

# Assessing Architects' Knowledge of Passive Cooling Design Strategies in Selected Office Buildings and Firms in Kuwait

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**Abstract** - Nowadays, Buildings are responsible for consuming over 32% of the world's energy consumption. This has led in conducting various strategies and prototypes for ensuring that buildings can optimally function with a reduced level of energy consumption rate.

In the modern world, designers seek to develop a new paradigm and method in the structure of the buildings which attributes to the natural surroundings and environment in order to obtain a great comfort level for users.

The perception of passive design planning has been established to achieve a thermal performance strategy in reducing energy consumption to its minimal. The study conducts an assessment on the knowledge level of Architects conducting high rise buildings in Kuwait and the necessity of using passive design strategies. Specifically, this research used a questionnaire survey by targeting the top known firms in Kuwait. Descriptive statistics were carried out on the data and the results were presented using tabular illustrations. Generally, the study revealed that Architects in Kuwait have a good knowledge on the importance of using passive cooling strategies in office building in Kuwait.

As a result, building orientation, natural daylighting and ventilation are important aspects in passive design strategies for office buildings in achieving and accomplishing thermal satisfaction and comfort.

**Index Terms** - Passive cooling, Kuwait, office building, Architecture, design, energy consumption, environmental performance.

## 1 INTRODUCTION

APPLYING passive cooling strategies in office buildings in Kuwait can result in obtaining an energy efficient building. A significant capacity of the global energy consumption is the cause of high utilization of heating, ventilation, and air condition (HVAC) installation. The growing population and the high standards of office buildings are increasing rapidly in Kuwait. In addition, the artificial cooling system in a building is also growing widely. Thus, it requires an immense energy power consumption which on the other hand affects the global energy consumption. Hence, converting to natural means aide and applying passive strategies will have a great impact on the globe and making it more eco-friendly. Such strategy will be enforced; in one hand, lowering the global impact of energy consumption, and on the other hand, maintaining the high level of comfort. This strategy will result in energy efficient buildings. This method has been conducted in several studies, converting mechanical technology into a more natural aided technology. It is crucial for Architectural firms to be knowledgeable in converting the use of (HVAC) into passive cooling strategies in order to cut down on the energy consumption.

In Kuwait, and because of its climate, the use of mechanical technologies has a high demand and usage. The buildings are growing to be more aesthetically pleasing while remaining oblivious to the impact it has on the world and the excessive energy consumption. Thus, revolving such a situation by balancing the equation simultaneously, maintaining the cooling activities of the building without trading-off the human comfort factor, there must be an integrated approach. Such approach satisfies the growing demand and needs of the population in a building and its eco-friendly strategy. This strategy

incorporates various passive cooling techniques and building requirements from the initiation of the building stage for adequate energy consumption in the Kuwaiti climate. There is an increasing rise in the market for air conditioning in the last two decades. Therefore, there is an urgent need for the investigation to be conducted on the knowledge of the architectures usage of passive design especially based on the geographical location. The focus of this study is to investigate the architectures level of knowledge about passive design strategies in Kuwait.

## 2 LITERATURE REVIEW

The construction sector consumes approximately 32% of the world's energy and emits 36% of the greenhouse gases. The expected slight increase in emission, which causes high temperature in the outer skirts of the main cities, will significantly contribute to the urban heat island (UHI) which causes the outer limits of the main cities with high temperature. Passive cooling designs include a natural cooling process in achieving the best-balanced interior conditions (Saffari et al., 2017). Such a design strategy is deemed necessary to be applied in the state of Kuwait. It is considered a perceptive approach, bearing in mind, the country's geographical desert region where its continental climate is dry and hot.

Kuwait overcame challenges to reach the economic success it has today. Its strategic location on the Northern end of the Arabian Gulf has certainly helped stimulates economic growth. It is steadfast adherence and commitment in the urban areas and its economic diversity has ensured that it is a safe and reliable economical location for investors to invest in the forthcoming years. (constructionweekonline, 2020). Focus-

ing on these qualifications and aptitude considering a passive design in high office buildings are a must. The geographical region and very accommodating economical location are a substantial place for investors, the passive design high office building will facilitate a considerably convenient environment. Thus, creating a haven for investors.

Passive design is a significant concept in the architectural environment. It is a theory and practice that emerged rapidly in the strategies of design during the last decade (Prieto et al., 2017).

Nowadays, environmental recognition is considered vital especially where its concept has been considered significant in the architectural industry. As it has been quoted in the (IPCC) (2015) that the atmospheric temperature is expected to rise over 21st Century under all estimated emission status. However, the focal point is that if the temperature will continue to rise, then the architecture must consider a phenomenal diversion on its architectural scheme. Bearing this in mind, the following questions have to be considered: Should the architect continue to design buildings that depend on effective means to reduce the impact of global warming and continues to add remaining challenges to greenhouse gas emission, as the use of generators remains the only certain force in most of the non-developed countries in the world? Or, if the transition to an architectural passive design strategy building are considered an alternative? (Bulus et al., 2017)

As a result, passive design strategies reduce energy needs to a great extent, for example the correlation between the sun's path, the building's location, and the buildings site features, which includes elements such as windows and outdoor shading devices have a very significant effect on the quality and effectiveness of natural daylight. By transitioning to an architectural passive design strategy, the result would be an alternative to the use of generators -which remains to be the main method in most of the underdeveloped countries (Polesello & Johnson, 2016).

### 3 RESEARCH METHOD

The data presented in this paper were drawn from questionnaires among selected architectural firms in Kuwait on the knowledge of applying the passive cooling design strategies in office buildings. It is designed to investigate the implementation and the adoption of an Eco-friendly method. The research population consisted of top well-known architectural firms. The questionnaire used in this research consisted of using two thematic sections.

The statistical package for social sciences (SPSS) was used for analyzing the data presented. The results were illustrated in tables and an analysis and discussions was made based on the outcome of the research, and a comparison of the result was made in accordance vis-à-vis the literatures gathered

In section A the questions were divided into 3 sectors: years of the respondent's design industry, the respondent's company size and the company's experience in low energy design projects. In order to get the frequency and percentages outcome in line with the research study, the research focused on

the years of the design industry itself. This is to have a substantial ground on the percentage of the respondent's knowledge in the passive cooling design strategies.

Section B illustrates the general information of the respondent's experience in the passive cooling design industry. The sections were considered to identify the importance of design based on low energy cooling, as well as illustrating the necessity of researching the buildings type and the percentage of good practice in this domain. It also set forth the importance of the clients/ users awareness of the buildings concepts and systems. Finally, the percentages and numbers of the site's microclimate were gathered, to identify the impact and performance acknowledgment on both the energy and environmental aspect of a building. This section presents the results of the study and discusses the subject matter in line with literature.

### 3.1 General information related to your company

TABLE 1. YEARS IN DESIGN INDUSTRY

Number of Years	Frequency	Percentage
Less than 5 years	1	3.125
5 to 10 years	2	6.25
10 to 15 years	0	0
Over 15 years	28	87.5
No answer	1	3.125
Total	32	100%

Table 1 shows the number of years the respondents' firms have been engaged into design industry.

Respondents with more than 15 years of experience in design industry accounted for 87.5% of the study subjects, while 6.25% of the respondents had between 5 and 10 years of experience. Representing 3.12% of the subjects, the remainder whose years of experience amounted to less than 5 years did not complete the survey questionnaire.

TABLE 2. COMPANY SIZE

Number of Employees	Frequency	Percentage
Less than 20 employees	0	0
Between 20 to 100 employees	0	0
More than 100 employees	30	93.75
No answer	2	6.25
Total	32	100%

To determine the company's size, Table 2 depicts the respondent's number of employees.

It could be inferred from table that 93.7% of the companies surveyed had employees numbering beyond 100 while the remaining 6.25% did not give a response.

TABLE. 3. COMPANY EXPERIENCE IN LOW ENERGY DESIGN PROJECTS

Experience in Low Energy Design Projects	Frequency	Percentage
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With experience	9	28.125
With no experience	11	34.375
Not aware	12	37.5
Total	32	100%

To obtain enough data on the companies' experience in low energy design projects, Table 3 shows this information.

The table shows that the greatest portion of the respondents (37.5%) had lack of awareness of low energy design projects, while 34.3% of the respondents had no experience with low energy design projects. On the other hand, only 25% of the respondents accounted for those with experience in working on low energy design projects.

### 3.2 General information related to your experience

TABLE 4. IMPORTANCE OF DESIGN BASED ON LOW ENERGY COOLING

Verbal Interpretation	N	%
Very Important	4	12.5
Important	15	46.875
Somewhat important	12	37.5
Not Important	1	3.125

MEAN	2.6875	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

With regard to the question of the degree to which design is important in low energy cooling from the perspective of the study subjects, 12.5% of the respondents perceived that design is very important, while 46.8% (n = 15) considered design as important. While 37.5% (n = 12) of the respondents viewed design as somewhat important, a mean score of 2.68 was obtained regarding the importance of design in low energy cooling.

TABLE 5. IMPORTANCE OF RESEARCHING THE BUILDING TYPE AND ANALYZING GOOD PRACTICE EXAMPLES

Verbal Interpretation	N	%
Very Important	7	21.875
Important	15	46.875
Somewhat important	9	28.125
Not Important	1	3.125

MEAN	2.875	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

The respondents' answer on how important is researching the building type and analyzing good practice examples is shown in Table 6.

Out of all respondents, only 21.8% (n = 7) expressed that

conducting research on building type and analysis of best practice examples is very important, while an overall mean score of 2.87 relayed an indication that it is important. On the other hand, 15 (46.87%) of the respondents indicated that conducting research on building type and analysis of best practice examples is important, while 9 (28.12%) indicated that it is important.

TABLE 6. IMPORTANCE OF MAKING THE CLIENT UNDERSTAND BUILDING CONCEPTS AND SYSTEMS

Verbal Interpretation	N	%
Very Important	12	37.5
Important	15	46.875
Somewhat important	5	15.625
Not Important	0	0

MEAN	3.21875	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

The majority (n = 15) representing 46.8% of the respondents indicated that making the client understand building concepts and systems is important, while 37.5% (n = 12) of the respondents expressed that it is very important. Only 15.6% (n = 5) of the respondents relayed that such task is somewhat important. Overall, a mean score of 3.21 was obtained for the question of whether the respondents considered the importance of making the client understand building concepts and systems.

TABLE 7. IMPORTANCE OF ANALYZING SITE MICROCLIMATE

Verbal Interpretation	N	%
Very Important	9	28.125
Important	8	25
Somewhat important	12	37.5
Not Important	3	9.375

MEAN	2.71875	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

Table 7 depicts the respondents' reply when asked about the importance of analyzing site microclimate.

While 28.12% (n = 9) of the respondents indicated that site microclimate analysis is very important, 37.5% (n = 12) expressed that it is somewhat important. Only 8 respondents (25%) viewed site microanalysis as important, while the mean score for its importance reached 2.71.

TABLE 8. IMPORTANCE OF PROVIDING OUTLINE ILLUSTRATION OF ENVIRONMENTAL PERFORMANCE THRU PLAN AND SECTION DIAGRAMS FOR PASSIVE AND ACTIVE ENERGY FLOWS FOR COOLING SEASONS

Verbal Interpretation	N	%
Very Important	5	15.625
Important	11	34.375
Somewhat important	14	43.75
Not Important	2	6.25

MEAN	2.59375	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

Table 8 shows answers of the respondents when asked about the importance of providing outline illustration of environmental performance thru plan and section diagrams for passive and active energy flows for cooling seasons.

Only 5 respondents (15.6%) indicated that the provision of outline exhibit of environmental sustainability with plan and section diagrams for active and passive flows of energy for cooling seasons is very important. In relation to this, 43.75% (n = 14) of respondents relayed that it is somewhat important, while 34.37% (n = 11) perceived it as important. The perceived importance of the provision of outline exhibit of environmental sustainability with plan and section diagrams for active and passive flows of energy for cooling seasons garnered a mean score of 2.59.

TABLE 9. IMPORTANCE OF USING THE LATEST TECHNOLOGY TO DESIGN A BUILDING GENERATING ELECTRICITY (SOLAR ENERGY)

Verbal Interpretation	N	%
Very Important	2	6.25
Important	8	25
Somewhat important	13	40.625
Not Important	9	28.125

MEAN	2.09375	Somewhat important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

Table 9 depicts the answers the question of the importance of using latest technology of renewable energy in the design of a building namely solar energy.

While only a few respondents (6.25%) expressed that utilizing the latest technology in designing an electricity-generating building is very important, 25% and 40.6% of the respondents considered it as important and somewhat important, respectively. Nonetheless, the mean score obtained regarding the perceived importance of utilizing the latest technology in designing an electricity-generating building is 2.09.

TABLE 10. IMPORTANCE OF MAKING CALCULATIONS FOR BUILDING ENERGY PERFORMANCE

Verbal Interpretation	N	%
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Very Important	6	18.75
Important	17	53.125
Somewhat important	5	15.625
Not Important	4	12.5

MEAN	2.78125	Important
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Legend: 3.26 – 4.00 - Very Important  
2.51 – 3.25 - Important  
1.76 – 2.50 - Somewhat Important  
1.00 – 1.75 - Not Important

The importance of computing for building energy performance earned a mean score of 2.78. In relation to this, 18.75% and 53.12% of the respondents (17 out of 32) viewed it as very important and important, respectively, while 15.6% considered it as somewhat important.

#### 4 CONCLUSION

The assessment conducted in this study was carried out on top architectural firms in Kuwait. Majority of which have over 15 years of experience in the market. The purpose of the survey is to reveal the knowledge and awareness among the architectural firms conducting business in the state of Kuwait, about the usage of passive design strategy in the design of office buildings. Although most of the aforementioned respondents were unaware of the low energy design, they nonetheless realized the importance of such schemes.

Overall, the results were good as the following rundown of the findings revealed. First, the majority agreed on the importance of explaining, to the clients, building concepts and systems, and the calculations required for building energy performance.

Secondly, respondents showed less enthusiasm on the importance of analyzing site microclimates, and/ or providing outline illustration of environmental performance through

plan and section diagram. The importance of calculations for building energy performance as seen in the conducted study that they are generally considered an “important” aspect. Moreover, their answer “somewhat important,” on the integration of solar energy within the design.

Given some limitations of the study, it is therefore recommended that future researchers should consider a different category of participants in the same field to make the results of the paper more conclusive and to cover a wider range of practitioners in this field.

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