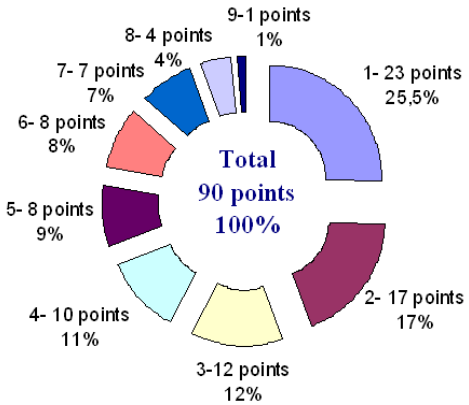

Fig. 2: Points and weights of credit categories in AZERI GREEN ZOOM certification system

Table 1: Assessment categories of AZERI GREEN ZOOM And their main requirements

Categories of assessment	Main requirements
Indoor environment quality	1-standards for indoor air quality 2- monitoring of IAQ during construction 3-enhancement of indoor air quality 4-ensuring the possibility of individual regulation microclimate parameters in the premises 5-prevention of tobacco smoke 6-the amount of Volatile Organic Compounds emitted by the materials is ≤80% 7- individual lighting fixtures installation 8-use fixtures with Color Rendering Index ≥80, lifespan ≥24000 hours 9- providing daylight utilization quality
Energy efficiency and reduction harmful emissions in atmosphere	1-optimal use of energy resources to achieve maximum energy efficiency 2-calculation of energy performance building: $E = \frac{E_b - E_p}{E_b} \cdot 100\% \geq 10\%$ Eb-total energy basic building consumption according to national construction standards Ep-total energy building consumption in terms of use of energy efficient procedures 3-energy consumption measurements for all kinds of consumers during exploitation period 4-use of refrigerants that do not destroy ozone layer 5-GHG emission control 6-use of innovations in the project to reduce harmful emissions in atmosphere 7-assessment of use of renewable energy sources
Water efficiency	1-constant account of water consumption 2-minimum values for indoor water consumption fixtures 3-optimal use of water consumption for outside irrigation 4-reduction of drinking water consumption 5-efficiency of water cooling towers
Site ecology	1-prevention of environment pollution at the construction stage 2-arrangement of the building site -recovery of the natural environment 3-asphalt pavement should be less than 5% 4-use local or adapted plants that do not require irrigation 5-promote plant biodiversity 6-organization of public space, it must be more than 30% of the total area 7-distance from smoking area to playgrounds ≥8m 8-rainwater monitoring: collect and redistribute rainwater 9-use a system of paving paths with water permeable geo-grid 10-minimize the excess exposure of solar radiation 11-use architectural and engineering elements and structures for reducing of light distribution in the upper hemisphere
Linkages, transportation and Site Location	1-pedestrian accessibility of infrastructure objects 2-pedestrian accessibility of public transport stops 3-possibility of using bicycle transport 4-amount of bicycle storage facilities
Materials, resources and waste management	1-quantitative account of construction trash and use it on the construction space 2-minimization of construction waste 3-materials used in construction must have ecological certificate 4-use of the amount of certified wood materials must be ≥50% of the total amount
Innovations	1-use of innovations during at all stages of building life cycle 2-cooperation with professional consultants on "green" construction is rewarded
Local issues	extra points for measures to reduce water use at arid areas, to reduce cold use in air conditioning, to reduce heat use in north region
Analysis of the project on design level	creating a workgroup for assessment of land features, architectural-planning-engineering solutions, identifying opportunities to improve energy efficiency, water efficiency and environmental friendliness

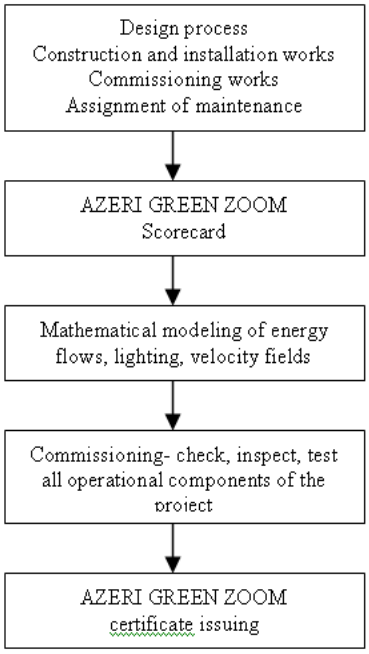

Fig. 3: Workflow of AZERI GREEN ZOOM building certification

Table 2. Points of the certain certificate [8]

Level	AZERI GREEN ZOOM
Bronze certificate	≥35 points
Silver certificate	≥45 points
Gold certificate	≥55 points
Platinum certificate	≥70 points

2.4. Examples of Certified Buildings

Only 2 buildings just have been certified in Azerbaijan by energy performance certifications standards (Figur 4):
office building Baku White City, in March 2014, according to the BREEAM standard with a "Good" rating;
Fairmont hotel, in April 2017, according to the AZERI GREEN ZOOM standard, the Platinum certificate, 70 points out of 90. Hotel Fairmont is the first building in the Republic, certified by the national eco-standard at the stage of its operation.

a)  б) 

Fig.4: a) Baku White City Office building, b) - hotel Fairmont

The main construction innovative technologies and energy-efficient measures which were applied in the Fairmont hotel building are:
- use of local environmentally certified finishing, construction, structural materials;
- energy efficient glazing with a heat transfer coefficient $1{,}1\frac{W}{m^2 \cdot K}$;
- energy efficient engineering and communication equipment;
- climate control system with heat recovery and efficient factor 0.75;
- use VRV system of fourth generation for cooling;
- use boilers for heating with energy efficiency more than 90%;
- energy efficient elevators;
- daylight with efficient LED, CRI=90, lifespan =34000 hours;
- artificial lighting with detection sensors;
- control of parking fans by means of CO sensors;
- reduction of supply air temperature in the parking lots to 7 °C;
- use of an efficient water fixtures.

As a result of all the listed energy-efficient measures, the building is 29% more energy efficient than the base one, the operating costs have been reduced by 22%, heating costs have been reduced by 13%.

2.5. Problems

Nowadays the certification of buildings in the republic is becoming more urgent due to the fact that it contributes to reducing the environmental impact of the construction sector, the actual saving of energy and natural resources, that is why this task is on the agenda of many owners of the modern buildings. The following problems in this area are observed [6]:
-lack of certified specialists in this field;
-lack of adequate technical standards makes its implementation slower than necessary;
- the availability of natural resources and their significant reserves determine the voluntary nature of the certification of buildings and the passivity of state structures;
-significant capital expenditures for energy efficient and environmentally friendly buildings, inadequate state measures of assistance and encouragement, insufficient awareness of building owners hamper the development of the certification system;
-local experts need to continue to develop and implement a building certification methodology based on national norms and standards.

3. Conclusion

Basing on the previous information it can be summarized that building certification market in Azerbaijan is very young and current dynamics of the development has very slow tempo. Energy performance certification of buildings is one of the ways extension of the number of the environmental friendly buildings [9]. Nowadays it has become mandatory to save energy for future generations and to take all efforts in order to develop the road map of national construction certification system in Azerbaycan. The significant potential for energy and eco-efficiency of construction dictates the need for planned and accelerated implementation of energy efficient actions to modernize construction and use cost-effective ways to mitigate the pressure on the environment. Elimination of existing obstacles is possible through the adoption and implementation of comprehensive government directives on resource-saving measures and energy-saving measures in accordance with international requirements, otherwise the problem of non competitiveness of the construction infrastructure will soon become acute.

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