

**“Assess the level of public awareness in UAE - Green roof &
Facades (benefits & obstacles)”**

**“الاسقف و الواجهات الخضراء – تقيم مستوى الوعي العام في الامارات العربية
المتحدة (فوائد و العواقب)”**

by

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**A dissertation submitted in fulfilment
of the requirements for the degree of
MSc SUSTAINABLE DESIGN OF THE BUILT ENVIRONMENT
at**

The British University in Dubai

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December 2016**

DECLARATION

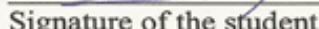
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Abstract (English):

Introduction - Green roofs and façade are getting more and more popular across the globe, it's not a new born concept it has been around since human lived in caves. Although the UAE has witness a major development in the last four decades, but still there is a lot to do when it comes to using these systems.

Research question – research aims to find out about the green roofs and façade benefits on different aspects for the end-user, also know how much people know about green systems, and their effect on buildings, and finally understand the reason behind lower demand of green roofs and façade in UAE.

Methods- in an attempt to answer the research question that is targeting community response toward greenery an online survey took place to in order to collect the maximal number of responds from different backgrounds, also interviews with architects contractors and policy maker to get more specified data from experienced individuals and finally case studies was part of the research to know results of existing examples of green envelope and how do the building managers user feel about this experience and how can they take it to the next level.

Results and findings- after conducting the surveys, interviews and field visits the author collected reasonable data about the level of community individual awareness and finding out challenges that face using this technology, as well as the learned lessons of the existing projects (case studies)

Key words- green roof, green wall, green façade, sustainable education, community awareness, cooling load, energy efficiency.

Abstract (Arabic):

يزداد انتشار الاسطح و الحوائط الخضراء يوما بعد يوم في جميع انحاء العالمو حيث ان هذا الاسلوب في البناء موجود من قديم الزمان عندما كان الانسان القديم يعيش في الكهوف.و في يومنا هذا و على الرغم من أن دولة الإمارات العربية المتحدة تشهد تطورا كبيرا في العقود الأربعة الماضية، إلا انه لا يزال هناك الكثير للقيام به عندما يتعلق الأمر باستخدام هذه الأنظمة.

الهدف من البحث - يهدف البحث إلى التعرف على أسطح و واجهات المباني الخضراء وفوائدها من جوانب مختلفة للمستخدم المباني، و أيضا دراسته مدى معرفة الناس لهذه الانظمة، وتأثيرها على المباني، وأخيرا فهم السبب وراء انخفاض الافبال على مثل هذه الحلول و عدم اعتباره كخيار مطروح في المشاريع المقامه في الدولة

منهجيه الدراسه - في محاولة للإجابة على السؤال البحوث الذي يستهدف مختلف الشرائح في المجتمع حول مفاهيمهم للموضوع المطروح و درجه ادراكهم للايجابيات و السلبيات لمساحات الخضراء في المباني تم عمل استطلاع للرأي على الانترنت مكان المناسب لجمع العدد الأكبر من المستجيبين من خلفيات مختلفة، وأيضا مقابلات مع المقاولين والمهندسين المعماريين وصانع السياسة للحصول على المزيد من البيانات المفصلة من من هم من ذوي الخبرات،و أخيرا دراسته مباني قائمه كأمثله لدراسه جميع الاحوال التي ساعدت في انجاح المشروع او التحديات التي واجهتهم و انطباعهم عن المبنى الذي يحتوي على غلاف مزروع

النتائج- بعد إجراء استبيان الراي والمقابلات والزيارات الميدانية جمع المؤلف البيانات و توصل الى مستوى الوعي الفردي المجتمع وعرف التحديات التي تواجه استخدام هذه التكنولوجيا، فضلا عن الدروس المستفادة من المشاريع القائمة

الكلمات المفتاحيه-الاسطح الأخضر، الجدار الأخضر، واجهة خضراء والتعليم المستدام، الوعي المجتمعي، وتحميل التبريد، وكفاءة الطاقة

Acknowledgment:

First, I would like to express my deepest gratitude to Allah for granting me with unlimited blessings and opportunities to be able to achieve my goals.

Secondly, I would like to thank my beloved parents, my kind mother and hardworking father for their unconditional love, support and motivation that they give me on a daily basis, they have supported me on every step of the way, everything I am today and everything I will ever be, I owe it to them.

To my sister Maha, whom I'm very blessed to have, you have helped me get by my sleepless nights and hardest days, your help throughout my Masters journey was incredibly amazing and will never be forgotten.

My profound gratitude goes to my beloved advisor and professor, Dr. Hasim, for his endless support and great guidance, he has always given me time and effort to guide me to the right direction whenever I needed it, and has always opened his doors for me to help answer any doubts and constantly improve my work.

I would like to acknowledge EngAmmarMakki in DEWA and Eng. Salem Zid from Dubai Municipality for your valuable time that you have generously given me throughout all of my visits to explain and answer my questions about the topic, you were tremendously helpful and inspiring.

My lovely friends, Mahbouba, Salma and Hawra, I would love to send you me deepest thanks for always being there for me and giving me energy and inspiration to continue seeking my passion, all of your care, love and help will always have a special place in my heart and memory.

Table of Contents

Acknowledgment:	6
Table of Contents.....	7
List of Figures/Tables	9
Chapter 01.....	12
Chapter1: Introduction	13
Introduction	13
1.1. Overview.....	14
Climate and Environment History:	14
UAE today	14
1.2. Current Environmental Situation in the GGC	15
1.3. Evaluation and preservation of the environment in UAE.....	15
1.4. Research Aim and Objective	16
1.5. Dissertation Structure	18
Research Limitations.....	19
Chapter 2: literature review.	21
2.1. Green roofs and green wall definition	21
2.2. Green roof and green walls history:	21
2.5. Green walls.	23
2.5.1. Types.	23
2.5.2. Construction.	24
2.6. Benefits of Green Envelope:	24
Environmental.....	25
Economical.....	26
Social and aesthetic benefits.....	27
Green envelope impact on building energy:.....	27
2.3. Case studies and researches of green envelope applications:	31
Adopted guide lines for sustainability in UAE:	37
LEED:	37

ESTIDAMA:	38
AlSa'afat:	39
Green roof and walls in ESTIDAMA:.....	40
Green roofs in LEED:	45
Green walls in LEED:.....	45
Literature review conclusion:	46
Chapter3: Methodology.....	48
3.1. Introduction.	48
3.2. Methodologies used previously.....	48
3.3. Justifying the Methodology which will be used.....	52
3.4. Survey, interviews and case studies.	54
Survey questions:.....	56
Chapter4: Result and discussion	59
4.1. Introduction	59
4.2. Results and discussion	59
Section one (survey):.....	59
Discussion conclusion:	87
Interviewing section 2.....	89
Interview with architects	89
Interview with contractor:	92
Section 3 (Case study):.....	93
Chapter5: Conclusion and Recommendation	104
5.1. Conclusion.....	104
5.2. Recommendations:	107
5.3. Limitations.....	108
References	110
Appendices.....	113

List of Figures/Tables

Figure 1.Earth shelters.....	22
Figure 2.Turf house (R ,1999)	22
Figure 3.Wattle (How to espalier ornamental and fruit trees , n.d.).....	23
Figure 4.Explanation of how green roof impact environment.....	28
Figure 5. The difference between dry and humid soil (Afrin ,2009)	29
Figure 6. Comparison between vegetated and bare roof.....	30
Figure 7.Temperature variation of green roof (Afrin ,2009)	31
Figure 8.Cooling load impact.....	34
Figure 9.(Ismail et al. ,2015)	36
Figure 10.Pearl Rating Systems	39
Figure 11.Steps of developing research methodology	56
Figure 12. (Author ,2016).....	61
Figure 13.(Author ,2016).....	61
Figure 14.(Author ,2016).....	62
Figure 15.(Author ,2016).....	63
Figure 16.(Author ,2016).....	63
Figure 17.(Author ,2016).....	64
Figure 18.(Author ,2016).....	65
Figure 19.(Author ,2016).....	65
Figure 20.(Author ,2016).....	66
Figure 21.(Author ,2016).....	67
Figure 22.(Author ,2016).....	68
Figure 23.(Author ,2016).....	68
Figure 24.(Author ,2016).....	69
Figure 25.(Author ,2016).....	70
Figure 26.(Author ,2016).....	70
Figure 27.(Author ,2016).....	71
Figure 28.(Author ,2016).....	72
Figure 29.(Author ,2016).....	72
Figure 30.(Author ,2016).....	73
Figure 31.(Author ,2016).....	74

Figure 32. (Author ,2016).....	74
Figure 33.(Author ,2016).....	75
Figure 34.(Author ,2016).....	76
Figure 35.(Author ,2016).....	77
Figure 36.(Author ,2016).....	77
Figure 37.(Author ,2016).....	78
Figure 38.(Author ,2016).....	78
Figure 39.(Author ,2016).....	79
Figure 40.(Author ,2016).....	80
Figure 41.(Author ,2016).....	80
Figure 42.(Author ,2016).....	81
Figure 43.(Author ,2016).....	82
Figure 44.(Author ,2016).....	82
Figure 45.(Author ,2016).....	84
Figure 46 .(Author ,2016).....	85
Figure 47.(Author ,2016).....	86
Figure 48 . (Author ,2016).....	95
Figure 49. Green housing villa model (Author ,2016).....	95
Figure 50.Water treatment unit (Author,2016)	95
Figure 51 .Green wall (Author,2016).....	96
Figure 52 . Side view green wall (Author ,2016)	96
Figure 53. Green roof technique (Author ,2016).....	96
Figure 54. Green wall irrigation system.(Author ,2016)	96
Figure 55. Green roof (Author ,2016).....	97
Figure 56 . Green roof (Author ,2016).....	97
Figure 57. (Author ,2016).....	98
Figure 58. (DEWA ,2014)	99
Figure 60.(DEWA ,2014)	100
Figure 62 . (Author ,2016).....	101
Figure 61 . (Author ,2016).....	101
Figure 63 . (Author ,2016).....	101
Figure 64 . (Author ,2016).....	102
Figure 65 . (Author ,2016).....	102

Figure 66 . conclusion diagram (Author ,2016)	107
Table 1. Dissertation structure	18
Table 2.Model of saving estimation (Afrin ,2009)	28
Table 3.The yearly saving estimation (Afrin ,2009)	29
Table 4.Tested materials	31
Table 5.Environmental benefits (Ismail et al. ,2015).....	35
Table 6.Economic benefits	35
Table 7.Social and aesthetic benefits (Ismail et al. ,2015)	36
Table 8.Pearl Building Rating System (UPC ,2010):	40
Table 9.Pearl Villa Rating System (UPC ,2010):.....	42
Table 10.Pearl Community Rating System (UPC ,2010):.....	43
Table 11.The contribution of living roofs (Afrin ,2009)	45
Table 12.The contribution of living wall (Afrin ,2009).....	45

Chapter 01

Introduction

Chapter1: Introduction

Introduction

Green roofs and façade are getting more and more popular across the globe, it's not a new born concept it has been around since human lived in caves. Although the UAE has witness a major development in the last four decades, but still there is a lot to do when it comes to using these systems. Despite the interest of spending more (Decision maker, Architect &Users) in these green system, the Green roof and Façade improves the quality of the city and the individual buildings by providing social, aesthetic, environmental and economic benefits. One of the major issues facing the implementation of this system is level of the understanding the concepts of the green envelop between the people. On the other hand, the fast-growing development in the UAE without considering enough the impotency of implementing these green systems was one of the major issues. Fortunately, in 2007 the first initiative has been established in Abu Dhabi (Estdama).

Haggag,2010 state that, applying livable structure features will benefit a building in different levels. In fact, plants increase energy efficiency, heat island effect and absorb the storm water and reduce carbon emission. Moreover, green walls create sound barriers from urban noise, adding greenery into the building structure will improve the building visual appear and add aesthetic aspect to the framework.

The main purpose of this paper is to highlight the level of understanding and awareness of the people (users) regard using the green roofs and façade. In addition to that, to assess and to explore the main obstacles the holding the architects and engineers using and recommending those technologies. Also, studying the existing precedence in UAE will be part of identifying the main issues.

1.1. Overview

Climate and Environment History:

When describing the United Arab Emirates land natural and artificial physical features, the area can be divided into five regions from the Arabian Gulf to the Gulf of Oman, which named as, Arenaceous seaside sporadic sabkha, The desert, pebble plains, the Hajar mountains and the Eastern Mountains with the border of Oman (Al & Vine, 2001).

Humans living on this land practiced many activities thousand years ago for living like hunting, grazing, cultivation, and fishing. Exploration has shown that groups of different species as living sequential in each zone wild animals like foxes, rats, gazelle, deer's and camels, and domestic like sheep and goats, birds like ostrich and flamingo, and a rich nautical life with species diversity. A number of discovered sites and living creature's record is an evidence of life existence since the fifth millennium BC. And as it is nowadays known about the UAE climatic and land nature of a wide desert and long coastal, which represent reverse situation of the life before a long period of time where it was fertile land full of massive available investing resources (Al & Vine, 2001).

UAE today

Four decades ago, this country was behind in the pace with civilization and progress. Today UAE is one of the highest income countries in the world in which comes aligned with the greatest country with strong production economy. The sudden leap in economy that the area is witnessing in the present happened is an extraordinary sequence in comparing to other cases, discovery of oil was the shortcut to all phases and curtailment normal procedures for money aggregation (Al & Vine, 2001).

The main reliance of economy growth was depending on the multitude grant of the black gold where the government has devoted all the efforts to invest on this natural resource. The huge unexpected profits motivated and pushed for the frugality system and community basic foundation, the United Arab Emirates was empowered and jumped to a new level quickly in the time between 1973 to 1982 during the oil business thriving (Al & Vine, 2001).

1.2. Current Environmental Situation in the GGC

It was an astounding event when the global footprint network unveiled a statistic that shows the UAE on the top list of the ecological footprint per person worldwide, and that was the time where decision makers decided to find the disorder and set things straight for the environment interest (Global Footprint Network 2015).

As a result of that, competent authorities started an initiative in 2007 called "Al Basma Al Beeiya". The purpose of assigning this movement is to investigate the reasons that led to the current situation, with the participation of the Global Footprint Network. Major managements like Ministry of Environment and Water, Emirates Wildlife Society-World Wildlife Fund, Emirates Authority for Standardization and Metrology, the Environment Agency Abu Dhabi. Concerted efforts will be dedicated to create a better future by plunging in the present and find the nowadays-unhealthy behavior affecting our environment and nature (Global Footprint Network 2015).

After all years of holding back and neglecting environment rights, nowadays the UAE became one of the top leader countries that gave priority for the footprint studies and experiments. Researchers and environmental affairs activist has found this nurturing environment encouraging to bring innovative proposal from UAE to the world (Global Footprint Network 2015).

1.3. Evaluation and preservation of the environment in UAE

Any kind of vitality form living within the emirates land has to adjust to scarcity of water and food, moreover the intensity of high temperature that stimulate the moist volatility hat make it harder for holding any amount of water. During such a harsh environment, the phenomenal industrial and architecture growth created a new urbanization feature for the city (Al & Vine, 2001).

The emirate is located in the cancer orbit, Known by its hot climate and is the character of this path. Humidity reaches 90% during in the period between May until November in the shore, while humidity decreases in the central part, but still higher in temperature, it might reach up to 50⁰ degreesand more in a summery July day. In winter temperature

decreases to reach about 25° day time and about 12° at night-time, as in the middle of the wilderness or an elevated surface it is possible to have degrees or even lower.

Rain is not a regular phenomenon in this part of the world, yet when it happens it takes place during the second and third months of the year (Al & Vine, 2001).

The UAE has been flourishing every day since 1973, maintaining the balance between a pleasant living area where natural resources are preserved, and keeping up with all of this advanced building technologies which increases the CO₂ emission is a major challenge. However, it is essential to consider taking all the required corrective and preventive action now to enhance and develop the UAE specially and the region environment. (Al & Vine, 2001).

As though boosting efforts in all scales toward a dominant goal will increase positive results, with the assortment of national and international organizations will prepare for utmost accomplishments. Planet earth and evaluation together is a considerable issue to UAE government and audience therefore engaging in a settlement conversation for the sake of covering both sides was preferred actually instead of creating a struggle for profit loss intent. Where the main purpose will be to create equilibrium in each hand (Al & Vine 2001).

In order to enhance the environmental condition in UAE, the country has followed different guidelines for sustainability, such as LEED. Moreover, developing local guidelines that suits the local environmental conditions, has been a priority as well, such as ESTIDAMA and most recently SAFAT green building rating systems, which are explained in literature review chapter.

1.4. Research Aim and Objective

With the growing number of sustainable buildings in the country it is important to assess people's awareness toward this movement. Since there are many approaches in making a building sustainable the author has chosen green facades as a focus point of the paper as it is the most visible element that resembles green building and have aesthetic value in addition to other significant benefits greenery contribute to a building.

The author determines in this study to explore more about the current situation of greenery incorporation into a building in shape of green roofs or walls, looking into this strategy from different perspective by understanding that this element is more than an aesthetic feature in the city, and plunging into the reducing energy consumption aspect and focusing on its impact on reducing energy bills for any type of building located in UAE or countries with similar climatic aspect. The target of the research is to have a closer look into the green façade industry and application in GCC in general and UAE in particular.

As mentioned earlier the aim of this research, is to highlight the level of understanding and awareness of the people (users) regard using the green roofs and façade. In addition to that, to assess and to explore the main obstacles the holding the architects and engineers using and recommending those technologies. Also, studying the existing precedence in UAE will be part of identifying the main issues.

Research questions

Biased on the mentioned aim of the research the question is summarized as follow:

- * What are the benefits of using green roofs and façade?
- * How much people know about green systems, and their impact on individual buildings and cities?
- * Why are the green roofs and façade are not commonly used in UAE?

1.5. Dissertation Structure

In order to fulfil the aims of research and find a convincing answer to the research question, this study has been structured as follow:

Table 1. Dissertation structure

Chapter No.	Summary
Chapter 1 (Introduction)	<ul style="list-style-type: none">– Introducing the issue that you are researching– Reviewing relevant previous studies– Highlighting the gap in research to be filled– Explaining your research questions/hypotheses– Brief signposting of dissertation structure
Chapter 2 (literature review)	Next segment is a recitation of green roof- walls researches and studies mentioned in literature review and that will support the aim of the study and provide profound perception.
Chapter 3 (methodology)	<p>This chapter expound the research methods used to procure results , with a fair justification of survey and interviews method used after comparing between old studies investigating the same topic.</p> <ul style="list-style-type: none">- Explains the research methods used to collect data- Method of data collection- Justifying the research methodology which has been used
Chapter 4 (Result and findings)	Present the results of the surveys and interviews moreover observe and discuss the outcomes.
Chapter 5 (conclusion & recommendations)	According to the obtained results on the pervious chapter concludes the moral of studies and what did this study add to former attempts.

Research Limitations

In this research some challenges led to restrictions creating a narrow area for research progress; interacting with community members and managers at different municipalities and major companies and authorities required a lot of approvals were in a lot of cases was not awarded due to their busy schedule.

Finding case studies to display in the study was part of the struggle ,as there was more example to include that can be suitable yet companies in charge of the project regulations consider the designs they have are confidential information and do not allow to share such details in public, even with providing university support letters and communicating with them for using the information for educational and research purposes only.

Moreover finding the direct impact on energy conception in the standing case study was a hard to specify where meters read the general energy load in a building that is a collective outcome of several factors in building like other strategies.

in addition collecting information from nonprofessional individuals was a challenging although it was an online survey yet some response were cancelled because of the contradicting answers in the application that may show some confusion for applicants.

Chapter 02

Literature review

Chapter 2: literature review.

2.1. Green roofs and green wall definition

Green roof acquaint is a plantation bearer located at the surface of the equable or tilted roof, that have a lot of benefits for environment and community. The system contains three main parts; on the top is the greenery layer and then the medium on which an organism grows or is attached, and finally the discharging layer to inlet the superfluous liquids (Magill et al., 2011).

A green wall is kind of a general expression that represents any kind of vegetation medium that is attached to a perpendicular form. This type of vegetation can be addressed into two patterns;

- (1) Living barriers
- (2) Green cover

Both types require certain kind of tools and specific detailing and technology besides the advantages and disadvantages (Hedberg,2008).

Basically, the difference between first and second proposals is the way of installing the plant, as for the living wall the plants are grown in the attached milieu to the wall where the planting process happens in the vertical position, yet in the green screen it is plants are grown in the vertical position and then modulate toward the wall or elevation (Hedberg, 2008).

2.2. Green roof and green walls history:

Digging up in to the past of green roofs and walls will show that they can be considered as one thing yet the only difference can be in the installing technique, by looking into their positive effects and also history it is hard to differ between a vertical or horizontal living wall.

First manifestations of vegetated facades has accord as earth shelters and turf domic, in those both kinds of shelters the green surface is wrapping the building where it is difficult to distinguish one from the other (Hedberg ,2008).

Going into details and elaborating into those two historical models, earth shelters (figure 2) are similar in shape to caves; as it will be shaped naturally as a big cavity in the

ground utilised by mankind after adding some touches to cover their sheltering needs (Hedberg ,2008).



Figure 1.Earth shelters

(Burrows ,2016)

In the turf house sample (figure 3) the form of green coverage is closer to a green roof sort shape in the present days, this kind of building style is common in Iceland. Due to shortage in wood in that country using a heavy layer of soil and grass creating a upper coverage of the house as a substitute for conventional roof, as a matter of a fact this thick part had a high insulation property that encourage using it in different part of the world like united states when there was a insufficiency in materials (Hedberg,2008).



Figure 2.Turf house (R ,1999)

The most resembling example of the living wall from the beginning of time is the wattle, (figure 4) this technique was used before to give support for plants that grow in the forest, and this will create a resembling environment to stimulate better fruits quality. Such approach will decrease the space needed for the tree to grow. Grapes, kiwi and peaches trees were grown mostly by this method. By the time, this form developed into a decorative aspect, where roman used to add it to their castles exterior (Hedberg 2008).



Figure 3.Wattle (How to espalier ornamental and fruit trees , n.d.)

2.5. Green walls.

2.5.1. Types.

Providing a better environment to nourish and bloom a growing plant is mostly same, easy to preserve like daylight, fertilizers, water and a structural support (Hedberg ,2008).

Installing method will differs between green walls kinds following is showing the different element of the categorize

Soil cells:

Basically a lot of different arrangements can be considered under this category, where it is using a growing container to put in the plant and then rotate it 90 degrees to settle into the wall.

The essential issue with this is that putting a layer of soil, regardless of how daintily or well attached, it will not hold to the side of a structure for period of time or any measure of quality, this obstacle can be addressed by splitting the area into a lot of small cells 1-2 sq., huge number of cell can be used to cover a certain wall or elevation. Mainly the main consideration will be how to strongly attach those cells into the building to prevent any accidents and allow in a certain arrangement that will allow water and air to penetrate (Hedberg ,2008).

Hydroponics:

This is a distinct approach than what have been mentioned in the previous example. The midst of this system is not the known material, it is a rigid form that will hold the plants root and supply it with a nurturing fluid. One of the medium specifications is that is capable of holding the plant root and the moist (Hedberg ,2008).

2.5.2. Construction.

Each design of a green wall has its own structural method according to their supporting theory. First type contains of cells or small units assembled in metal framework on the building façades in this system the water supply piping is equally important, the water feeding point start from the above part and then goes to the lower parts going through all cells to the end of the row after overloading each unit for better water management. In this pattern it is easy to access each block for maintenances and cultivation separately (Hedberg ,2008).

On the other hand, hydroponics supporting method has essential difference in the concept itself. This modular has three segments a metallic structure that will be suspended in the exterior of the building; an air gap is required for insulation means, and then comes the PVC plates installed on the framework which is the core support this arrangement and add a moist resistant part. Finally comes the last part of this set the plant medium in which it is a kind of solid hairy carpet. The indicated item contains high percentage of pores that equip it to become lighter and stop heat transition in addition a perfect greenery base (Hedberg ,2008).

2.6. Benefits of Green Envelope:

Since this study is aiming to assess and evaluate the awareness level of people towards green facades, the following section is showing the actual benefits and how

these application are contributing to a building, Based on the shown information in this section, and how is awareness level of people measured and compared.

Having green envelopes regardless of being wall or roof, have different benefits. Following section is showing the benefits of having them in a building in terms of: Environmental, Economic as well as Social and aesthetic point of view.

Environmental

- Green roof tops can be used instead of garbage landfills where it can be used protect the insulations sheets, moreover it can be used in the growing medium.

Manage storm water

- Large quantities of water will be trapped within the medium layers and then released into air in form of evaporation into the atmosphere.
- The percentage of the water evaporation differs depending on the season, where in hot weather 70% to 90% while in cold weather the percentage is lower 25%-40%, water amount trapped in the growing medium depends on the thickness of it, for example 4-20cm of sand will hold 10-15 cm.
- Planted roofs can also purify rain water from any unwanted substances.
- Reduction of runoff of storm water and lower the pressure on sewage.

Reducing urban heat island effect.

- Green facades on different forms will decrease temperature on of the surface and the ambient of the platform thus affect and reduce (UHI);and that is due to plants ability to suck the sunlight before light transmission to heat (Ismail et al. ,2015).
- Rooftops for existing buildings will also reduce urban heat island.

Air quality

- Plants have the ability to clear the air and refresh the environment which is the result of absorbing VOC and CO₂gases off air within daily process and release oxygen in the air.
- (Ismail et al. ,2015) removing impurity partials and dirtiness of air is related to the plants kind and also planting medium depth. Where the area of a plant declare how much cleaning power a plant have.

- On large scale there is having grass roof will work as a filter for air and clean it from flying dust and pollution, in addition to that greenhouse gas emissions will be affected gradually.

Economical

Energy efficiency:

- Building top face is considered the highest surface for heat loss or gain ,in summer sunray sunlight hit the roof directly , in the other case during winter heat escape will be greater from the roof side, therefore creating a buffer zone like growing vegetation will greatly help keep in the inside temperature stable without any heat loss or gain.

Extend life of roof membrane:

- Growing grass or plants in the roof create protection cover for the roof construction layers from the direct sun exposure and weather fluctuations that may cause damage and that is due to the radiation absorbance during the day and emitting it into air back at night; therefore it will stopping this process will increase the durability of the structure (Ismail et al. ,2015).

Marketing:

- The presence of green elements in a building will increase the value of it and distinguish the property maybe make it a landmark.

Fire fighting:

- Vegetation heat load is the lowest when it is compared to construction material, in the event of fire, burning load of the ceiling with a garden is less.

Enrich wild life and nature:

- The existence greenery like plants tree or grass will always nourish life and attract different kinds of living creatures like insects and birds and create a connection between modern civilized life and nature and that will add value for community.

Social and aesthetic benefits

Community gathering spaces

- Creating roof landscaping will contribute a lot for the city and entities, where more social activates can be created and people of all ages will interact and bond, where it will become easier to tenants to visit the park quickly.
- Utilising the presence of plantation equipment and encourage local food production.

Aesthetic

- the aesthetic impact would be the first thing that comes into someone's mind, where it has been known that green faces in the city will add a pleasant effect and also raise land value and create a wider platform for investments and tourist attraction (Green roof benefits - GRHC WEBSITE ,2016).
- the presence of greenery on a building roof or elevation will create a disparity from conventional dull building materials like concrete ,bricks and pavements and satisfy passengers and occupants (Ismail et al. ,2015).

Noise control:

- Roof garden is able to mitigate fuzzy voices depending on the thickness of the medium , extensive roof reduce 40 dc , yet the intensive 46- 50 dc(Green roof benefits - GRHC WEBSITE ,2016).

The thick layer of soil and plants contain a reflection property that will help inhabitant in areas with blatant noise like airport, train rails, factories high ways (Ismail et al. ,2015).

Green envelope impact on building energy:

Green roof:

As referred earlier the green roof impact on a building certainly reducing the electricity bills is part of it. one of the green roof specification is thermal isolation property in which it will stop the sunlight breakthrough the roof thus heat transmission into the space, in addition the evaporative cooling process that will happen eventually because of the moist evaporation of soil and plants.

According to akbari a building system meant to save power consumption for areas that is situated in temperate zones between the tropics and the Arctic and Antarctic polar regions, and that by targeting the UHI value and reducing it that can boost mechanical cooling function to 10 % . (Akbari, Konopacki&Pomerantz ,1999)

Studies also reveals that 27% of heat directed into the roof bounce back while 60 % reflect back to atmosphere in planted rooftop moreover 13% of it is absorbed into the topsoil, that explain the protecting capacity of a green roof(Afrin 2009).

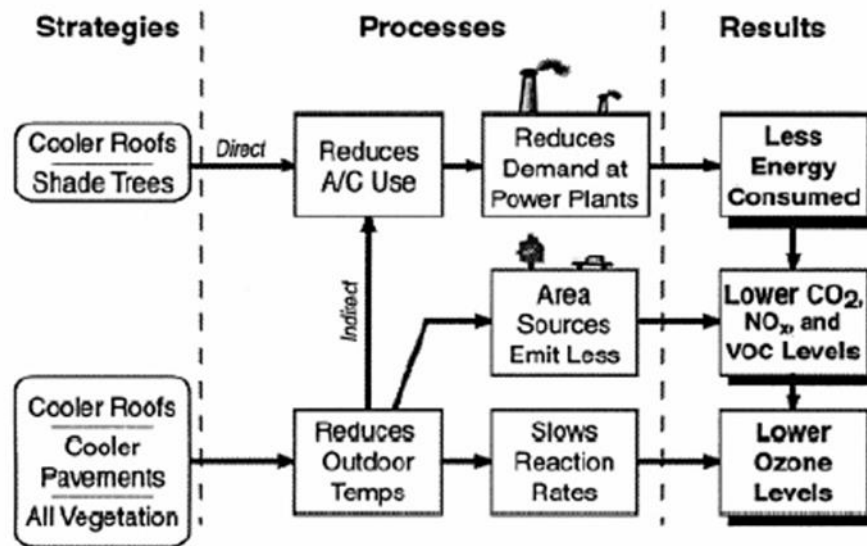


Figure 4.Explanation of how green roof impact environment
(Akbari, Pomerantz&Taha 2001)

Energy reduction estimation:

In an attempt to find base to calculate power mitigation. According to the research it is estimated that a green roof will reduce 2c of temperature, in the following (table 6) shows a model of saving estimation (Afrin 2009).

Reduced Energy	0.052kWh/ft ² (0.56kWh/m ²)
Air Conditioner Efficiency	400W/1000W
Electricity Rates (based on California residential average)	~12¢/kWh
Total Savings	0.25¢/ft ²

Table 2.Model of saving estimation (Afrin ,2009)

The pervious table shows the reduction in a mechanical cooling reduction per hour while in the following (table 7) show the yearly saving (Afrin ,2009).

Table 4: Average savings in air conditioning usage (Yamada, H. 2008).

Period	Days	Savings	Usage	Calculation
1	85	0.25¢/ft ²	60%	$85 \times 0.25 \times \frac{1}{0.6} = 12.75\text{¢/ft}^2$
2	85	0.25¢/ft ²	100%	$85 \times 0.25 = 21.25\text{¢/ft}^2$
3	85	0.25¢/ft ²	60%	$85 \times 0.25 \times \frac{1}{0.6} = 12.75\text{¢/ft}^2$

Yearly Savings per Square Foot = 46.75¢/ft²

Table 3.The yearly saving estimation (Afrin ,2009)

In a green roof the soil that hold the plants have insulation properties, wet soil emphasis the substance capacity of solar reflection .The (figure 8) bellow shows the difference between dry and humid soil (Afrin ,2009).

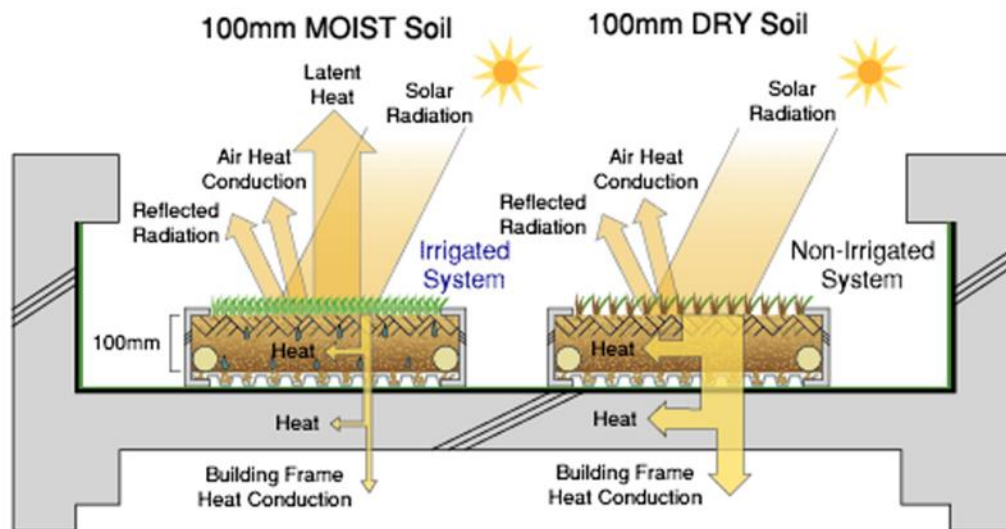


Figure 5. The difference between dry and humid soil (Afrin ,2009)

Also the following (figure 9) show the solar reflection between a bare roof and a green roof but with low vegetation coverage and almost dry soil as it indicate to the same level of reflection and heat gain due to the low moist impact and the absence of the evaporative cooling (Afrin ,2009).

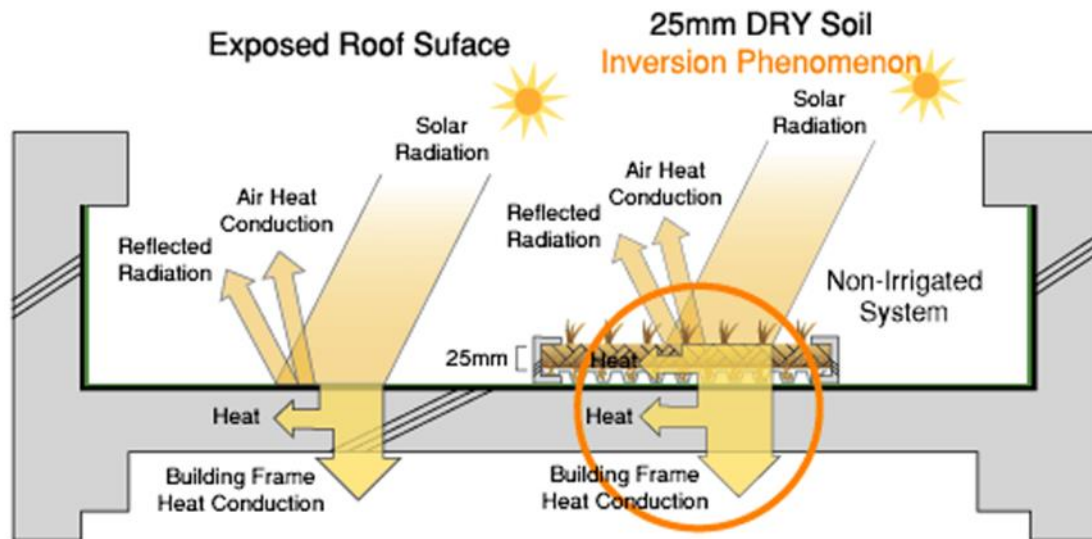


Figure 6. Comparison between vegetated and bare roof

(Afrin ,2009)

Green wall potential:

When it comes to vertical greenery position as a matter of a fact any influence will directly happen to the walls, a green wall will cover the building envelope. According to professors in Tokyo a 10 c degree reduction recorded in 1979. S shown in graph (figure 10) below heat convection is mitigated by $\sim 0.24\text{kWh/m}^2$ for each panel. While it is 60% lower than green roof impact, moreover the orientation of the green facade has a huge leverage, as the sun ray angle and other effective point regarding the latitude location of the project (Afrin ,2009).

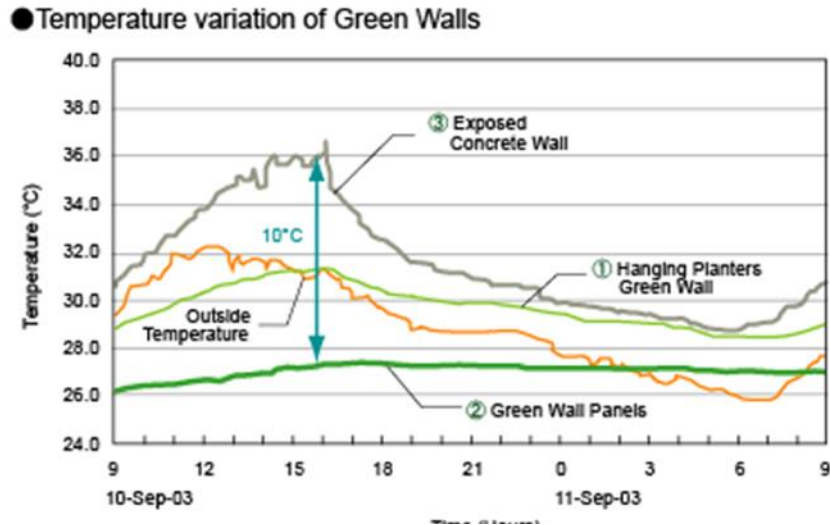


Figure 7. Temperature variation of green roof (Afrin ,2009)

In addition to heat gain it also impact urban heat island is a phenomenon that green wall has a hand in its reduction.

2.3. Case studies and researches of green envelope applications:

By running a quick research to look into green envelope, a most studies found concentrate impact on the indoor temperature and comfort level and building energy efficiency (Fioretti et al. 2010), (Wong et al. 2003) (Kumar & Kaushik 2005)

In a study done by engineers at Southern Illinois University Edwardsville in the USA, researchers were aiming to find out the thermal insulation of greenery on a roof and the impact of applying different plants and growing medium may on the insulation strength, Following is the details of the study.

Three types of soil and four kinds of small flowers used as showed in the table below:

Table 4. Tested materials

Growth Medium	Vegetation Species
Lava	Sedum spurium
Arkalyte	Sedum kamtchaticum
Pumice	Sedum sexangulare
Haydite	

Temperature segregation within green roof depends on intensity and porosity. Additionally liquid trapping features affect the cooling process by evaporation and heat reflection. The result of heat transference varies according to the soil and plant interrogation. When it comes to insulation, rocks with more porosity tend to create better insulation like lava ~70%, pumice ~90% with sedum spurium, and sedum kamtchaticum, but in the other hand when it combine with other plant thermal mass will change, therefore when it comes to green roof execution it is important to consider the combination between the vegetation and growing materials (Celik et al ,2011).

(Alnaqbi, 2013) in his dissertation discussed how adding a green façade is going to decrease energy loose for domestic units in our country. Using two different approaches of calculation and simulation, a villa with two floors was studied. According to the research a calculation for heat gain conduction was done to get the heat flux through the building, and to compare the cooling load between two samples with and without garden on the top the IES-VE is used to find out each case readings.

In this sample the purpose of the roof plantation was to understand the thermal behaviour of the green roof affected by soil base depth, foliate size sign and the holding amount of water in the medium.

By the end of this study a positive feedback indicates that emerging greenery within the roof will hold high prospect for this region in terms of lowering electricity consumption yet it is advanced adjustment. Actually the mechanism of the reducing the temperature inside the house or on the top of it designated in the process of conveying water drop from plants leafs in to the surroundings and lower heat transferring due to vegetation implementation. After going through the process of mathematical formula and software simulation for the model villa the results was promising, where as a result the reduction of cooling power in both hot and cold seasons was between 6% to 12% .that was an outcome of two factors discussed before had separated reduction percentage as for insulation properties of planted roof platform it was 7.3% and for evaporative cooling it 7.7% reduction in cooling load (Alnaqbi ,2013).

(Niachou et al. ,2001) in an experiment done in the beginning of this century by a group of Greek researchers on a building hotel located in Loutraki province around Athens, the main purpose of such study is to show the actual condition for inside out the planted building heat temperature and

This study showed that the green roof performance will vary depending on the plants used, the farther it have the more efficient it gets. Furthermore, compering between the inside air temperature during hot season for planted and non-planted roof surface, it was found that when the temperature is override 30 C without a green top it is less than that reading in the green roof scenario. As for energy consumption, the study showed

the highest percentage of power conserving was 37% in the non-isolated roof with a green roof case and reached 48% during night. Likewise in the modest insulation system energy was saved in 4 to 7 % while in the third case the well-insulated it gave 2% only (Niachou et al. ,2001).

In other study Treatise was conducted in a school located at Al AIN city, focusing on the building envelope. Whereas a building envelope has a high impact on the heat transmission into a building and in order to achieve the lowest energy consumption rate it is suggested to control heat transition through building skin (Haggag, Hassan &Elmasry ,2014)

Green wall has the capability to reduce and lower the thermal transmission coefficient (U-value). According a study done by a Green company, it proved installing a green surface that can minus 10 C in façade thus u-value of the surface is going to support decreasing cooling load inside.as it is proven in previous events that a portion of power input was minimized in each category as for air-conditioning load reduction was around 23%, ventilator 20% whereas for yearly gross usage it save 8%. Moreover creating a plant cover will create a buffer zone to stop noise pollution and effect, where it has been proven that a planted roof is able to reduce 10db correlate with plain surface. While for green wall it was found that insulation property tend to give further reduction around 30 decibel. Mainly a green surface capability in decreasing noises frequency is the thickness of growing soil, vegetation kind, the typed substance used to support a greenery wall and the capacity of emptiness amidst the built up wall and the foliage (Haggag, H &Elmasry ,2014).

An important benefit of a green façade is in adding a protection. The green covering of external wall will play a role in reducing direct contact with weathering and erosion factors as sunlight, rain, heat and that will expand building material age.

The reduction in heat was obvious which the difference in temperature was between 5 to 13 degrees C on surface and inside a space. As a result the reduction in temperature will directly impact on the cooling load as shown in (figure 5), and lower the conditioning indigence to 20%.

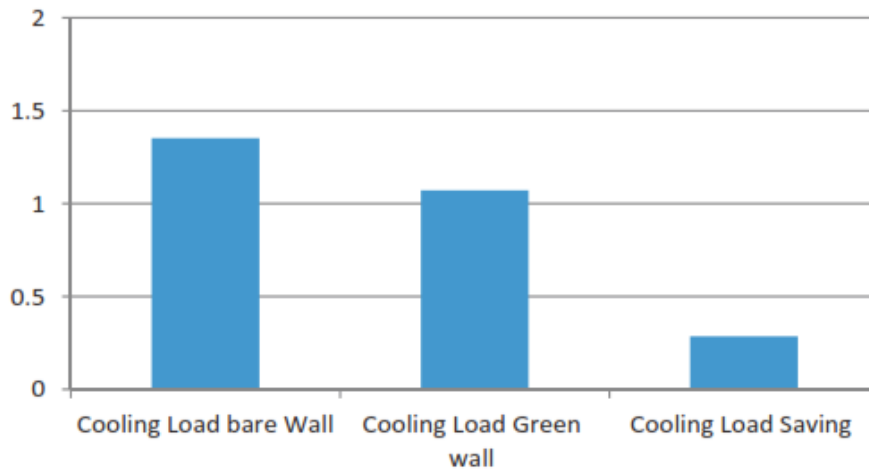


Figure 8.Cooling load impact

(Haggag, H &Elmasry ,2014)

This finding cooling load need was done by using following formula:

$$Q_c = \rho V . c_p \Delta T$$

Q_c for heat removal V volume flow rate air density ρ specific heat c_p capacity ΔT temperature difference between outdoor indoor.

Ismail et al. in a review published in 2015 focused on Malaysian residential development. The government aimed to provide residence of decent standard in reasonable price. Huge jump in housing in 2000 was the result of the economical rise of the country, To cover the necessity and guarantee better performance and longer life for the new housing units adding sustainable elements was an important consideration. Although a green roof was not common to the city architecture in that time, however, it was recommended by the sustainable guidelines. Researchers in this project conducted survey to find tenants perception of adding green roof in buildings they are using. Results of the survey are shown in the tables bellow for each interest and numbers show how the audience response in details. (2015).

Table 5.Environmental benefits (Ismail et al. ,2015)

Table 1 Environmental benefits

Description		1	2	3	4	5	Mean
Improve air quality	%	0	0.7	28.3	49.8	20.2	3.90
	<i>f</i>	0	2	84	148	60	
Reduce heat absorption in the building	%	0	0.7	32.3	57.6	8.4	3.74
	<i>f</i>	0	2	96	171	25	
Reduce air temperature	%	0.3	0.7	30.0	57.6	10.1	3.77
	<i>f</i>	1	2	89	171	30	
Storm water management	%	0	0.7	40.1	47.1	11.1	3.69
	<i>f</i>	0	2	119	140	33	
Encourage biodiversity	%	3.7	11.4	43.1	33.3	7.1	3.29
	<i>f</i>	11	34	128	99	21	
Average mean							3.68

Table 6.Economic benefits

(Ismail et al. ,2015)

Table 2 Economic benefits

Description		1	2	3	4	5	Mean
Energy efficient building	%	0	1.0	34.0	57.9	6.1	3.70
	<i>f</i>	0	3	101	172	18	
Increase roof life	%	0.3	3.7	48.1	39.7	6.7	3.50
	<i>f</i>	1	11	143	118	20	
Average mean							3.60

Table 7. Social and aesthetic benefits (Ismail et al. ,2015)

Table 3 Social and aesthetic benefits

Description		1	2	3	4	5	Mean
Provide leisure and functional open space	%	0	0.3	24.9	50.5	22.9	3.97
	f	0	1	74	150	68	
Health and therapeutic value	%	0	0.3	29.0	52.9	16.2	3.86
	f	0	1	86	157	48	
Reduce noise pollution	%	0	1.0	40.4	40.8	41.8	3.70
	f	0	3	120	133	38	
Visual amenity value to the building and its surrounding	%	0.3	0	16.8	42.1	39.4	4.22
	f	1	0	50	125	117	
Average mean							3.94

Having a closer look into the means of survey outcome it is found that among the three aspects the social and aesthetic benefit offers the highest score. In the (figure 6) shows the shows the difference between each aspect.

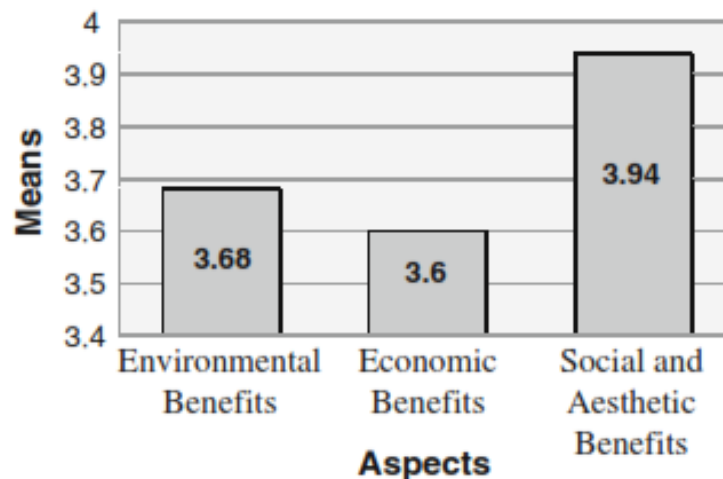


Figure 9.(Ismail et al. ,2015)

Coming to an end of this study, the plurality of the resident who has done the survey be in accord with the importance of having a green roof toward the visual aspect and the aesthetic value of a place.in relation to that landscaping in a roof will ameliorate dwellers life level in high rise buildings. Finally having positive views from the public will encourage investors and owners to apply vegetation and become widespread scenery in the city (Ismail et al. ,2015).

Adopted guide lines for sustainability in UAE:

After showing the conducted research in this aspect it is important to consider the available guidelines and how they addressed green roofs and green walls in their rating systems. Following parts are showing the sustainability guidelines adopted in UAE with a focus on the green roof application in each specified guideline. Since the main focus of this study is about roofs and green walls each guidelines in mentioned briefly and the focus is made only in the parts related to green envelope.

LEED:

LEED is an American rating system that is also well known within the UAE constructing field community. LEED stand for Leadership in Energy and Environmental Design, it is an American voluntary organisation that main purpose is to enhance building functioning toward the environment, and it happens to have credit for plantation integration in a structure (GEBS).

LEED Rating System Structure In order to measure if a building has met the definition of a high-performance green building as defined by LEED, every LEED rating system (except LEED for Neighbourhood Development) has performance criteria in these major areas:

- ☐ Location and Transportation – to maintain environmentally sensitive places and benefit from the existing infrastructure, community resources, and public transit.
- ☐ Sustainable Sites – the ability to extend sustainability in future on the site
- ☐ Water Efficiency – to preserve the maximum amount of water for indoor and outdoor usage.
- ☐ Energy and Atmosphere – increasing the energy efficiency and find new ways to save or generate energy.
- ☐ Materials and Resources – use materials from local resources and control waste.
- ☐ Indoor Environmental Quality – provide a healthy indoor environment to make building occupants satisfied and more productive.
- ☐ Innovation – discover that beyond the rating system to add even more value to the project
- ☐ Regional Priority – study the local environmental issues

Project Certification (GEBS).

The 'greenness' of a LEED project is based on a 100 point scale with an additional 10 bonus points.

There are four levels of LEED certification (GEBS):

- ☐ Certified: 40-49 points
- ☐ Silver: 50-59 points
- ☐ Gold: 60-79 points
- ☐ Platinum: 80+ points

ESTIDAMA:

The term ESTIDAMA is an Arabic word that stands for sustainability established and supports this proposal; (UPC) is Urban Planning Council in Abu Dhabi in 2007. The organization was intentions are focused for AD 2030 vision that put sustainability as a priority. As a wise leader, Sheikh Zayed bin Sultan Al Nahyan the born of this initiation was a fruit of his foresight where he was always encouraging development on all levels. Abu Dhabi heads where seeking the best approach to invent a set of standards and rules that will be a guideline for green building in Abu Dhabi adapting current conditions like weather and society. ESTIDAMA is one of the initial green buildings rating frameworks in the Arab world that makes it special, holding high expectations and promising sustainable future for this city, considering the high progress potentials without neglecting the cultural features and local considerations of this region. With respect of all project member and design stages until the end of construction process, ESTIDAMA has planned all scenarios to provide the healthy predicted outcome (Abu Dhabi Urban Planning council 2010)

The Pearl Rating System includes three project levels as bellow;

- Pearl Community Rating System: Design & Construction.
- Pearl Building Rating System: Design & Construction.
- Pearl Villa Rating System: Design & Construction.

The assessment of the system is divided into seven denominations that are essential for the sustainable advancement:



Figure 10. Pearl Rating Systems

(Abu Dhabi Urban Planning council 2010)

New proposal submitted to planning and authorities must all achieve one pearl class at least while for governmental facilities it is 2 pearls, pearling rate highest score is at 5 pearl class (Abu Dhabi Urban Planning council 2010).

AlSa'afat:

Dubai municipality has developed Al Sa'afat rating system as enhanced stratify for green building regulation system which was implemented in all new buildings in Dubai. Al Sa'afat was launched in mid of 2016 as an appropriate solutions for Dubai sustainable challenges, the word "Sa'afat" is the plural of palm frond which represent the local system in building way time before air-conditioning and luxury lifestyle where using such kind of material keep indoor temperature quite reasonable, while it is supposed to be applied by September (mahendriyani, 2016).

In four rating levels AL Sa'afat is divided into platinum as the highest score and then comes golden, silver and bronze which is the minimum for any new submitted building aiming for a permit from Dubai municipality. Though a minimal requirements to get the bronze rate, proprietors and developers are foster to obtain the upper grades in an attempt to improve life and environment (mahendriyani, 2016).

According to Essa al Haj Maidour the concentration in Sa'afat will be on the building operation process and any issues related to it like water management, energy reserving and building services adequacy. Using Sa'afat guideline will enhance energy saving by 34%, existing building was also included in the picture by setting plans to involve sustainable materials and devices. Dubai government objective by beginning this initiative to reduce from the main impacting tools as water 15%, electricity 20%, rubbish 50% and CO2 emission 20% (mahendriyani, 2016).

Green roof and walls in ESTIDAMA:

In the process of collecting points aiming to get a certain value where it will determine the pearl rate a building a UPQ working on, a Pearl Qualified Professional job is to assist the project to gain a certain score of pearls and that is by holding the responsibility of grasping the UPQ requirements and apply it, and do the coordination between all project team, drive the design process and all duties that will procure a pearl grade .The presence of a greenery in an pearls qualified building will have an impact on the score within the scorecard .following points are the green walls and green roof related that will increase the Preponderance of the existence(Abu Dhabi Urban Planning council ,2010)

Table 8.Pearl Building Rating System (UPC ,2010):

Category	Credit in category		Description	points
Natural Systems	NS-R2	Natural systems protection	Existing natural systems on the site before construction like plants can be located within the site on the roof as a green roof	Mandatory Credit
	NS-R3	Natural Systems Design & Management Strategy	The replaced elements in the green roofs will be well managed and protected on different levels irrigation, fertilisation and pest control.	Mandatory Credit
	NS-3	Ecological Enhancement	The plantation of native or adaptive species that is considered as additional plants to the existing in the green roof from the site.	1-2pts
	NS-4	Habitat Creation & Restoration.	Create a new environment that provides the minimum space that allows the exciting system to function as meant to be in nature.	2-4 pts
Liveable	LBo-	Outdoor Thermal	Enhancement of building outer local	Mandatory

Buildings :outdoors	R3	Comfort Strategy	climate can be impact by the roof greenery and shading like playgrounds and pathways.	y
	LBo-1	Improve Outdoor Thermal Comfort	Same as the previous features it will differs in the percentage of impact.	1-2 pts
Liveable Buildings :indoors	LBi-4	Car park Air Quality Management	Green walls is a refreshing Elmet that can be installed in exterior walls of the building parking where it will clear air and create a barrier at the same time .	1 pts
Precious Water	PW-4	Storm Water	Incorporating a green surface in a building will reduce excessive water that result from rain on the roof as for the sewage system.	1 - 2 pts
Resourcefu l Energy	RE- R1	Minimum Energy Performance	Mitigate heat transference and reducing cooling load demand.	mandator y
	RE-1	Improved Energy Performance	Same as mentioned above although it has to have a stronger impact.	1-15 pts
	RE-2	Cool building Strategies	Reducing mechanical ventilation and using passive strategies that increase insulation and solar reflectance on the external surface.	1-6 pts
Stewarding Material	SM-1	Non-polluting Materials	Vegetation on the building façade can substitute other synthetic materials that increase carbon dioxide emission in manufacture process.	3 pts
	SM-3	Design For Flexibility	Introducing a garden roof which can have a lot of functions through the	1 pts

		&Adaptability	life time of the space like sitting area, playground etc.	
	SM-6	Design For Durability	Adding a planting layer into a roof or a wall will protect structural components from external conditions.	1 pts
	SM-7	Building Reuse	Using building components in other form in other place like plants.	2 pts
	SM-8	Material Reuse	Any part of a greenery system can be recreated in new project.	1 pts
	SM-11	Rapidly Renewable Materials	Plating a building roof or wall is considered material with re growing characteristic.	1 pts
Innovating Practice	IP-2	Innovating Practice	Significant contribution on sustainability performance toward the energy efficiency and occupants comfort level.	2 pts

Table 9.Pearl Villa Rating System (UPC ,2010):

Category	Credit in category		Description	points
Natural Systems	NS-1	Landscape Design& Management Plan	Green roof support soil stability	2 pts
	NS-2	Landscape Enhancement	Using suitable plants in a building to the local environment boost the connection between the buildings the climate condition like water efficiency.	1-3 pts
Liveable Villa	LV-R2	Outdoor Thermal Comfort	Roof garden and plan shading will enhance external thermal	Mandator y

			satisfaction.	
	LV-3	Community Facilities And active Urban Environment	Green roof can be part of community active centre within a range of walking distance.	1-2 pts
Precious Water	PW-3	Storm Water Management.	Increase roof capability of holding rain water.	1 - 2 pts
Resourceful Energy	RE-R1	Minimum Energy Performance	Provide effective insulation on the building envelope	Mandatory
	RE-1	Improved Energy Performance	Give significant heat insulation extent then the mandatory required.	1-8 pts
	RE-2	Cool building Strategies	Impact cooling load and reduce air-conditioning use.	1-5 pts
Stewarding Material	SM-1	Non-polluting Materials	Plant 100% natural material that will not have a negative impact on a human being wellness.	2pts
	SM-2	Design For Durability	Extent building component life time when a plant covers the villa external faces.	1 pts
	SM-3	Building Reuse	Utilise existing green roof or wall in a new construction	2 pts
	SM-8	Composting	Utilize villa organic waste in the greenery medium as fertilizers	2 pts
Innovating Practice	IP-2	Innovating Practice	Develop significant strategy that will serve sustainable higher goals.	2 pts

Table 10. Pearl Community Rating System (UPC ,2010):

Category	Credit in category		Description	points
Natural Systems	NS-R2	Natural System Protection	Preserve the site habitat as replacing existing plants in the roof.	Mandatory
	NS-R3	Natural System Design & Strategy.	Intercepted the soil drifting from the desert and site and increase	Mandatory

			landscape life	
	NS-3	Ecological Enhancement	Enrich environment features and increase quality.	2 pts
	NS-4	Habitat Creation & Restoration	Greenery in a building will introduce a part of nature of the domestic environment.	6 pts
	NS-5	Food Systems.	Growing fruits and vegetables in the roof will create Self-sufficiency	2 pts
Liveable Communities	LC-R3	Provision of Amenity and Facilities.	Prepare green faces on top of buildings to serve community needs and to be accessed.	Mandatory
	LC-R4	Outdoor Thermal Comfort Strategy	Plantation mend the outdoor temperature	Mandatory
	LC-7	Active Urban Environment.	Green roof in a city will create an attraction points for community activates in a city	1 pts
	LC-9	Improved Outdoor Thermal Comfort	Higher standard for thermal comfort	4 pts
Precious Water	PW-2	Storm Water Management.	Retain rain water and mitigate pressure on waste water system	6pts
Resourceful Energy	RE-1	Community Strategy For passive Cooling	The more green roof are publicize the more positive impact on microclimate on community level	6 pts
	RE-2	Urban Heat Reduction	Green roofs and walls reduce overall heat gain.	1-2 pts
	RE-5	Energy Efficient Building	Minimise carbon release and for on wide range when implying greenery	7 pts
Innovating Practice	IP-2	Innovating Practice	Earn higher levels of sustainable results via vegetation technology	2 pts

Green roofs in LEED:

A merger of vegetation on the roof and the way it associate with the other facility duties, is going to increase 15 potential points for the LEED TM, while in other cases the a green garden will not add a value directly under the same category, meanwhile in other categories like site annoyance reduction, refurbish and conserve outdoor area, urban heat island and roof space, water management (Afrin 2009).

In the following (Table11) shows the contribution of living roofs and the points that s offered (Afrin ,2009).

Table 11.The contribution of living roofs(Afrin ,2009)

Energy and atmosphere	Material and Resources		
First credit will give 2-10 pts under “Optimize energy performance”	Material Credit 1 “Building Reuse” (1 to 3 pts).	Material Credit 2 “Construction waste management” (2pts).	Material Credit 3 “Resource reuse” (2pts).
Accomplish a high-energy execution exceeding the normal requirement.	Reusing existing green roof in new project then you need replace membrane insulation layers.	Transfer the construction wreckage instead of disposal through landfills to utilising it in refurbishment	Expand the age of some materials and elements in a building.

Green walls in LEED:

A green wall is a possible element to add credit to the LEED (Afrin ,2009).

Table 12.The contribution of living wall(Afrin ,2009)

Sustainable Sites Credit 7.1:	Water Efficiency Credits 1.1, 1.2:	Energy and Atmosphere Credit 1:	Innovation in Design Credits 1-4:
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One point for minimize UHI by avoiding direct contact of sun light with the wall	Water Efficient Landscaping (1 to 2 points).	Innovative Wastewater Technologies (1 point).	Optimize Energy Performance (1 to 10 points).	Innovation in Design (1 to 4 points).
	Relaying on recycled water no potable will add credit to the project.	As are mediation method using second hand water as manure.	Diminish building Electro-mechanical Equipment used in a building by decreasing heat gain.	Green-wall will build up in the Used water innovation and ventilation.

Literature review conclusion:

Most of the studies which have been highlighted in this paper and in many other studies regard the efficiency of the green envelopes were focusing in highlighting the numerical benefits of using green roof and the façades. For example, the amount of saving you will get by using a specific system. However, understanding those kind of benefits is important, but most of these studies did miss the fact that, to educate the users about the system and to increase their level of understating the benefits of using them, also to improve the policies to support using these systems (decision makers).

In this research the author is intending to use these previous studies as background data to support his approach for examine and to explore the level of awareness among users and the constraints which holding them from using those systems.

Chapter 03

Methodology

Chapter3: Methodology.

3.1. Introduction.

this chapter takes the research question to the operating level by taking the extract of the precedent studies and shown in literature review observing the method used to find the desirable goals. Where the author will show which method was chosen.

the author will elaborate on the chosen method which is required to collect the needed data. For example, after an extensive research in literature review chapter, it has been seen that some studies select case study, while other studies use software simulation to predict the answers to their research question. Moreover, some studies look for the answer through survey method. Survey is a method that looks to collect answers form large groups or focused group of individuals who go through certain experience, regularly and/or constantly, these individuals are directly involved to that selected environment such as occupants of the building. Other methodologies the author chooses a case study to study in depth.

The moral of methodology research is to choose the survey and case study method to drive the presumption of answer.

3.2. Methodologies used previously

When we take a close look on researches covering green roof and walls benefits in reducing energy consumption usually gone to the experimental methods and simulation analysis to prove by demonstrate the numerical findings of green envelope impact in cooling loads and electricity bills, yet to find community concept a lot of topics used the survey questioner method.

Since this study is a focusing on the public perspective and their awareness the following part is focusing only on methodologies adopted in similar researches.

Therefore, methods used for reducing energy consumption and enhancing energy performance are not elaborated here.

Survey:

Rahman, Ahmad & Rosley (2013) where studying level of consciousness specialist have toward green roof and expectation this field in the market of Malaysia. Case studies used to support the study. The survey was conducted through online network, and was targeted professionals related to designing and contraction field.

The survey had a timeline from when it was posted to where it closed to the users. The survey was posted online for 44 days, in which it was directed to individuals who have field background on green roof and individuals who have sole involvement to this area and in many other levels specifically in Malaysia.

According to the research it is evident that the questioner was divided into 3 portions with eleven questions, with close and open ended that is targeting in the first part Initial information about participant and their backgrounds and their experience in this field. Second part aims to understand the awareness of green roof advantages among engineers and concerned people. In addition, this section was aiming to find out the common green roof used in this region according to inquiries and local environment. Third and last section was addressing the market expectation for green roof and how can it be implemented more often in Malaysia.

Fernandez-Cañero et al. (2013) explore public audience concept of roof gardens based on apparent appealing compared to other roofing suggestions, where attitude, social and demographic factors are the criterion.

Conducting a picture based survey, in which it requires a high-resolution imagery which was edited using Photoshop CS3 to have closer outcome to real status. Types the green roof and plants used where the two milestones for the survey (What do you mean) .where for green roof tiles there was 4 types gravel extensive, semi-intensive and intensive, and for plants kinds different between grass and bushes and little trees, the fusion of the both standers generate 8 options.

The questionnaire for this study consisted of three sections. The first section included the visual imagery with scaling system in 5 levels. Second section targeted people's perception on the advantages and disadvantages of using this type of technology, rating scale was used for this section. Third section of the survey was targeting background

information and understanding of the participant which plays a role in their assumption on the previous sections.

To collect the answers from participants, the researchers invited participants to one location. The survey took place in a closed hall, where 450 people participated in taking the survey; most of them were university students and local citizens of the area. Since the study was depending greatly on imagery, the researchers depended on projector to showcase the images, selecting a closed hall was a good approach to give the participants clear vision and better resolution, in which it must have had an impact on answering the questions clearly without hesitation (Fernandez-Cañero et al. ,2013).

(Ismail et al. ,2015) introduced a paper that aimed to measure the view of occupants in residential towers toward vegetation in their living environment. (Not needed)

The writer in this study was targeting the building users perception about using a green roof, so five buildings was chosen as case studies. Feedbacks from 297 individuals were collected in the form of survey. Building tenants answered the survey according to their awareness and understanding. (Ismail et al. ,2015).

As the survey was aiming to understand the occupant's perspective about green roof benefits the questioner configuration was coming in the same structure of the benefits as mentioned in his study.

The survey started by questions targeting general information such as; 1)Age 2)Gender 3) Race. This will help to categorise the feedback based on gender and age in order to find any difference and resemblance. Furthermore, the outline of the survey was revolving around three points, environmental, economic and social features, on each point a sub division comes with a range of 5 scale rate for the building tenant to fill in the form of 'strongly disagree' 'disagree' 'natural' 'agree' strongly agree'.(Ismail et al. ,2015)

Literature review:

Banting et al. ,2005 has prepared a report that discusses green roof drivers in Toronto market, for the purpose of boosting building vegetation in the market. The researcher aimed to highlight the role of the governors in the city in order to reach a certain

comprehension about different types of green roofs and quantifiable positive leverages. Moreover, looking at the impact of green roof on the financial provision for the town authority.

Crew of researches worked in this report relaying on literature review to determine green roof advantages. Furthermore, information's was gathered about the architecture in the city and land nature . Moreover, the team invented a software programme to calculate advantages of the controlled value for the green roof. And finally inspection showed the standing examples of green roof in the city and craterous used to cognize concerned affaires about the minimal demands for a green roof (Banting et al. ,2005).

Velazquez (2005) showcased the origins of green roof. He tried to explore green roof potentials from all aspects where it started with the general concept mentioning history of this strategy, and how old man combined nature to architecture.

Going into more critical level, it is significant to mention technologies used green roof benefits from all environmental, economic, panoramic and psychological level. Where the author used literature review to cover paper aims and objectives.

Experimental:

Haggag, H &Elmasry(2014) tested the amount of energy consumption amendment can a green wall add to the a facility situated in such hot and aired area like UAE.

Where the approach that was conducted is to treat was in a school located at Al AIN city. For the experimental mean Liwa international school in al ain was chosen where plastic cases built up in the walls attached to the pipeline for irrigation. A temperature measurement device with two wires placed in multiple places to find the temperature difference between the green and bare walls. Of course the two points were located in the external wall of two classrooms with same areas and orientation and window size, in addition a reader was attached to capture the temperature in 4 points, external and internal faces and I meter (what do you mean?) from outside also from the inside. The test was done during the hottest periods of the year in the seventh month (Haggag, H &Elmasry ,2014).

Niachou et al. (2001) target to study the green roof behaviour toward heat transference and energy performance in the building.

As for empirical strategy the writers put twofold examples a green roof with insulation and other with no insulation, for the first case reading was gathered from three zone of the face in the dark greenery and coloured flora and the white unplanted surface and the same for the insulated case. The fluctuation of the temperature readings in first case consequent to diversity of plants used moreover of the difference on the layers thickness and continent difference on each case, that for the greenish slant of blackness readings where between 26 C to 29 C while in the colour plants area it reaches to 36 C to 38 C ,the rang of the plant less white part is 27 C for walls and 40 C for roofs , where we can find a slit difference between the three status (Niachou et al. ,2001).

Second example with non-insulating layer, had a different outcome. It was found in the comparison of temperature between green and non-green surfaces around 10 c degree differences. As for the internal thermal comfort the air temperature variation was witnessed in the two cases. On the other hand, the hypothetical there was three case studies studied the thermal conductance coefficient for each case, whereas first was the roof with no protection layer with a green roof as well as a medium protection and last the perfect protection.

In the first status heat transfer was quite huge different between the planted roof and non-insulated surface in the u-value while in the moderate is almost the same, yet in well-insulated roof the existence of greenery exerted unrecognized disparity (Niachou et al. ,2001).

3.3. Justifying the Methodology which will be used.

In order to determine the suitable methodology for this research, the author had explored different methods used in previous studies that focus's on greenery. These studies discuss the impact of greenery on the occupants in both physical and psychological perspective.

In this part it is essential to remind the reader of the research orientation in an attempt to answer the research questions mentioned before.

At the beginning as an introduction for this study the researcher wanted to determine greenery influence when merging it in a tower or a villa, where literature review explained this part as it has been approved in many researches using different methods.

Second part is the fundamental quest of the research, which is the determine public's awareness of the greenery positive impacts. And to determine whether the public/building occupants can identify the use of greenery in buildings other than beautification purposes. Investors and owners understanding of creating vegetation surface added to their building, moreover construction specialist and governmental authorities

Whereas the reason of choosing samples and of older studies discussed green roofs and the benefit impact on the urban scale, thermal comfort, occupants and energy conception, where as it was narrated briefly a range of different approaches took place answer the research question as stated by the author, to find results in a smooth logical way that will satisfying targeted viewers.

After the observation of Haggag, H & Elmasry(2014) has claim to identify cooling load or energy conception in quantity forms, to point out the difference between adding a greenery in a building and create an isolation system that prevent transferring heat.

Thus keep thermal heat reasonable for occupants to practice their daily habits in an office or a domestic building, experimental method using measuring devices same as for Liwa school at Al Ain after adding green wall to understand plantation heat conductivity in to the wall which required finding solid readings and compare between temperature of greened walls and other bare ones.

Same apply for the Niachou et al. (2001) where in that study object is to find out how can applying a green roof affect the top roof surface temperature and heat travelling inside the space in three scenarios , first a green roof with roof with full isolation and second with medium insulation and finally with no insulation. That kind of study required a field experimental method to collect data as weather factors measurements.

Velazquez (2005) and Banting et al. (2005) researches was depending on collecting data from earlier literature review to present collective report narrating all about building greenery that can be considered as a data base.

Fernandez-Cañero et al. (2013) in Spain as mentioned in the previous section public audience perceptions about building greenery and there awareness scale on this matter ,as for the green roof impotency thus a survey was used to collect responds.

Ismail et al. (2015) use some kind of survey form to collect occupants review for greenery in residential towers and measure the investment potentials for a green roof in Malaysia involving specialist feedback as well.

Rahman Ahmad &Rosley(2013) target was directed to high qualified professional and the level of knowledge about green façade at Malaysia also to study their respond.

As reflected in the previous methods overview, research methodology choice was determined as per as the research aims and objectives. This study intent to discover the current situation and obtain a perception from individuals regardless their backgrounds and level of education a series of survey had to be conducted to pursue the author goal.

3.4. Survey, interviews and case studies.

In this proposal there were four categories of respondents where targeted:

- 1- End-users such as common people those who don't have any related background to the field and may or may not have the knowledge of green roofs /walls benefits.
- 2- Property owners: villa owners, investors and developers as they are the founding resource and part of their awareness may affect greenery popularize.
- 3- Professionals: Several specialties who are related to construction field as designer's contractors and sustainable consultants, examining the depth of general and technical knowledge of the most important party of building design and construction that can have an impact on merging a green element into a building.
- 4- Governmental authorities: government has always been the powerful motivator for any kind of change, by setting rules and putting regulations it is possible to force all project participants to apply sustainable practices in a building, therefore scaling the level of awareness inside makes it essential.

Participants were divided into four categories according to knowledge background and its relationship to the construction process ,while on the other hand each group have its

influence on the other group, where as an example end-user lifestyle force investors to maintain property that suit their needs, therefore designers will have to meet with what the market requires and municipal and urban planning regulations ,and that will make it a cycle of influence for each part as shown in the diagram bellow:

As a first step in the journey in an attempt to answer first part of the research question, an online survey took place to in order to collect the maximal number of responds from different backgrounds the four categorise that where mentioned before.

In this survey a general overview was taken to judge what the next step to go further in this investigation and where can we dig deeper to title a better understanding of the individual's mentality toward plantation in building roof or elevation with different background.

Therefore an ancillary detailed surveys and interviews where done with professionals with decent experience in designing and construction field that may be aware of the whole project process of designing and getting approvals from municipalities and executing in the site, this process will include a list of various participants as engineers, architects, sustainable consultants, governmental employees, and contractors.

Moreover, aiming to investigate real examples of green roof application, yet have a closer look to the current situation of the standing projects, therefore site visits was part of the investigation and interviewing who are in charge of the building to know more about green roof application technology and benefits inquired.

A case study can be vital prove of level of different people categories behaviour toward it ,that can paint a clear picture of all stages from deciding to install a green roof to the technology used then the maintaining tis part of the building.

In the diagram bellow **(figure 11)** present the methodology stages in sequence:

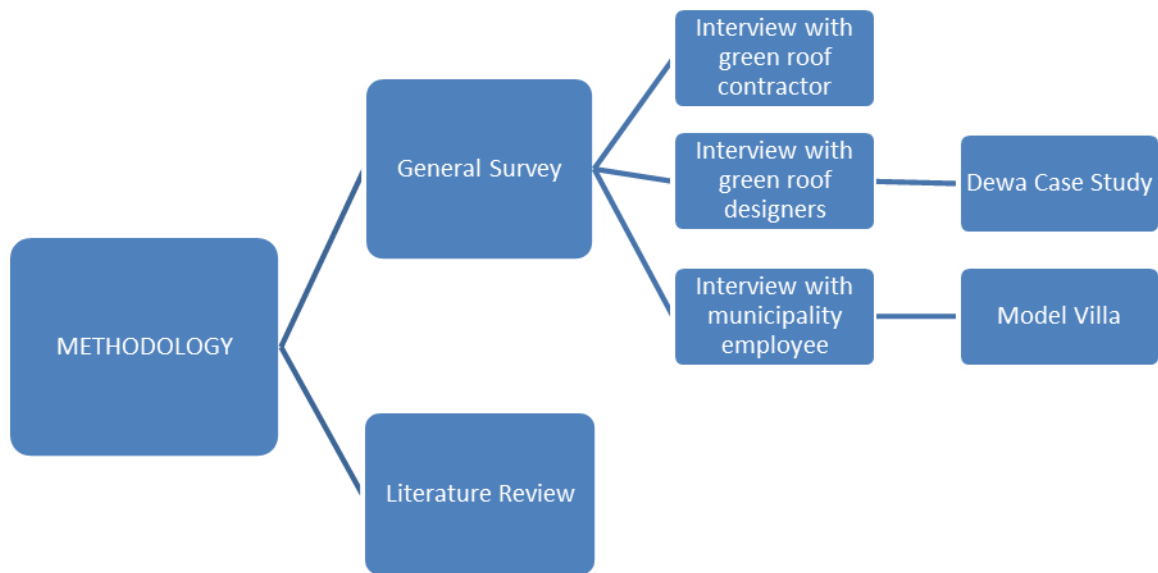


Figure 11.Steps of developing research methodology

Survey questions:

The first part of the survey indicates general information about participant location or place of residence to compare the knowledge of people from different regions.

The second part of the study was detecting the background for each participant academic degree and experience field and finally the relationship between of each person and building industry, and if they were involved in any of designing decision. Asking about the graded educational degree to segregate participant with a designing or engineering background who have academic basic knowledge about building requirement and other random specialties that did not get any engineering learning. Such information can lead to understanding how can educations and occupation influence their answers on the survey and expand their knowledge about sustainability particularly

In the Third part of the survey author targeted to define the level of the participants interaction with green roof or wall and if a participant saw it physically, to understand if audience knew about the existence of green roof and where they received the input about the subject, and as the study go further the urge to collect more detailed data arise.

Fourth part was a development to lead the research to the next level toward the specialist survey of the survey questions was determined to find designer, contractors, governmental authorizes and developers those who are in charge of delivering the best proposal according to local rules and circumstances matching with owner requirements and budget to deliver in in form of the building layout and exterior designs.

Fifth part to knowing how does randomly picked participants think of the green roof/wall from negative aspect and the reasons that can possibly stand in front of this technology from spreading and become more common.

In the sixth part of the survey was meant to find participants views and suggestion to push and encourage greenery knowledge and increase the turnout on greeneries which might give a realistic approach and in light more effecting actions toward the issue.

Chapter 04

Results and Findings

Chapter4: Result and discussion

4.1. Introduction

In this chapter results will be presented and discussed in three sections as shown previously in the methodology section, the main approach was by using online surveys ,also interviews conducted with professionals as well as case studies of existing examples. as the same sequence of the research question the result collection was parallel, online survey brought up an overview of the real awareness and different opinions from random mentalities about building vegetation, and elevated to the second level into the more specific interviews with designers contractors and governatel to discuss the greenery in a technical way and more related to the market movement and understanding where do green roofs/walls stand in the sustainability agenda and finally expanding the knowledge that was gained by relating al the theoretical research and look further in the physical models available .

4.2. Results and discussion

Section one (survey):

As a part of the discovery journey and aiming to find closest corresponding reality to the knowledge situation for persons from different background conducting an online survey was the easiest way to reach the as much as possible around the world, since the study was targeting UAE there for participant from emirates are considered as for GCC countries that share same geographic zone and climatic context.

In order to grant a bigger picture of UAE current situation regarding general awareness of green roof, wall benefits the survey that took a further step to collect more response from different countries beyond the gulf region, as importing other parts of the will support the results . The comparison between different regions will give an indicator of the country place within the world in terms of environmental awareness and sustainability knowledge and most importantly green roof/ wall market.

Results for the first general survey are divided into three divisions according to each region and the responses collected. First one was the UAE and other GCC where is the main aim of the study and the second region was Arab countries (north Africa and

middle east) in and finally another part of the world from east and west like America Europe and parts of Asia (India and Malaysia).

UAE and GCC:

The questioner was posted online using a survey website that provided a suitable window to collect participant from all over the world in a handy quick procedure (appendix 3). This questioner was available for 45 days, shared and passed on through websites and emails. 154 individual was the total of participants from different educational back grounds, various career path and wide experience range. As for this part of the quest targeted portion is the United Arab Emirates and Gulf Cost countries. At the beginning of the filling form, there was a brief explanation about study purpose, that step was enabling the participant to know more about the topic and researcher objective which made participant more accurate and series.

In Thirteen questions the author tried, to sum up, a summary represent the respondent background and noetic extent toward the proposed sustainable approach.

The first part of the survey indicates the participant location or place of residence to indicate in which region they belong so as showing in the following parts the percentage of participants from three regions in three survives.

- apparently for the UAE and GCC countries, the outcomes showed 153 responds in total where 72% of them were from UAE whiles the remaining 43% were from other GCC Countries (KSA, Qatar, Bahrain, Kuwait and Oman), where the concentration was navigated to UAE where the base of the research located. In the next cake chart (figure 12) shows the percentage in details:



Figure 12. (Author ,2016)

In the second region middle east and north Africa total of respondent where 66 participants 85% were from north Africa and the lowest portion of middle east 15 % cake chart (figure 13)

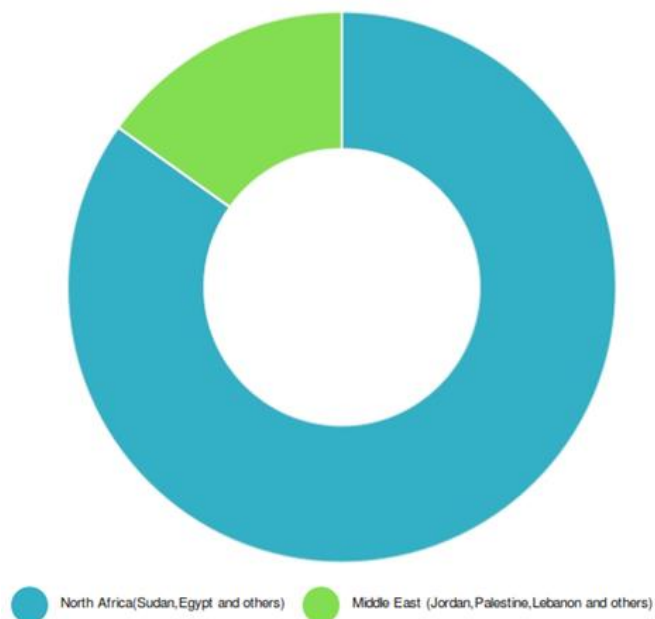


Figure 13.(Author ,2016)

In the Non-Arab countries from America Europe and Asia, we got 20 participants 20% from America 25 % from Europe and 25% from Asia in (figure 14).



Figure 14.(Author ,2016)

Total response where 240, as the research was targeting UAE most response was from there, a fluctuate in the responds number accord due to the topic and questions more related to GCC countries.

The second part of the study was detecting the background for each participant academic degree and experience field and finally the relationship between of each person and building industry, and if they were involved in any of designing decision. Asking about the graded educational degree to segregate participant with a designing or engineering background who have academic basic knowledge about building requirement and other random specialties that did not get any engineering learning. Such information can lead to understanding how can educations and occupation influence their answers on the survey and expand their knowledge about sustainability particularly.

Education

In UAE and GCC 45% where architects, interior designers ,landscapers while from other engineering categories like civil, mechanical 39% and remaining percentage which is the highest it was 47% , this percentage was including a lot of variety as from

the medical field and from administration, business ,marketing, and other human sciences (figure 15).

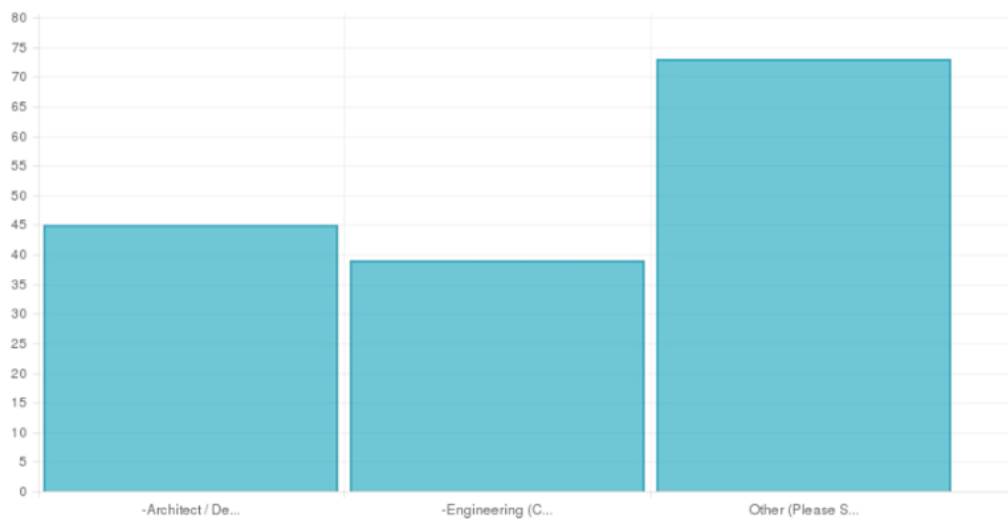


Figure 15.(Author ,2016)

In second specified region Arab countries statistic shows that 21% are architects and designers, 30% other engineering specialties and 48% from other majors (figure 16).

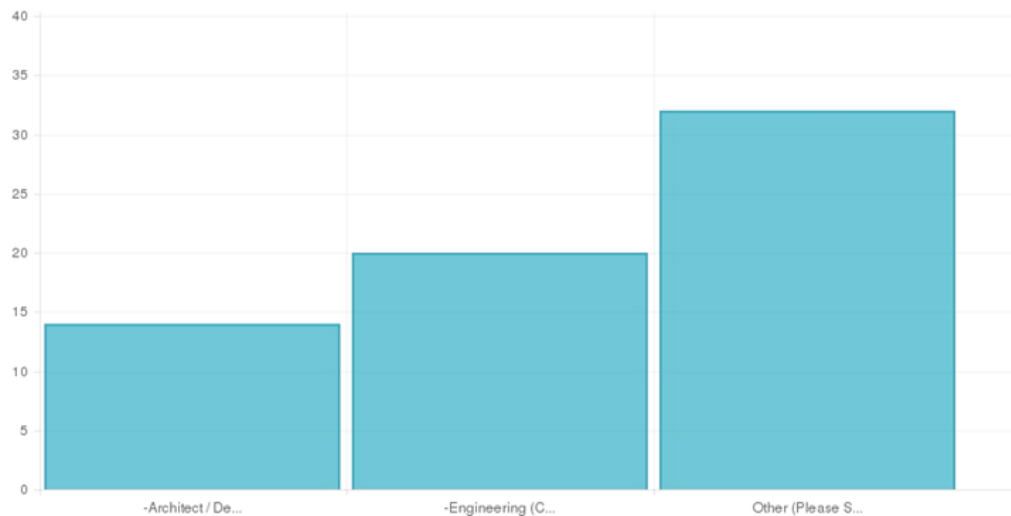


Figure 16.(Author ,2016)

Survey showed participants in westerns and far eastern countries 15% are architects and designers and 45% engineers and 45% others (figure 17).

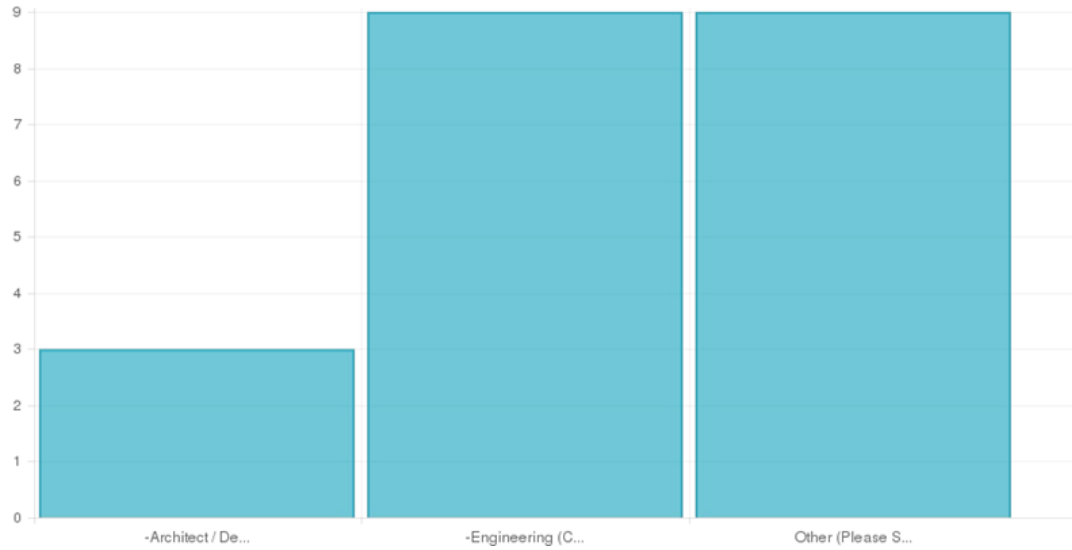


Figure 17.(Author ,2016)

Career

in term of career , it is shown in chart bar (figure 18) 36% work in engineering consultants that are concerned to provide a building design and supervise the construction process , 8% building contractor responsible to execute the project on the site according to approved plans and specifications , 5% government authorities that are in charge somehow to put rules and regulate standards for all buildings in a city for example Dubai municipality, Planning department , DEWA,RTA ETC. while the remaining 53% of response are between hospitals clinics business companies and other authorities according to their specialties.

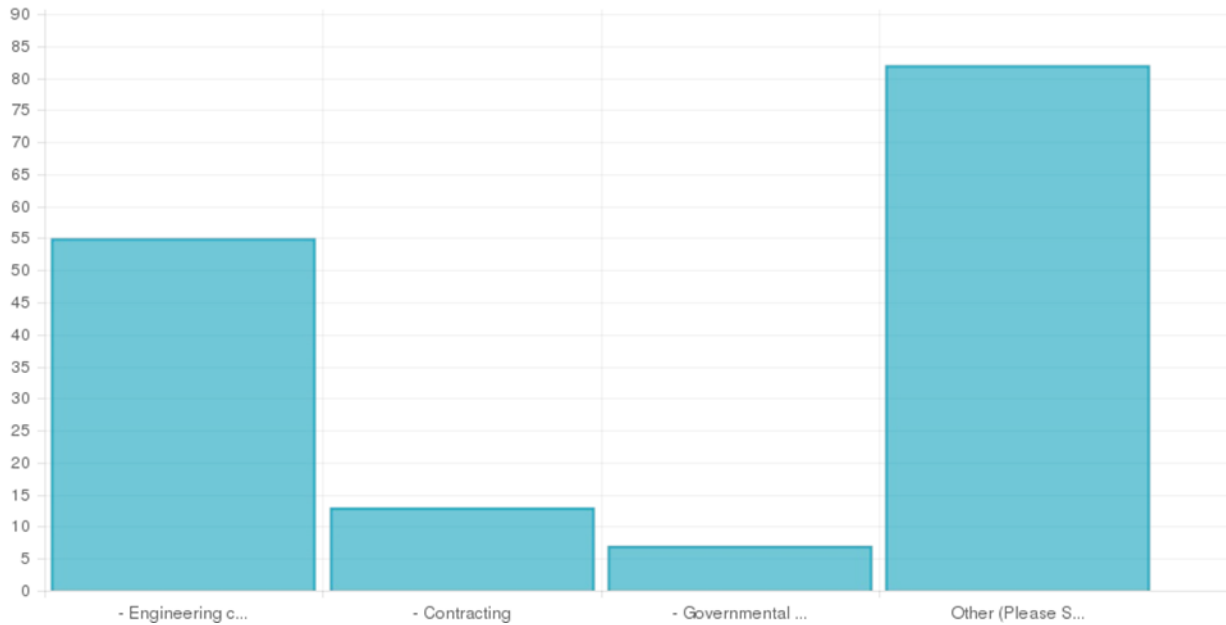


Figure 18.(Author ,2016)

In (figure 19) this bar chart represents MENA region where 29% work in engineering consultants, 15% of contractors, 3% in the government and 58% belong to different companies for many other designations.

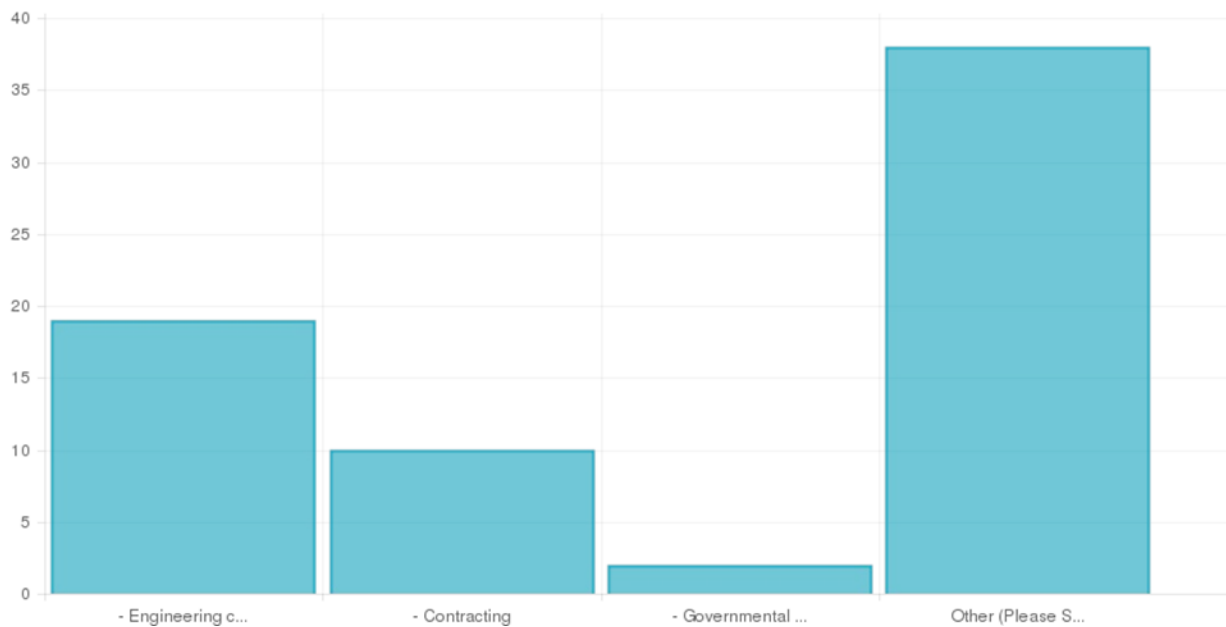


Figure 19.(Author ,2016)

Other parts of the world the like UK and the USA and some part of Asia respondent were divided into 15% engineering consultancy offices and 5 % government , as the remaining percentage 80% was from further specialties (figure 20).

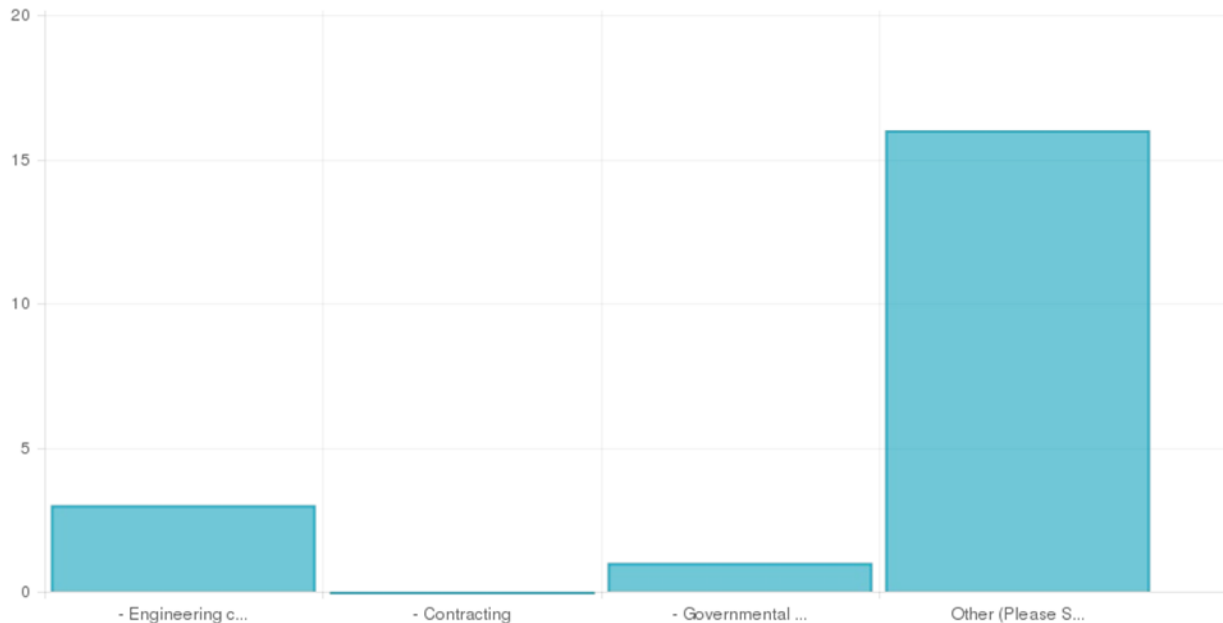


Figure 20.(Author ,2016)

In a comparison between the three regions most of the respondents are from various background who are not related to architectural or structural education either for career experience that will make this study more oriented to people who build their point of view from non-professional point of view and that what will help to define what do a common person perception think of greenery in roof or walls.

As a conclusion of this part of the survey, it shows that the highest figure of participants at all regions is from the random background which is not related to any construction field or specialty that make the study a reflection the common person and understand ones understanding level.

Plunging into a deeper level of data extracting and trying to understand more about the survey participants a question was introduced to know the level of involvement of the participants and their backgrounds (designed maker and end-users) in a building construction.

UAE and GCC region:

61% were not involved in any kind of designing activity or taking any decision regarding a construction project ,31% were involved in the process while 11% was owners of the property where several main designing decision can be up to them (figure 20).

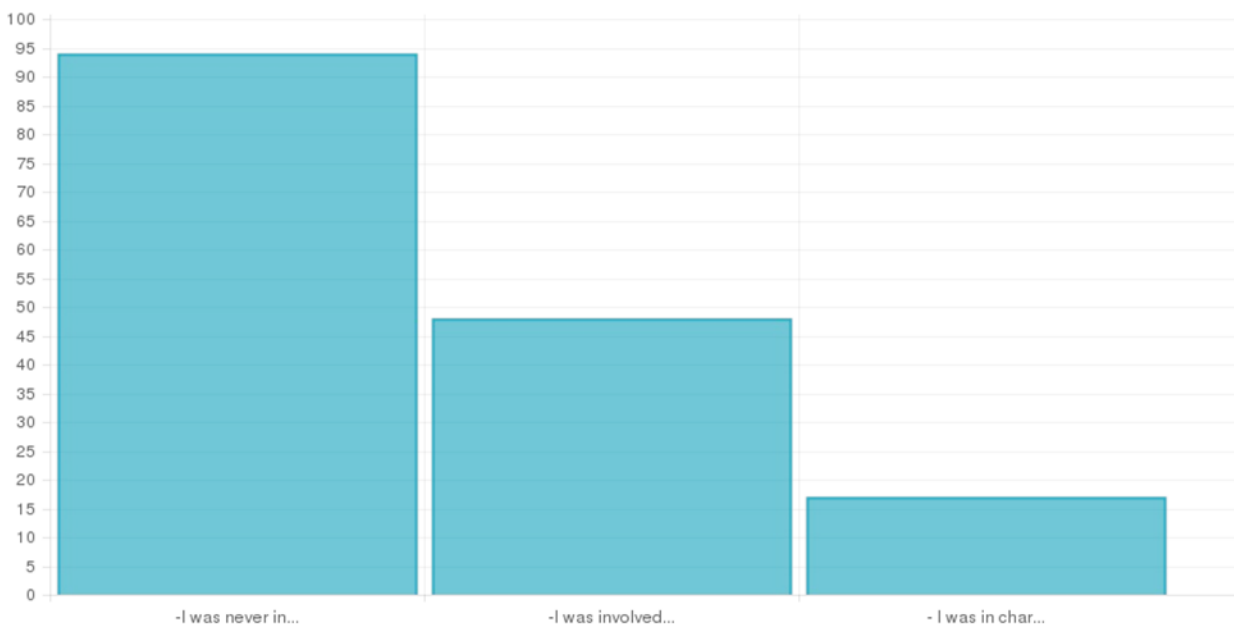


Figure 21.(Author ,2016)

Middle East and north Africa

the proportion was slit different that the previous case; 56% did not have anything to do with construction or building activities while 36% was involved somehow in managing or constructing , and 11% were involved in their own property discussion making (figure 22).

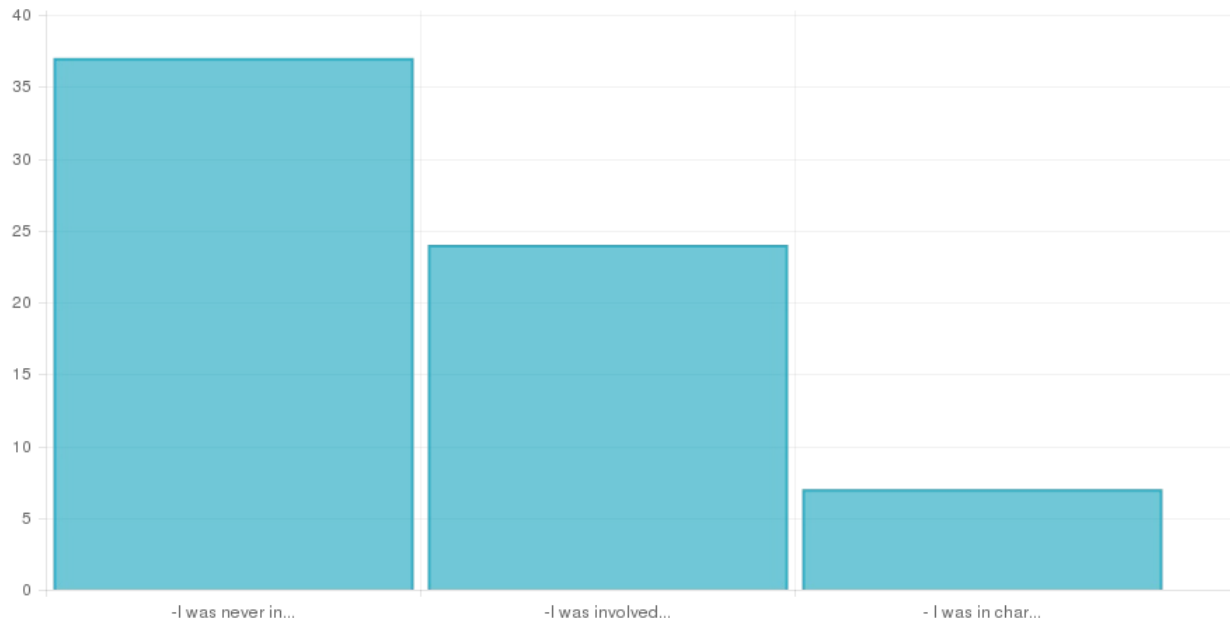


Figure 22.(Author ,2016)

Countries in **America and Europe and Asia** 60% with blank experience, 40% where in charge while nobody got the opportunity to become an owner (figure 23).

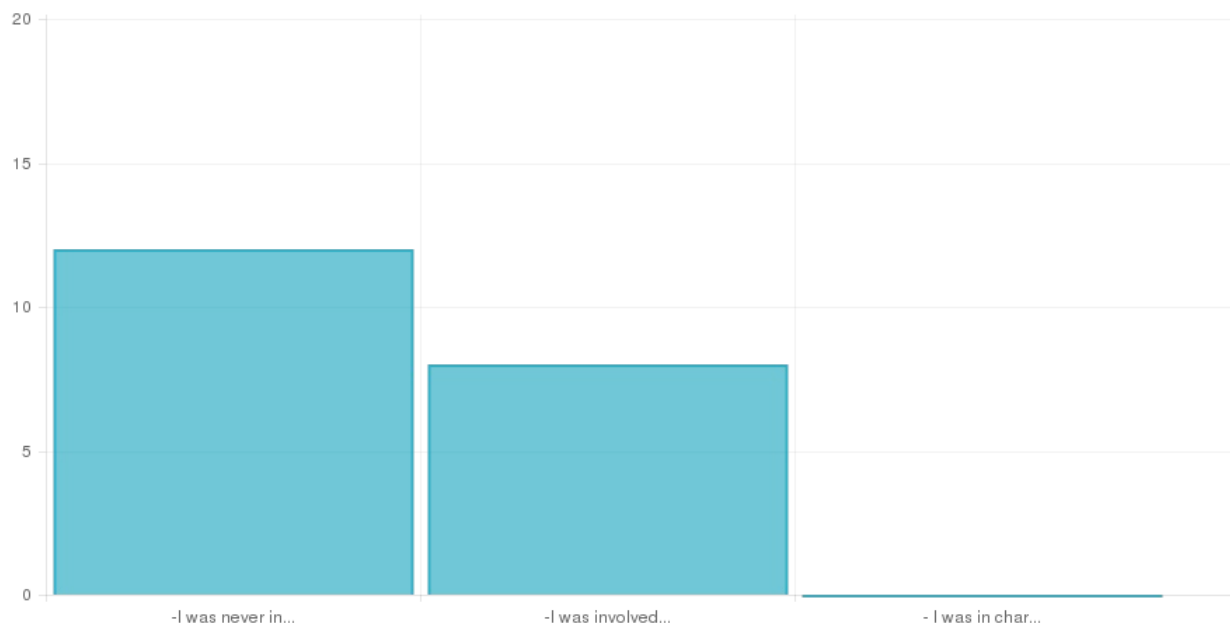


Figure 23.(Author ,2016)

Looking into those results that give a strong indicator that major portion of participants was not involved in any designing and project site work or a client that plan to invest in a building which supports the previous part and make it more obvious that participants have a clear mindset toward dealing with building sciences or business.

In this part of the survey the author tries to measure the ratio of person knowledge about the combining greenery in building and know if they heard about such a technology and if they knew about it how did they get to know about it, as it was important to understand if they have seen any kind of greenery in the roof or walls in their real life.

In UAE region 14% have never heard about green facades, 18 % who know about this thing but does not really understand what it does; 43% with a limited knowledge of the environmental knowledge about green roof and wall, 34 % of the respondent are mindful of this strategy and how does it impact the environment from both positive and negative aspects (figure 24).

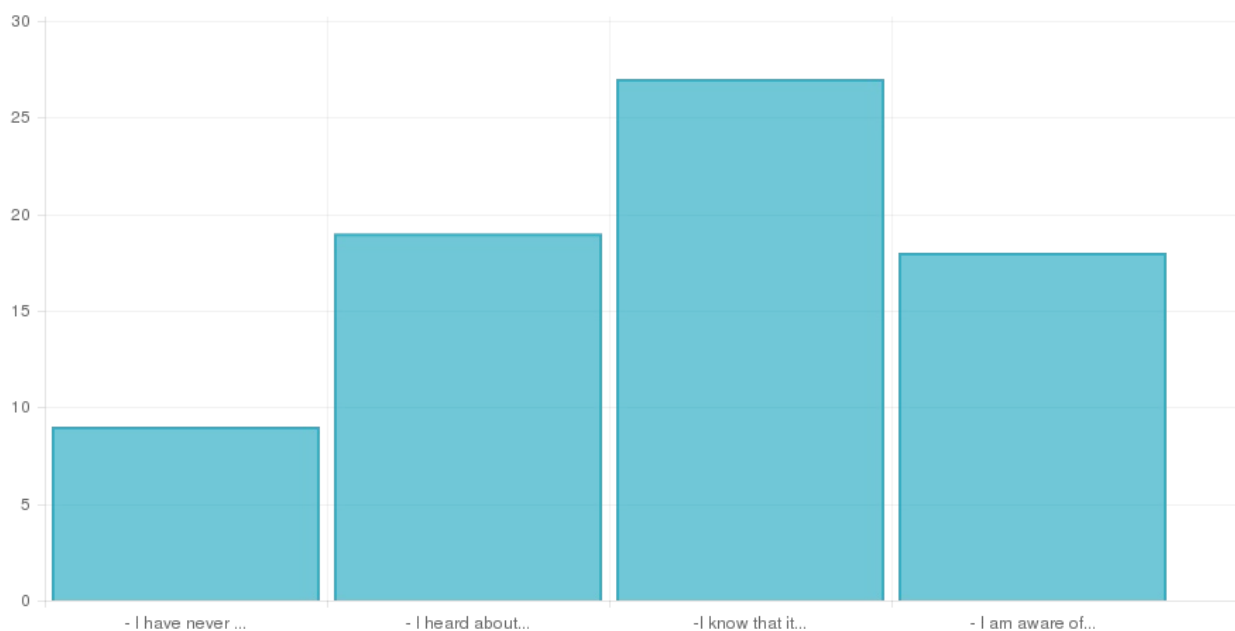


Figure 24.(Author ,2016)

Moving into MENA regarding this quest it is found 14 % same as UAE case did not the information , 29% was exposed to this idea no further information , 41% participant know that it has a satisfying effect on the environment, 27% have a professional insight about it (figure 25).

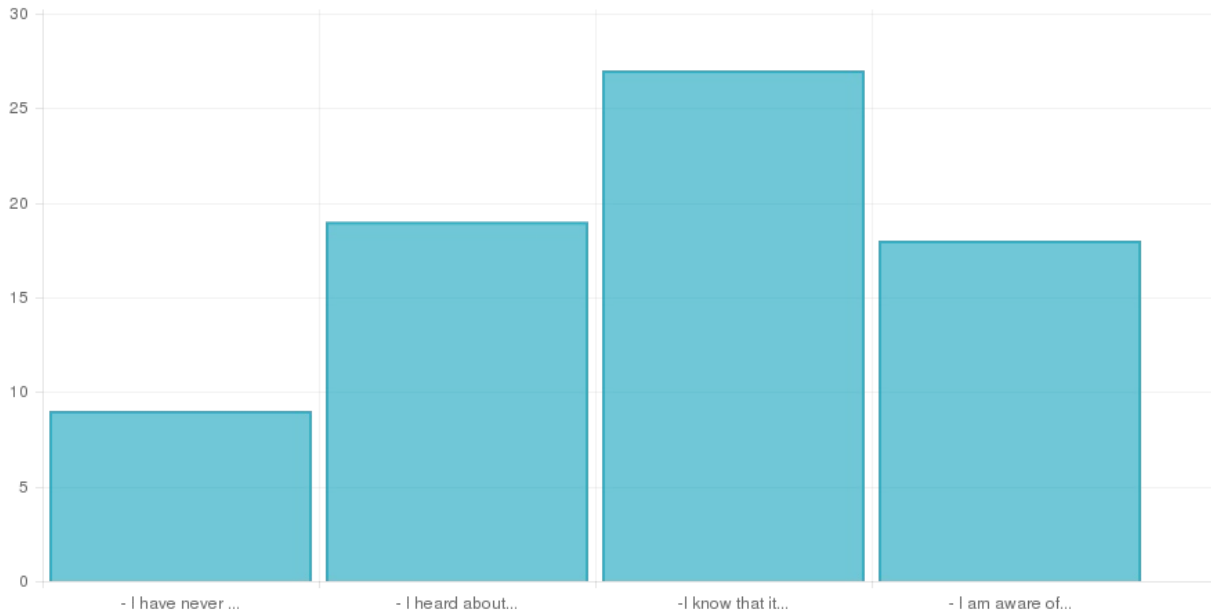


Figure 25.(Author ,2016)

In third case none speaking Arabic countries 15% did have any back ground about greenery, 20 % heard about it without any information, 30 % know that is effective for the planet only, 35% had the extent professional knowledge (figure 26).

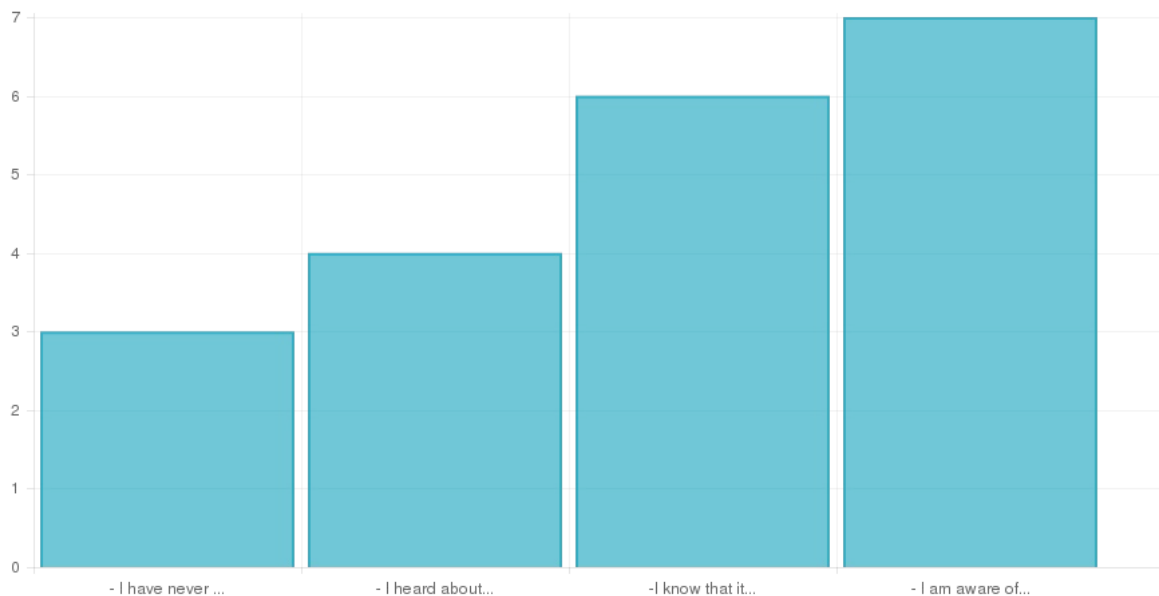


Figure 26.(Author ,2016)

Comparing results in (figure 27) shows the in GCC and Arab countries know that greenery has a positive effect but not in a specific scientific understanding while in third group the majority have the deep understanding while in the three groups the lowest

number refer to the ignorance portion who have never heard about it, which is a strong indicator that community has an idea about this topic.

Knowing the most used tool to deliver attentiveness and awareness could build more understand about how people really get influence on their perception

Discovering the method people in UAE and Gulf region lead us to find that 41% find about green roofs and walls through media, 27% by going through articles as a general knowledge, 25% through discussing with coworkers or specialties that in rich their experience, 21% by scientific researching to developed academic outcome, 12% did not get any kind of information through any of the mentioned methods.

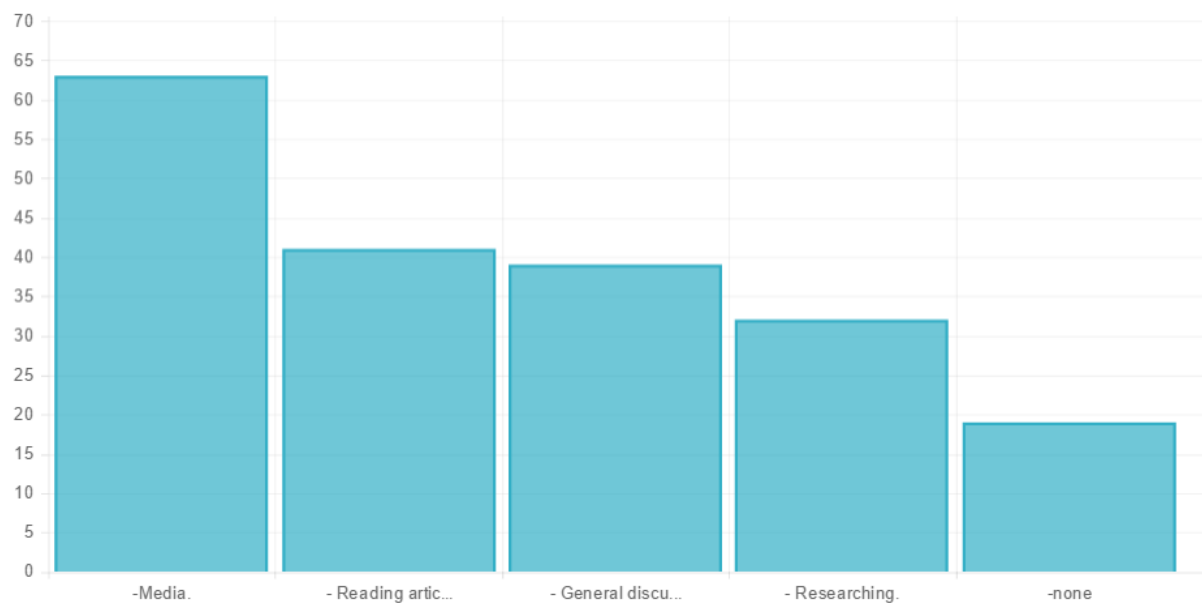


Figure 27.(Author ,2016)

In the middle east and north Africa media has the foremost impact on participants knowledge about sustainability where 47% has been introduced through media, 30% by reading, 24% by discussing between each other's, 17% by researching and looking deeper into the issue while the remaining 12% has no any information about it (figure 28).

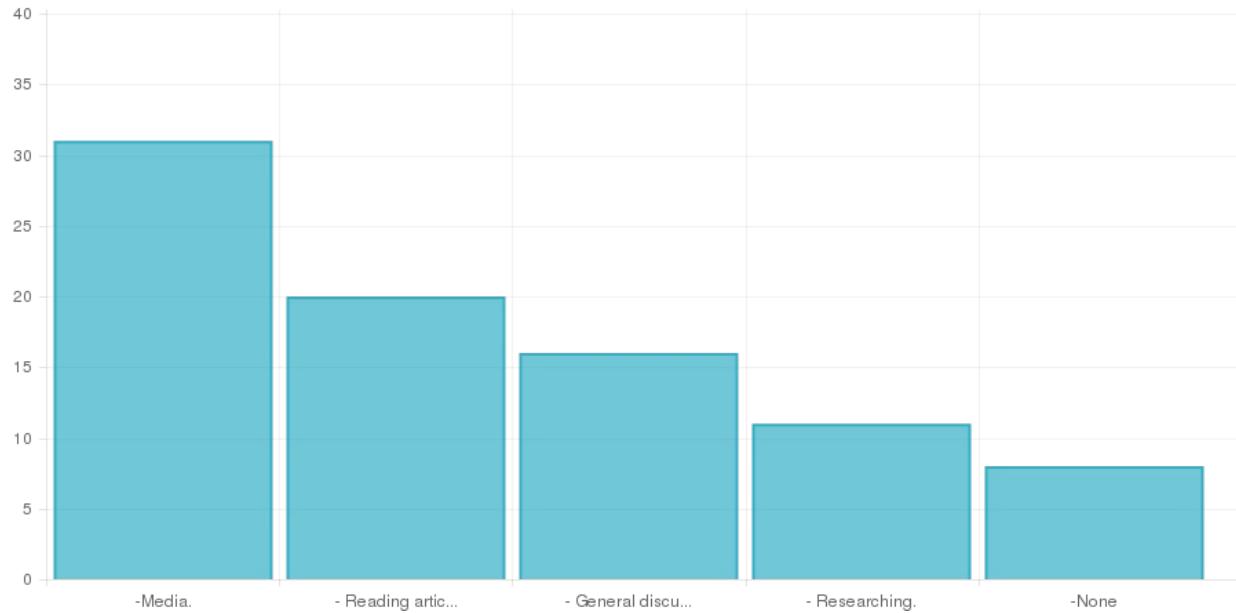


Figure 28.(Author ,2016)

America /Europe/Asia was had similar results for each option, as for media and article reading 40 % and 25% through discussion and researching, but the remaining 15 % did have the opportunity to get the information (figure 29).

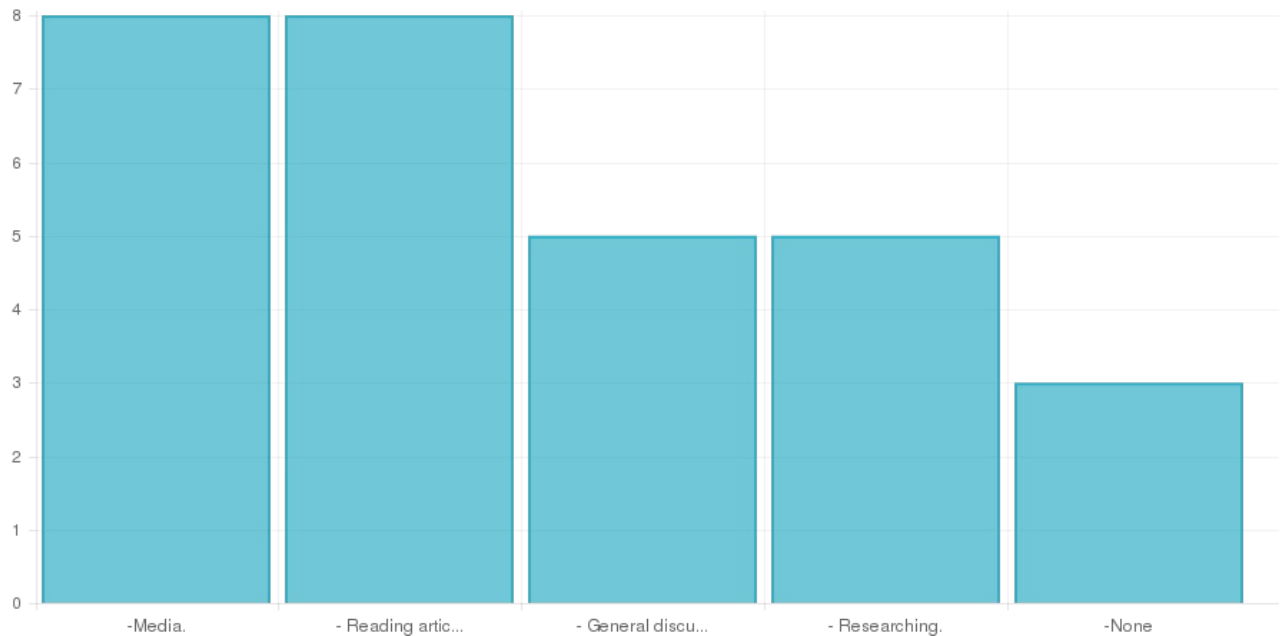


Figure 29.(Author ,2016)

Bar charts for previous results give the impression of how does media TV, Newspapers, magazine etc. to deliver any message for individuals from various background, especially in UAE and MENA countries while in another non-Arab region general

reading considered as a competitor to media, therefore utilizing media in promoting sustainability.

As a starting from the knowing participants experience background and shifting into another level of exploring to understand if audience knew about the existence of green roof and where the received the input about the subject, and as the study go further the urge to collect more detailed data arise, thus the author wanted to define the level of interaction with green roof or wall and if a participant saw it physically.

In first region 32% have never seen a green wall/roof anywhere, 44% only within media, 33% saw it actually inside the region, like UAE university, Liwa school , king Faisal financial center , JBR, Dubai municipality headquarter , 360 mall , Novatel hotel in sheikh Zayed Dubai, and outside this area like Europe America and others (figure 30).

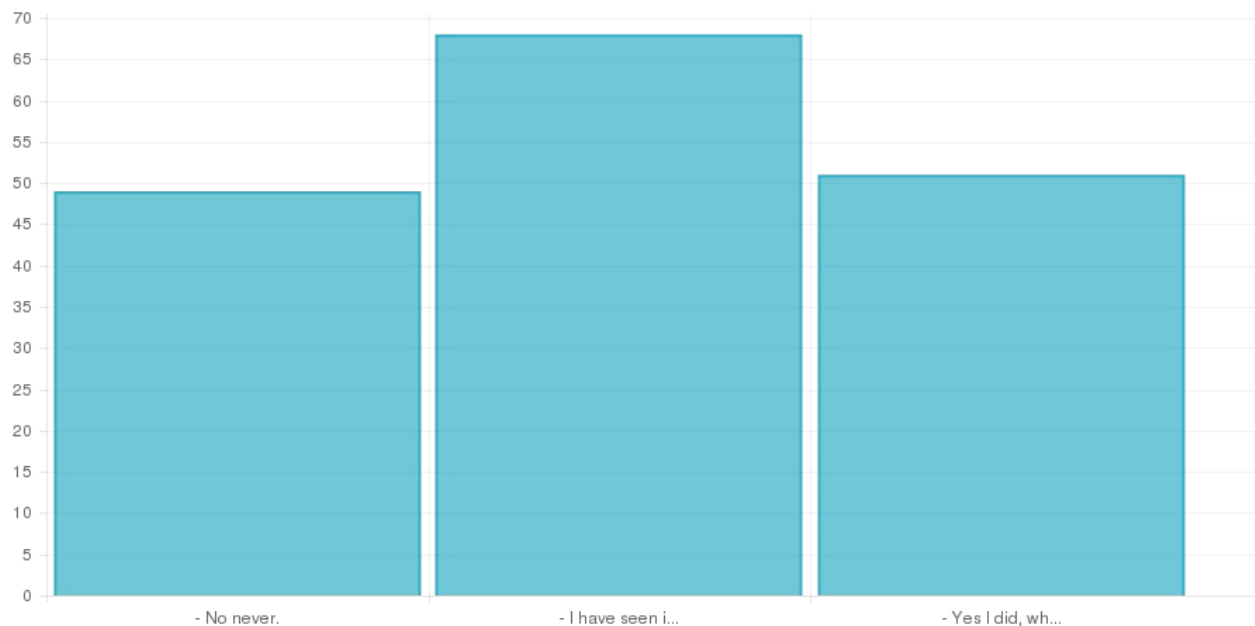


Figure 30.(Author ,2016)

In second area 42% did not see it anywhere, 38% only on TV and the remaining saw it in deferent areas around the world 20% , (figure 31)

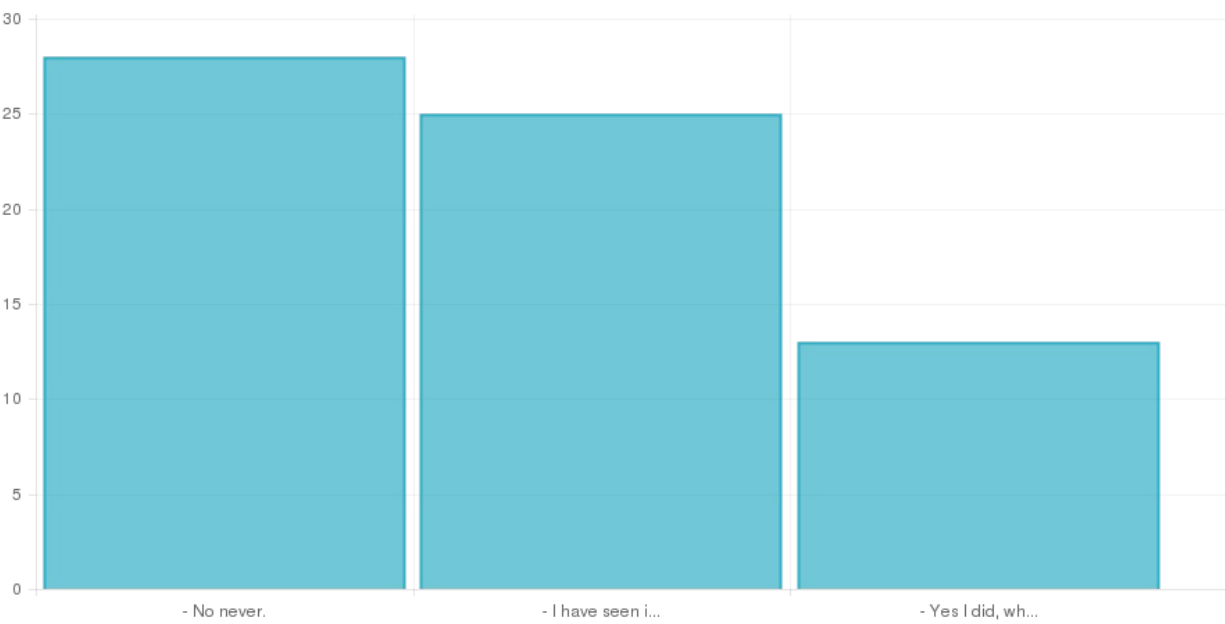


Figure 31.(Author ,2016)

Moreover the last part of the world had 30% respondents did not actually see a greenery in a building before, while 25% saw it only in Media and 50% percent saw in a lot of locations for example Bre innovation park(UK), Kuala Lumpur International Airport (figure 32).

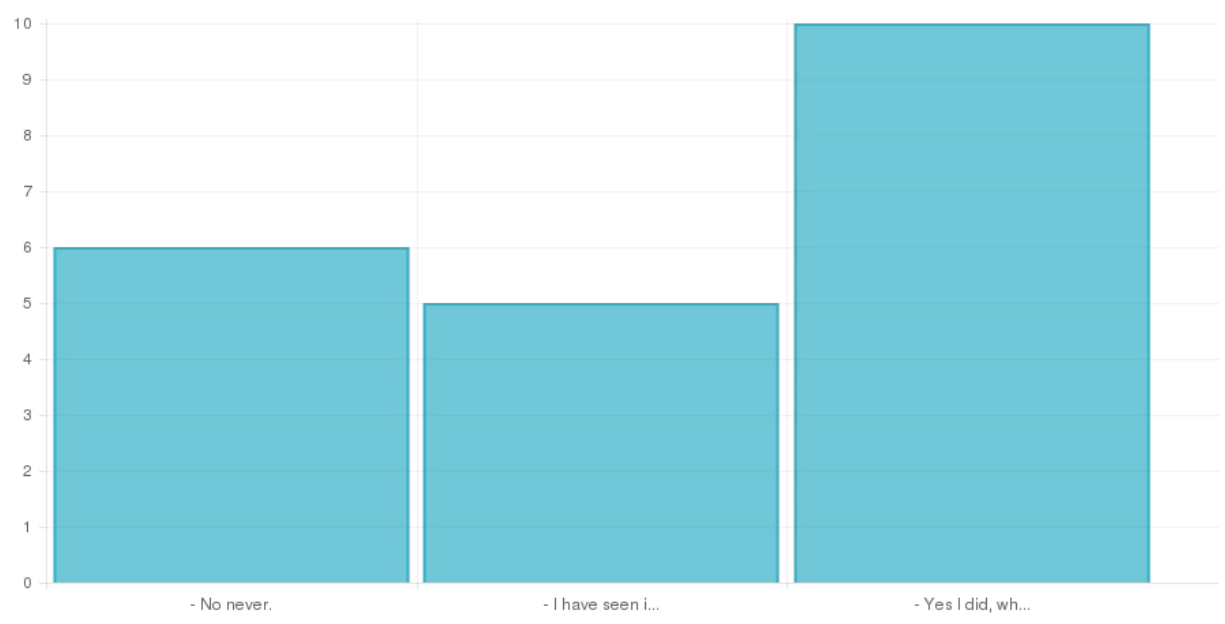


Figure 32. (Author ,2016)

In this part also it shows the massive power of media in UAE and other Arab region in introducing these technologies and will increase knowledge circle around, while in UK and USA and more Asian countries where exposed directly to such projects which is an indicator that UAE is still behind on the track and individuals living there are not that exposed yet.

Trying to elaborate in this study and become more specific, some questions were directed to a certain slice of available applicants in order to develop a guidance that will lead the research to the next level toward the specialist survey in the coming section.

In this following part of the survey first question was determined to find designers and architects those who are in charge of delivering the best proposal according to local rules and circumstances matching with owner requirements and budget to deliver in in form of the building layout and exterior designs.

The subject of this question is to know the real practice in this field toward greenery, and until what extent a green roof is considered as a sustainable element integrated into a building from designers' point of view.

At main area, 8% of designers did not try to involve greenery at their essential design.6% who does not have any knowledge to involve it, 8% that will add it when the client ask for it,10% will want to suggest roof vegetation in their proposals but due to ignorance and thinking it is not worthy client won't be encouraged to add it, 14% of the professionals will try to go into more details and clarify the idea to the beneficiary side.

(figure 33)

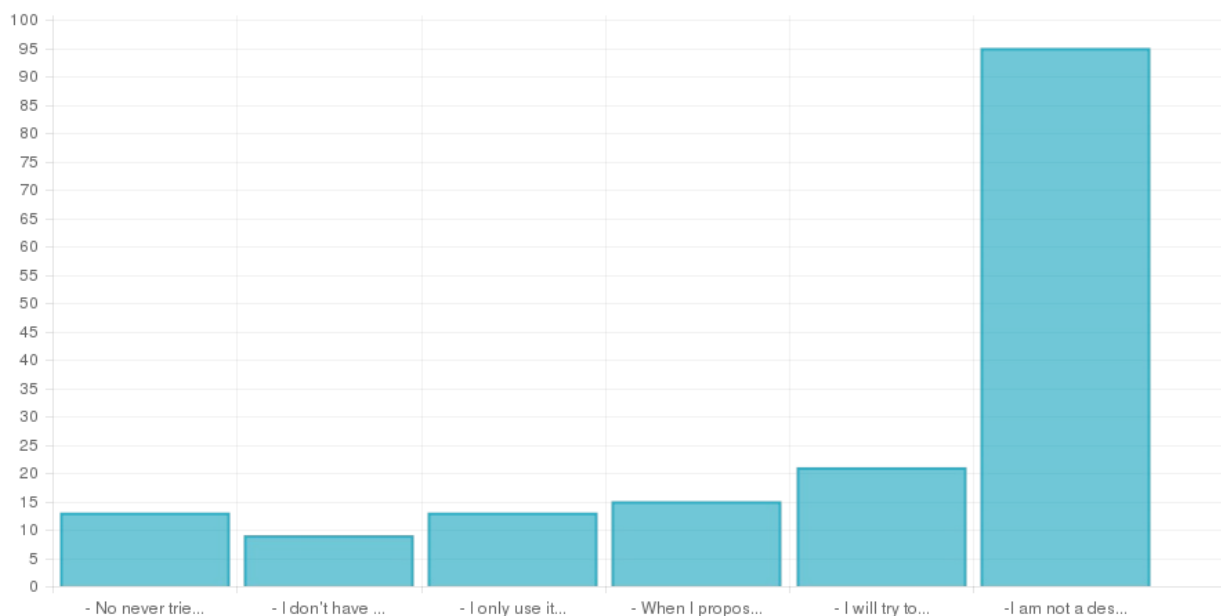


Figure 33.(Author ,2016)

While in the second group of countries 9% vegetation is not one of their options, 9% cannot argue to a client about it due to little information's, 6% use it when they are requested to do so, 8% mostly rejected by owners due to limited budget , 11% will put some effort to convince the client and show them the good side of it (figure 34).

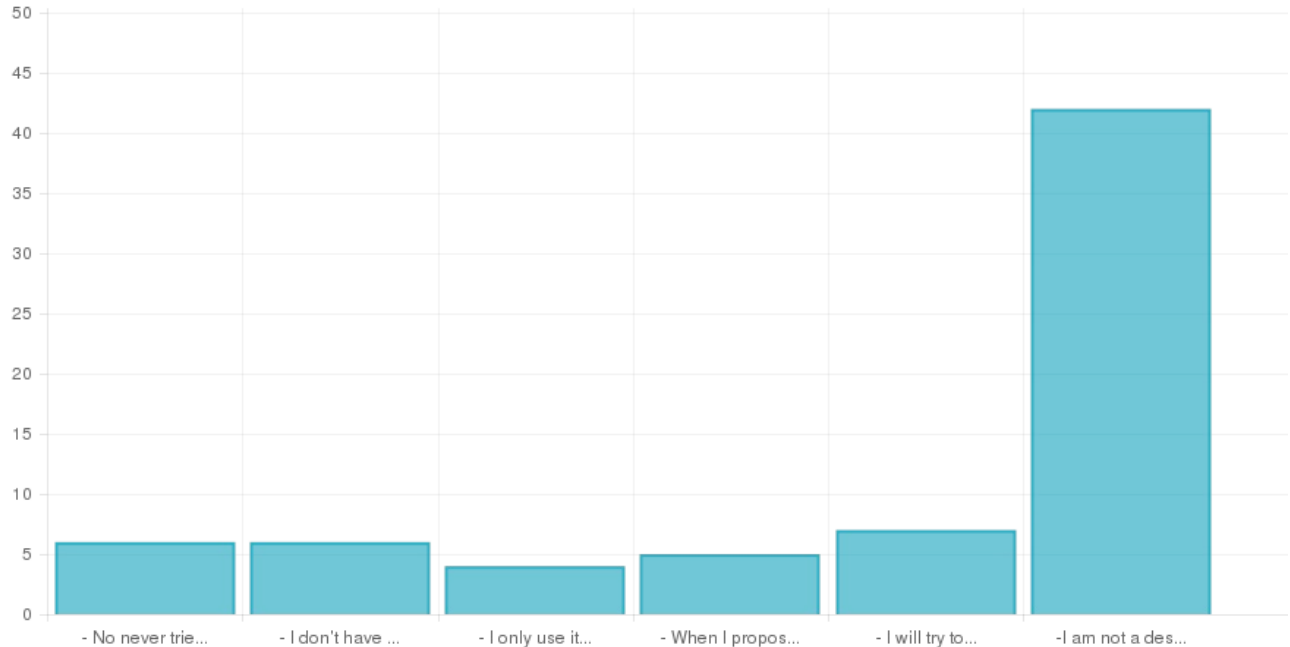


Figure 34.(Author ,2016)

Third group of countries professional designers were not a major number, 5% do not have any intentions in building landscaping ,5% are less interested in finding out more about this technology, 10% do not find any positive reaction when green roofs or wall are on the table of discussion because of the additional expenses , 10% recommend it as part of their designs (figure 35)

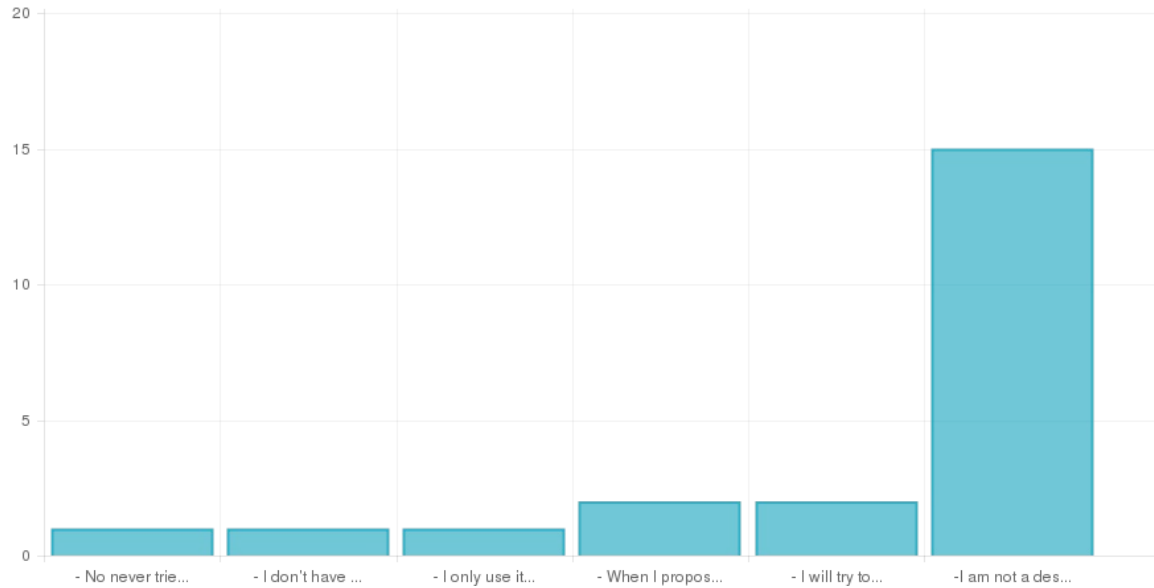


Figure 35.(Author ,2016)

It is interesting to know that in the all designers from different parts of the world will be putting time and effort to convince a client to use a green roof and that is a good indicator.

Polices makers who witness the process of buildings approval on all stages and got the power to push environmental activities forward for the public interest.

In GCC 4% of the governmental employees do not consider this as a solution,14% believe that it can be an option yet require more expenses, 10% got positive point of view and would put effort to promote it (figure 36)

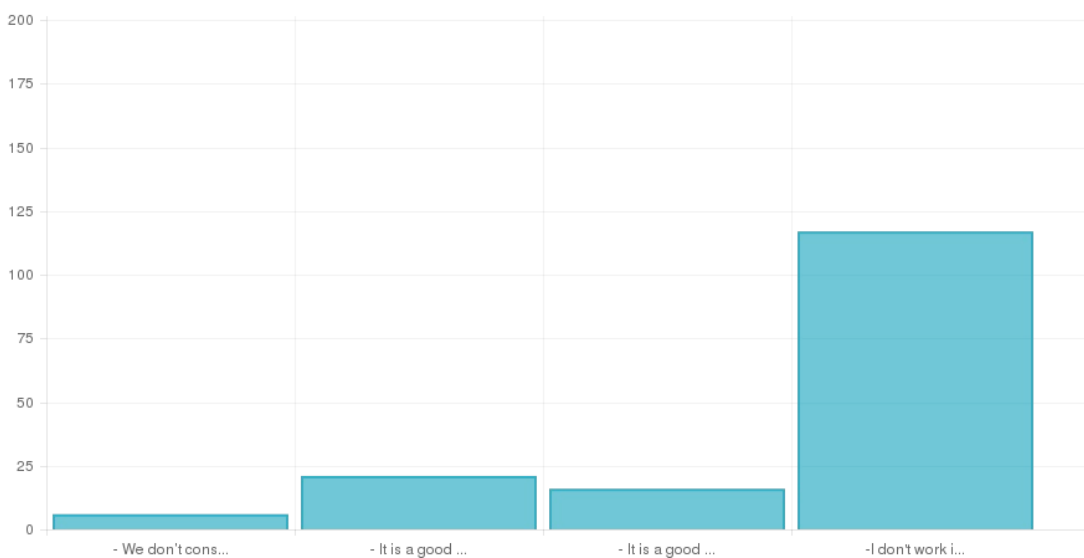


Figure 36.(Author ,2016)

Following group 0% on the first notion, 14% thinks that it is expensive, 2% are supportive and looking forward to being applied more often (figure 37).

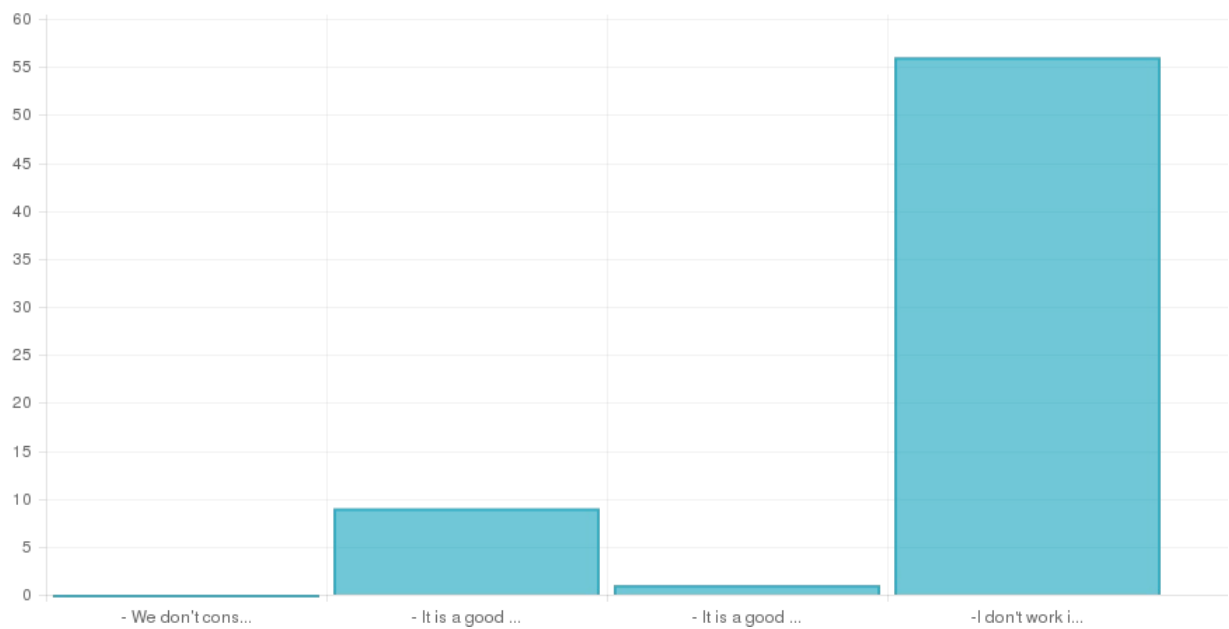


Figure 37.(Author ,2016)

Third group 5% not interested, 0 % thinks it is expensive, 5% have a good feeling toward this proposal (figure 38).

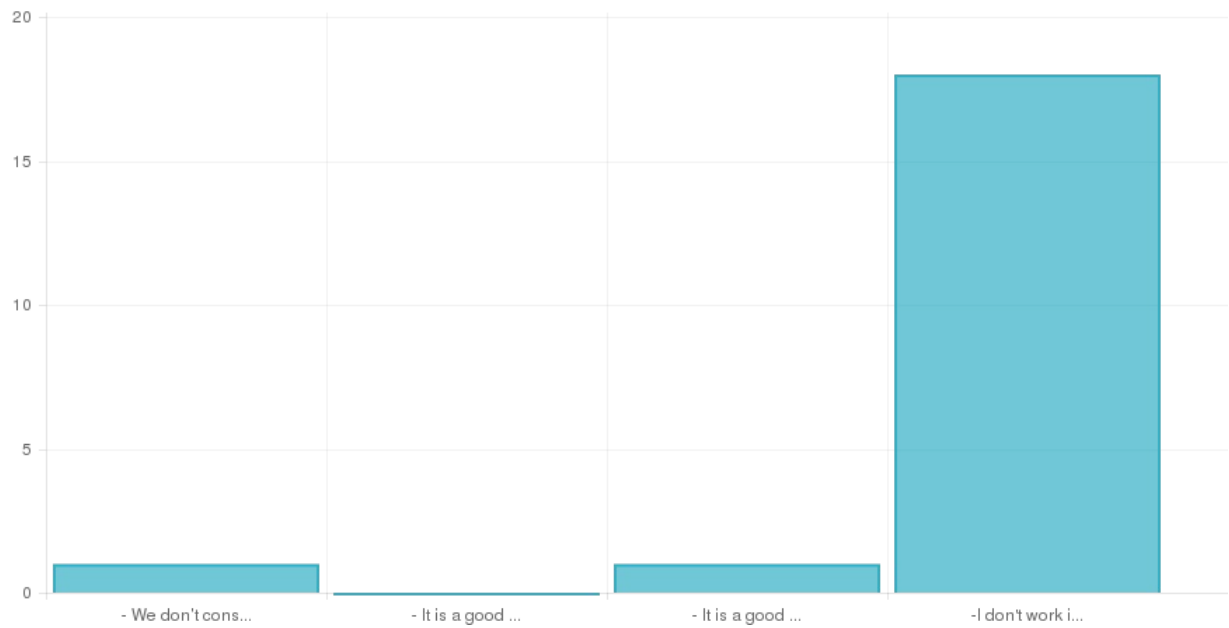


Figure 38.(Author ,2016)

Finding results for a municipal worker in UAE and MENA believe that it can be a good solution yet it cost too much where it shows some governmental sides still look at it from an economical point of view.

Contractor's perspective upon complications that face building greenery market, in GCC 14% of participant contractor did not use it at any of their projects, 4% they actually get inquiries of garden roofs and living walls due to limited experience they reject it, 5% rely on sub-contractors with skilled labors and experts employee in this area with extra charge , 1% of those contractors do this kind of jobs regularly and are skilled and prepared to manage this kind of projects (figure 39).

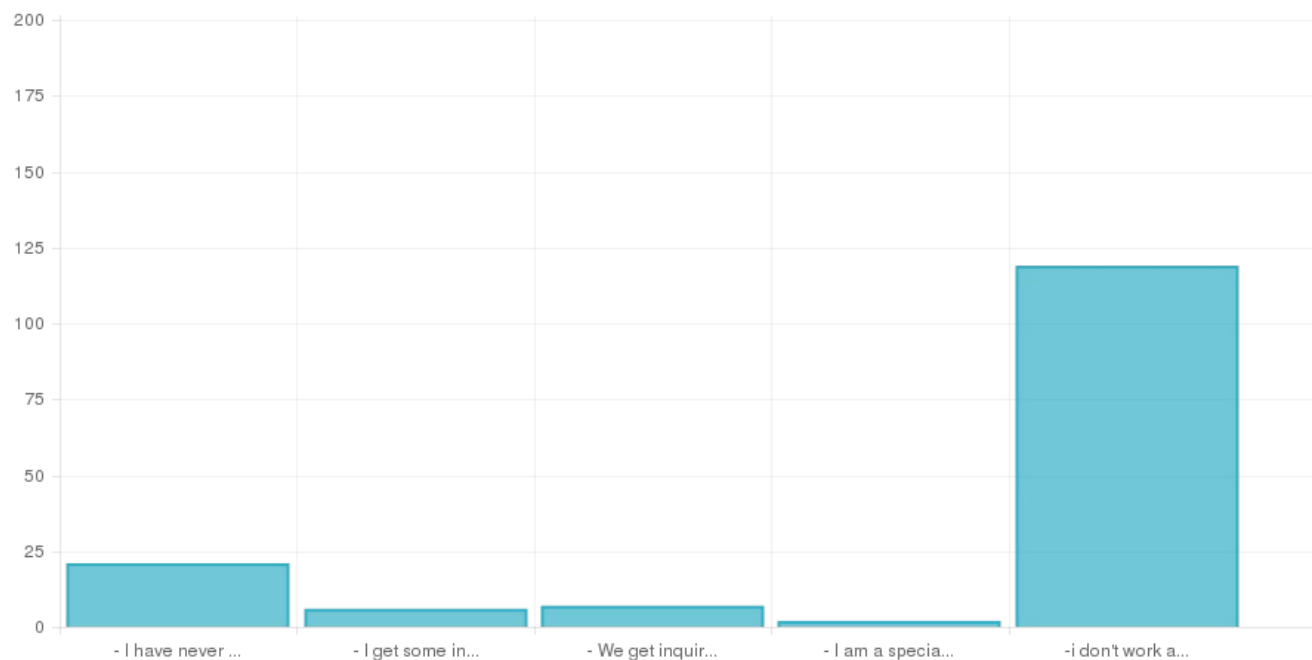


Figure 39.(Author ,2016)

Other Arab countries may have a slight different in the percentage , 18 % green roofs/walls was not proposed at any of their previous work, 2% did not know how to excavate therefore they didn't accept any, 6% who put more money to bring specialist contractors , 0% have a experience in this place (figure 40).

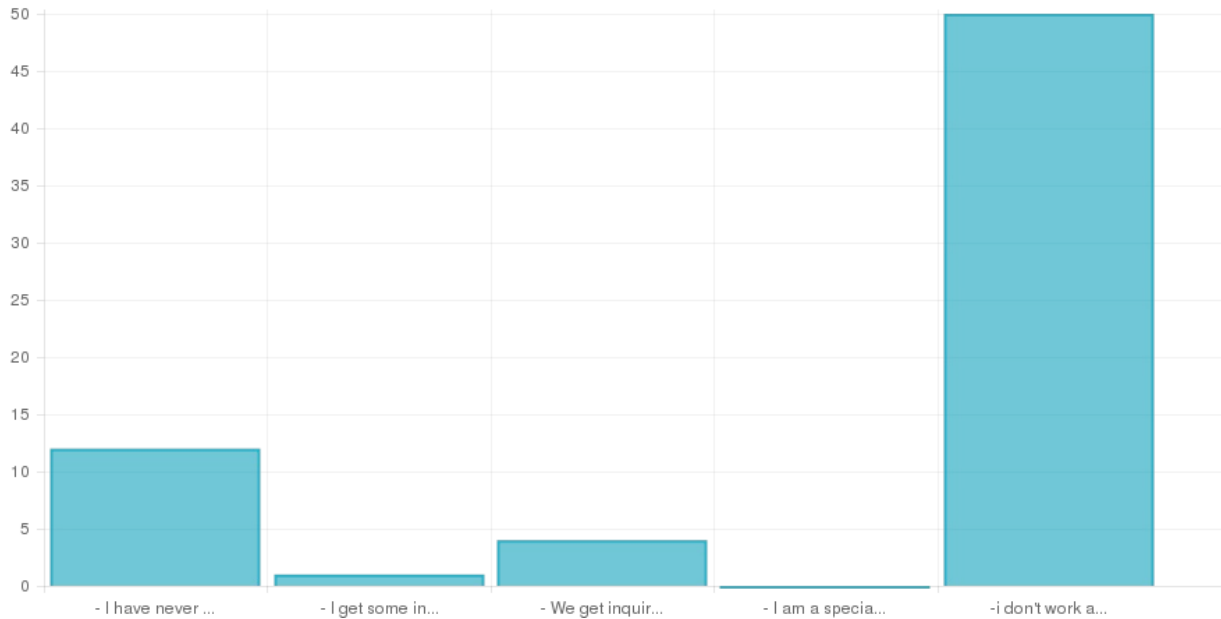


Figure 40.(Author ,2016)

The third regional group had only responds at two options,5% find them self not qualified to involve greenery in their construction site while other 5% would get help from a specialist and the remaining participant are not contractors (figure 41).

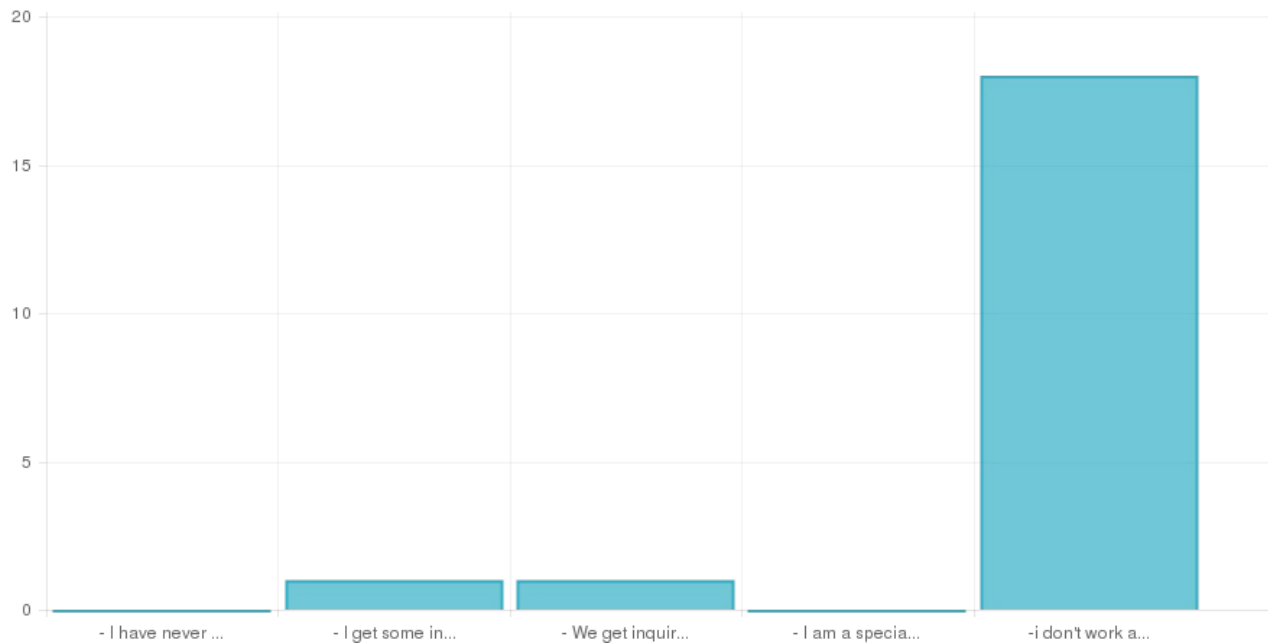


Figure 41.(Author ,2016)

The majority of contractors participating from UAE and other Arab countries do not get any inquiries to do this kind of scheme that signpost green roofs/walls droopy market, in the European American Asian countries the situation was balanced..

It was important to know how does this portion of people who were picked randomly to fill the survey application think of the green roof/wall from negative aspect and the reasons that can possibly stand in front of this technology from spreading and become more common.

In UAE 60% thinks that less sustainable education can possibly make it hard to find and know positive aspects in green roof, 16% find think that it need more budget that it is not worthy, 41% believe that GCC climatic circumstances (water shortage, hot climate) might not be a proper place to plant and take care of vegetation in a building, 17% find easier ways to apply in the building envelope to give the same effect that require minimum maintenance and care, while the remaining 6% of participants had a lot of other problems that face vegetation like portions in community neglect the importance of energy conception reduction and believe that they do not have to act anything toward climate change in any mean moreover other thinks that low quality of materials and implementation may affect the reputation of this technology due to lack of experience (figure 42).

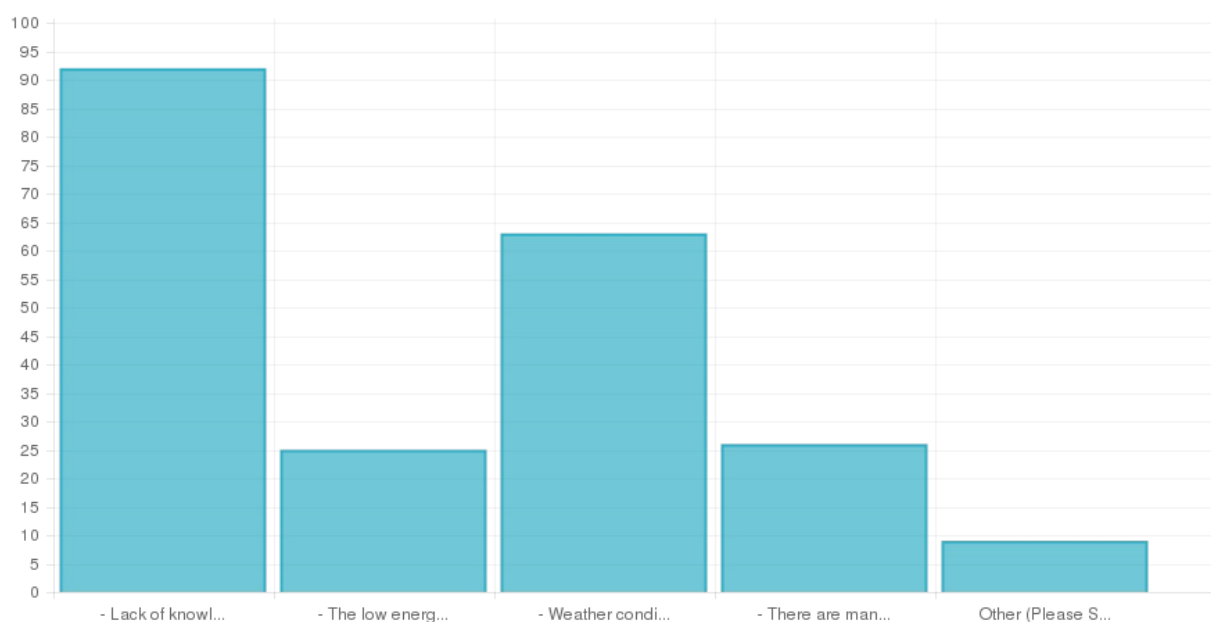


Figure 42.(Author ,2016)

The second scenario 67% find that advantages are not well presented to the public where it can be a reason, 21% have a notion that it will not have a remarkable impact on reducing electricity bills comparing with money spent on it, 12% weather and climate restrictions, 18% believe on the synthetic substitutes (figure 43).

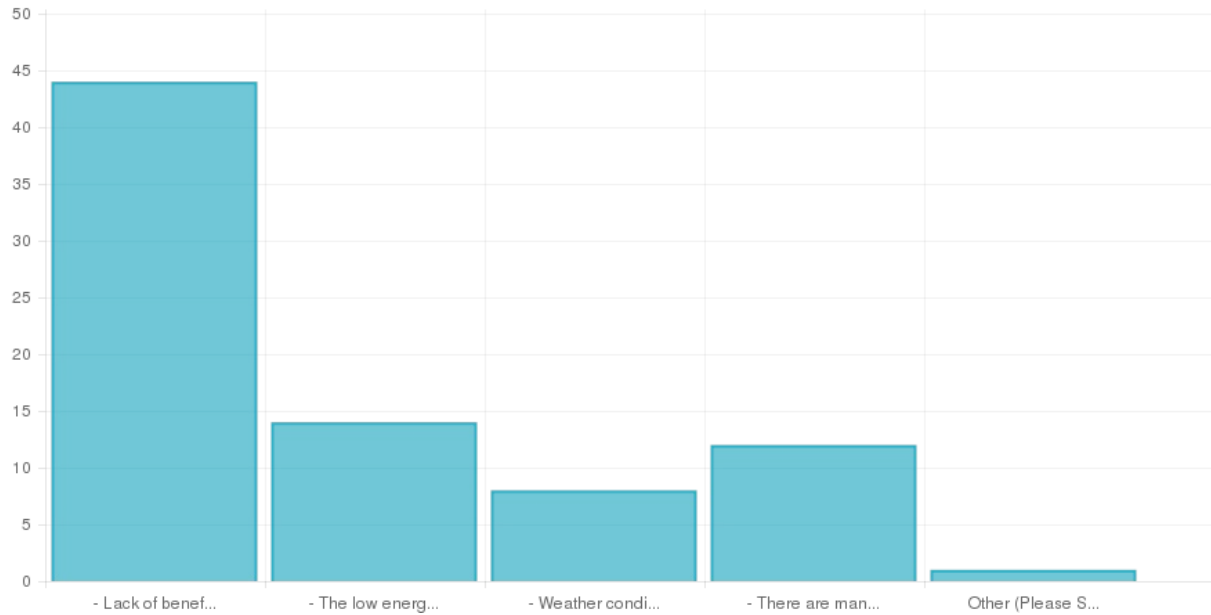


Figure 43.(Author ,2016)

Third scenario present 75% consider that limited green awareness and positive understanding might be a reason, 10% have problems with green roof expenses, 20% put it on the climatic condition and the possibility to provide plantation requirements can be hard , 20% adapt the flexible artificial materials used as insulation and prefer using those instead of greenery (figure 44).

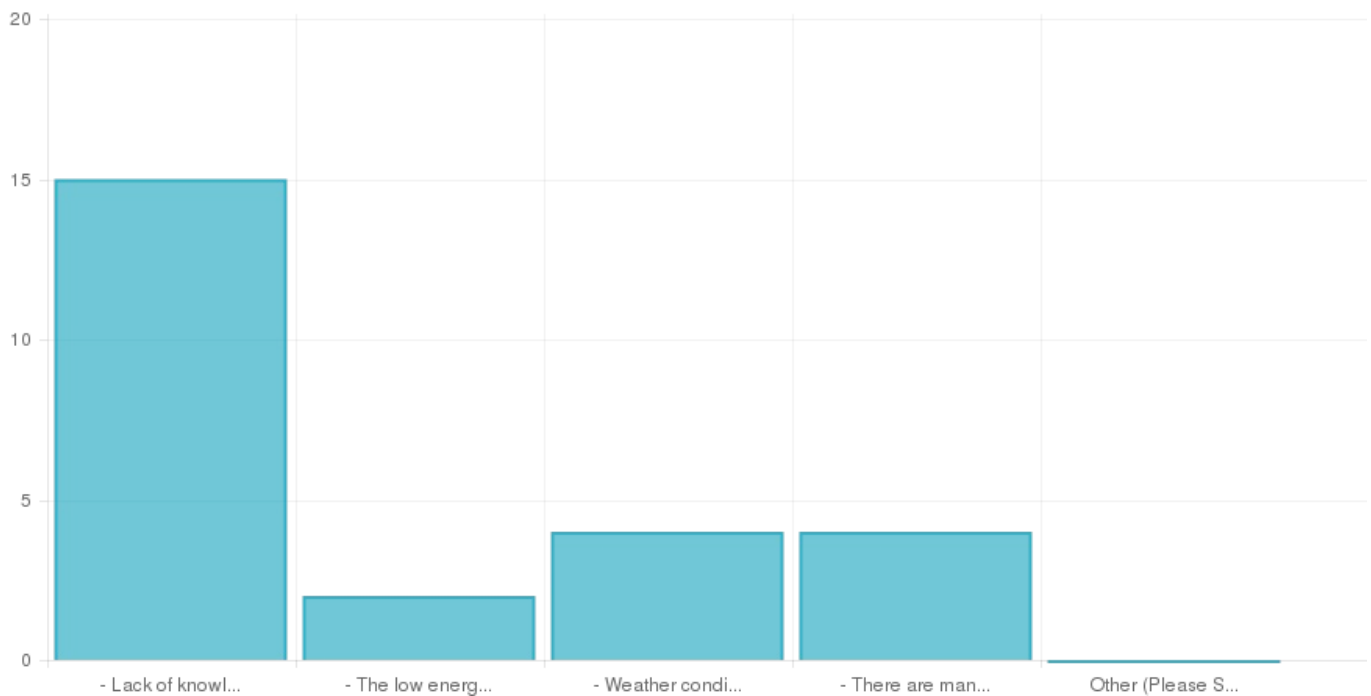


Figure 44.(Author ,2016)

Generally, all regional teams agreed mostly on the fact that neglecting importunity of sustainable familiarity and not knowing the adequate benefits of a green roof wall is the real challenge that must be overcome.

Restoring the main driver of the quest, which promote and support green envelope usage to have a positive impact on occupants that will make them feel it and encourage investors and discussion makers to consider more vegetation around .thus the coming question trigger thoughts of participant about suggested approaches to reach the desired outcome.

In gulf region 18% believe that regulation and policies from authorities can be the strong force to push this attempt, 46% suppose that enhanced technologies and well-equipped methods that make installing green roof easier and higher impact can encourage more usage, 17 % respondents deem putting more effort on explaining and convey the right information's about green roof and make the public understand the impotency of using 100% natural strategy in reducing heat gain instead of other synthetic conventional solutions , 18% wants to stress the idea of utilizing the beautification aspect and encourage to add it around. 2% had another opinion like selecting projects where such features offer an amenity aspect - not simply a visual or symbolic element (figure 45).

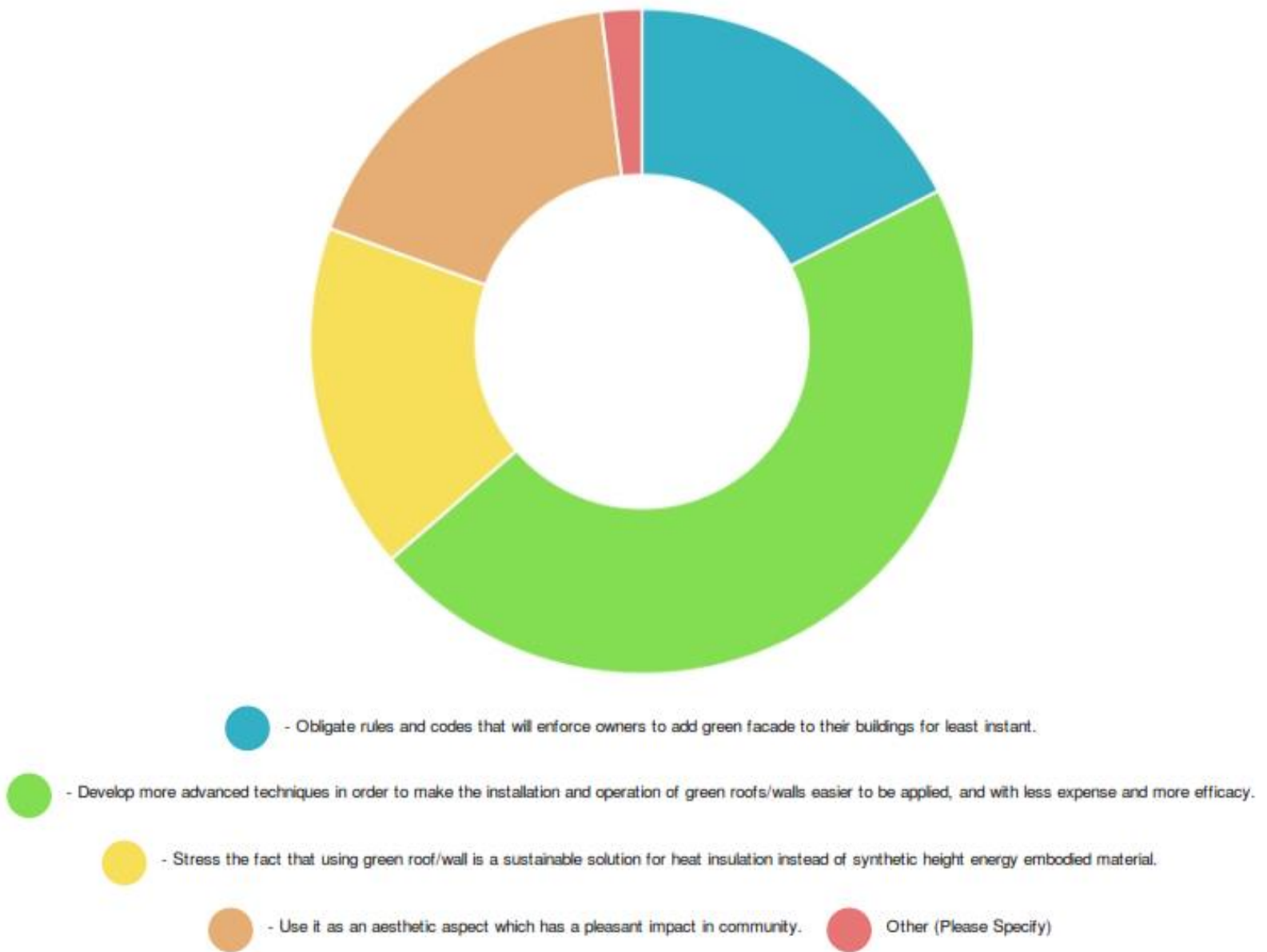


Figure 45.(Author ,2016)

Moving to MENA region the results shows that 20% choose the first option, 41% encourage development green roofs technology, 20% show the best impact on household energy consumption, 20% promote the attractive aspect and pleasant effect (figure 46).



Figure 46 .(Author ,2016)

In third region 5% rules and codes have a deep impact on audience behavior with the notion,45% findings modern applicable methods for this strategies ,25% benefits of green roofs/walls , 20% adding pleasurable visible effect on the place,5% other.(figure 47)

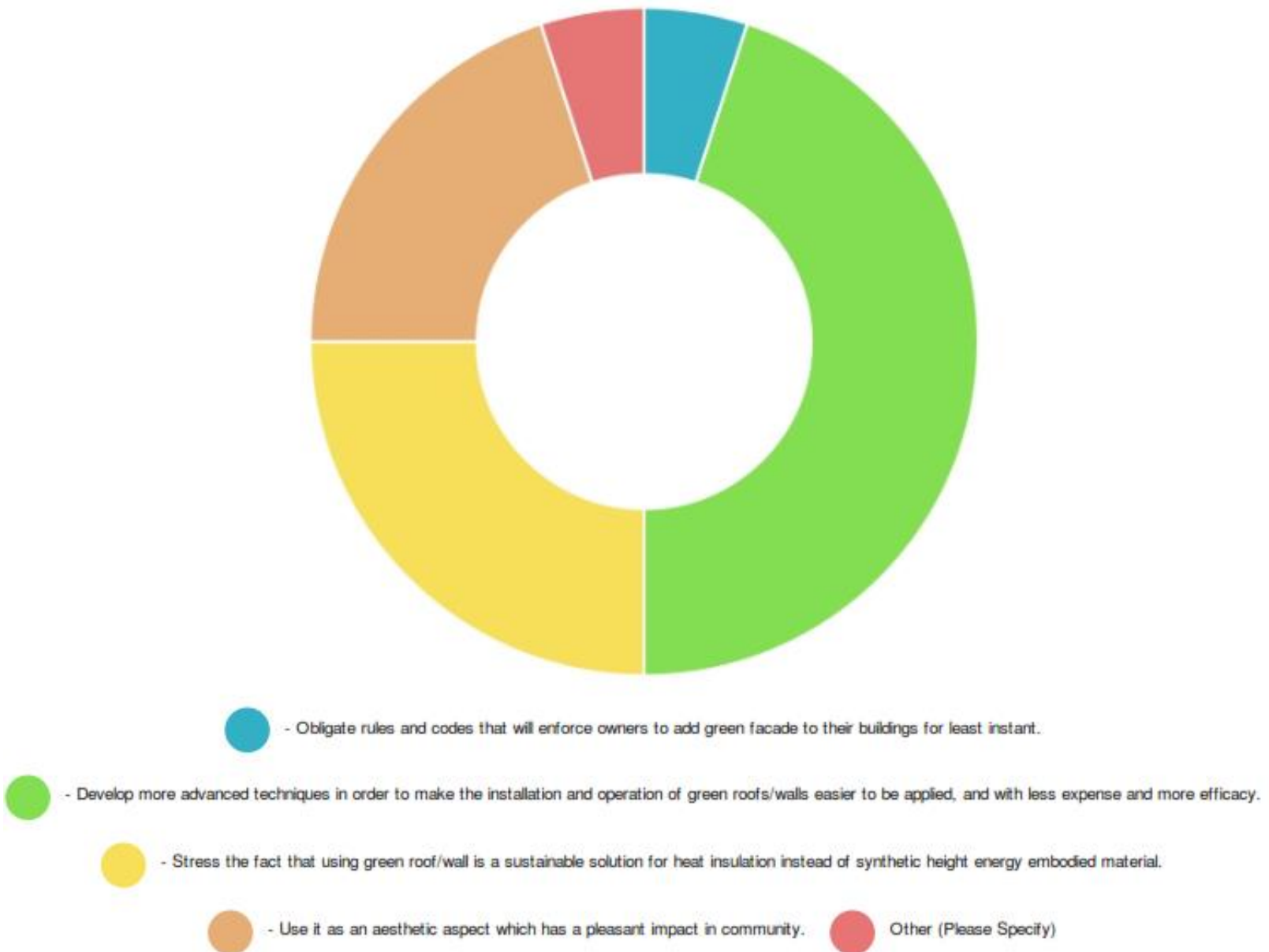


Figure 47.(Author ,2016)

Discussion conclusion:

Absorbing the feedbacks from prior query display that preponderance respondents choose to invest in developing and enhancing facade vegetation to make it easier and more conceivable for different project parties and consider it more seriously.

in last part of the survey where respondent determines the level of importance according to their beliefs and in a scale of four grading as a concluding understanding after going through full application.

In GCC group 19% believe that it is the main concern, 29% have believed in it is good, 54% want to apply it when it is reasonable, 3% do not that it is important.

In MENA group 26% thinks it is so important, 27% are convinced it is important, 39% according to surrounding condition, 8% are not interested at all.

in other parts of the world 30% want it to apply as a significant element, 20% moderate assumption about it, 50% relying on the current situation.

Closing question concludes that they advise installing the presence of a green roof or wall only according to the status quo where having a green facade will improve a building quality from all aspects that means that most respondents believe including it must be reasonable enough.

The study is mainly directed to UAE and Gulf region despite the spectrum including other parts of the world was to build a comparison to gain a deep understanding about GCC situation compared to other parts of the world. Looking into the results it is giving an almost same percentage for all questions with all regional parts.

In the beginning of the survey answers gave an indicator about participants' consensus and education standard with regard to any construction experience where results show that majority are with not that much familiar with academic or specialist experience wise while people who had any background are minimum, this point out that that feedback are collected will measure the level of awareness within common people with minimal knowledge related to environmental, this targeted portion in order to measure those people's mental understanding where enhancing anything will apply effective change in community connotation toward sustainability and that will push government and investors to adapt those notions and work to apply it devolving to the next partial in the questioner that show similar results at first to expect for the third region that presents a positive knowledge about the material despite any details, where in non-Arab countries respondents were more it was with more cognizant of details.

On the other hand discussing the manner used in conveying information's about the green roof or walls was to public knowledge, that can show the level of authenticity

and how can a person rely on it, media had the highest rank between four methods in GCC and Arab countries while in European and Asian countries media came align with reading at the top, thus it is the biggest portion of public people who are exposed to TV, Newspaper, the Internet and so on, where it is has deep influence on culture as well, therefore utilizing this tool in the best way to serve environment and community will have the greatest impact and will bring back satisfying results.

As it was presented that in GCC and UAE the majority didn't experience or even see with naked eyes any form of a green wall or roof only in minor cases, and most of them had the chance to see it only in media, that show the poor level of visual of imagining this kind of strategy which limit the demand for it, while in other countries was not in a better case as majority did not see it, but in third group it was more popular and close to eyesight and that could be due to better awareness and environmental situation.

Trying to capture a small picture about specialist like designers contractors and inspectors perspective as a joiner step toward detailed interrogation, in general in UAE a promising attitude toward introducing greenery in their design where most of them in UAE thought that it is worth it to push a client to use yet the problem was the lake of skilled labours and experienced contractors in this field. While in MENA region respondents was not that optimistic as in the previous which means that it may need a push to flourish.

Finding out problems from reviews toward this subject might be the first step to find the better proposal for a green sustainable municipal, respondents focusing was on two points the knowledge gap and the climatic situation of a dry aired region with water miserliness, and both factors can be a strong reasons that restrict vegetation, moreover solutions was proposed mainly stress the fact of creating and innovating more handy and reasonable materials and methods to choose this strategy ,moreover feedbacks also put codes and regulation as a resilient approach to support this movement.

In the remaining areas, a similar outcome was on the table to tell also that lack of greenery benefits is the main issue, as it is obvious that they thought that green facade technology should be more advanced and adapt to the conventional building and convince more tenets to ask for this kind of properties.

Finally on a scale of four evaluating levels a level of awareness is possible to be detected, whereas a conclusion of this quest it is important to understand if this person who went through all those questioning values investing in a building by merging landscaping into it exterior surfaces, the level of grading was going from very important to important to moderate impotence to not important at all.

The result for three regions where agreeing on the third level that show that including this technology is important only if the current situation allow and need to be there,

which present a variable valuing for green roof accordingly and people are not willing to add it without reasonable justification, and that may lead to knowing that majority of people still need more effort to consider greenery in building as a priority.

Interviewing section 2

In this section interviewing method was the most convenient method to obtain most of the needed information of mindful expertise in this field and catch any scattered thought that may lead to a deep impact on the subject to be discussed.

Interview with architects

As an endeavor to spot how do experts in construction industry architects and engineers behave toward the roofing and walling green proposal as a closer picture of the operation roof for such initiative, where it is possible to understand what are the real challenges facing a designer who is trying to imply sustainable approach like green roof, a total of 13 interviews was done with specialist with different years of experience, only UAE interviews were under observation for this part of the study. This argument can create a potential envisage of the current situation in greenery market, and this discussion will evolve around initial points as following:

- Green roof/wall introduction in a building:

To make any kind of green facade or roof tops a common scene in the city i that require a journey that start with the first step which is putting the option of choosing a green roof or facade on the table for all project parties to approve initially, thus it was important to ask about sides behind introducing a green roof in a project and who is the decision maker regarding this. Mainly adding this types of accession is not priority or an essential requirement generally, whereas adding vegetation in a building can will be a result many reasons,

After interviewing with a number of designers architects and engineers who decent experience in suitable design field which is between 3 to 10 years in UAE, the argument will be between property owner and the designers while most of the interviews indicated that the client has the strongest influence in such a decision, and as an architect with a quite good experience in the field will try to convince the other side and explain all the effect of this strategy to present a clear vision for the client.

As a matter of a fact reaching to the developers and trying to expand their prospect and lighten their imagination and bright the positives of this technology can be a better proposal for achieving a greener facades.

-Participant Understanding:

When the author is trying to evaluate the extent of participant's knowledge about green roof and the benefits gained out of installing, answers show a high level of understanding about the greenery impact on reducing cooling load and heat gain that will impact indoor air temperature and urban heat island as well, It is changing the standard view of the buildings. It is important to invest on by providing good information and new techniques. Moreover, the Positive aesthetic and greenhouse gasses reduction promote biodiversity, gray water recycling, the potential for agriculture or produce, adding to the natural system associated with the building. Basically, they believe that it is important to invest in this strategy to offset the negative impact buildings can have on the environment.

- Challenges:

As expected any rising ideas such as including gardens in roof or façade for a lot of purposes is going to face some challenges because it will need more efforts and preparation. In the dialogue some major topic was given to interviewers to find out what are the obstacles and issues they are facing in this field according to their perspective, mostly answers was revolving on the UAE harsh climate which make it hard to grow and maintain gardens horizontally on top of the roof or vertically lined with external walls, where knowing that this will condition will make people in charge of the building less interested in it, moreover a lot of designers think that reducing heat gain can be achieved in other ways like insulation materials that will not require any kind of care and minimum maintenance neglecting the fact that vegetation is considered 100% natural material that is going in harmony with nature.

-alternatives:

Some respondents thought that in some situations where there is limited roof space, it is a bigger advantage for the building owner to utilize the space for renewable energy: PV or Solar Thermal. While from an energy performance perspective, a similar insulation effect can be obtained using insulated roof finishes, e.g. roof combo systems with an insulation of 0.17 W/m²K. From an eco-friendliness perspective, I believe roof gardens are a better option as they contribute to open spaces, biophilic design strategies, and heat island reduction.

- Solutions:

Ideally, mostly they agreed on creating more advanced applicable technologies would hold green roof and elevate it to next level more over it is thought the use of green roofs to a limited extent should be driven by building code. However, to promote its use this should be backed by a comprehensive cost-benefit analysis detailing how much money

could be saved per sqm of green roofs installed in the building. Again though, building owners with the limited amount of roof space should be given a higher incentive to use the space for renewable energy generation.

-on-site projects:

It was important to scan the number of projects with green roof or walls that specialist were involved in to find out the how can specialist people with high qualification in this field can use it , mainly not all of the participants was involved at any of such project , there were involved with different types of building like villas and residential towers hotels and office towers, where the highest figure of project was 5 projects and that reflect as a small number comparing to years of experience and the number of accomplished buildings that is considered as a green building, and that bring us to conclude that using a greenery is still not that common in the field.

Interview with government:

Initiating a legit correspondent with governmental affairs was part of the survey to go further in discovering the inner system procedure where it will make it easier to find out how to responsible authorities response to this concept,

The meeting was conducted face to face with Eng. Salimzid a Senior Building Services Engineer Building Department, basically, the interview was a small talk discussing how codes and regulation interact with green roofs and walls.

As a beginning it was mentioned that that Dubai municipality does not have any kind of restricting regulation or code that force owners of any properties to include this technology at their homes or building in order to complete the green building requirements, where mostly another kind of roof insulations with high SRI value cover the heat gain reduction part where green roof and wall are costly and need, Eng. Slim stress the fact that greenery in a building will be more effective in villas used at their tops more than residential or office towers where it will impact only the portion that has a direct contact with the planted area as for the roof or wall.

And what is so interesting to know that since (2014) the green building department opening, the department did not get any new submission for authority approval that contains any of the gardens application, which is contrary to expectations especially in villas case that a green roof can give an outdoor area to spend time with family for relaxing and pleasure as predicted, yet that was not the case due to what was mentioned earlier because of the effort and money wanted to keep this going in best form.

From the interviewer perspective this strategy is not flourishing further levels because of the extra costs, mainly this overestimation for roof vegetation is assign to the expensive insulation materials used to installation in order to prevent any moist leakage to the roof structural elements from the irrigation system.

Therefore it is important to finally point out that the main driver in this formula is the project funder who will put the main outlines according to his own believes and priorities in his investment or villa, here the general knowledge will play a role in influencing his choices and judgments.

Interview with contractor:

Respecting all parties of this constructing process and considering that the responsible side of transferring any design in a blueprint to a standing solid bricks is an important influence this topic as the availability of qualified installer is important to the success of any outcome, therefore interviewing an experienced contractor in the landscaping field will spot the light in the actual events in creating a plating face on the roof or the wall,there for an interview was conducted with Mr. Rodolfo R. Ajero Jr. Agriculture Engineer in landex agriculture.

First it was important to know the number of jobs this company was involved on that was including any of the matters the research is evolving around, as example the company accomplishes around 10 projects that contain a green roof or wall in Dubai and Doha including DEWA sustainable building, Model Villa (sheikh Mohamed bin Rashid program), and RTA Accommodation building at Jebel Ali Dubai and more villas and offices it is possible to find more details in the [appendix \(1\)](#), commonly villas owners are more interested in Green Roofing, while building structures prefer Green Wall as government facilities regularly interested in mutually vertical and horizontal plantation technologies.

Next part of this interrogation determined to understand how the company understanding about greenery impact on the energy consumption and if they have any guideline to know or calculate how much temperature drop it may lead, based on a longer time experience of this company for this technology, the company make sure of the quality and technical parameters will implemented in each every projects the deal with. Regarding energy matter, science already proved that having the natural greenery in the surrounding improved energy efficiency. The plant mass traps a layer of air to limits the movement of heat through thick vegetation mass and reduces ambient temperature via shading and plant processes of evapotranspiration. Using the US Environmental Protection Agency they quoted they “Trees and vegetation lower surface and air temperatures by providing shade and through evapotranspiration. Shaded surfaces, for example, may be 20–45°F (11–25°C) cooler than the peak temperatures of

unshaded materials. Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 2–9°F (1–5°C).”

Based on experience in the market difficulties that may face adding these elements (green roof /wall) in the project, is represented in the installation of greenery technology in their vicinity is one aspect they considered. Not only for the aesthetic improvement but for some health and environment benefits they after for the technology. But, the market and the client delimited on the technology due to high financial requirement and maintenance features.

Speaking about the Cost estimation for this kind of projects is based on the site situation and technical workability. Location settings for the green wall if it is outdoor or indoor settings. For the cost estimation, the maintenance should also be considered.

Approximate the cost would be: Green Roof AED. 450.00-650.00/sqm. Green Wall AED.3,000.00-4,500.00/ sqm. The cost will vary, based on the workability, technicality, etc.

In this part of the world consequent to harsh climate condition choosing a suitable plant that will tolerance hot climate, water shortage and has a satisfying impact founded on company experience is mention in attached file [appendix \(2\)](#)

Section 3 (Case study):

Finding actual samples that represent a vegetation building embodiment bring this study to the higher level of authenticity , as it is easier to know from this examples what was the difficulties and complications such assignment can face.

In this section two case studies where under the microscope, conducting interviews and applying a field trip was the best method to gather information to cover the research need, as discovering how does a green roof or wall operate and the conditions that help to apply in the first place.

Green Housing Model:

The green housing model house no. 1004. There are 1240 houses in Barsha project. The model has 4 bedrooms is pilot model presentment by sheik Mohamed Bin Rashid housing Est in order to promote sustainable solution in the local style. The foundation converted the house into a green housing model by the application of sustainable, green systems as well as energy-saving and smart systems for housing, such as systems which are meant for operation, control and surveillance by the participation and contribution of 16 various companies with different specialties, which contributed 49.4% of the total overall cost of these systems amounting to 686,063.70 AED, while the foundation has borne a percentage of 51.6% of the total cost figure, [\(figure 48\)](#) to [\(figure 56\)](#) show different views from the chosen case study.

A review of sustainable green surfaces and the irrigation system that have been applied in the green housing Model

- 1- Applying the Green mat system which is the cultivation of green surfaces on the roof of the house which creates additional protection and thermal insulation of the house from sun rays thus reducing the energy needed for cooling.
- 2- Application of the Green Mat system in planting green spaces in the garden of the housing which in turn contributes to the retention of moisture beneath the plants which decreases the consumption of irrigation water as well as serves as a protection for the crops from insects and harmful plants.
- 3- The planting of a green wall on the façade of the house which adds an aesthetic touch to the house.
- 4- The treatment of the gray water (used in washing and rinsing) which accounts for 55%-75% of the total amount of water produced from the house and converting it to irrigation water by building an underground concrete tank for the purpose of gray water treatment, in the backyard of the house. The tank must be well prepared and equipped with the necessary electromechanical connections. This process will result in saving 30% to 40% of water.



Figure 49 . (Author ,2016)



Figure 48. Water treatment unit (Author,2016)



Figure 50. Green housing villa model (Author ,2016)



Figure 52 .Green wall (Author,2016)



Figure 51 . Side view green wall (Author ,2016)



Figure 54. Green roof technique (Author ,2016)



Figure 55. Green wall irrigation system.(Author ,2016)



Figure 56. Green roof (Author ,2016)

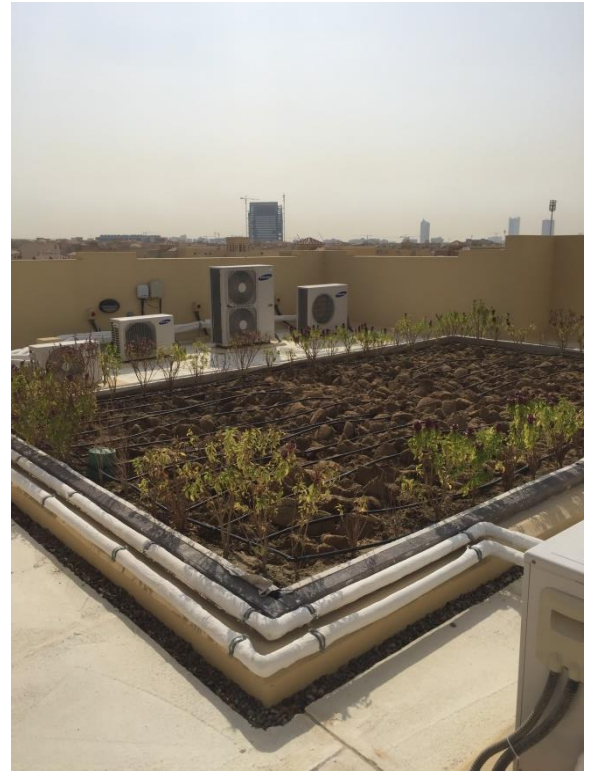


Figure 57 . Green roof (Author ,2016)

- **DEWA SUSTAINBLE BUILDING**

Dubai Electricity and Water Authority considered one of the most significant governmental authorities in Dubai government due to significant responsibilities it holds, establishing the biggest sustainable governmental office building and first to achieve LEED platinum award. Obtaining LEED points was awarded for seven categories according to LEED scorecard though applying the green roof was a credit point in 3 categories sustainable site cities and innovation and design.

Green roof benefits in the building according to the building management resource:

- The green roof is covering 33.5% of the building roof that reduces massively the heat island effect.
- Considering that protecting the natural habitat will gain credit to the building in term of LEED scorecard, yet 21% of the area is used to plant adaptive and native species that is suitable for UAE climate (figure 55).

- Using the most saving methods in irrigation like dripping has saved a huge amount of water putting in mind that the building is saving 48% by using efficient fixtures to decrease filtered water intake.

Drawing facts for all rationale accompanying in making this building and applying a green roof lead the researcher to conduct an interview and do a field visit, AmmarMakki who is a Manger Electron for Civil Projects & Engineering department in DEWA.

Eng. Ammar started his talk saying that the green roof is an optional subject with no obligation from Dubai municipality, explaining that there are a lot of landscaping companies that are qualified to apply green roof though each one has a different method to apply it , but they are all common in using an adaptive landscaping that can bare lowest amount of irrigation that can be from UAE or any other similar climate zone, and also he stressed the fact that the in charged company is responsible for installing the vegetated surface on the roof ensuring that there is a good protection layer that will stop any kind root penetration and protect the roof structure from any weakness in the roof membrane that might cause damage.in the market, there are a lot of accredited contractors from DM while they had agreed with one of the best contractors to hold this project green mat.

Moreover the municipality is opening the door for larger plants scale to be used in roof garden, and it is significant to say that one of the coming projects it is planned to use palm trees as one of the plants at the top, this information draws attention that vegetation in the roof is considered in all DEWA coming projects where it is a propriety as EngAmmar stated.



Figure 58. (Author ,2016)

Asking about the reasons behind adopting this idea on all coming projects and how the live experimenting influenced dissection maker to repeat the experience onward.

Firstly he stated that using a green roof has granted the project credit for LEED because it goes under one of the categories as it was mentioned previously, and then comes the insulation specification that this layer got thus reduce the heat gain depending on the covered area that directly will reduce the cooling loads in the building.

Energy reduction

In an attempt to dig deeper into energy reduction character and find a clear guidance that will clearly specify the amount of reduction a vegetated surface may apply in the heat gain hence cooling load yet the providing such information is hard to point out within the energy conception measurement that is because of the other strategies that are used to impact the power usage as that measurement give general results that cover collectively all the aspects of the process, yet in figures (figure 57) &(figure 59) it shows the difference between the meter readings for this building and other conventional building with similar aspects except for any sustainable features.

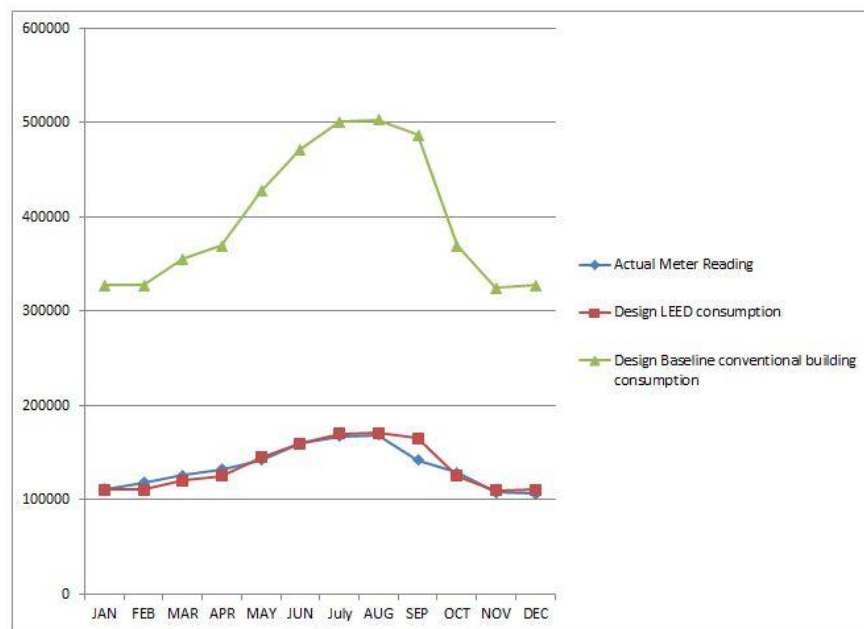


Figure 59. (DEWA ,2014)

	Actual Meter Reading	Design LEED consumption	Design Baseline conventional building
JAN	111482	111021	327226
FEB	118253	111084	327412
MAR	126345	120560	355342
APR	132562	125442	369731
MAY	142031	145061	427556
JUN	159630	159856	471164
July	167582	169856	500638
AUG	168563	170523	502604
SEP	142352	165213	486953
OCT	128562	125218	369071
NOV	108234	110242	324930
DEC	106542	111053	327320
Total	1612138	1625129	4789946

Figure 60.(DEWA ,2014)

EngAmmar carried on describing that since starting building operation metering system in the building is got one reading device that is installed near the air conditioning outlet.

-Irrigation system.

Ideally, the drainage system was segregating the waste water into gray and black water where the gray water is discarded portion from resulted from the air conditioning drain, storm water, and shower trail that will be reused accordingly while the water used for the plantation watering is the black water that is a result of flushing toilets. In order to use black water, it has to go through a treatment procedure using a treatment plant sdp moreover he adds that using backwater is a common thing in irrigation by Dubai Municipality.

- Additional benefits.

Elaborating on further positive features that enhance the vegetation review according to the building user it is stated that the greenery has added a beatification feature more over increasing oxygen levels through the day that add a satisfying effect on this area visitors, also the decrease in air temperature in the ambient area due to evaporative cooling .

This spot within the building boundary has created an outlet environment for the occupants that will let them relief their stress and enjoy some time in an outdoor area which is easy to access anytime during working hours that improve the productivity levels , and also some inside event such as farewells and celebration is held there.

food production is a pilot version that started 3 years ago, vegetable planting added another dimension to the roof garden where the harvested vegetables is 100% organic where it will be displayed for staffs to use and take home, and this will create a new concept for the roof garden and how do common people think about, as using this area for farming to invest on fruits and vegetable production will encourage more interaction

in this part of the roof. Different kind of vegetables are grown depending on the season like cabbage ,rocca and sometimes strawberry (figure 61) to (figure 63)



Figure 62 . (Author ,2016)



Figure 61 . (Author ,2016)



Figure 63 . (Author ,2016)

- Cost

Tackling the expenses matter needed to accomplish this project, it was important to understand the funding side opinion on applying this object within the provision whether it is worth the extra amount of money spent on this, basically the representative of the building administration expressed a full satisfaction regarding this technology on all terms, where he elaborated that this technology was an additional phase where they

decided to add green roof after constructing the project. So merging his elements required to out a lot of aspects in consideration like loads and proofing where all those issues was covered by the selected contractor.

It was important to stress the fact that providing skilled labour and adequate supervision focal point to acquire a high quality and best performance. As for preparing for all scenarios and provide an easy access for direct intervention for maintenance and repairing in the damaged area.

In a conclusion is obvious that this green element had input a high level of satisfactory for building users' employees and building managers where it had given a great enhancement in the heat insulation and air temperature and aesthetic touch and psychological.



Figure 64 . (Author ,2016)



Figure 65 . (Author ,2016)

- Future project

Further moreover this project was the first governmental office building that delivers a successful example of using a green roof in an office building that encourages stakeholder to stratify this method in any future project .regarding the other projects contained a green roof and is one of DEWA'S building is Warsan DEWA office building in warsan 2 ,and more under construction building data centre, labour accommodation and 4 stories office building that are already prepared to hold a green roof from the designing stage. Moreover, the new DEWA headquarters building that targeted to be the largest and smarter building with zero carbon emission over the world will establish a new level for green roofing that will include palm trees and al Ghaf tree, interestingly they are arranging to plant 1000 tree.

Chapter 5

Conclusion and Recommendation

Chapter5: Conclusion and Recommendation

This study focused on green vegetation in building, particularly community concept and understanding of the topic and having a deeper way of thinking beyond the common beautification purposes for vegetation on the roof or walls. As the author insisted on looking at this strategy as a physical leverage in energy conception and reducing cooling loads, and most importantly find out the level of education and interest to use it as an insulation method to reduce heat gain on the building and substitute the synthetic conventional materials for heat insulation. The author used literature review to prove the greenery benefits and positive impact on the buildings while surveys and interviews allowed addressing community from all levels and background point of view In order to answer the research question:

- * What are the benefits of using green roofs and façade?
- * How much people know about green systems, and their impact on individual buildings and cities?
- * Why are the green roofs and façade are not commonly used in UAE?

5.1. Conclusion

Reviewing the solid results that gradually address research aims and objects by several means, and obtaining answers to the research question .During the development of the research approach the survey cover the broad spectrum of community in the first place has discussed the level of realization toward green building enhancement in different aspects as following:

According to the survey, it introduced the biggest portion of the community (61%) have a primary cognition of the term green roof and wall even though careful consideration that the vast majority are ordinary individuals who are part of the community with minimal building construction practice.

Hence minds with sophisticated understanding in relation to this technology come as a minority yet 46% considered the highest percentage have positive mindset toward planting roofs and facades, people believe that including a green roof or wall will be a valid adjustment into a building although they do not know why or introduce a further extent. Previous consequences display the wide spread of the terminology itself yet show the need of deeper notion enhancement.

While inspecting more aspects touching the subject in this investigation it was substantial to look into the level of audience physical interaction with greenery in a building and the results offered the minimal expectation of this, where 41% has been introduced to the idea through media (TV, magazine...etc.).

That was a great indicator to the rareness of this element within the city scenery, expressing the lowest visual experience of building landscaping, addition to that the high influence that media achieve can guide us where it is good to pour our concentration to push the general cognition and utilize such tools like documentaries and advertisements and also try to involve the more greenery scenes into TV programs and shows or maybe movies.

the lowest direct contact to boulevards building landscaping's and depending on various media paraphernalia did not deliver greenery culture to the receiver in an ideal image in order to give it more attention and put in as a priority while planning to start a building process. As 60% of respondent had expressed their lowest knowledge as a major issue that will take the developer in this field to push for more education on this subject in earlier stages.

Moreover 46% thought of developing more practical solutions and handy technologies for contractors to use that will reduce the expenses and attract more inquiries and push the market to put this strategy in demand. In general there was a medium level of interest and a certain feel of intimidation toward adding a greenery that reflects less trust in it due to the lower experienced providers and skill workers in this field and the lack of advanced handy technologies to this tool, and also tending to study more about any situation and predict if adding gardens to a building will be well applied and operated and here comes the real challenge between two parties the green believers and the other group that have the minimal knowledge about greenery impact on energy consumption and further more.

When the study look into sustainable specialist perspective that will give a mature read on the current situation, architects and experts expressed the fact that the project funder or investor play a dominant role in the decision of adding a green roof or wall, where will take us again to what was mentioned previously about the general knowledge of public people and the level of interest to this object.

Drawing lines under main challenges that will face any designer to convince a client to use a planted surfaces in a building to prevent massive heat gain in addition to the other countless physical and visual benefits can grow to another extent because of the other alternatives that provide same insulation with less expensive and more durable materials according to a client understanding, here come the role of an environmental designer and may build a responsibility to show the difference between using a green roof or wall for insulation purposes and to other synthetic materials to a customer.

Governmental authorities were expecting higher demand when Dubai municipality started to accept green building and create a sustainable mold to embrace new projects that go under green architecture although there was not great turnout of this product

that was a kind of frustrating, and again reasons were revolving around the owners' negative background and the extra charges that a green roof wall require.

Looking into successful examples in the city through the landscaping contracting company that is high-qualified in this matter and describe a number of different projects that is accomplished by them and included green roof and green walls where number of governmental building are on the list which considered as an advanced step in this journey and show a rising interest in the market.

DEWA sustainable office building in AL Qouze Dubai present a felicitous model that present the best practice of green roof in all aspects as for lowering heat gain and decreasing air temperature and influence on employees satisfaction level, an ideal example that encouraged stakeholder to adapt this strategy in any coming project in the future.

In another words looking at the bright and dark side of the subjects it is significant to point out that an architect or a designer had a strong influence in this process providing tools for an architect to impress a project funder and convince him to involve a green roof, so according to surveys and interviews were done revolved around two points:

- Green roof and walls installation material cost and the attention needed after placing it in the project.
- Paucity realization of the object heats insulation purposes and the capability of reducing the power input to a building.

Therefore addressing the issue start from working on these points proposed in the following diagram.

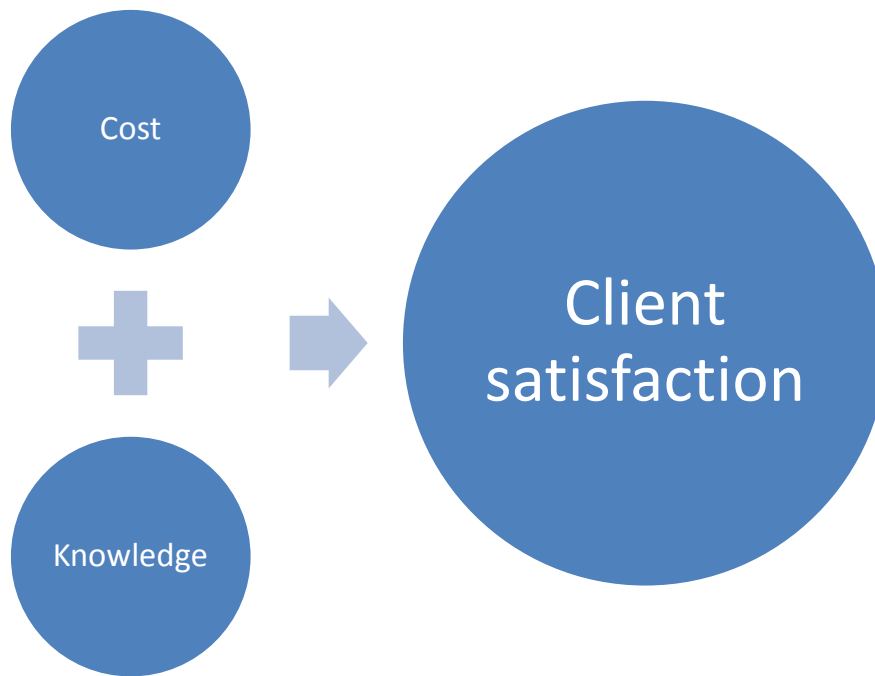


Figure 66 . conclusion diagram (Author ,2016)

According to the previous figure, the combination reasonable cost and enough knowledge will make the client more interested in the subject. In order to reduce cost developing more advanced materials of the which are required to build green roof and walls and also the technologies used to improve that as for the waterproofing layers prevent the excessive moist that result from irrigation system and root control to stop any damage to the roof or wall structure and steel. And finally elevating the common assumption of vegetation and the put more effort on designers and architects to convince a the other side that using a natural insulation face will have a great impact on the indoor temperature and build with minimal environmental loss and great contribution in enhancing the metropolitan sight, and combining the two factors cost and knowledge is conveying green façade as a valid option for the construction industry to use.

5.2. Recommendations:

Base on the findings of this study, the following recommendation are put forward for further consideration

- More researchers which is community oriented needed in this field to measure the awareness of people.

- This researches targeted four different groups in general therefore more in-depth research can be conducted to target each group separately.
- Develop public awareness is an essential tool to transform the way of life to be more helpful to the environment, and more sustainable in terms of using resources.
- Media & decision maker should operate collectively in order to generate awareness among the public.
- Green movement should be addressed among people, to be environmental friendly.

5.3. Limitations

In this investigation a lot of restrictions created a narrow area for research progress, interacting with community members and managers at different municipalities and major companies and authorities required a lot of approvals were in a lot of cases was not awarded.

Finding case studies to display in the study was part of the struggle, as there was more example to include that can be suitable yet companies in charge of the project regulations consider the designs they have are confidential information and do not allow to share such details in public.

Moreover finding the direct impact on energy conception in the standing case study was a hard to specify where meters read the general energy load in a building that is a collective outcome of several factors in building like other strategies.

In addition collecting information from nonprofessional individuals was a challenging although it was an online survey yet some response were cancelled because of the contradicting answers in the application that may show some confusion for applicants.

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Appendices

Appendix 1 list of accomplished project



A Member Of Landex Group

LANDEX AGRICULTURE
P.O.BOX 16110,Dubai,U.A.E
Tel : +971 4 3 251 251
Fax : +971 4 3 250 004
greenmat@landexuae.com
www.landexuae.com

COMPLETED PROJECTS USING GREEN MAT

Project : Green Roofing at the new Extension
of the Greenfield Community School
Location : Dubai Investment Park
Client : Taaleem
Area Green Roofed : 216 M²
Project Completed : December, 2010
Contractor : Al Jasaf Building Technology LLC
Contact Person : Eng. Nadeem,
Project Engineer, Al Jasaf
Contact No : 050 5592840



Project : Green Roofing at the
Operations & Facilities Centre
Client : Dubai Silicon Oasis Authority
Area Green Roofed : 400 M²
Project Completed : January, 2011
Contact Person : Mr. Ameer Ahmed Manyar
Agricultural Engineer (DSOA)
Contact No. : 050 375 1270



Project : Landscaping at the Cedre Villa D 1,
Client : Dubai Silicon Oasis Authority
Area Landscaped : 200 M²
Project Completed : January, 2010
Contact Person : Mr. Ameer Ahmed Manyar
Agricultural Engineer (DSOA)
Contact No. : 050 375 1270



Project : Green Roofing at DEWA Sustainable Building
Client : Dubai Electricity and Water Authority
Area Landscaped : 2,500 M²
Contact Person : Engr. Syed Mohammad Zafar
Agricultural Engineer
Contact No. : 0555400158



Project : Green Roofing at RTA Accommodation building at Jebel Ali Dubai
Client : Road Transportation Authority- Dubai
Work conducted in March 2012
Contractor : Ali Moosa and Sons Contracting LLC



Project : Green Roofing at commercial building at Gold Souk, Deira.
Client : Private



Project : **Green Wall Landscape at MRHE Green Villa Building**
Client : **Mohammed Bin Rashid Housing Authority –Dubai**
Contact Person : **Engr. Mohammed Saeed Al Imam**
Contact No. : **0555660756**



Project : **Green Wall Landscape at MRHE Head Office**
Client : **Mohammed Bin Rashid Housing Authority –Dubai**
Project Completed : **March, 2011**
Contact Person : **Engr. Mohammed Saeed Al Imam**
Contact No. : **0555660756**



Project : **Green Wall Landscape at The Palm Jumierah Frond B97**
Client : **Private**



Appendix (2) list of adaptive plants used








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Below the suggested list of plants for Green Roof and Green Wall. Our technical experience for this plants, roots are not destructive. But we also suggest to use anti root barrier along with the water proofing.




List of Plants for Green Roof.

Shrubs	Images
1. Jatropha	  
2. Thevetia	 

3. Muraya jasmine	 
4. Bougainvillea	 




All the above mentioned plants can be grown to a height of 100-150cm and can be mix planting.

Ground Cover	
1. Sesuvium portulacastrum	

2. alternanthera	
3. Wadelia	
4. Asparagus	

5. Rhoeo Discolor	
-------------------	--

Annuals	Images
1. Carissa	 
2. Ruselia	 

<p>3. Ruvelia</p>	
<p>4. Portulacaria Afra</p>	
<p>5. Scandens plants colour deep green</p>	

Appendix 3 Survey report

Saved Report

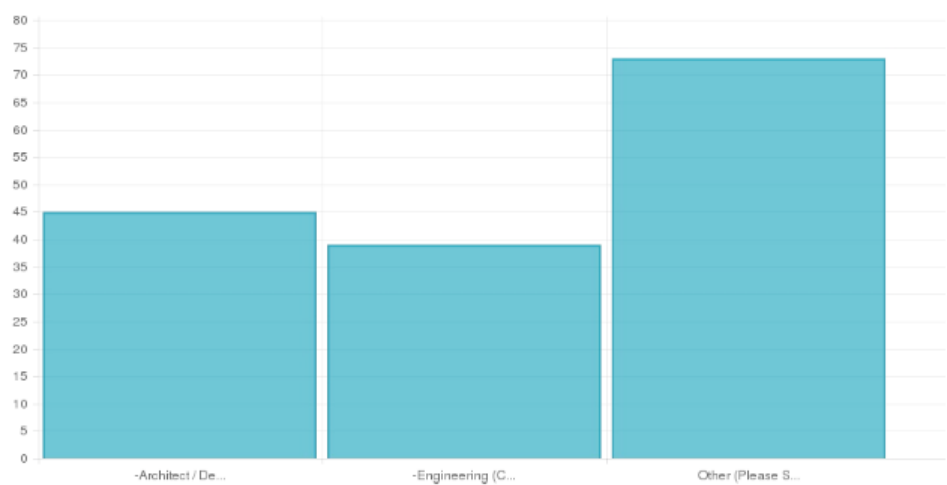
Country of residency?

	UAE	OTHER GCC	Standard Deviation	Responses
All Data	110 (72%)	43 (28%)	33.5	153



What is your Academic background?

	-Architect / Designer, Landscape Architect.	-Engineering (Civil, Mechanical, Electrical, etc.).	Other (Please Specify)	Responses
All Data	45 (29%)	39 (25%)	73 (47%)	154

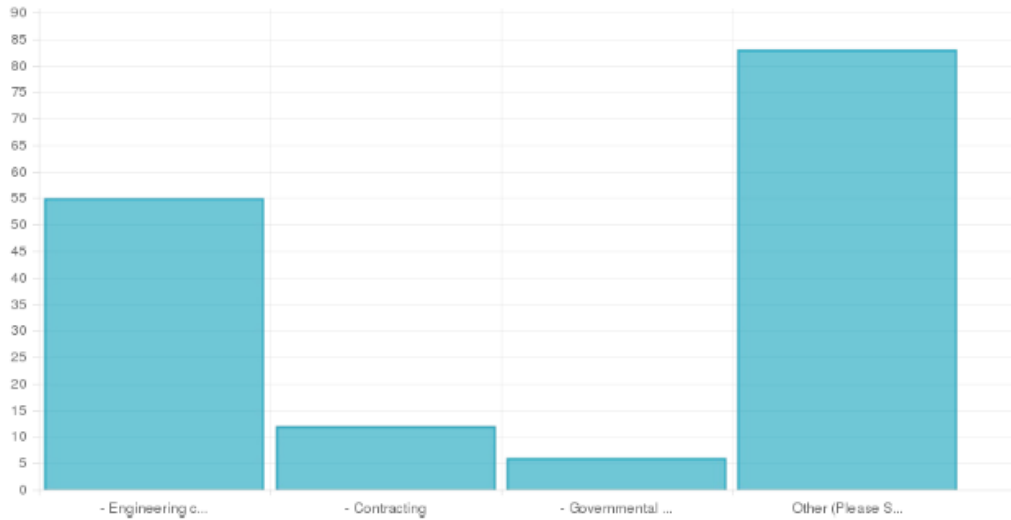


Text Responses

pharmacist
 Biotechnology
 science - chemistry teacher
 nursing
 dentist
 Marketing
 Medical Student
 Highschool
 Medical student
 Medicine
 Dentistry
 Doctor /- OBGYN
 Dentist
 DOCTOR
 medical student
 Media
 Medicine radiologist
 International Business
 Medical Sciences
 Medicine
 Pharmacy
 Information Systems
 Mass Communication
 Accounting
 Business administration
 medical
 Medicine, health care
 Islamic studies
 Doctor
 Economist
 Dentistry
 Medical doctor
 Applied physics and astronomy
 I'm pharmacist
 Medicine
 psychology
 Dentist
 Medicine
 Dentist
 Administration
 Arts
 Orthodontist
 Pharmacist
 Science
 Medicine
 I.T banking
 Translation
 Medicine
 Dentistry
 Oral medicine
 Financial studies
 Medicine
 BBA
 B/A Fine Art
 Master of Project Management
 nutrition and food processing engineer
 Mechanical
 Student
 Dental medicine
 Dentist
 Dentistry
 Dentistry
 Health Sciences
 Graphic design
 Student
 Dentistry
 Interior Design
 CIVIL STRUCTURAL
 Master of Business Administration
 Logistics management
 Medicine
 Dentist
 Health science

What is your Career field?

	- Engineering consultancy	- Contracting	- Governmental authority (Municipality, SEWA, DEWA, FEWA, Planning Department, RTA, etc.)	Other (Please Specify)	Responses
All Data	55 (36%)	12 (8%)	6 (4%)	83 (54%)	154



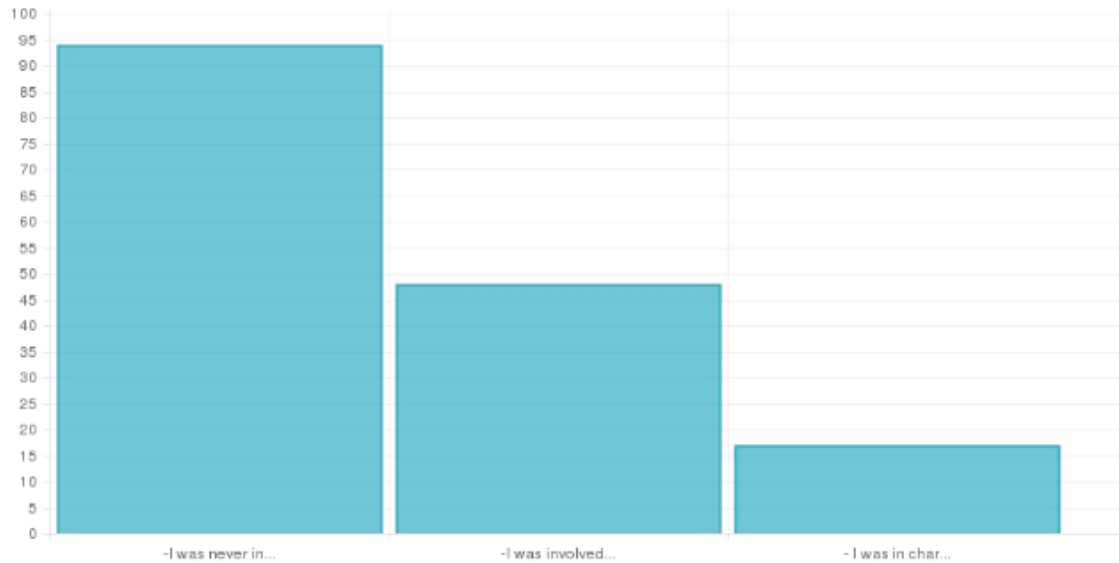
Text Responses

hospital
 medical field
 Science
 teaching - science teacher
 nurse
 dentist
 CORPORATE SALES
 Student in architecture Engineering
 Student
 Leading international manufacturing & services company
 Medicine
 Medicine
 Medicine
 Health care
 Dentistry
 Doc
 Just graduated from dentistry field
 DOCTOR IN PRIVATE HOSPITAL
 Medicine
 Production
 Radiology
 Engineering research
 Banking
 Architecture student
 Pharmacy
 Medical Doctor
 Pharmacy
 Student
 Journalist
 Accounting
 Media and digital delivery
 No
 Health care services, insurance
 Student
 Student
 Doctor
 Banker
 Designer

Dentistry
Tourism
Medicine
Researcher
Pharmacist
neurophysiology
Nun
Physician
Teaching
Medical field
Human resources
Animation
Orthodontics
Pharmacist
Labs
Doctor
accounting
Telecommunication field
Shipping
Health
Ajman University of Science and Technology
Dentist
Physician
Banker
NGO's
Social Services
Student
Student
Dental surgery
Dentistry
Dentistry
dds
Health Care
Media
Student
Dentist
Manager
Research
Interior design
Education
Supply chain
Real estate development
Medicine
Radiology
Museum

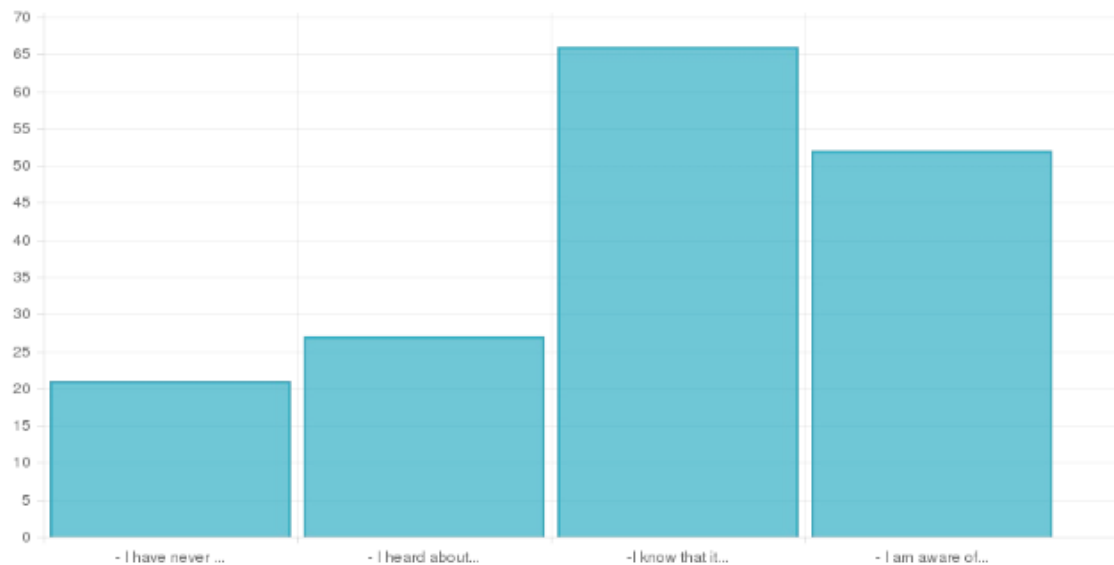
Your background about building design or construction before.

	- I was never involved in a building design or construction.	- I was involved in building design or construction of a building.	- I was in charge and decision maker of designing or constructing a building as an owner.	Responses
All Data	94 (61%)	48 (31%)	17 (11%)	154



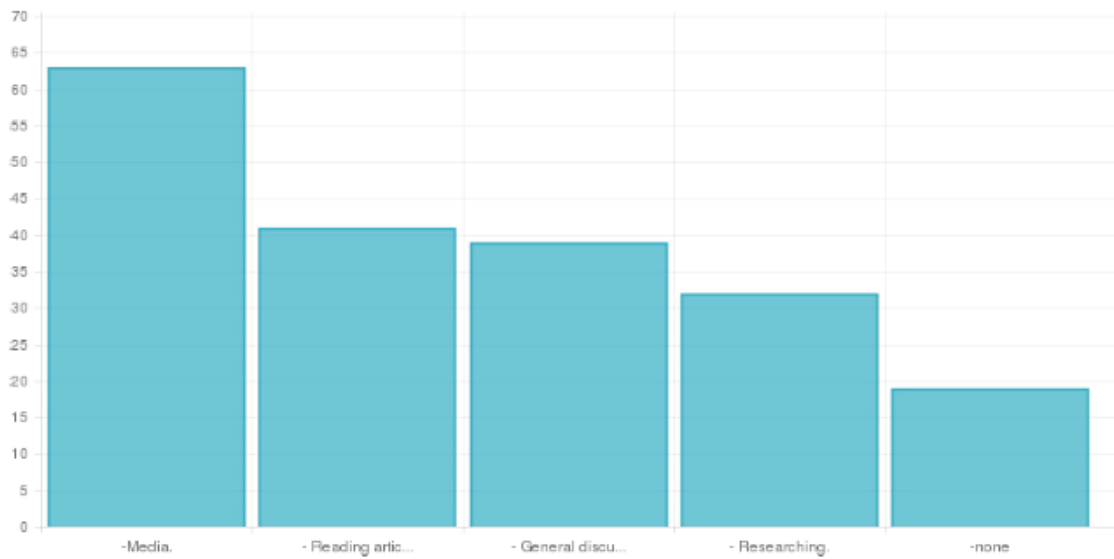
Green roofs and green walls.

	- I have never heard about such a thing.	- I heard about it but I don't know what it is exactly.	- I know that it is good for the environment.	- I am aware of it and know how and why it is used, and what the positives and negative are about it.	Responses
All Data	21 (14%)	27 (18%)	66 (43%)	52 (34%)	154



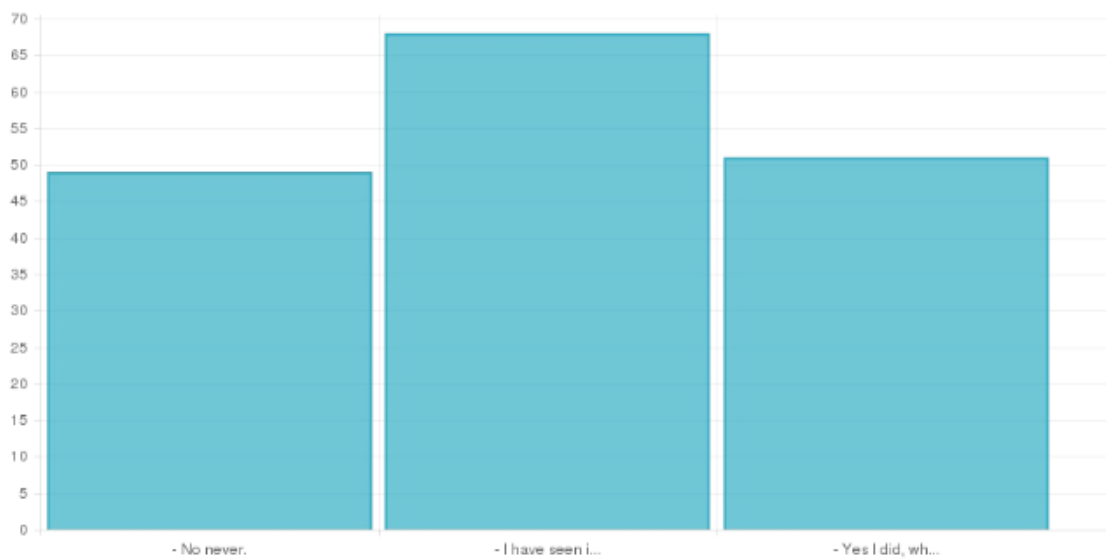
How did you get to know about green roofs and walls?

	-Media.	- Reading articles.	- General discussions.	- Researching.	-none	Responses
All Data	63 (41%)	41 (27%)	39 (25%)	32 (21%)	19 (12%)	154



Have you seen a green roof or wall, which is real and not artificial?

	- No never.	- I have seen it in magazines and on TV.	- Yes I did, where? (Please Specify)	Responses
All Data	49 (32%)	68 (44%)	51 (33%)	154

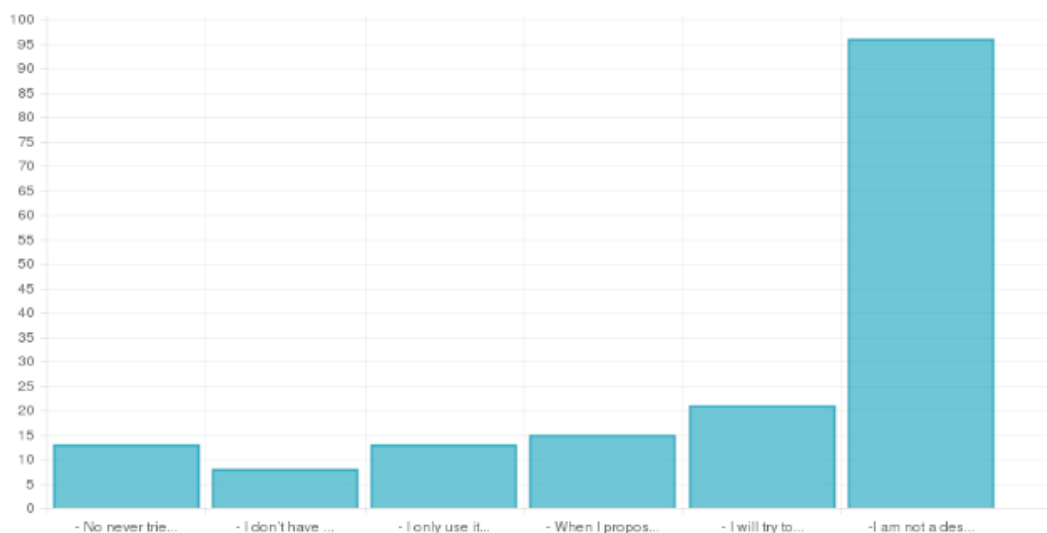


Text Responses

I built one in UAE university
Yes in Dubai but I am not sure if it's not artificial
Amman - Jordan : housing bank compound
In some building in Dubai plus Liwa School Al Ain
Dubai skh Zayed road, near time square
Dubai
Scotland
Jordan, amman
In Iran they used it in their houses on their garden walls
HOME
In my university and in an airport
in ksa it was for a garden for my friend
Studios
In North America
Some buildings Riyadh
It was in China I think
Friend house
Syria, Salameya
China
In some houses in my hometown Khartoum
yes king Abdullah financial center in Riyadh
Malaysia
I see it but i think it's because of weather and small human work in Ad
United Kindom, UAE
Sudan ,in old buildings
Dubai, JBR
Abudhabi
Green Wall (Fake) in Privilon Downtown
DM head quarter
yes we did a project in our company
Dubai Municipality HQ (New Opening)
Malaysia
advertisements, streets
UAE, Germany
All over Europe
360 mall Kuwait
Sunshades
In Kuala Lumpur, Malaysia
Istanbul turkey and dunai uae
Yes, the old pavilion in downtown. Media City. Resturant in JBR
Dubai
Dubai
I've seen a part of a parking openings
Singapore
In Dubai (garden center)
novotel sheikh zayed road
In Europe
Aprons and hammers restaurant
Different places
Chicago, United States
Public areas, restaurants, buildings, parking

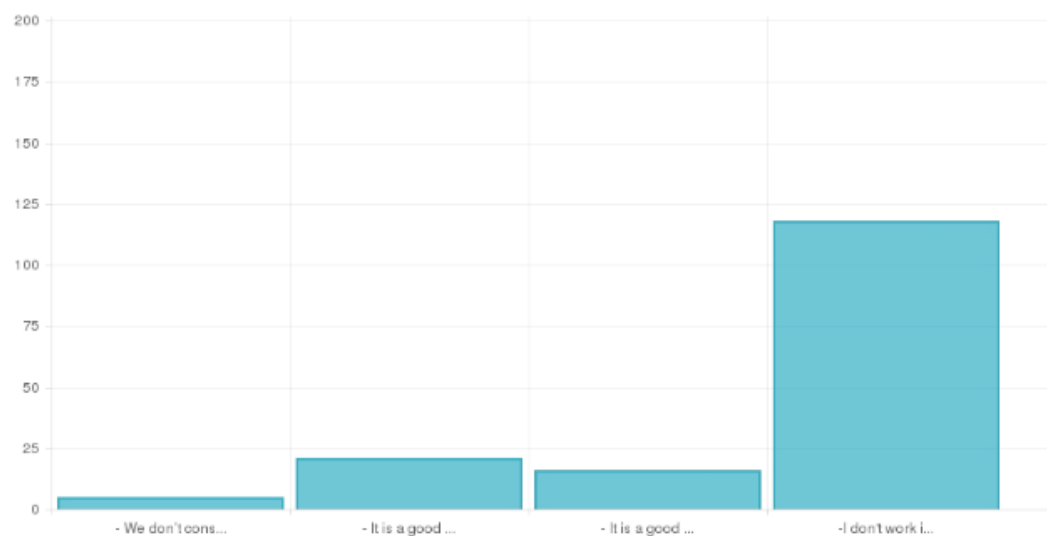
As a designer (architect, interior designer, landscape architect, etc.) IS 'green roof or wall' considered at your designs?

	- No never tried to introduce in my designs.	- I don't have the good knowledge of its benefits and negatives.	- I only use it as per my client request.	- When I propose it in the project, owners/the client don't wish to use it due to their lack of knowledge or the extra costs associated with it.	- I will try to convince my client to use it by explaining its benefits and the positive impact y this.	- I am not a designer.	Responses
All Data	13 (8%)	8 (5%)	13 (8%)	15 (10%)	21 (14%)	96 (62%)	154



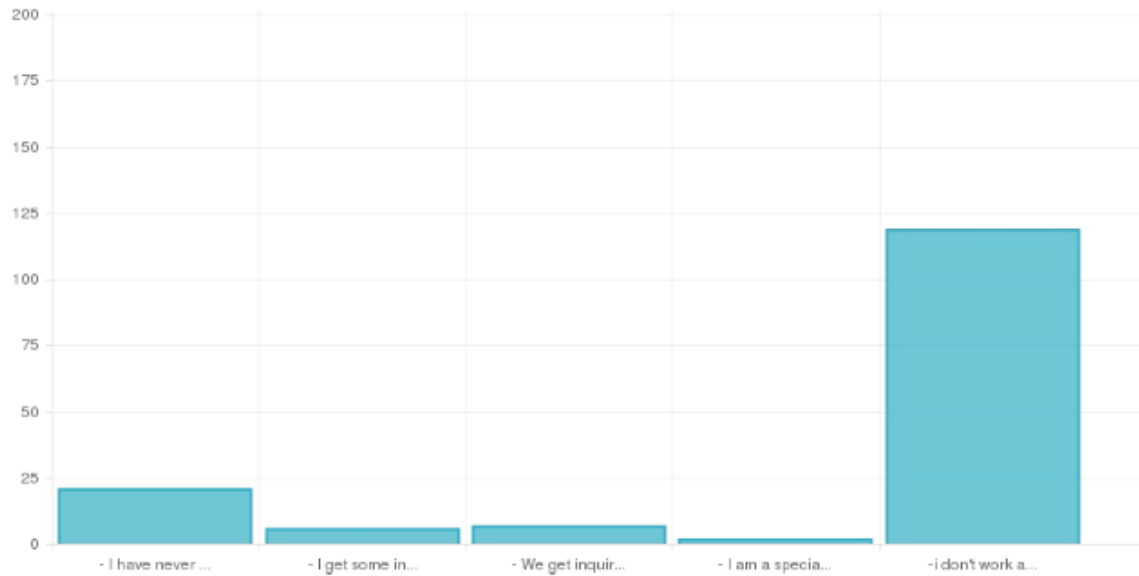
As a governmental authority, do you consider the green roof/wall?

	- We don't consider it as a solution at all.	- It is a good solution but it is hard to apply such obligation due to its costs; the lack of information in terms of its energy impact and reduction levels; and owners' objections.	- It is a good solution and we encourage owners to apply in their buildings.	- I don't work in any governmental authority.	Responses
All Data	5 (3%)	21 (14%)	16 (10%)	118 (77%)	154



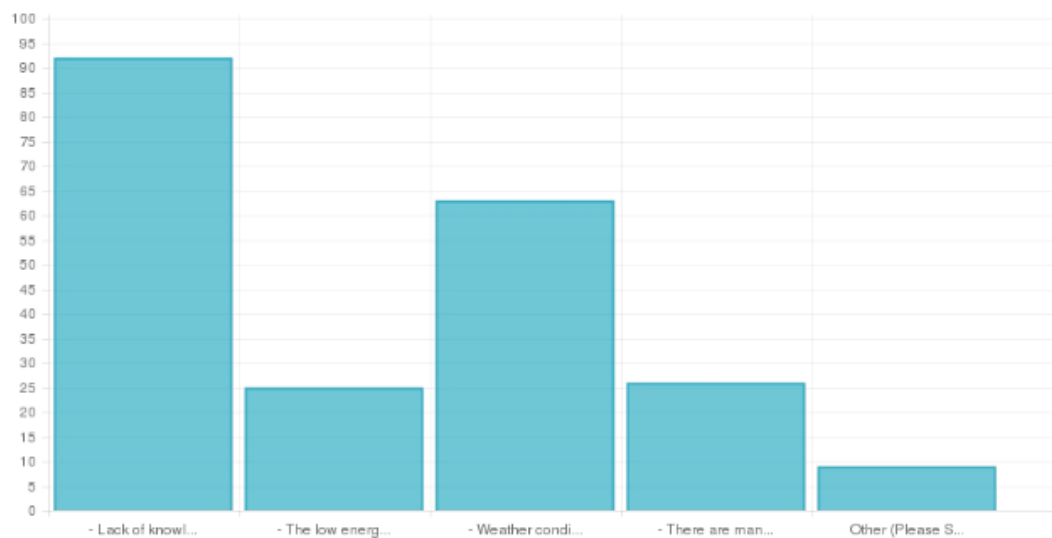
Contractors' green roof and green walls.

	- I have never used such technique on any of my previous projects.	- I get some inquiries to apply it but I don't take it due to my limited experience in this field.	- We get inquiries but we use specialist to help which increase the expenses.	- I am a specialist in this field, I always get inquiries and construct such projects on the site.	- I don't work as a contractor.	Responses
All Data	21 (14%)	6 (4%)	7 (5%)	2 (1%)	119 (77%)	154



In your opinion what are the main obstacles standing in the way of spreading the use and applications of such features (green roofs/walls)?

	- Lack of knowledge of the benefits.	- The low energy reduction comparing to its expenses.	- Weather conditions / lack of water in the UAE which will make it hard to take care of plants.	- There are many easier solutions to get the same impact of thermal insulation that do not need care and come with less expense.	Other (Please Specify)	Responses
All Data	92 (60%)	25 (16%)	63 (41%)	26 (17%)	9 (6%)	154

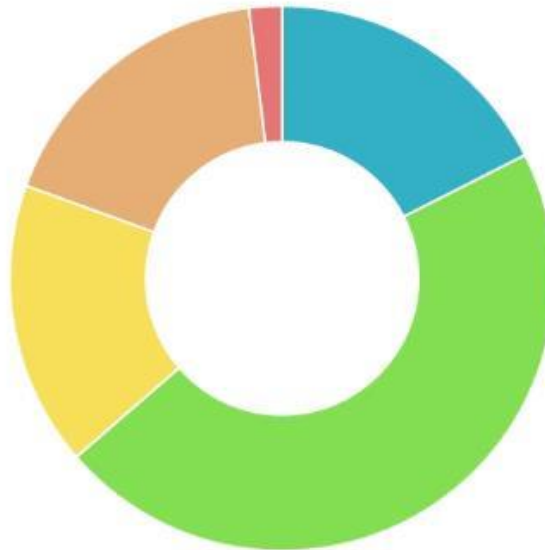


Text Responses

the very hot weather but water is not a problem as I think
 I think most people don't care about reducing energy consumption
 It needs continuous caring like watering and so on.
 Security for example
 needs maintenance, extra insulation, extra initial cost.
 Significant additional cost and complexity, lack of commitment to management by building owners and operators
 High SRI materials
 Expensive
 Bad implementation

How can roof garden and green walls become more common in the designing field?

	● - Obligate rules and codes that will enforce owners to add green facade to their buildings for least instant.	● - Develop more advanced techniques in order to make the installation and operation of green roofs/walls easier to be applied, and with less expense and more efficacy.	● - Stress the fact that using green roof/wall is a sustainable solution for heat insulation instead of synthetic height energy embodied material.	● - Use it as an aesthetic aspect which has a pleasant impact in community.	● Other (Please Specify)	Standard Deviation	Responses
All Data	27 (18%)	71 (46%)	26 (17%)	27 (18%)	3 (2%)	22.09	154



Text Responses

We can work in all of the above .

All of the above

selecting projects where such features offer an amenity aspect - not simply a visual or symbolic element

How important is adding a green facade according to you.

	Very important, it is a priority.	Important.	Depends on the situation, if it is helpful why not.	Not important at all.	Responses
All Data	30 (19%)	45 (29%)	83 (54%)	4 (3%)	154

