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The Implementation of Energy Efficiency For Buildings In Algeria: A Perspective of Stakeholders

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Abstract: The implementation of the building design provides the sustainability of the building and the environment. However, it offers many benefits to building owners and users to reduce maintenance costs and extend the service life, which is a feature of the building design. The intent of this research is to implement the energy efficiency for building constructions in Algerian perspective of stakeholders. There are two objectives in this study which are to investigate the challenges of building designs in achieving energy efficiency and to recommend the possible ways of investigation of building designs for energy efficiency. Besides the populations in this study are 210 architect firms but only 136 architect samples are selected according to the recommended Kerjie Morgan table for sampling. The quantitative approach is used in this study where samples distributed by set of questionnaire and analyzed by using Statistical Package for the Social Sciences 23.0 (SPSS 23.0). The result for this study is measured by average mean which is looking for the highest factor to the lowest factor. The highest factor is challenge of sustainability for energy efficiency in building design, followed by challenge of energy minimising consumption in building due to building services, third challenge of high cost of building design for energy analysis, the fourth is challenge of knowledge of energy efficiency during building design and the last factor is challenge of the high cost of energy efficiency in building. Eventually this study produced several recommendations for future research, there are stakeholders must use the natural resources in lighting and ventilation and also the electrical side in the building design. they have to aware about the high value of energy wasting, government must create a regulation for energy consumption in construction in order to control the energy use in buildings, Algerian government must support the implementation of energy efficiency in building design and provide training centre, workshop, conferences about the possibility of energy efficiency analysis to elaborate daylighting analysis, and energy analysis during the design stage. This recommendation is to improve the sustainability in energy efficiency for a better future for a better generation.

Keywords: Construction, sustainability, energy, efficiency, consumption, building design

1. Introduction

The implementation of building designs provides construction and environmental sustainability. However, it offers a lot of benefits for building owners and users to reduce maintenance costs and extend the service life, all of which are characteristics of the architectural design. In addition, the impact of energy efficiency is very important in architectural design due to Algeria's lack of relevant data in the study of architectural design. This is to urge Algeria to be more involved in investments related to sustainable development, especially in the current situation. Passive

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housing investment opportunities to achieve socio- economic benefits, such as reducing consumption, reflecting the reduction of household and country energy bills, in particular creating thousands of jobs directly or indirectly related to architectural design. It seeks to inform the reader about the real benefits which energy efficiency measures can unlock and aid the reader to understand why energy efficiency is a high priority in supporting greater sustainable energy supplies for development. In Algeria levels of access to basic energy supplies are among the lowest in the world and where modest energy consumption can often have very high developmental benefits. By using energy more efficiently nations can maximize the effective use of available resources for the economic benefit of their populations. The experts of the German company Bayer, who hosted a meeting on the topic of energy efficiency on May the 29th 2012 (the German-Algerian Chamber of Commerce), the building sector is the biggest energy consumer, with a share of almost 50% of the total consumption of all types of buildings (Bayer, 2012).

However, more efficient use of energy at all stages of the supply/demand chain could reduce the negative impacts of energy consumption, while still allowing the same economic development. In addition, the inefficient use of energy generally implies higher than necessary operating costs to the customer (the energy end-user).

2. Literature Review

Much effort has sought to apply renewable materials and renewable energy resources in buildings in order to use energy efficiently and to reduce the carbon footprint. Reducing energy use at lower costs in buildings will offer greater potential to meet CO 2 reduction targets than any other sectors (Goh et.al, 2017).Energy efficiency in buildings is compelling, cost effective and can help consumers to save money in the long term (Goh et.al, 2014). Energy is one of the most critical material bases for human survival and social development as well as a major contributor to climate change and environmental pollution. Economic theories indicate a balance between supply and demand. But considering energy resource conservation and environmental protection requirement, we cannot keep using energy to promote economic growth without constraints, let alone taking energy as one of the ordinary goods totally determined by its demand and supply on the market (Liu & Lin, 2016).

Energy efficient machines and devices would be increasingly invested in productions as energy price rises, thus leading to the substitution of capital for energy. However, operation of the new machines and equipment would demand extra energy, of which the amount might be even more than the saved one. In that case, energy and capital present to be complements. (Liu & Lin, 2016). An optimization of building envelope is required to achieve a high energy performance of the building (Lin et al., 2016).

The Algerian government invests heavily in sustainable development and scientific research, new laws on sustainable housing, reducing CO2 emissions. Shows the interest of the Algerian state to promote sustainable development other the legislative side, the national scientific research encourages researchers to engage in research that is the case of PNR projects and achieving the pilot projects, the organization of international meeting to develop new concepts. (Hacene & Sari, 2013).

Algeria has the potential to be one of the major contributors in solar energy and become a role model to other countries in the world. Renewable energy now is one of the major elements of Algeria's energy policy and in view of boosting the national effort in terms of renewable energy beyond 2011, Algeria has developed a national programme for the period 2011–2030 to promote concrete actions in the fields of energy efficiency and RE in line with the approach adopted by the government on February 3, 2011. Besides, it confirms Algerian's ambition to become an international hub for industrial and energy production and exportation in the solar sector. With this in mind, along with the environmental responsibility issues, public awareness gradually increased over the last seven years and alternative energy resources have become a new area of interest.

As a tangible target, the Ministry of Energy and Mines (MEM) strategic plan aims to reach a 40% share of renewable energy (mainly solar) in electric energy production by 2030. The various future projects are all factors that will undoubtedly give Algeria an important role in the implementation of renewable energy technology in North Africa, the capacity for providing sustainable supply of cost-effective electricity from renewable energy sources for the needs of the population, and the possibility of even exporting 10,000 MW to neighbouring and European market (Boudghene & Stambouli, 2012). Since that Algeria has all this energy that makes it able to be used to reduce the energy consumption of electricity. Energy efficiency is called to play an important role within the national energetic context, characterized by a strong growth of the consumption, especially, of households with the building of new housing, and the achievement of public infrastructure and the industry relaunch (Centre de Développement Ener gies Renouvelables, 2015).

In order to incorporate the concept of sustainable development into the design of building envelopes, it is very important for all stakeholders to participate in the designing process of sustainable building envelopes. Succeeding in the design of sustainable envelopes must take into consideration all competing sustainable development factors to achieve the goal of building sustainability (Iqbal, 2009). Therefore, efforts to achieve building sustainability through the design of sustainable building envelopes should not only focus on the construction of performance evaluation methods, but should focus on the type of building envelope structure design. (Al-Hammond et al, 2007). Buildings are one of the keys to energy use sustainability planning (Azzi et al., 2015).

In Algeria, the National Energy Efficiency Program of the Ministry of Energy and Mines of Algeria encourages the implementation of innovative practices and technologies around the insulation of buildings. There have been plans to take appropriate measures during the shell structure and design phase (Ghedamsi et al., 2016). In HVAC, ventilation is a key issue in providing proper indoor air quality, and it is also responsible for the energy consumption of buildings. Improving ventilation systems will increase the energy efficiency of buildings. (Chenari et al., 2016). Designers must understand all information about occupant behaviour, low-carbon technologies, construction practices, and user-building interactions in order to predict building energy consumption (Santin et al., 2014).

Table 1 - Summary table of energy efficiency challenges in building design

Author	Challeng
	Challenges of sustainability for energy efficiency
(Chabane, 2010) (Mokhtari, 2011) (Bayer,. 2012) (Santin *et al*, 2014) (Guan *et al*., 2016)	˙ Challenges of Sustainability for energy efficiency in building design. ˙ Challenges of energy minimizing consumption in buildings due to building services. ˙ Challenges of analyzing the different components of the building during design ˙ Challenges of energy minimization due to occupancy. ˙ Challenges to minimize the air emission produced by construction ˙ Challenges to minimize the environmental impact due to energy consumption in building. ˙ Challenges to minimize the energy consumed to ensure indoor environment comfortable.
	Challenges of investigation of building design for energy efficiency
(Azmy *et al* ,.2010) (Bei & Xiao , 2011) (Azzi *et al*,.2015) (Ghedamsi *et al* ,.2016)	˙ Challenges of high cost of building design for energy analysis ˙ Challenges of knowledge of energy efficiency during building design ˙ Challenges of the high cost of energy efficiency in building ˙ Challenges of limited use of energy efficiency ˙ Weak support from the government ˙ Difficulties in software choice to elaborate energy analysis. ˙ Challenges of compatibility between of design and energy analysis

3. Methodology

There are specific methods based on surveys and experimental studies that identify samples and populations, specify design types, collect and analyze data, display results, interpret and write research reports in a manner consistent with surveys or experimental studies (Creswell, 2013). In this study a quantitative research will be carried out through a survey in order to investigate the challenges of building design in achieving energy efficiency and to recommend possible ways of investigation of building design for energy efficiency. This section of the study would focus on the method of study to be carried out to achieve the objectives of this report. Therefore, every measure taken must be appropriate and relevant to the related topic of study. Three approaches throughout this study to gather and collect reliable and relevant data, literature review, Quantitative Research method (questionnaire), and suggestion of requirements. This research is based on a questionnaire, which is designed to respond to all the research objectives and to recommend the requirements of energy efficiency in building designs for energy minimisation.

4. Results

Reliability Analysis

The National Council of the Algerian Architects consists of 230 architect firms. Based on the research 210 questionnaires were distributed to respondents, 136 responses were returned is accounted to 64.76%. The respondents involve three types; principal architects, senior architects and designers.

The results show the positions of respondents. Of the 136 respondents, 42 (30.9%) were designers, and the remaining 38 (27.9%) were senior architects. Finally, 56 respondents (41.2%) were principal architects. Therefore, the most replies came from the principal architects, indicating that most of the respondents were principal architects.

The results show that 30.9% of respondents are between 1-5 years old, of whom 42 are respondents. 22 of the respondents had 6-10 years of experience, accounting for 16.2% of the total number of respondents, and 11.8% of

the respondents had 11-20 years of experience. At the end of the period, the proportion of respondents with more than 21 years of experience was the highest, accounting for 41.2%, of which the total number of respondents participating in the survey was 56.

With 79.4% representing 108 respondents the results show that most construction companies undertake private and government projects, At the same time, 14.7% of the respondents stated that 20 of them indicated that they were undertaking private projects, and 5.9% of respondents said that they were responsible for government projects by 8 respondents.

According to results, the software used by the firms for energy analysis, none of the firms are using energy analysis for the different projects undertaken. As shown in Table 1, the results of this study are ranked from the highest average to the lowest average. The respondents ranked this variable first, with the highest average being 4.83. The results show that the most significant challenge is the challenge of energy efficiency sustainability in architectural design. Second, the most significant challenge in the second-ranked challenge is that the average value of construction services is 4.49, which minimizes the challenge of building consumption. Respondents showed that one of the most important challenges was the challenge of minimizing energy due to occupancy and the environmental impact of minimizing the impact of building energy consumption by an average of 4.47. In order to minimize the air emissions rom construction, respondents ranked this variable fifth, with an average of 4.19. It is difficult to understand and calculate energy performance during the design phase. It is the second-ranked variable with an average of 4.05. This is the sixth challenge. This variable is ranked 7th, which is the challenge of analyzing the different components of the building in the design, with an average of 3.89.

Table 2 - Challenges of sustainability for energy efficiency

No	Variables	Mean	Rank
1	Challenges of Sustainability for energy efficiency in building design.	4.83	1
2	Challenges of energy minimizing consumption in buildings due to building services	4.49	2
3	Challenges of energy minimization due to occupancy	4.47	3
4	Challenges to minimize the environmental impact due to energy consumption in building	4.47	3
5	Challenges to minimize the air emission produced by construction	4.19	5
6	Difficulties to understand and calculate energy performance during the design stage	4.05	6
7	Challenges of analysing the different components of the building during design	3.89	7
8	Challenges to minimise the energy consumed to ensure indoor environment comfortable	3.83	8

According to the survey results shown in Table 2, the respondents ranked this variable as the first in the group, with a mean of up to 4.90. This result shows that the most significant challenge is the high cost of architectural design for energy analysis. The second variable is the challenge is to implement the energy efficiency knowledge during architectural design, with an average of 4.68. The high cost of building energy conservation challenges and the challenges faced by limited energy use are ranked third and fourth respectively, 4.61 and 4.24, respectively. The government's weak support ranks fifth, with an average of 4.18. The sixth variable ranking has difficulty in software selection, using an average of 4.12 to elaborate energy analysis. Respondents indicated that the compatibility challenge between design and energy analysis was listed as the last variable with an average of 4.03. These variables have been developed to understand the relationship between energy efficiency and building design. This relationship is very important because it contributes to the energy efficiency of building design.

Table 3 - Challenges of investigation of building design for energy efficiency

No	Variables	Mean	Rank
1	Challenges of high cost of building design for energy analysis	4.90	1
2	Challenges of knowledge of energy efficiency during building design	4.68	2
3	Challenges of the high cost of energy efficiency in building	4.61	3
4	Challenges of limited use of energy efficiency	4.24	4
5	Weak support from the government	4.18	5
6	Difficulties in software choice to elaborate energy analysis.	4.12	6
7	Challenges of compatibility between of design and energy analysis	4.03	7

Building services have an influence on energy consumption in buildings, if this relationship is known .it will be easy to investigate energy efficiency for its benefits in building design and energy conservation.

Table 3 shows possible methods for investigating energy efficiency building designs. Respondents ranked the well- understood variable of the material properties for energy analysis with the highest mean value of 4.71. The second variable is that the use of endothermic materials can reduce the average energy consumption of 4.66. The building energy consumption management regulations, the variables for improving the natural ventilation system and the use of economic and electrical equipment were ranked 3rd, 4th, and 5th, respectively 4.60, 4.58, and 4.54. Respondents ranked the considerations for using insulation in the design phase, with an average of 4.51, which is variable 6. The meaning of 4.32 is related to the variables of consciousness and the culture of improving energy efficiency, ranking seventh.

Table 4 - Building design and energy efficiency in construction

No	Variables	Mean	Rank
1	Good understanding of Materials properties in conducting energy analysis	4.71	1
2	Usage of heat-absorbing materials can reduce the energy consumption	4.66	2
3	Create a regulation for energy consumption in construction	4.60	3
4	Improving natural ventilation systems	4.58	4
5	Usage of economic electrical equipment	4.54	5
6	Consideration of using thermal insulation during design stage	4.51	6
7	Awareness and improving the culture on energy efficiency	4.32	7
8	Good understanding of building geometry in conducting energy analysis	4.11	8

9	Knowledge on low carbon energy to predict the energy consumption of building	3.96	9
10	Knowing the occupant behaviour to predict the energy consumption of building	3.84	10

Based on the results of Table 4 The government's proposed financial support suggests that the possible building energy- saving design method ranks first. This shows that this is the highest average of 4.85. The second variable is also very important. The results of the study show that the average value is 4.70. As found in the data compilation, sixth. The respondents' full replies ensured that the basic training learned and applied energy efficiency in architectural design, with an average of 4.68. As shown in Table 4, recognizing that energy efficiency can reduce the negative impact of buildings on the environment, the average is 4.61, ranking fourth. According to Table 4, the fifth ranked ranking provides training and seminars on energy efficiency in solar energy and sunshine analysis, with an average of 4.58.

Table 5 - Possible ways to investigate the building design for energy efficiency

No	Variables	Mean	Rank
1	Financial support from the government to recommend the possible ways of building design for energy efficiency	4.85	1
2	Coordination with other firms that have considered energy efficiency in building design	4.70	2
3	Ensure the basic training to learn and apply energy efficiency in building design	4.68	3
4	Awareness about the capability of energy efficiency to reduce the negative impact of the building to environment	4.61	4
5	Provide training and workshop regarding energy efficiency capability for thermal and daylighting analysis	4.58	5
6	Secure necessary resources (Software and hardware) to recommend energy efficiency	4.40	6
7	Provide training about energy analysis software	4.17	7
8	Selection of suitable projects to recommend the possible ways of building design for energy efficiency	4.05	8
9	Motivate people to recommend energy efficiency	3.91	9
10	Provide contractual arrangement for energy efficiency recommendation	3.87	10

From the ranking table in Table 4, it can be seen that the recommended energy efficiency of the necessary resources (software and hardware) ranked sixth, with an average of 4.40. Provide training on energy analysis software and select appropriate projects to recommend possible ways of energy efficient building design, ranking 7th and 8th respectively, with an average of 4.17 and 4.05, respectively

5. Discussion

According to the analysis in this study, respondents believe that sustainability is the most important factor affecting the construction industry as we can see in the results of the sustainability challenges of building designs. The average is 4.83. This is a comparison with previous studies which sheds light on how occupants consume more energy in buildings through the use of facilities. In addition, this finding suggests that sustainable development is critical to achieving a sustainable society.

In this study, respondents held the same view on the challenges brought about by the minimization of energy consumption in construction services and the challenges brought by the minimization of occupancy energy. The challenges were 4.49, 4.47 and 4.47 respectively. These challenges face the architecture during the design phase. This finding is consistent with the findings of previous studies; in buildings, heating is the main energy consumption,

especially in hot climates, to ensure a cool environment and a lot of electricity to ensure the functionality of household appliances.

One of the major factors that cause global environmental impact is the construction sector, which may affect the environment. Among the respondents to the study, there were architects who agreed that the challenge of reducing the impact of building energy consumption on the environment and minimizing the air emissions generated by the buildings to 4.47 and 4.19 was the impact The reason for the environment. In addition, respondents were concerned about the difficulty of understanding and calculating energy performance during the design phase at 4.05, and found that the architecture must have knowledge of architectural shapes, orientations, functions, and encapsulation materials in order to consume energy buildings. The survey results show that when using electrical appliances, electricity and HVAC, occupancy has an impact on energy consumption.

The high cost challenge of energy analysis for building designs is the most important factor in respondents' opinions, with an average of 4.90. This is a very high average, and it declares that this challenge is an obstacle to their need to solve its architecture. This argument has been supported by previous research and found that the high cost of building energy analysis design is a big challenge. In addition, the respondents agreed that the knowledge of challenges of energy efficiency during the architectural design period also means that the average energy efficiency achieved is 4.68, which is a huge challenge. In order to achieve energy efficiency in architectural design, respondents believe that the other challenges faced by the architecture are the challenges of building energy-saving costs, with an average of four.

This challenge has a great influence on the construction industry. The challenge of limited energy efficiency is at an average of 4.24, because respondents believe that this challenge has an impact on energy consumption and therefore needs to control the energy efficiency of the construction industry. The government's weak support means that the average of the survey results is 4.18, which is consistent with previous research findings. The study finds that the government must provide support to achieve energy efficiency in the construction industry.

However, other challenges towards energy efficiency in architectural design have difficulties in software selection and cannot be used to describe energy analysis using 4.12. Respondents shared the same view of previous research. They found that the building must have knowledge of architectural design. If the shape of the building is complex, the process will be very complicated (Jin & Jeong, 2014). The final challenge for this study is the challenge of compatibility between design and energy analysis. The average of this challenge is 4.03, which represents the compatibility between the design and energy analysis faced by the respondent.

It was found that the average value of a good understanding of material properties when performing energy analysis is 4.71, which is a very high value, and therefore affects the energy analysis and the factors that affect energy efficiency in the design process of the construction industry. The design process has three activities: analysis, synthesis, and evaluation. The second process of achieving energy efficiency in building designs is that the use of heat- absorbing materials can reduce energy consumption because respondents agree that the average is 4.66 in order to fully understand the demand side of building energy use. The third is to establish an average energy consumption regulation of 4.60.

Respondents' views on this ensures that, in order to analyze heat energy, it is necessary to confirm the power consumption for ensuring heating. The natural ventilation system has an average value of 4.58. From the perspective of energy-saving, natural resources and energy consumption, it can bring more benefits to the construction industry. The use of economic electrical equipment reached 4.54, which will help save energy. There are many reasons for the increase in the energy of buildings, for example, the increase in the number of electrical equipment per house and the use of non- economical electrical equipment. Respondents agreed that the average awareness and energy efficiency culture is 4.32, which has a great impact on the energy efficiency of buildings. Lack of awareness of energy conservation and lack of culture, people's desire for more and more comfort is the reason for increasing energy consumption in buildings.

Based on the analysis of this study, in order to achieve the energy efficiency of architectural design, the builders must pay attention to some factors that affect the use of energy. In this section, the researchers will introduce the main key factors of energy minimization architectural design, ranked by the mean from the highest to the lowest.

In order to reduce the high temperature related problems in building designs, there are many solutions that make the occupants more comfortable by reducing the heat and cooling through the heat absorbing material. Respondents agreed that the government should provide financial support and suggest that the average possible building energy-saving design method is 4.85, which is the most important factor in achieving energy efficiency in building design. Regarding coordination with other companies that have considered energy efficiency in architectural design, the respondents agreed with an average of 4.70 that coordination and communication with other companies can help achieve energy efficiency. The architecture agrees that ensuring that the basic training for learning and applying energy efficiency in architectural design has an average of 4.68, which is the reason that contributes to energy efficiency. Training is an important factor in improving energy efficiency, including training to understand how to apply. And, according to the respondents, one of the most important factors that helps improve energy efficiency is to realize that energy efficiency can reduce the negative impact of buildings on the environment, with an average of 4.61.

In this study, respondents agreed with training and seminars on energy efficiency capabilities for heat and sunshine analysis, with an average of 4.58. This finding was supported by previous research in Algeria. Several associations provided software solutions and provided a series of resources to ensure the best training conditions. Ensuring the necessary resources (software and hardware) to recommend energy efficiency represented by 4.40, this finding includes providing the necessary resources to optimize training conditions, which provide training on energy analysis software, with an average of 4.17. Respondents believe that providing energy analysis software can provide more energy efficiency assistance for building design.

6. Conclusions

The survey results show that the top five of the most significant factors based on the average mean represented by the challenges from highest to lowest are: sustainability in building design challenges energy efficiency, and the challenge of energy minimization of building consumption Service, energy analysis, high cost of architectural design challenges, knowledge of energy efficiency during architectural design challenges, and high cost of building energy efficiency.

Based on the findings, the possible method of implementing the energy efficiency of architectural design in Algeria based on the survey results is to provide financial support for the government to recommend possible architectural design methods to improve the knowledge of energy efficiency in the architectural design process. According to energy analysis, the use of heat-absorbing materials can reduce the energy consumption and high cost of building energy.

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