THE CHALLENGES OF SUSTAINABLE CONSTRUCTION IN SYRIA AS A CASE STUDY

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NEAMAT ABDULHADI

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Approval of Director of Graduate School of Applied Sciences

Prof. Dr. Nadire Cavus

We certify this thesis is satisfactory for the award of the degree of Master of Science in Civil and Environmental Engineering

Examining Committee in Charge:

Prof. Dr. Hüseyin GÖKÇEKUŞ	Supervisor, Department of Civil Engineering, NEU
Assist. Prof. Dr Anoosheh IRAVANIAN	Co Supervisor, Department of CivilEngineering, NEU
Assist. Prof. Dr. Beste ÇUBUKÇUOĞLU	Co Supervisor, Department of CivilEngineering, NEU
Dr. Shaban Ismael ALBRKA	Committee Member, Department of Civil Engineering, NEU
Assist. Prof. Dr Youssef KASSEM	Committee Member, Department of Mechanical Engineering, NEU

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Name, Last name:

Signature:

Date:

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To my parents…

ABSTRACT

The increase in the world population and the increase in the number of buildings around the world in recent years have led to a significant increase in environmental degradation. The increase in the number of population and structures required the consumption of large amounts of natural resources and materials. With the uncontrolled consumption of natural resources and materials, most countries have adopted the necessity of green buildings and many countries have taken steps to adopt this concept. At an individual level, many people and investors are turning towards sustainable buildings with the aim of reducing the negative impacts of buildings on human health and the environment and minimizing the use of water and energy, thereby increasing interest in sustainable buildings. The main purpose of this thesis is to compare the difficulties faced by Syria and other countries close to Syria in terms of location and lifestyle, such as Lebanon and Jordan, and to address the challenges that may be faced by sustainable structures in Syria. Another aim of this study is to examine the perspectives of developing countries towards sustainable buildings after the implementation of sustainable construction projects. Syria has gone through a long period of war, which has caused serious damage to the environment and infrastructure, so the need to rebuild Syria urges practitioners to implement sustainable principles. As a result of this study; it has been demonstrated that Syria does not currently have sustainable building policies and that there are some difficulties limiting the implementation of sustainable buildings in Syria. The data obtained through the survey revealed the existence of material difficulties, lack of construction materials and difficulties with construction rules. The study concludes that awareness of sustainable buildings should be emphasized in developing countries. The difficulties were similar in Syria, Lebanon and Jordan. As a result, based on the experiences observed in these countries, it was possible to find suggestions to address the challenges of sustainable building construction in Syria.

Keywords: Sustainable building; sustainability; green building; environment; construction; sustainable development

ÖZET

Son yıllarda dünya nüfusundaki artış ve buna bağlı olarak dünya genelindeki yapıların sayısının artması, çevresel bozulmada önemli ölçüde artış olmasına neden olmuştur. Nüfus ve yapıların sayısının artışı ise doğal kaynakların ve malzemelerin büyük miktarlarda tüketimini gerektirmiştir. Doğal kaynakların ve malzemelerin kontrolsüz tüketimiyle çoğu ülke yeşil binaların gerekliliğini benimsemiş ve birçok ülke de bu kavramı benimseme yolunda adımlar atmıştır. Bireysel düzeyde, birçok insan ve yatırımcı, binaların insan sağlığı ve çevre üzerindeki olumsuz etkilerini azaltmak, su ve enerji kullanımını en aza indirgemek hedefi ile sürdürülebilir binalara yönelmekte ve bu vesile ile de sürdürülebilir binalara olan ilgi giderek artmaktadır. Bu tezin esas amacı, Suriye ile Lübnan ve Ürdün gibi konum ve yaşam biçimi olarak Suriye'ye yakın olan ülkelerin yaşadığı zorlukları karşılaştırarak, sürdürülebilir yapıların Suriye'de uygulanması halinde karşılaşabileceği zorlukları ele almaktır. Bu çalışmanın diğer bir amacı ise, sürdürülebilir inşaat projeleri uygulanmaya başlandıktan sonra gelişmekte olan ülkelerin sürdürülebilir binalara karşı olan bakış açılarını incelemektir. Suriye, çevre ve altyapıya ciddi zararlar veren uzun bir savaş dönemi geçirmiştir, dolayısı ile Suriye'yi yeniden inşa etme ihtiyacı bu süreçte uygulayıcıları sürdürülebilir prensipleri uygulamaya çağırıyor. Bu çalışma sonucunda; şu anda Suriye'nin sürdürülebilir bina politikalarına sahip olmadığı ve Suriye'de sürdürülebilir binaların uygulanmasını sınırlayan bazı zorluklar olduğu ortaya konulmuştur. Anket yoluyla elde edilen veriler maddi zorluklar, inşaat malzemeleri eksikliği ve inşaat kuralları ile ilgili zorlukların varlğını ortaya koymuştur. Çalışma, gelişmekte olan ülkelerde sürdürülebilir binalar hakkında farkındalık ve bilginin arttırılmasına vurgu yapılması gerektiği sonucuna varıyor. Konudaki zorluklar, Suriye, Lübnan ve Ürdün'de benzerlik göstermiştir. Sonuç olarak, bu ülkelerde gözlemlenen deneyimlere dayanarak, Suriye'deki sürdürülebilir bina yapımında karşılaşılan zorluklara çözüm üretecek öneriler bulmak mümkün olmuştur**.**

***Anahtar kelimeler*:** Sürdürülebilir bina; Sürdürülebilirlik; Yeşil bina; çevre; İnşaat; Sürdürülebilir gelişim

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CHAPTER 1
INTRODUCTION

The increasing environmental pollution is causing a lot of risk to the planet where the construction sector is considered the main sector that make meaningful destruction to the environment as the natural resources are the major contributors to greenhouse gas emission. Therefore, the use of sustainable buildings can make a major difference to global environmental sustainability because it takes into account environmental considerations at each stage of the building and the sustainable buildings use the resource in high efficiency throughout its life cycle. It is also characterized by its absolute effectiveness in the use of energy and water supplies, which helps to expand infrastructure capacity and longevity, prompting many countries to adopt the concept of sustainable buildings to protect the rights of future generations.

1.1 Sustainability

Sustainability is a holistic concept that contains balanced environmental, social and economic factors (Hydes & Creech, 2000), as well as a complex concept, difficult to define in simple terms. Brundtland report of the World Commission on Environment and Development (WCED) One of the first studies on sustainable development(Robert, Parris, & Leiserowitz, 2005).

1.2 Sustainable Development

Sustainable development has gained increasing importance in the construction industry. One of the most common definitions of Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development later became a combination of three dimensions or "pillars" - the ecological, economic and social dimensions, as shown in Figure 1.1 (Brundtland, 1987).

Sustainable development depends on managing the relationship between human needs and the environment in a way that does not harm the environment and does not exceed the limits that affect fundamental human rights and social equity, including the right to

participate in development. The goal is to preserve the future of mankind from environmental and social collapse and not just to preserve modern society (Du Plessis, 2007).

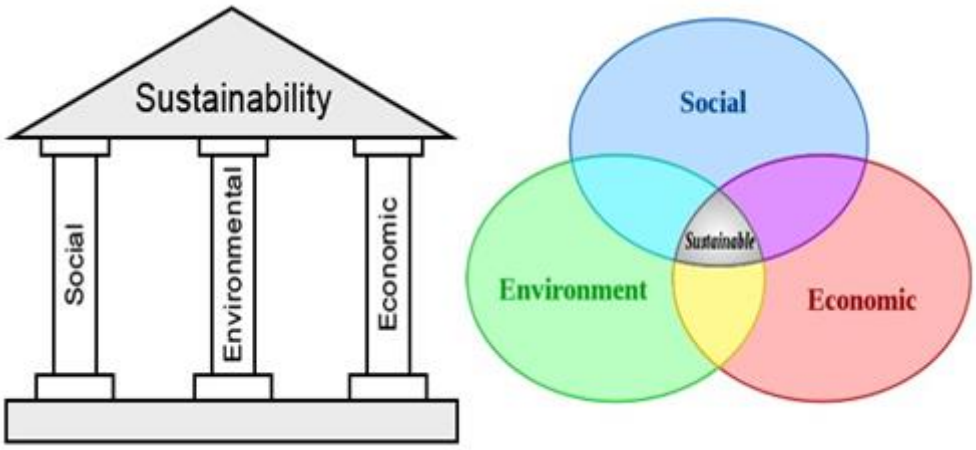

Figure 1.1: The three pillars of sustainability (Jagran josh, 2019)

1.3 Green Building

The "green" building is a building that is designed, built or operated, to reduce or remove negative impacts throughout the life cycle of the entire building and can create positive impacts on our climate and our natural environment. Green buildings protect natural resources and improve the quality of our lives(Council, 1998).

1.4 Sustainable Construction

Sustainable construction is a mean for the construction sector to move toward sustainable development, taking into account environmental, social, economic and cultural issues. the Term "sustainable construction is Originally suggested " to describe the responsibility of the construction industry to achieve sustainability (Hill & Bowen, 1997).

During the first International Conference on Sustainable Building in Tampa, 1994, Charles Kebert proposed the first definition of sustainable building as “responsible creation and management of a healthful ecosystem based on resource-beneficial eco-friendly sources." Bordeau studied green buildings in 14 countries and concluded that sustainable building is an important element in the establishment of sustainable development and that it is necessary to create a common global model "(Bourdeau, 1999).

In 1994, (CIB) Council International du Batiment, an international organization for the exchange of research in construction, identified the aim of sustainable construction as the production and implementation of a sound environment based on resource performance and environmental design. The CIB listed 7 principles of sustainable construction which are:

- Emphasizing quality
- Overcoming using the resource
- Nature safeguard
- Using the resources again
- Utilizing recyclable sources
- Eliminating toxics

There are four key strategies that must be pursued during the sustainable building planning process: sustainable project orientation, an integrated project team, integrated design process, and sustainability and code compliance systems (Alias, Isa, & Samad, 2014).

1.4.1 Benefits of sustainable construction

Environmental benefits in improving ventilation and water goodness, reducing waste elimination, decreasing energy and water exhaustion, ozone coat safeguard, climate stabilization, conservation of natural resources, expansive spaces, and biodiversity safeguard (Atombo, Cudjoe, Dzantor, & Agbo, 2015). Economic benefits decrease functioning and servicing costs and raise income (selling payment or rent); power productivity and preservation of resources and materials (Hayles, 2004). Social benefit: Improving the quality of human life and the human living environment, including culture, health, education and intergenerational equity (Atombo et al., 2015).

1.5 Problem Statement

Nowadays, it has become widely recognized that humanity faces major challenges such as climate change (Polzin, 2017), resource depletion (Darko & Chan, 2016), and environmental degradation (Yanan Li, Yang, He, & Zhao, 2014). Unfortunately, the construction industry is responsible for the rise of these challenges to a large extent, especially because of its heavy consumption of energy, water and raw materials

(Olubunmi, Xia, & Skitmore, 2016). According to the United Nations Environment Programme (UNEP), the construction industry has become a major energy consumer consuming 40 percent of global raw materials and 40 to 50 percent of global energy.

Sustainable building is one of the best solutions to these challenges, it is "an approach of securing a better condition of life for everyone, in the present and future time and for all generations, through sustainable social, economic and environmental attainment," as sustainable construction recycles the resources used Throughout the life cycle of the building and at each stage of construction from planning to demolition, (Atombo et al., 2015), as follows:

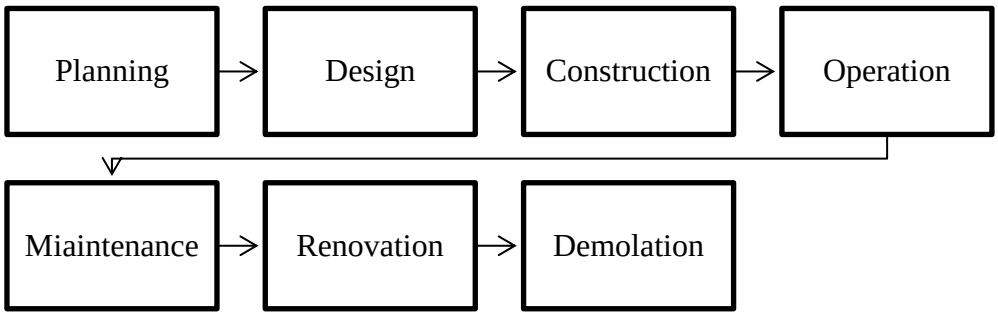

Figure 1.2: Stages of Construction

Achieving sustainable design will reduce consumption of energy and harmful emissions; use of reusable, renewable, recyclable and recyclable resources; and more efficient use of water (Ashe et al., 2003).

Achieving sustainable construction has become a global challenge, which is greater for developing countries because of the fact that these countries also have to deal with the problems of continuous development. However, developing countries like Syria have an opportunity not to make the same mistakes and to benefit from the mistakes of other countries that have implemented Sustainable buildings. Syria has suffered a long period of war and this has caused significant damage to the infrastructure and the environment. To find solutions to current obstacles in the buildings and environment of Syria, it is necessary to take into account environmental, social and economic aspects. Especially as the

construction industry is one of the factors of economic growth in these developing countries.

The problems facing sustainable development and priorities, as well as the level of skills and local industries in developing countries are different from those in developed countries. There is also difference in cultures and perspectives, all of which affect the understanding of sustainable development and sustainable construction in both countries (Du Plessis, 2002). CIB and other organizations published Agenda 21 for Sustainable Construction in Developing Countries (Du Plessis, 2002). However, there is a lack of awareness of sustainable construction in developing countries.

1.6 Objective of This Study

Objectives of this study is to address the challenges of sustainable construction in developing countries and then to provide recommendations for Syria to use environmentally-friendly construction methods. This study will also address sustainability standards and practices implemented in region countries which are close by to Syria in order to a better assess of the current status of sustainability and public awareness in the Syria construction.

The research ends by identifying the different challenges that Syria may face in the implementation of sustainable construction and provides recommendations to enhance sustainable development and to promote green buildings in Syria.

1.7 Significance of the Study

This study will be beneficial to Syria in terms of the construction industry and infrastructure development since Syria now urgently needs sustainable reconstruction plans since the country has been in war for a long time and the environment has been severely polluted and damaged.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The term "green buildings" is the common name for the definition of "sustainable buildings" in terms of the design, construction, operation, maintenance, renovation and demolition of buildings in a manner that the environment and efficiency of sources is taken into account, reducing negative environmental impacts and considering the convenience and health of occupants at all times (Huovila & Richter, 1997).

Recently, awareness of sustainability in the construction industry has increased among construction professionals (Bansal, 2005). Sustainable buildings have a positive impact on the public health and the environment, also reduces operating costs, increases institution building and marketing, increase the productivity of building occupants, and helps to create a sustainable society (Fowler & Rauch, 2006).

2.2 Sustainability in the United States

There are several organizations in the US (United States) that contribute to the implementation of sustainable development, and most significantly the Environmental Protection Agency (EPA) that appears laws, rules, agreement, and implementation. The Environmental Protection Agency (EPA) deals with the construction sector by observing pollution, waste and other hazardous pollutants resulting from construction. Various building codes are issued compatible with the particular conditions of every region or state. The newest of that is the International green building code 2012 announced by the International Code Council and sponsored by the American Institute of Architects and also the United States Green Building Council. This law is an Organizational framework for new and current buildings that outline sustainability needs from the design stage to the construction and operation of the building (Yang & Jackson, 2011).

2.3 Sustainability in the United Kingdom

For the UK, (United Kingdom) the government is directly concerned with help and sustainable development planning. The sustainable Housing Act and the Energy Performance Certificates (EPCs) specify minimum building requirements for sustainability. The sustainable Homes Code is a method for evaluating the environmental assessment of new homes that evaluate the environmental production of the building throughout the design and post-construction stages. The environmental influence of the building is measured in 9 groups namely: energy and carbon emissions, surface runoff, water use, materials, waste, pollution, etc. This code is compulsory for all new residences and therefore the outcomes of the assessment are listed on a certificate assigned to the residence (McManus, Gaterell, & Coates, 2010).

The UK government has launched a number of significant policies and many initiatives reports to promote reform in the construction industry (Opoku, Cruickshank, & Ahmed, 2015). Sustainable Buildings Task Group report (2004) presented recommendations of minimum standards in principal resource efficiency criteria such as the use of material, waste, water efficiency and energy efficiency (Oluwole Akadiri & Olaniran Fadiya, 2013).

2.4 Sustainability in European Union

European Union (EU) member states have developed their long-term strategy for sustainable economic, social and environmental development and set specific objectives to be achieved by 2020. Throughout the Sustainability Plan, Europe has passed several legislation policies affecting the construction industry, several of which target energy efficiency in buildings, control of unsafe building materials and conditions of treatment of alternative workers. Among these, the framework directive on waste aims at higher management of waste from the construction industry as well as the energy efficiency group aiming to decrease energy consumption (Schey, Milanova, & Hutchings, 2011).

2.5 Sustainability in Middle East Countries

The conception of green building has become one in all the foremost important issues in Arab Countries within the Middle East countries. according to a study conducted by

Merrill lynch, one of the leading companies within the field of financial management and consulting within the world, within the middle east regarding 20% of the rich investors who invested in the act within the techniques associated with green building, green Building Councils are established in most Arab countries, others produce their own rating systems like the ARZ system in the Lebanese Republic, Estidama within the United Arab Emirates and therefore the QSAS in Qatar(Issa & Al Abbar, 2015).

2.6 Economic Benefits of Green Buildings

Evidence is growing that sustainable buildings provide a financial payoff for building owners, operators, and occupants. Sustainable buildings commonly have low annual costs for energy, water, maintenance/renovation, and other functioning expenses. These reduced costs should not come at the expense of the first higher costs. Through integrated design and innovative use of sustainable materials and tools. Some sustainable design features have higher initial costs, but the recovery period for additional investments is often short and the cost of the life cycle is usually less than the cost of conventional buildings. Sustainable buildings are characterized by direct cost savings and also provide indirect economic benefits to the community and to sustainable building owners, for example, sustainable buildings can enhance the well-being, health and comfort of the building occupants, thereby reducing absenteeism, which increases productivity. Other economic benefits of the buildings Sustainable construction are: reducing time, reducing project licensing costs resulting from community acceptance and support for sustainable projects. It also has the potential to attract new employees. The economic properties of sustainable buildings have benefits for all society like reducing costs resulting from damage caused by air pollution as well as reducing the infrastructure costs (Ries, Bilec, Gokhan, & Needy, 2006).

2.7 How Sustainability is Measured in Buildings?

Many Building Performance Assessment Systems (BPASs) have been grown worldwide to measure principally on the environmental aspect of sustainability in building such as LEED, BREEAM, CASBEE, and GBI Malaysia and many others (Fauzi & Malek, 2013).

Green construction is growing all over the world, through a combination of voluntary certification and essential needs. The LEED Comprehensive Assessment System in the United States has expanded its international presence. About 40 percent of LEED-registered projects are located outside the United States (USGBC, 2011). For developed countries, the main aim of registering and certifying LEED issues from the opportunity is to decrease operating costs. For developing countries with rapid economic progress, there may be a tendency to focus only on the construction of new buildings (Tathagat & Dod, 2015).

2.7.1 Leadership in Energy and Environmental Design (LEED)

The LEED method is used to evaluate green buildings; it is the most common used method in the world. It was developed in 1998 by the United States Green Building Council (USGBC); it is used in its original form in the USA, Canada, Brazil, Argentina, Mexico, Italy, and India. Through the Green Building Council (GBC), are located in more than 20 countries in the world (Markelj, Kitek Kuzman, & Zbašnik-Senegačnik, 2013).

LEED's new construction system has been an important means for construction professionals and all stakeholders, allowing them to determine the time to increase the benefits of sustainable processes. LEED Green Building Assessment System Leadership in Energy and Environmental Design (LEED) is a voluntary accreditation program created to improve the high performance of sustainable buildings. An architect can assess the building and be directly informed of the impact of design options in terms of environmental impact, classified into five categories affecting human health and the environment: (Amiri, Ottelin, & Sorvari, 2019).

1. Water efficiency
2. Energy and atmosphere
3. Materials and resources
4. Indoor environmental
5. Sustainable sites

LEED certification reduces stress on the environment by encouraging energy-efficient buildings, savings from increased building value, higher rental rates and lower service

costs. The LEED panel in a building is a sign of quality and success in green buildings. LEED projects gain points in 9 key areas: Integrative process; Location and transportation; Sustainable Sites; Water use efficiency; Energy and Atmosphere; Materials and resources; Quality of the internal environment; Cooperate; and Regional priority that discuss fundamental aspects of green building (Council, U. G. B., 2016). Leadership in Energy and Environmental Design (LEED). The Energy Leadership and Environmental Design Reference Manual is a classification system that rates buildings for their overall environmental performance. The reference guide is divided into environmental categories with weighted importance such as sustainable sites twenty-two percentage, water efficiency eight percentage, energy and atmosphere twenty-seven percentage, materials and resources twenty percentage, indoor environmental quality twenty-three percentage, and innovation and design process (Joel Ann Todd, 2002).

Depending on the number of points earned in relative to the criteria, the building is given a classification in one of four categories: the classifier (40-49 points), silver (50-59 points), and gold (60-79 points) platinum (80-110 points) was shown in Figure2.1 (Kibert, 2016).

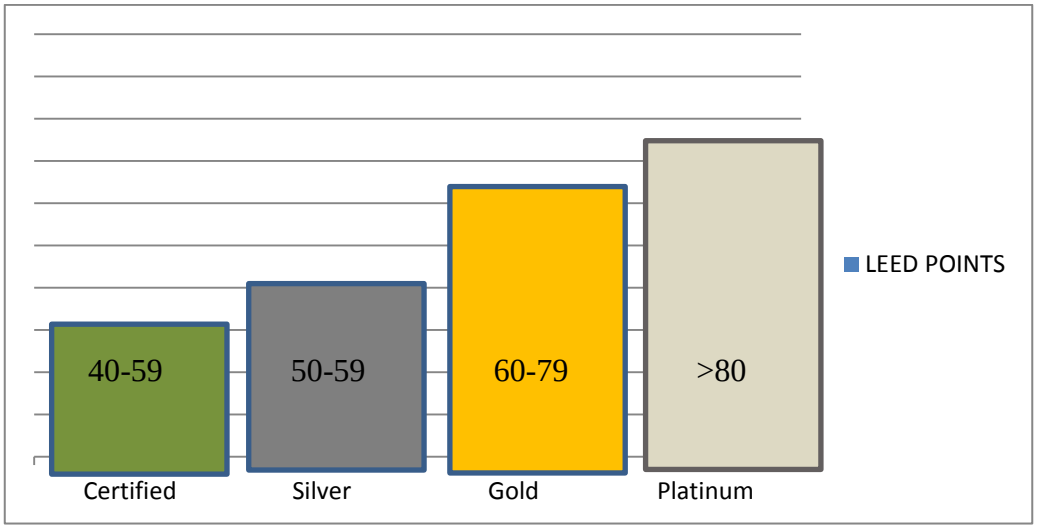

Figure 2.1: The LEED Ranking and points

- LEED Assessment Systems

LEED works for all buildings in all stages of construction, from new construction to existing buildings, as well as all construction sectors, from houses to hospitals to corporate

headquarters. Evaluation information can be obtained at the planning stage, but a personal evaluation and certificate display is only performed after construction has been finished. If the assessment is done according to LEED-New Construction: Core & Shell, an initial certificate can be taken for marketing the project while the building is still in the planning stage (Herda, Autio, & Lalande, 2017).

More than 79,000 LEED projects are taking place in 160 countries and territories, covering more than 15 billion square feet (Cottrell, 2014).

CHAPTER 3
MATERIALS AND METHODOLOGY

3.1 Study Area and Data

Syria is one of the Middle East countries in the continent of Asia. It has an edge at the eastern Mediterranean Sea. Iraq, Palestine, Jordan, Lebanon, and Turkey border it, it also shares maritime borders with Cyprus. Damascus is the capital city of Syria, as shown in Figure3.1. The Syrian Arab Republic has an area of 185,180 km^2, which is 183,630-km^2 land, and 1,550 km^2 of water that makes it the 89th largest nation in the world (World Atlas, 2015). The current population of the Syrian Arab Republic is 18,287,228 (Worldo meter, 2019).

Climate: Mostly a desert and the weather from June to August is hot, dry, sunny summers and mild, rainy winters from December to February, in Damascus it has cold weather with snow or sleet periodically (World Weather and Climate Information, 2010).

Figure 3.1: Map of Syria (Alamy, 2012)

In 2015, a study by the Chatam House Center showed a decline in economic activity measured in terms of GDP by half compare to the time before the war. In other estimates, the International Monetary Fund (IMF) has seen economic activity by the end of 2016 almost a quarter of what was in 2010. The oil, which had a production of 387,000 barrels per day, was out of state control and is an important source of financial revenue and energy, and government-run refineries use imported oil. Electricity generation from the

official grid has been reduced by 70 percent. Inflation surged exceptionally, and in mid-2015 the lira exchange rate fell 78 percent from 2011 and 83 percent in the parallel market. In 2018, the government regained control of most of the land it had lost and tried to tighten its administration of difficult economic conditions much better than it had in 2016. Perhaps the opportunity for a large or comprehensive reconstruction in 2019 (Gobat & Kostial, 2016).

According to the Reuters news agency, the energy sector tops the list of sectors affected, according to participants announced at the conference held in Damascus entitled "The war in Syria: its repercussions and prospects" In addition to the oil sector, electricity has been severely affected. Electricity Minister Zuhair Kharbotli said, "the demand for the Electricity the pre-conflict was 97 percent, while now it is down to 27 percent due to limited fuel and gas" (Global risk insights, 2019).

The war in Syria has created the worst humanitarian disaster. The residential and housing sector is primarily affected by the destruction, which makes this sector a priority in the reconstruction strategies and plans, especially as this sector is primarily related to the provision of housing for displaced persons who have moved to other cities and rural areas within the country, Or to nearby and distant states. And the energy sector comes in second place in terms of losses and destruction, followed by the sector of health, medicine and hospitalization, followed by the education sector, followed by the sector of transport and roads, and finally the water sector, wastewater treatment, hygiene, and public health issues, As reconstruction begins soon, it is important to start new ideas and help the country recover from the devastation and pollution it suffered during the war.

The environmental impact of conflict and war is very large and has a profound impact on all aspects of human life and for future generations. There are the direct environmental effects of the war, which have been inflicted on various elements and environmental communities as a result of the hostilities and destruction over the years of the crisis, as well as the indirect effects on human health and well-being and on the services of environmental systems. If these impacts are not taken into account, they can lead to new internal and external migration, as well as socio-economic instability. It is therefore important to assess and identify environmental risks, opportunities for the formation and

evaluation of appropriate policies, plans, and development programs. These policies can provide opportunities for sustainable development, taking into account the particular circumstances of Syria.

So one of the important solutions that we have to think about is the sustainable buildings. This thesis will examine the challenges that sustainable construction may face in Syria, however, we must consider the end of the war for a new beginning for the country. Some damages of the war are shown in figure 3.2 and 3.3.

Figure 3.2: Damage in Aleppo, Syria (BBC News, 2014)

Figure 3.3: Damage in Homes, Syria (Abc News, 2015)

3.2 Methodology

In this study, we will use quantitative and qualitative approaches together. This assessment is carried out through two complementary approaches:

- A literature review is conducted about the sustainable buildings and environmental Building Performance Assessment methods,
- Conducting the questionnaire in Syria with the Syrian parties that represent a key role in achieving sustainable development such as engineers, contractors, and the architects. The questionnaire is a set of diverse questions that relate to each other in a way that achieves the goal that we seek. The questionnaire makes it possible to collect a lot of information. The questionnaire is characterized by the ease of data collection, which makes it easy to interpret and get the best results, gives the study sample complete freedom to choose the time to answer questions, and saves time and effort, and material cost. The operation of a questionnaire does not need traveling, mobility, and easy design does not require a great cost. This study will present a comparing between the status of the sustainable buildings and the challenges that they face in Lebanon, Jordan, and Syria. This study will focus on finding appropriate solutions to the difficulties that the sustainable buildings face in Syria, through the use of experiences and studies in Lebanon and Jordan.

The reason for the choice of these countries (Lebanon and Jordan) is that they are located on the Syrian border and have the same characteristics as climate and progress. Lebanon and Jordan are developing countries like Syria, and the challenges of the application of sustainable buildings in these countries may be the same as Syria.

The Data will be analyzed, and common points will be shared in the three countries to find appropriate solutions to the challenges of sustainable buildings in Syria, by using SPSS (Statistical Package for Social Sciences) which is used in scientific research and studies. SPSS (Statistical Package for Social Sciences), also known as IBM SPSS Statistics, is a software package used to analyze statistical data. In figure 3.4 the methodology of the work is shown briefly.

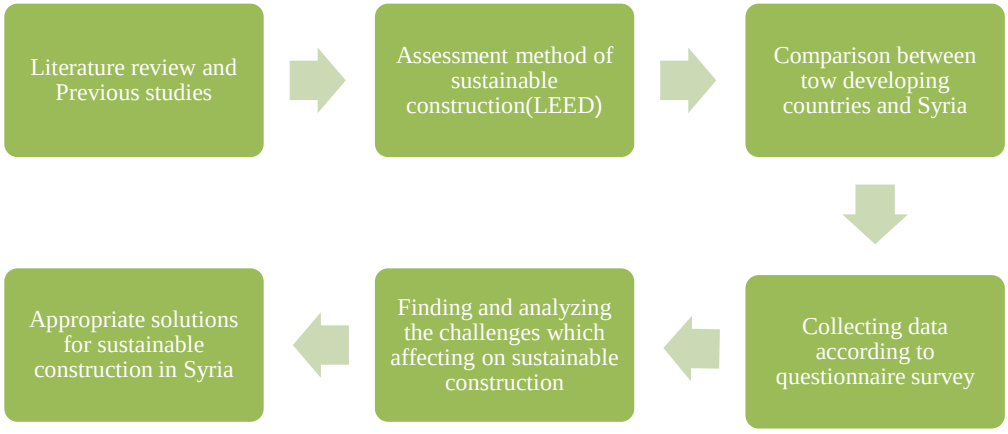

Figure 3.4: Methodology

3.3 Questionnaire Survey

A survey is being conducted to explore awareness and knowledge of "green buildings" in Syria. The survey is distributed to 100 Syrian engineers, architects, and contractors. This survey aims at clarifying the degree of awareness among professionals of the concept of green buildings in Syria and to explore the challenges of the urban buildings in Syria and the developing countries.

The questionnaire consists of three parts. The first part of the questionnaire consists of questions related to Engineers socio-economic characteristics like age, gender and engineering specialization. The second part consists of questions related to engineers experience and questions about the construction industry. The third part consists of questions related to green and sustainable construction.

3.4 Specify the Sample size

The number of engineers in Syria is 150000, and there are 15,000 of them outside the country, according to this number, the population is 135,0000 and therefore to study conducted in Florida university which said when the population is more than 100,000 the sample size should be 100 (Israel, 1992).

3.5 Materials of Sustainable Building

The Damascus sites used natural building materials such as stone, mud, wood, straw, and others in the construction of their old buildings, these materials are of great thermal capacity. Building materials can be classified as environmentally friendly when the following conditions are met:

- It shall not be a high energy consumption material whether in the manufacturing, installation or even maintenance phase.
- Do not contribute to the increase of internal pollution in the building that is to be from the collection of building materials that are described as healthy, which are often natural (Al-Qusaybati Nada, 2013).

Some of the building materials used in modern buildings were classified from the point of view of their energy consumption per unit of weight in the manufacturing phase. They were classified into three groups: low energy content, medium content, high energy content, this is illustrated in the following table 3.1 (Waziri Yahya, 2003).

Table: 3.1 Energy content classifications for some building materials

Material	Energy content (kilowatt-hours / kg)
Materials of Low content	
Gravel and sand	0.01
Wood	0.1
Concrete	0.2
Brick (Gear + Sand)	0.4
Lightweight concrete	0.5
Materials of medium content	
Bricks	1.2
Gear	1.5
Cement	2.2
glass	6
Porcelain	6.1
Materials of High content	
Plastic and steel	10
lead	14
zinc	15
Aluminum	56

Conserving resources and not wasting them is one of the most important standards of environmentally friendly and sustainable architecture. This encourages designers to decrease the use of new resources in buildings, reuse building materials used in old buildings to be removed, and be careful when using modern building materials to be recyclable materials. Syria will begin the reconstruction phase as there are many destroyed buildings that can be utilized by recycling and reuse building materials again (figure 3.5).

Figure 3.5 Destroyed buildings in Syria (Reuters, 2013)

Many environmental friendly building materials have appeared on the market to reduce the environmental impacts of building buildings and processes. But identifying the most environmental friendly building materials in the world could be a bit difficult because different people have different definitions of sustainability.

For example, considering if the material is locally sourced or not. Searching for things available, that doesn't have to travel far, that use local resources and what is readily available in the construction market. Sustainable construction also takes into account the suitability of the material to the climate in which it is used. Some materials hold well in arid and exquisite environments but degrade in wet and warm areas. There are no perfect materials, but some are more sustainable than others. There are some common characteristics of materials with a low capacity to embody them, such as lightweight and local sources.

Smart Cities Dive has compiled a list of five materials that often provide expert lists of environmental friendly building components.

- Bamboo

Sustainability experts agree almost universally that bamboo is one of the best green building materials on the planet. Their self-generated rate is incredibly high, with some species growing to three feet within 24 hours. Bamboo is technically a permanent herb, not a wood, and continues to spread and grow without having to be re-cultivated after harvesting. It is spread all over the world and can be found on all continents except Europe

and Antarctica. Bamboo has a high ratio of strength to weight and exceptional durability - even greater strength than the pressure of brick or concrete - so it can take batting without replacing it often and this is not necessarily the case with other fast-growing sustainable ingredients such as hemp. This makes bamboo a viable option for flooring and cupboards. Because it is lightweight, the bamboo is much less energy consuming than many other similar endurance materials. The disadvantage is that it requires treatment to resist insects and rot. Unprocessed bamboo contains starch that insects love and can swell and break when water is absorbed (Janssen, 2000) .

Figure 3.6: Bamboo Trees (Swedbrand group, 2017)

- Cork

Cork is a fast-growing resource. And earn extra points for its ability to harvest from a living tree that will continue to grow and reproduce cork, the bark of the trees. The cork is flexible and returns to its original shape after maintaining pressure. Flexibility and corrosion resistance are common elements in floor tiles. Its noise absorption capabilities make it ideal for insulation panels, and the shock absorbing properties make it perfectly suitable for substrates. If left uncoated, the corks are naturally fire resistant and do not release toxic gases when burned. This also makes the cork insulator good. Cork is almost impermeable so it does not absorb water or rot. Over time, cork becomes more fragile. Cork loses few sustainability points because it is mainly found in the Mediterranean Sea

(figure 3.7). However, the cork is very light so it requires less energy to charge, thus saving embodied energy points (Corkor, 2016).

Figure 3.7: Cork (Corkor, 2016)

- Reclaimed or recycled wood and metal

Aluminum and steel are energy materials embodied by the energy needed to produce them, such as iron ore mining, heating and forming products, and the transport of relatively heavy material. But each time the metal is re-used properly and efficiently or recycled into new products, the energy involved decreases and the material becomes more sustainable because it does not extract the raw aluminum. Recycled metal is a long-lasting material that does not need frequent replacement. It does not tend to burn or twist, making it a viable option for ceilings, structural supports and facade construction. Reclaimed metals, such as plumbing components, can sometimes be used in their current forms rather than recycled and manufactured in a new product, like recycled metal, the restoration and reuse of wood reduce its embodied energy, which is already less due to its lightweight. Wood is less powerful though, so the safety of each piece must be evaluated and chosen for a suitable project. Reclaimed wood can be used for a large number of construction purposes, including structural framing, flooring, siding, and cupboards. The density varies depending on the type of wood, while others improve over time. However, most woods are susceptible to insects and degradation, which enhances the need for a careful examination of each reclaimed pieces (Americas, 2016).

- Precast concrete slabs

The concrete slab is formed at the manufacturer's site and is shipped incomplete sections to construction sites. Outer layers are often coated with lightweight paddings, such as foam insulation. Other versions of the concrete are made entirely but contain large hollow areas such as concrete blocks. Precast concrete slabs (figure 3.8) are usually used for walls and building facades because they hold up well for all types of weather, but certain types of floors and flat roofs, especially floor surfaces, can be used. Concrete is actually good because despite being heavy, it requires little processing. The sustainability factor of precast concrete slabs increases many of the traditional concrete options cast because the panels often take less energy to produce and assemble. In addition, prefabricated concrete provides an opportunity to process the material properly in a controlled environment, rather than exposing it to a variety of unfavorable conditions during treatment at the construction site. Improper treatment can lead to cracks and structural errors inside the concrete. In the worst case, the need to demolish the new concrete and start over again (Yee & Eng, 2001).

Figure 3.8: Precast concrete slabs (Florida Engineering, 2015)

CHAPTER 4
CASE STUDY IN SYRIA WITH COMPORATION LEBANON AND JORDAN

4.1 Sustainability in Syria

In Syria, the five-year plan (2000-2005), of economic and social development, adopted its general objectives of protecting the environment and achieving sustainable use of resources. However, the actual performance to achieve this, the plan was modest. The Tenth Five-Year Plan (2006-2010), sustainable development, can only be achieved by analyzing social, economic and environmental indicators in order to link the problems to their real causes and to try to explore and utilize strengths and to identify weaknesses to overcome their risks. The process of development and safeguarding the rights of future generations is achieved by achieving sustainable environmental development as a third object that is organically linked to economic and social objectives. The environmental priorities in Syria are to protect water resources from pollution and depletion and to deal seriously with the problem of random housing, as well as the need to disseminate environmental culture at the governmental, private and civil levels. However, dealing with these priorities must be achieved through logical interrelationships, which define the characteristics and problems of each region (geographical, City, village) have their own priorities and optimal solutions to these problems, and hence environmentally sound projects that serve these priorities.

Renewable energy and energy efficiency will provide a number of Syria's energy wants while not disadvantageous environmental impacts. Syria is well dowered with renewable energy sources such as sun and wind as well as to a lesser amount with biomass and hydro sources. Direct or indirect solar energy is clean and has been intrinsically given goodly attention. A renewable energy plan has been ready within the year 2002 in cooperation among the Ministry of electricity and UNDESA/UNDP (Hamzeh, 2010).

- Renewable energy

As part of the work to invest renewable energies to achieve sustainable development, the Ministry of Local Administration and Environment has implemented several alternative

projects in various governorates such as street lighting projects, pumping of well water and generating electric power through electroplating panels and others. The Ministry of Local Administration and Environment said in a report that the total number of lighting devices installed in cooperation with UNDP in the governorates of Damascus, Aleppo, Latakia, Tartous, Hama and Homs reached 5136 lighting devices with a total capacity of 1285 kW. The Ministry pointed out that in the province of Damascus countryside, the project of lighting the streets of the cities of Tal and the suburb of Qudsia and the installation of 261 lighting equipment on the poles of lighting in the two cities after the rehabilitation of damaged columns as a result of terrorist acts and the planting of new lighting poles in some places. The project serves about half a million people and covers about 11 kilometers and provides 200 thousand kilowatt-hours of electricity per year equivalent to 50 tons of fuel, saving 155 tons of carbon dioxide. The ministry pointed out that work is underway to implement the project of solar street lighting in the city of Zabadani in the countryside of Damascus and installed 319 lighting devices on the columns and replace these columns and the planting of new lighting poles in most streets of the city and will cover the project distance of 12 kilometers and provides 235 thousand kilowatt hours of electricity Equivalent to 60 tons of fuel, which avoids the emission of 180 tons of carbon dioxide and serves the project all the residents of the city (Sputnik, 2018).

- Pumping of well water

In the field of solar water well pumping projects, the ministry explained that a number of projects have been implemented in the province of Damascus countryside with a total capacity of 117 kilowatts, including the pumping of the water of Maaloula well, which serves between 600 and 700 dunums of agricultural land belonging to about 600 farmers and includes some 15,000 fruitful trees of the types of almonds including the trees pistachio, pomegranate, apricot and shrimps. Also installed an electric pump with capacity of 11 kW with electrical installations and electrical control panel and consists of the solar system of 90 pickup capacity of 200 watts per pick and the reservoir of water Oxfam capacity of 100 cubic meters was turned on More than 100 years For Maloula within the project of local laborers and it produces this system annually approximately 27,900 kilowatt hours of electricity and provides 975.6 tons of fuel (Sputnik, 2018).

4.1.1 Sustainable building in Syria1

As Syria runs out of petroleum and faces ever-mounting tension on the water and electricity supplies, the growing interest in energy-efficient architecture appears as no wonder. Indeed, consultants argue that following eco-friendly buildings that use less energy, water and cut back pollution is not any longer a luxury to Syria, it's a necessity. The efforts to promote sustainable architecture are very influential on a global scale, however, it is understandable how important is it in Syria no matter how much sources are limited, and energy is pricey to produce while consuming and pollution may be major jeopardy. While nowadays we can observe everywhere there is a concrete building, while the country's building code should pay a little attention to energy performance or the natural environment. Syria's Islamic architectural method was sustainable architecture with traditional construction methods and materials carefully selected to work with the natural environment instead of against it, producing houses which were naturally warm in the winter and cool in the summer, that means what is happening in Syria is a new phenomenon for this country (Nadia Muhanna, 2010).

4.1.2 Traditional building

- State of Environment and Climate

There is no doubt that the climate that tends to heat and drought, which prevails in our region, requires a method of architecture suited to its conditions, and serves people in the summer where the inhabitant needs to leak air currents. Or in the winter where it is necessary to retain thermal gain provided by maximum enjoyment of the sun while reducing the heat loss of the building. In general, the architecture sought to secure thermal adaptation, lighting, and ventilation, and these conditions have been met through (Ferwati & Mandour, 2008).

First: by choosing the appropriate location for the city, a location where all the conditions for enjoying nature, ensuring security, and making contact with the city's outskirts and gates are available.

Second: resorting to the principle of "convergence", that is to say, the city's buildings converge with each other in a concerted manner, to prevent the exposure of the facades to the weather, and the difference in height of the buildings will reduce the impact of the sun and wind.

The result of this compact principle was that the streets narrowed and became mere alleys or narrow approaches, accommodating the movement of pedestrian people, rarely accommodating the passage of vehicles, since the buses were not yet counted and needed wide streets.

- Search for Lung

The buildings seemed to be a single closed building that does not overlook large squares or roads. It was necessary to look for a specific lung for each dwelling. The solution was in the inner courtyard to ensure openness to sunlight, serenity and air purity in distant space. For noise, pollution and thermal variability (Ferwati & Mandour, 2008).

- Building materials

The most important elements of traditional architecture are building materials. It has been confirmed that the main building materials are clay, wood, stone. Cement and iron were not common.

- The clay has been seen in various forms, namely dak and dried laban, such as bricks, bricks, and grilled clay.
- Stone, whether it is calcareous or basalt, is also preserved for heat and becomes an ornamental method when it is used by successive dams, alternating colors. The engraved or embossed motifs on the earthen stone added to the building a distinctive and beautiful characteristic.
- The wood is characterized by its ability to absorb the heat by a large proportion and is characterized by an easy form of biting or drilling, in addition to its durability and Lightweight and the possibility of coloring.
- The wall cladding with lime helps to protect the house from heat fluctuations.

Two traditional buildings are shown in figure 4.1 and 4.2.

Figure 4.1: Traditional Building in Damascus (Sana, 2018)

Figure 4.2: Another Traditional Building in Damascus (Telegraph, 2018)

The thinking about the sustainable buildings in Syria existed before the war but the implementation was slow because of some challenges which this thesis focuses on. The war was harsh and destroyed many areas in Syria, but we must now think about reconstruction and that this war despite its cruelty We can see a glimmer of hope after it ends by thinking about new ways to develop the country in all fields, especially infrastructure and the construction sector, where we can start thinking better about sustainable buildings as a new and useful solution that contributes to saving energy and electricity in the long term, Because Syria Suffer from a severe shortage of energy resources. The following are examples of sustainable projects in Syria before the war.

4.1.3 Example of sustainable buildings in Syria

- Residential building in the suburb of Qodsia

A residential building project (F136, Island 5) is part of the Youth Housing Project in the expansion of the suburb of Qodsia near Damascus, which was established within the framework of sustainable pilot projects, with the support of the European Union (figure 4.3 and figure 4.4).

This building consists of 32 apartments spread over five floors. In this building, water heating and heating system were used by solar power stations installed on the roof of the building, In order to achieve thermal insulation, the walls and the final surface were insulated according to European standards, and windows of isolated aluminum were used with double glass to reduce air leakage (Al-Qusaybati Nada, 2013).

Figure 4.3: 3D picture of Residential building in the suburb of Qodsia (Al-Qusaybati Nada, 2013)

Figure 4.4: Residential building in the suburb of Qodsia from the front side (Al-Qusaybati Nada, 2013)

- The Massar Children's Discovery Centre

Location: Damascus, Syria
Client:Syria Trust for Development
Gross floor area: 16,000 m2
Year of construction: 2008 – 2013

The Massar Children's Discovery Centre (figure 4.5 and figure 4.6) will be the center of the Syrian-course curriculum. Within the practical science-based expertise, the Center will present activities to disable young Syrians to participate actively in creating their future. The Discovery Center has a unique location in the heart of Damascus. The building includes a library, exhibition, administrative space and educational. The center will be an integrated main attraction within a new public area of 170,000 m^2. The building has a unique concept taken from a Damascene rose. The proposal introduces a structuring structure which provides light and cheerful light visuals in interior spaces - such as filtering light between rose petals. The administrative and galleries areas are located between rose petals, which create inner-inspired walking mazes in the ancient city of Damascus, created from the walls with the sky (Sanjay Gangal, 2011).

This Centre is allowed energy building using local materials, talents, and sources. Energy loads are decreased by creating the building to use the sunlight. The shape of the building and the material has been developed to diminish the requirements for effective or operational heating and cooling. By using and controlling solar gain can hugely reduce energy waste and by harnessing and saving solar energy, in the winter can lessen the amount of heating and the same thing during the summer. This building cannot currently be evaluated in an environmental thought as it is still under construction, but it is one of the leading Syrian projects in the field of sustainability (Sanjay Gangal, 2011).

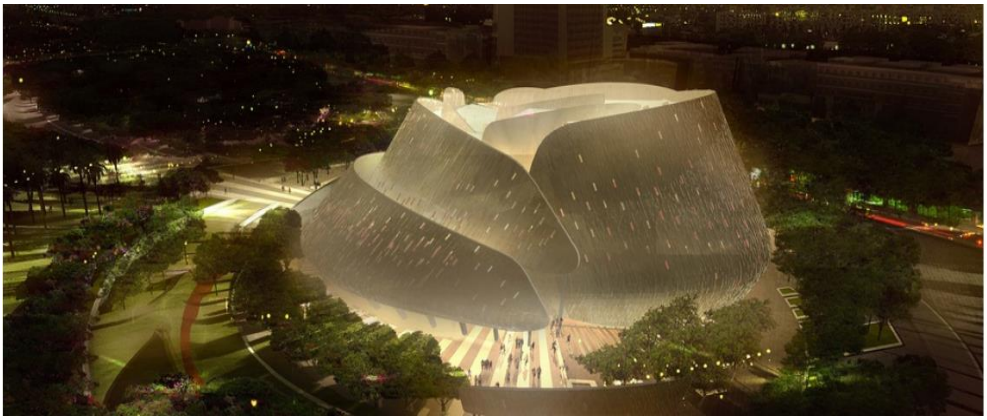

Figure 4.5: 3D picture for the Building (Sanjay Gangal, 2011)

Figure 4.6: The Massar Children's Discovery Centre during the implementation phase (Syrian Arab Republic, 2014)

4. 2 Comparison with Jordan

The current population of Jordan is 10,011,143 as of Sunday, February 24, 2019, based on the latest United Nations estimates (Worldometers.info, 2019). Amman is the capital of Jordan, as well as a cultural and economic center in the country that attracts tourists from all over the world (World atlas, 2017). Map of Jordan is shown in figure 4.7.

Figure 4.7: Map of Jordan (vectorstock, 2012)

4.2.1 Sustainability in Jordan

In Jordan, sustainability is still a new concept, and many of the few buildings that are sustainable are yet to mature. The first building to be awarded the Silver LEED Certificate is the Dutch Embassy building in 2010 (Al-Azhari & Al-Najjar, 2012).

In accordance with Agenda 21 (Johannesburg, 2002); Jordan depends to a large extent on its poor environment and ensures that environmental resources - water, soil, vegetation, etc. - are employed in a sustainable manner as one of the most pressing commitments to the principles of sustainable development, Earth Summit in Rio Janeiro 1992 (Omer, 2011).

Jordan is still a long way away from developing a strategy for the sustainable building industry. The survey showed significant differences in the level of awareness regarding green buildings within Amman and other governorates, Karak and Irbid. The survey showed that 88.9% of respondents in Amman have information about the green building (Royal Scientific Society of Jordan and the Friedrich-Ebert-Stiftung Amman Office, 2013).

Jordan is apprised with some of the several countries in the world with limited water resources and is one of the smallest developing countries on a per capita basis. The balance of usable water resources per capita is declining as a consequence of population growth and is expected to fall from less than 160 m3 per capita per year at present to around 90 m3 per capita/year by 2025, which putting Jordan in a higher water deficit. The lack of water in Jordan is the most serious obstacle to the development and expansion of the country because water is not only an element of food production, it is necessary for health, survival, social and economic development (Al-Sarkhi, Akash, Abu-Nada, Nijmeh, & Al-Hinti, 2008).

4.2.2 Sustainable buildings

Jordan is at a dangerous state in terms of energy and water security, and thus enhancing the value of green buildings and their vital importance more than ever before. Residential sector energy consumption share in addition to electrical energy represents 23% of all energy consumption with different sectors in Jordan (Zawaydeh, 2017).

In the context of Jordan, traditional buildings were built with concentration given to the incorporation of natural lighting, wind direction, shadowing effects, and insulation material. However, due to urbanization and population growth, there was a shift in building patterns, land use, zoning, and technology. Realizing the spillover effects of economic growth, a shift towards green building concepts and sustainability took place. This shift in the way buildings are designed, constructed and operated is crucial in minimizing the negative impact on the natural environment (Royal Scientific Society of Jordan and the Friedrich-Ebert-Stiftung Amman Office, 2013).

The relationship between urbanization and sustainability has long been the focus of numerous studies (Rogers et al., 2012). In Jordan, a transition to a green economy is highly

favorable due to the water and energy constraints Traditional principles have evolved over a long period of time in almost all countries of the world. People have developed building techniques that are perfectly adapted to available building materials and local conditions such as climate. The original construction is a similar principle used by "simple people" (without specific education in construction), adapts their homes to the immediate natural environment and uses locally available materials economically. The third alternative, colloquial construction, can be defined as a culture of building adapted to the existing environment and available resources, producing homes with the help of traditional techniques that have a specific purpose and represent the values, economic conditions, and lifestyle of builders (Oliver, 1997).

In Jordan, the concept of green buildings has been gaining interest since 2009. The Jordan Engineers Association hosted a core group of dedicated professionals, academics and entrepreneurs to begin work on the establishment of the Jordan Green Building Council (Jordan GBC). Jordan GBC was registered as a non-governmental organization under the Associations Act No. 51, Article 11 on 13 October 2009. It is an industry-led initiative to lead the Jordanian real estate industry to become more environmentally friendly (Almatarneh, 2013).

In addition, the Jordanian government has taken significant measures to guide and regulate the practice of green building in Jordan, including the issuance of a comprehensive set of energy and renewable energy legislation, water efficiency and savings incentives, waste management legislation, and the National Green Building Code. By June 2017, seven buildings had received a LEED certification in Jordan, one of which received the Platinum Certificate - the ABS Randa Kawar IB College Building while more and more buildings adopted green building strategies (Chan, Darko, & Ameyaw, 2017).

The Green Buildings Guide in Jordan, issued in 2013, includes comprehensive technical standards and standards in seven chapters. This includes green building management, site sustainability, water efficiency requirements, energy efficiency requirements, internal health environment, materials, and resources (Tewfik & Ali, 2014). Some examples of sustainable buildings in Jordan with their details are given in Table 4.1, 4.2 and 4.3. Dutch embassy building in Amman (figure 4.8), World Health Organization building (WHO)

(figure 4.9) and Middle East Insurance Company building (figure 4.10) are the main examples of sustainable buildings in Jordan.

Table 4.1: Examples of Sustainable Buildings in Jordan

Buildings with a LEED Certificate	The most important elements of sustainability in the building	Description Of Buildings
Dutch Embassy Building In Amman	• Reuse of existing building • Transparent external design • Sunlit patio for optimal daytime use • External shading equipment • Cooling area for building cooling • Use the existing pool to enhance the cooling capacity of the building • Use of solar panels • Benefit from existing trees • Limited water consumption in the garden • Harvest rainwater for irrigation (Arch daily, 2012).	Date built**:** 2010 Location: Abu Bakr Siraj Al-Din Street, Abdoun, Amman Designer**:** Rudy Uytenhaak Architects, Netherlands. The Dutch Embassy received the LEED International Green Building Certificate in 2010 and was the first building in Jordan to receive this certificate with a silver rating (Arch daily, 2012).

Table: 4.2 continuous of table 4.1 Examples of Sustainable Buildings in Jordan

(WHO) World Health Organization building	•Energy saving from landfill by 22% • Reduce carbon dioxide emissions • Water savings of 60% • Recycling 78% of construction waste (Tewfik & Ali, 2014)	Date built: 2011 Location: Mohammad Jamjoum Street, Amman Designer: Engicon is a global engineering consulting firm based in Amman, Jordan, with offices across the Middle East and in the United States. The headquarters of the World Health Organization (WHO) in Jordan received the LEED International Certificate of Green Building with a Golden Classification. The World Health Organization (WHO) is located in Amman, the capital of Jordan and is one of the main green buildings(Tewfik & Ali, 2014).

Table 4.3 continuous of the table 4.1Examples of Sustainable Buildings

Middle East Insurance Company Building	• Rainwater collection and processing system Rainwater collection and treatment system with a storage capacity of 380 cubic meters. •Front and side facades designed to decrease direct heat absorption. • Energy savings of 27.19% due to the basic design • 50.2% savings in drinking water due to the basic design • Green areas and irrigation systems designed to reduce the consumption of drinking water for irrigation by 66.55% (Jane Hosking, 2015).	Date built: 2013 Location: Zahran Street, Amman Designer: Faris Bagaeen Middle East Insurance The Middle East Insurance Company (LEED) was awarded a LEED certification The building achieved a significant reduction in water use (Jane Hosking, 2015).

Figure 4.8: Front elevation with colonnade and shading of the Dutch Embassy Building in Amman (Al-Azhari & Al-Najjar, 2012)

Figure 4.9: 3D Ideal of World Health Organization building (WHO) (Tewfik & Ali, 2014)

Figure 4.10: Front side of the Building of Middle East Insurance Company (Jane Hosking, 2015)

4.2.3 Laws and technical standards

- The Renewable Energy and Energy Efficiency Law no. (13) For the year 2012:

States that all systems, equipment of renewable energy and efficiency together with inputs, local production and imports are exempted from customs fees and sales taxes (Steiner, 2015).

Since 2008, the Building Research Center has been promoting the development of the Energy Efficiency Code in Buildings under a series of building codes under the jurisdiction of the Jordan Green Building Council. This latest energy stander contains Mechanical services terms; Electrical service specifications; Gas extension code; Thermal insulation code (updated); Energy efficiency code in buildings (Jordan & and the Friedrich-Ebert-Stiftung Amman Office, 2013).

- Law No. 73 of 2012

The Act aims at organizing energy saving measures and means to develop a policy for rationalizing energy consumption, enhancing the efficiency of use, promoting investment and improving energy efficiency and awareness (Steiner, 2015).

4.24 Examples of initiatives and programs in Jordan to develop the environment

- Voluntary Classification Systems

A green certificate or classification is a voluntary process initiated by the client or real estate developer who wishes to obtain a certificate of appreciation and description of the building. The classification and certification indicate the extent to which the building considers the well-being of the population, its low costs, and respect for the environment.

Two major institutions are developing green building classification systems in Jordan. In contrast, the Jordan Green Building Council has created a simple and customized tool to classify existing and new buildings in Jordan. The objective of this tool is to develop a simplified checklist in light of market conditions that meet the need for more efficient and sustainable buildings. This step is in line with the establishment of a market for real estate activists where their properties are granted privileges as they are more operationally efficient and have a sustainable impact. In the same context, the categories of certification of leadership in energy and environmental design (LEED) have formed the Basis to put the list of audit, given to being a standard mark. Reference was also made to the Jordanian National Building Council (JNBC) and the Jordan Green Building Guide (JGBG) to ensure compliance with applicable local building laws and regulations. On the other hand, the Royal Scientific Society issued the Green Building Guide in Jordan, which was developed and approved by the Jordan Green Building Council in November 2010 (Zawaydeh, 2017).

The green building classification guide and classification system is a mandatory reference to Jordanian national building codes, International building classification systems, such as the Energy Leadership and Environmental Design System, the Environmental Impact Assessment System for Buildings, the Abu Dhabi Urban Planning Council's Estidama Initiative, and others(Zawaydeh, 2017).

- Green Building Guideline of Jordan

Since green buildings have a profound impact on our natural environment, economy, health, and productivity, the approach of the inexperienced building guideline is to know

the building's total impact on the environment in six classes that offer the inspiration for green building design. These classes are:

- Green Building Management.
- Site sustainability
- Water efficiency
- Energy efficiency
- Healthy Indoor surroundings

Materials and Resources The guide's standards are designed to suit climate, resources, legislation, policies, policy tools, building techniques, and local strategies. The intervention of a third-party volunteer in cases where manipulation is feared, and the assistance of clients to obtain reliable testimony and objective endorsement of their premises, is acceptable. The entities responsible for the voluntary classification of buildings also cooperate with public institutions to participate in government incentive schemes (Awadallah, Habet, Mahasneh, & Adas, 2011).

•Jordan Standards and Metrology Organization

Jordan Standards and Metrology Organization Have set a number of standards and regulations related to environmentally friendly materials and products and electrical appliances that achieve energy and water efficiency. The aim of the move is to develop household energy resources, install renewable energy technologies, adopt demand-driven management, conserve energy, and initiate initiatives to improve its use efficiency (Ali & Al Nsairat, 2009).

4.2.5 The challenges of sustainable construction in Jordan

There are a variety of general problems facing developing countries, like fast urbanization rates, extreme impoverishment, social difference, low skill levels, institutional deficits, AN unsure economic setting, and environmental degradation, that in them produce a challenging setting.

- Lack of information regarding sustainable design
- Perceived high price

- Higher final price
- Lack of Laws and rules
- Risk of investment
- Construction prices
- A restricted number of pilot or demonstration sites and case studies for information management
- Lack of demand
- Limited government support (regulatory, incentives)
- Lack of credit resource to hide the direct cost
- And the restricted numbers of demonstration sites are the first obstacles

Different barriers to green building in Jordan include lack of credit resources to cover initial price, lack of client demand, and high initial cost. Investment in certified occupation and professional training in green technology, eco-design, and associate degreed eco-construction is important to promote new green jobs for a rising market (Jordan & and the Friedrich-Ebert-Stiftung Amman Office, 2013).

4.2.6 Some solutions for the challenges of sustainable construction

The Jordanian government has taken significant measures to guide and regulate green building practices in Jordan, including a comprehensive set of energy and renewable energy legislation, water efficiency and savings incentives, waste management legislation, green building codes and a Booklet to increase awareness among Jordanians about green building practices in Jordan (Yuanyuan Li, Chen, Wang, Xu, & Chen, 2017), We will show some of these procedures:

• Ministry of Public Works and Housing - Green Building Award:

Jordan's Ministry of Public Works and Housing will award an annual award for the best building in the field of green design, ensuring that the building complies with the standards and regulations set by the Green Building Guide in Jordan (Saidan, 2012).

- Investment Law No. 30 of 2014:

This law provides benefits and incentives in paragraph 8 / a. Excludes renewable energy projects in development zones from licensing fees for the necessary infrastructure and limits the license fees for these projects (Alawin et al., 2016).

- Regulation No. 49, 2015 (Promotion of renewable energy and energy conservation fund regulation):

Provides financing for the exploitation of renewable energy sources and energy efficiency. Seeks to develop programs and projects in cooperation with international institutions (Al-Salaymeh, Abu-Jeries, Spetan, Mahmoud, & ElKhayat, 2016).

The engineers pointed out that the main entities responsible for green building practices are the Jordanian Green Building Council, followed by the Engineering Society and Greater Amman Municipality. The media with different universities throughout the country play a limited role in environmental awareness. The scientific discourse of the Green Building can be achieved through the media and transformational education. Education and information are thus transformed into a green economy (Stiftung F. and Royal Scientific Society 2013).

Some studies recommend that an incentive system should be established for contractors to ensure the cost-effectiveness of green buildings and the development of information services for users and product information through reliable professional sources such as ministries of public works, housing and energy , and the Jordanian environment. The studies recommend that government incentives be strengthened through grants, the program of reductions, tax incentive programs, classification systems and technical assistance.

4.3 Comparison with Lebanon

The current population of Lebanon is 6,075,480 as of Sunday, February 24, 2019, based on the latest United Nations estimates, and the total land area is 10,230 Km2 (3,950 sq. miles)

(Worldo meters, 2019) Beirut is the capital of Lebanon. Beirut is located on the peninsula in the middle of the Mediterranean coast of Lebanon (World atlas, 2018) (figure 4.11).

Figure 4.11: Map of Lebanon

4.3.1 Sustainability in Lebanon

Lebanon isn't totally different from developing or even developed countries, within the face of shortages, depletion, and degradation of environmental resources, attributes, a share of worldwide contribution to warming, consumption of natural resources, land occupation and transformation and its effects on human health, perpetually seeking sustainable means that to conserve these resources (Searle, 2006).

Over the past few years, environmental issues in Lebanon have received considerable attention because the country's environmental degradation has reached serious levels. Unfortunately, Lebanon has no government policy at all to protect its natural resources. Some situational initiatives are being taken by some ministries but are less than adequate. The private sector and civil society seem more aware and enthusiastic about green issues in Lebanon, but much remains to be done to achieve a satisfactory level of environmental quality.

Many sectors have recently begun to acknowledge the impact of their activities on the provision of resources by tracking the 3 components: environment, social and economic, to seek ways in which to considerably mitigate negative impacts and improve positive options. The owners of commercial buildings, especially, have recently begun to recognize their responsibilities not just for the environment, however additionally for social influences, leading to a shift in how buildings are designed, built, and more significantly, however they operate or perform. This shift in attitudes is essential because of the exaggerated market demand for environmentally sound products and services and energy efficiency. A key issue in seeking to attenuate impacts is that they would like for a viable and possible standard for measuring environmental performance and energy performance (El-Aby, 2014).

Even civil society has established its Green Party following the footsteps of civilized societies. However, the Green Party in Lebanon has the main priority, the role of outreach, both with the general public and with all political actors in the country, to create awareness about hot environmental issues before the government begins to deal with the green regulatory framework in construction (Ifpinfo, 2015).

Lebanon looks to possess taken some initial steps towards the sustainability arrange, however a lot of remains to be done thus far that it will have a place among the leading countries in this area. In addition to its scarceness of natural resources, Lebanon suffered an extended war of concerning fifteen years, therefore conveyance the country into serious monetary debt and impeding its economic process. In fact, only 2.4%of total public funds are allotted to environmental protection (United Nations Environment Programme). Of course, green construction needs immediate higher investment than traditional investments, makes convincing developers and users of opting for sustainable construction a challenge (R. Awwad & El Khoury, 2012).

Sustainable construction has begun to attract the attention of some developers in the Lebanese market, but much remains to be done in this area: improving building codes to include more incentives for green building and strengthening the legislature to implement them. The recent increase in construction activity in the world and the increasing depletion of natural resources has encouraged researchers to think about sustainable building

techniques. These technologies include the use of renewable energy, building energy-saving infrastructure and recycling of building materials. The success of these technologies is related to local conditions, standards, and practices. For example, after the end of the civil war in Lebanon, an attempt was made to recycle the building demolition materials in the central business district of Beirut, which contained an estimated 4 million cubic meters of debris resulting from the destruction during the war (Lauritzen, 1998).

The 2007 battles within the Nahr al-Bared camp in northern Lebanon resulted in another great amount of demolition waste, estimated at 0.6 million m3 (UNRWA, 2008) . Efforts are current, as a part of a research project, at the American University to review the potential for recycling or reuse of the 2006 war or battle materials in Nahr al-Bared camp (Srour, Chehab, Awwad, & Chong, 2010).

4.3.2 Sustainable buildings in Lebanon

The green buildings in Lebanon are still ambitious because it is a comparatively new idea. Now there are some projects under construction by Companies which is specialized in this field. One notable example is the Sama Beirut project in Sodeco. The project will be adopted using LEED std, and employs many sustainable strategies with maximum respect for the environment in essence: water efficiency, reduced energy consumption, improved energy performance, green power on site, daytime lighting, ventilation effectiveness, with low emissions and the capability to control systems to improve thermal comfort in Sama Beirut. Other projects include Badaru Gardens in Badaro, La Broceliande in Yarze, as well as planned AUB engineering lab (Mneimneh, Hamdan, & Mourtada, 2012).

In 2008, Magal, the Academic Urban Observatory, launched the project "Promoting Sustainable Construction in Lebanese Universities", which aims to raise awareness about sustainable construction mechanism in architecture's schools throughout Lebanon, prompting students to use sustainability standards in their new design projects and encourage Schools to insert categories on sustainable building into their courses. Following the success of the project in 2008-2009, sustainable construction techniques were inserted to architecture students and teachers around Lebanon, leading to 221 students from 7 Lebanese, sustainable construction techniques were introduced to architecture students and

teachers throughout Lebanon, leading to the participation of 221 students from 7 Lebanese universities in Majal's sustainable building competition in 2009; MAJAL decided to follow up this project in 2010 through the launch of the second edition of the Sustainable Architecture Competition (Heinrich Boll Stiftung, 2014).

Concern about the social, economic and environmental impacts of buildings in Lebanon led to the establishment of LGBC. The Green Building Council of Lebanon was built in 2008 by 10 founding members, today of 100 members (companies and individuals). Is a non-profit organization whose mission is to accelerate the adoption of energy-efficient, hygienic and environmentally sustainable building practices by promoting green building practices and improving the Lebanese environment through the development of technical standards and the adoption of Buildings rating systems. LGBC has joined WGBC, an active member of the WGBC MENA region. Several international forums are now recognized in many United Nations agencies, the European Union and other international affiliated associations (Lebanon Green Building Council, 2012).

The American University of Beirut (AUB) conducted research on sustainable building systems and targeted on building materials, sustainable design, and energy efficiency. One research program tested the impact of using changed automotive motor oil on concrete mixes as an associate air-entrained agent. Results indicated that the used engine oil acted as a plasticiser, increased the air content, resulted in average losses in flexural strength, rending tensile strength, and modulus of elasticity, nevertheless, the concrete compressive strength wasn't affected(Hamad & Rteil, 2003). And preliminary studies on organic fibers were conducted at the American University of Beirut (E. Awwad, Mabsout, Hamad, & Khatib, 2011).

Cement is specially provided by two firms, HOLCIM, and AL-SABAA, In Lebanon, situated in northern Lebanon. Additionally, sand and gravel are excavated from AMIOUN and DANNIYEH; mountainous areas also situated within the northern a part of Lebanon. Additionally, steel bars employed in the construction of buildings are equipped by a widely known company in Lebanon known as Yard that is found in the capital of Lebanon (Beirut) and imports materials from abroad. Unfortunately, the construction industry

continues to follow ancient construction ideas instead of a sustainable thought (Folfol, 2015).

Today, with new financial incentives for sustainable projects, such as the Lebanese Central Bank's low-interest loan on energy-saving and environmentally friendly developments, we are seeing more efforts to reduce pollution, reduce energy consumption and value the environment, while more and more local projects are seeking BREEAM, LEED, or ARZ certificates (Karkour, 2014).

Bakirzai, an environmental tourist village near Baaklin in Chouf, will open in early September. Ramzi Salman is the founder of the village, which was developed on a plot of land of 200,000 square meters. The Bkerzay has 34 guest rooms, small rooms for hikers and young students. All lodges were built using local building materials in an architectural style that reflects the rural setting. A hiking trail is also available. The whole project works on solar energy (Businessnews.com.lb, 2017, Aug 11).

Verdon Heights is a new residential project under construction in Beirut, Lebanon. The exclusive high-rise property is located on two adjacent blocks (A and B) occupying 2,648 square meters on the main Verdun Street in a prestigious area of Beirut overlooking the Mediterranean Sea. The building has seventeen floors and six basement levels. There are 249 spacious residential units (three in floor) ranging in sizes of 260 square meters, 300 square meters and 360 square meters. Retail, coffee shops and boutiques can occupy street-level areas. Verdon Heights is one of many construction comes within the Middle East that have been designed to realize LEED certification. The design, planning and construction of green buildings became a high priority throughout the region. The U. S. green Building Council (USGBC) has developed LEED Leadership System. The non-profit organization that oversees the LEED certification has 1,188 licensed projects within the Middle East. Verdon Heights is one amongst twenty four projects in Lebanon (Energy International, 2013) (figure 4.12). Examples of sustainable construction in Lebanon are given in table 4.4 and 4.5 and the pictures are shown in figure 4.13, 4.14, 4.15, 4.16 and 4.17.

Figure 4.12: Verdon Heights Building (Energy International, 2013)

Table 4.4: Example of Sustainable Construction in Lebanon

Example of sustainable buildings in Lebanon	Description Of Buildings
International College Elementary School	Architect: Flansburgh Architects, Boston, MA, USA Khatib & Alami Consolidated Engineering Company, Beirut, Lebano. Location: International College Bliss Street, Ras Beirut Lebanon The International College Elementary School is the first project in Lebanon to be awarded the Leadership in Energy and Environmental Design (LEED) Award from the Gold Class for Schools in March 2013. International College (IC) has constructed three new buildings on the Ras Beirut campus, including the Elementary school building and, (building of Preschool & Middle School) and the new activity building with a 420-seat hall and a gymnasium.. The project consists of 3 interconnected buildings from 3 to 5 layers with an underground garage. The three buildings are connected to the ground floor and parking, with a total area of 22,670 square meters. This modern Elementary school includes study rooms, music, arts, scientific laboratories, workshops, offices, a meeting room / theater, and two sports rooms. The also houses the central heating, cooling and power plants of the school(Ecoconsulting, 2012) .

Table 4.5: continuous of Table 4.4 Example of Sustainable Construction in Lebanon

Casa Batroun, Lebanon	Architect: MAHA NASRALLAH Location: In The Seaside Town of Batroun, in The North of Lebanon. Date: 2011/2013 The traditional Petron house was restored In accordance with the Environmental Impact Assessment for International Buildings for Customized Licenses 2010, and achieved BREEAM Excellent certification. Certificate obtained in February 2014. The project included the rehabilitation and expansion of an old 100-square-meter family home located in the coastal city of Batroun, overlooking the Mediterranean Sea, In northern Lebanon(Arab center architecture, 2014).
BLC Bank headquarters	Date: 2012 Location: Beirut, Lebanon The LBC is the first building to be awarded an ARZ Green Building classification as an acceptable aggregate for meeting building standards and green performance. Therefore, the building was awarded the Bronze ARZ became the first green commercial building licensed in Lebanon. The building covers an area of 7,800 square meters. The building consists of 10 floors (Ibrahim, 2017)

Figure 4.13: 3D for the International College Elementary School (Ecoconsulting, 2012)

Figure 4.14: International College Elementary School Source (The Daily Star, 213)

Figure 4.15: Casa Batroun, Lebanon from Outside (Maha Nasrallah architects, 2014)

Figure 4.16: Casa Batroun, Lebanon from Inside (Maha Nasrallah architects, 2014)

Figure 4.17: BLC Bank headquarters (Anid construction, 2014)

4.3.3 Laws and technical standards

- The Lebanese Environmental Action (LEA)

The Lebanese Environmental Actions extra funding tool launched by the Central Bank in cooperate the Lebanese Council for Energy Conservation in 2015 within the framework of the "green initiatives" implemented by the Bank. The mechanism is designed to finance environmental initiatives, such as garden, green walls, green roofs in buildings, recycling, natural agriculture, eco-tourism, wastewater processing, rainwater collection, and others (The Lebanese Center for Energy Conservation (LCEC) 2019).

- The Lebanese Environmental Pollution Abatement Project (LEPAP)

The Lebanon environmental Pollution Reduction Project (LEPAP) aims to decrease industrial pollution in targeted industrial facilities and to strengthen the monitoring and enforcement capacity of the Ministry of the Environment. LEPAP is a joint initiative of the Ministry of Education, the Ministry of Finance, Banque Du Liban (BDL), the World Bank and Italian Cooperation to develop a mechanism to finance industrial pollution reduction in targeted industrial facilities and provide technical help to make sure the implementation and sustainability of those interventions (Lebanon UNDP, 2017).

4.3.4 Institutional programs

- Lebanese Green Building Council:

The Lebanese Green Building Council (LGBC) is a non-profit organization founded in 2008 by a distinguished group of Lebanese engineers, architects and academics to promote sustainability in the urban environment in Lebanon. In pursuit of this ambitious vision, LGBC has spared no effort in producing publications, making presentations at conferences and contributing to the development of new building standards in Lebanon (Al-asad & Emtairah, 2011).

- National Energy Efficiency and Renewable Energy Action (NEEREA)

The National Energy and Renewable Energy Initiative is a national funding tool launched by the Lebanese Central Bank to finance green energy designs in Lebanon. It established and originated in 2010 under Circular No. 236 issued by the Central Bank, which sets forth the terms and conditions of benefiting from loans granted to green projects cooperate the European Union. In 2013, the Central Bank, under Circular Nos. 313 and 318 and, more recently, Circular No. 346, entered new considerations for energy productivity, renewable energy, and sustainable buildings. The Lebanese government is functioning onerous to raise its portion of renewable energy within the creation of electricity and decrease greenhouse gas emissions (GHG) by 2020. For this purpose, the government has set strategic targets to realize a 12 percent system increase in renewable energy. By 2020 and to reduce energy demand by five percent by 2014 as an intermediate goal .The main objective of NEEREA is to support the funding of environmentally sustainable projects, including the implementation of the EE and RE implementation, through the provision of soft loans for eligible and feasible projects in Lebanon. NEEREA will so by permitting private sector entities, including individuals, small and medium-sized enterprises or even corporate entities, to use for increased loans for any type of EE and/or RE projects. The creation, development, and implementation of NEREA have clear and necessary benefits (Perakis, Anagnostopoulos, & Jouni, 2012).

- The Green Demonstration Room

Project: The green Demonstration room is found at the Jounieh research and Development Center, where students from public and private schools from all regions of Lebanon will visit and study the concept of green buildings, the principles of energy efficiency, water conservation, and different environmental issues (World green building council, 2017) (figure 4.18 and 4.19).

This project is that the results of three cooperating partners:

- The Center for research and Development (Affiliated to the Ministry of Education and High Education).
- Makhzoumi Foundation.
- The Lebanon green Building Council "LGBC "

Aim and objectives: The main objective of the project is to increase public awareness of the importance of energy efficiency, water conservation and pollution reduction through the introduction of green building concepts.
The objectives are:

- Create a green demonstration room and renewable energy equipment for students.
- Demonstrate the concept and principles of green buildings.
- Develop awareness of the importance of the principles of energy efficiency, water conservation and other environmental issues by helping as many learners as possible of all ages and backgrounds.
- Encourage the use of renewable energy technologies.
- Train the science teachers of the center (World green building council, 2017).

Figure 4.18: The Green Demonstration Room (linked in, 2017)

Figure 4.19: The Green Demonstration Room(linked in, 2017)

4.3.5 The green building rating system in Lebanon

The ARZ rating system is designed to measure the extent to which commercial buildings in Lebanon have convenient workplaces and consume the right amount of energy and water, with little impact on the natural environment. In addition, the rating system will encourage building owners and facility managers to achieve higher levels of credit than ever before to attract tenants and discerning customers. To date, ARZ has granted licenses to three projects, while two other projects are under study. Accredited evaluators are required to

sign the ARZ Code of Ethics and require them to abide by its contents without any conflict of interest, whether visible or not. On the other hand, owners are entitled to appeal if certain credits are denied, and ARZ BRS will be responsible for resolving these claims within a specified period (Al-asad & Emtairah, 2011).

There are nine modules to the ARZ BRS: eight core modules, and one bonus module, each weighted according to the Lebanese context. A building can achieve 150 points from the eight core modules and a further 16 points from bonus, broken down as follows (Ibrahim, 2017).

Table 4.6: The Modules of the ARZ BRS

Module	Item	Max Possible Points
M1	Energy Performance	06 pts
M2	Thermal Energy	38 pts
M3	Electrical Energy	33 pts
M4	Building Envelope	36 pts
M5	Materials	08 pts
M6	Indoor Air Quality	09 pts
M7	Operation and Management	11 pts
M8	Water Conservation	09 pts
M9	Bonus	16 pts

Table 4.7: ARZ Building Rating Ranking

ARZ Building Rating Ranking	Minimum Required Score
Gold	135 pts
Silver	120 pts
Bronze	100 pts
Certified	80 pts
Non - Certified	< 80 pts

At the same time, other international classification systems for green buildings, including the Energy Leadership and Environmental Design System is the most widely adopted sustainable building rating system in the United States,(LEED) (Azhar, Carlton, Olsen, & Ahmad, 2011).

Building Research Establishment Environmental Assessment Method (BREEAM) UK: Excellence in Design for Greater Efficiencies (EDGE). The International Finance Corporation (IFC), and CEDRE rating system (Industrial Research Institute) are in place. The LEED certification is the mostly prestigious in its field and awarded to four completed projects and three innovative projects in progress. BREEAM has been awarded two projects, while four other projects are being evaluated. Two recently acquired EDGE certificates have also been awarded (UN Environment, 2016).

4.3.6 The challenges of sustainable construction in Lebanon

The main challenges are the high cost of the green project. Some of the main barriers to green buildings are lack of technical support and technology, unreasonable costs, initial cost and real life , moreover, people's lack of awareness about sustainable buildings (Professional Project Management Education, 2010).

Another major barrier to sustainable development in Lebanon is that the absence of an applicable legislative regime liable for imposing and watching green building practices. Whereas the Ministry of environment and also the Department of Energy and Water are attempting to raise awareness through alternative campaigns and initiatives, the absence of a robust building code or laws coupled with the absence of a reliable oversight agency is the most difficult threat to overcome(R. Awwad & El Khoury, 2012).

4.3.7 Solutions for the challenges of sustainable buildings

Sustainable construction has attracted the attention of some developers in the Lebanese market. However, much remains to be done in this area: improving building codes to include more incentives for green building and strengthening the legislature to enforce these regulations(R. Awwad & El Khoury, 2012).

The Lebanese Central Bank (BDL) supports green loans, which consumers can apply for a reasonable interest rate of about 2% on the cost of funds. The loans, run by commercial banks, were initially aimed at supporting industry and eco-friendly agriculture, but were expanded to support green construction and eco-tourism, and even renovate existing facilities for prior environmental standards. To expand the initiative, both BDL and UNDP have agreed to establish the National Energy Efficiency and Renewable Energy Action (NEEREA) to finance energy efficiency, renewable energy and green building projects throughout Lebanon (Al-asad & Emtairah, 2011).

4.3.8 Some recommendations and suggested solutions for developing sustainable building in Lebanon

- The government should at least implement minimum needs for the submission of environmental impact assessment of latest buildings to the corresponding authorities for approval. It should additionally make sure that public enterprises use at least the components and energy-efficient and environmentally sustainable building practices that offer a model for the private sector.
- Another incentive the government can start is to organize the green city Award, just like the European Commission, to encourage Lebanese cities to compete for sustainability. The cooperation and coordination of efforts among government parties like the Ministries of environment, industry and public works, the Council for Development and Reconstruction, and varied non-governmental organizations like LGBC et al, developers and educational and coaching establishments and also the public could be an essential factor for meeting the current challenges and putting the country on track and quick towards sustainability (R. Awwad & El Khoury, 2012).
- Educating the public on the concept of green buildings through sustainable advertising and programs, demonstration projects, information sessions, workshops and green labeling programs.
- Develop green building training programs to increase the number of skilled professionals in green building operations.

- The provision of economic incentives, for example, tax relief and development fees, loans and financial rewards to major players in the industry who commit their projects to a minimum green estimate.
- Implementing plans for granting top green projects an assessment.
- Conducting research to adapt the existing ARZ classification system to suit the local context and priorities (El-Aby, 2014).

A summary of comparison between the three countries Syria, Lebanon and Jordan is shown in table 4.8.

Table 4.8: Comparison between the three countries Syria, Lebanon and Jordan

	Jordan	**Lebanon**	**Syria**
Capital	Amman	Beirut	Damascus
Population	10,011,143	6,075,480	18,287,228
Area	89,342KM^2	10,400km^2	183,630km^2
Sustainability Situation	Most developing countries That are still taking the initial steps towards achieving sustainable construction.		
Assessment Method of Sustainable Construction	LEED.	have their own system ARZ System And also they use LEED.	LEED.
Green Building Council	They have Jordan Green Building Council.	They have Lebanon Green Building Council.	None

Table 4.9: continuous of table 4.8 Comparison between the three countries Syria, Lebanon and Jordan

Challenges of Sustainable Buildings	•Lack of information regarding sustainable design. . • Lack of Laws and rules. •Lack of demand. •Risk of investment •Higher final price •Lack of credit resource to hide the direct cost •Limited government support (regulatory, incentives). •And the restricted numbers of demonstration sites are the first obstacles.	•The main challenges are the high cost of the green project. •Lack of technical support and technology. •Perceived high price. •Lack of awareness about sustainable buildings. •The absence of an applicable legislative regime liable for imposing and watching green building practices.	•Lack of knowledge and awareness of people about sustainable buildings. •Economic challenges. •Lack of experience of engineers in this field. •Absence of laws related to sustainable buildings. These challenges has been taken from questionnaire survey.

CHAPTER 5
RESULTS, DISCUSSTIONS AND CONCLUSIONS

5.1 Introduction

Syria has gone through a difficult phase due to the war which has been a caused lot of destruction in the environment and infrastructure. Therefore, the concept of sustainable buildings is an appropriate idea to start during the reconstruction of the country. A questionnaire was prepared to collect data about the view of the contractors, civil engineers, and architects understand the level of experience of the concept of sustainable buildings in Syria and to find the challenges that sustainable building may face in Syria. The survey is distributed to 100 Syrian engineers, architects, and contractors. The number of engineers in Syria is 150000, and there are 15,000 of them outside the country, according to this number, the population is 135, 0000 and through this, we can determine the sample size which is 100.

The questionnaire was analyzed using the SPSS program where the questions were divided into three sections. The first part of the questionnaire consists of questions related to the social and economic characteristics of engineers such as age, gender, and engineering specialization. The second part consists of questions related to engineers' experience and questions about the construction industry. The third part consists of questions related to green and sustainable construction. A sample of a questionnaire is provided in Appendix 1.

5.2 Results

First part: Engineering characteristic and specialization

The responses of the first part of the questionnaire show that the percentage of male respondents is higher than that of females. Where, 64 % of them are male and 36% female. The largest proportion of respondents is between 20 and 30 years of age with the percentage of 59%. While the Respondents aged 40-50 years were the lowest with 11%. 57% of the respondents were civil engineers and 37% were architects and it is showing in figures (5.1, 5.2, and 5.3).

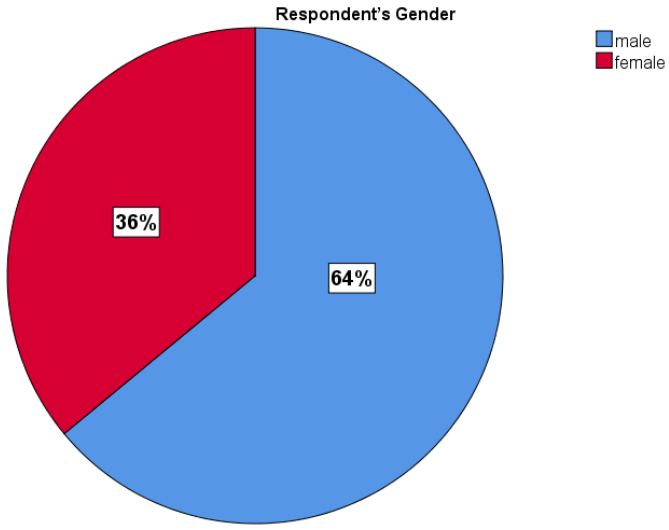

Figure 5.1: Respondent's Gender

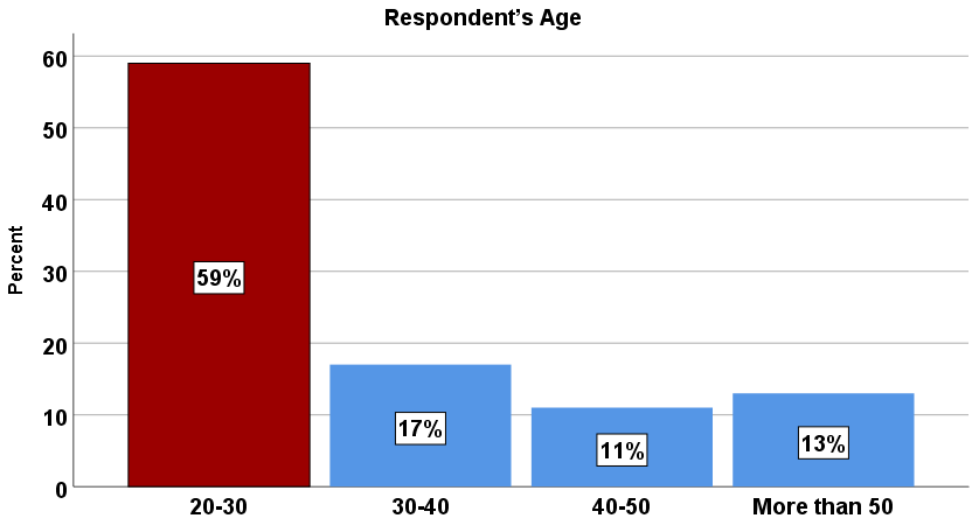

Figure 5.2: Respondent's Age

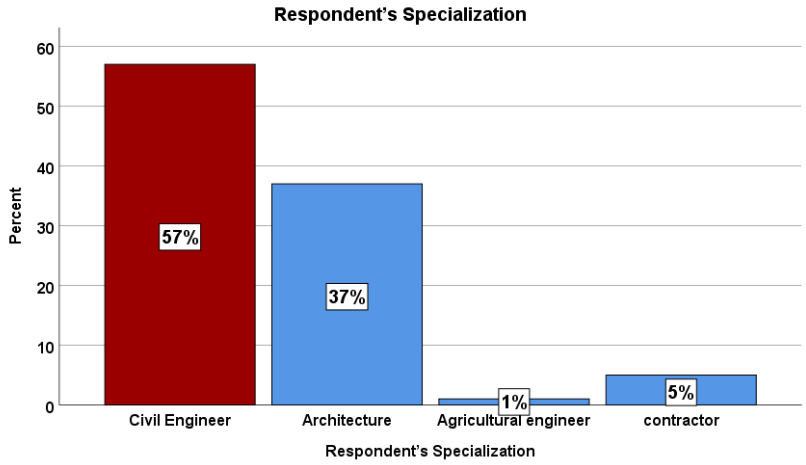

Figure 5.3: Respondent's Specialization

Second part: Engineers experience and construction industry

The results of the second part of the questionnaire showed that the largest number of participants had 1-5 years' experience with 42%. As a result of the war in Syria, access to engineers with long experience (more than 20 years) was difficult 16%. There are also 16% of respondents who did not have experience because of the war in Syria and as show in figure 5.4.

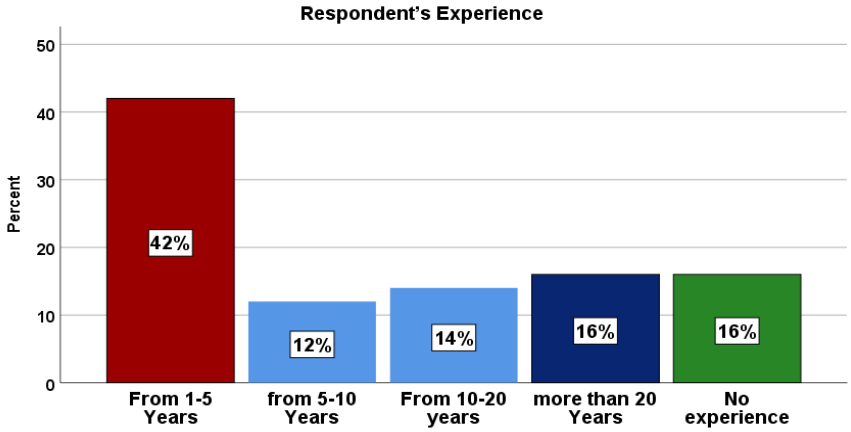

Figure 5.4: Respondent's Experience

66% of the respondents have an idea of the construction code in Syria and 34% do not have information about the construction code in Syria. The results showed that 83% of respondents said that the building code in Syria does not contain any information related to sustainable buildings and 17% said yes. This question has posed one of the challenges facing sustainable buildings in Syria: the absence of laws and information about sustainable buildings in the Syrian Building Code.

Responses show that 83% of respondents believe that the construction industry in Syria is not progressing, and this is also one of the obstacles that lead to weak construction and lack of implementation of sustainable buildings in Syria.

Responses to the challenges facing the construction industry in Syria showed that 69% of respondents responded to the selection of all challenges. That there are financial challenges and challenges related to building materials. The results showed that the building materials used are not environmentally friendly of the respondents which have confirmed by 75%, also there are challenges regarding construction codes and the absence of modern engineering equipment as show in figure 5.5.

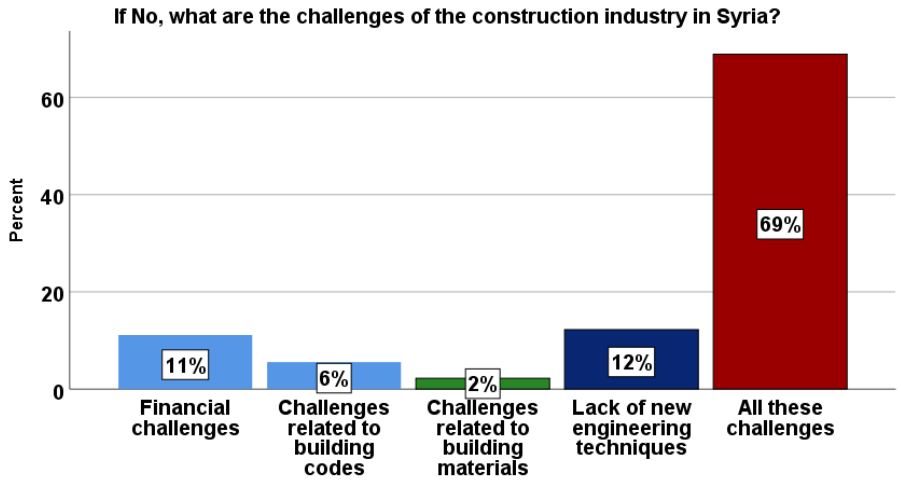

Figure 5.5: participants' responses about the challenges of the construction industry in Syria

Therefore, these challenges must be carefully considered in order to find solutions which help to progress and develop in this field. 74% of the respondents answered the building materials used in Syria are steel, wood, concrete, reinforced concrete and mud. Local building materials also is use in Syria, 80% of respondents have confirmed this as show in figures (5.6, 5.7).

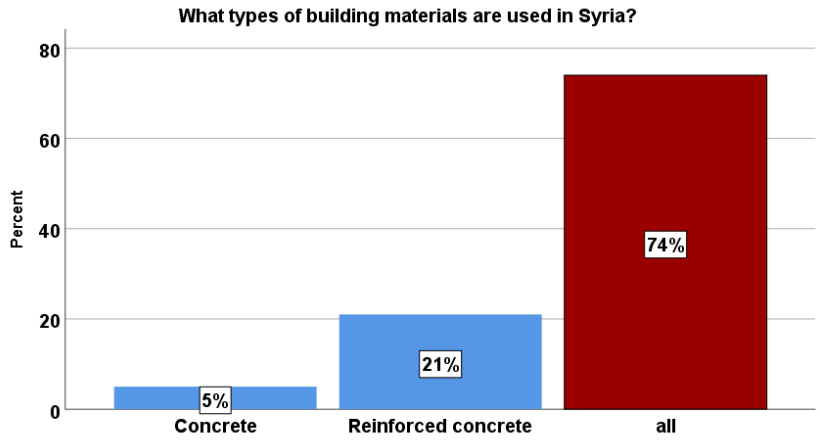

Figure 5.6: participants' responses about the building materials are used in Syria

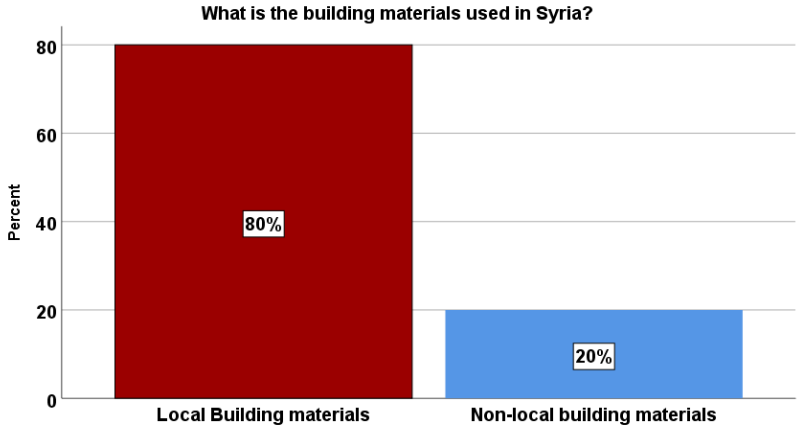

Figure 5.7: participants' responses about the building materials are used in Syria

Third part: green and sustainable construction

The results showed that 55% of the respondents had information about green buildings and sustainability and that most respondents with information about sustainable buildings were between the ages of 20-30. Despite these positive results, a large proportion of respondents did not have information about sustainable buildings and were 45%, which not a small percentage. This indicates that there is a lack of knowledge among some respondents and this indicates that the concept of sustainability and sustainable buildings does not spread in Syria. The survey results showed that participants received information on sustainable buildings with special effort, 31% of respondents heard about sustainable buildings from daily newspapers and 37% of participants received information from lectures. A small percentage of the respondents received information from the training workshops; most of them received training outside Syria, where the percentage was 10% and as indicated in figure 5.8. 60% of the respondents who received their information about the sustainable buildings from the training workshops said that the training was inadequate and 40% of the respondents said that the training is sufficient. Awareness of Sustainability and sustainable building can be deployed by focusing on education and education curricula to spread the concept of sustainability on a large scale in Syria and as indicated in figure 5.9.

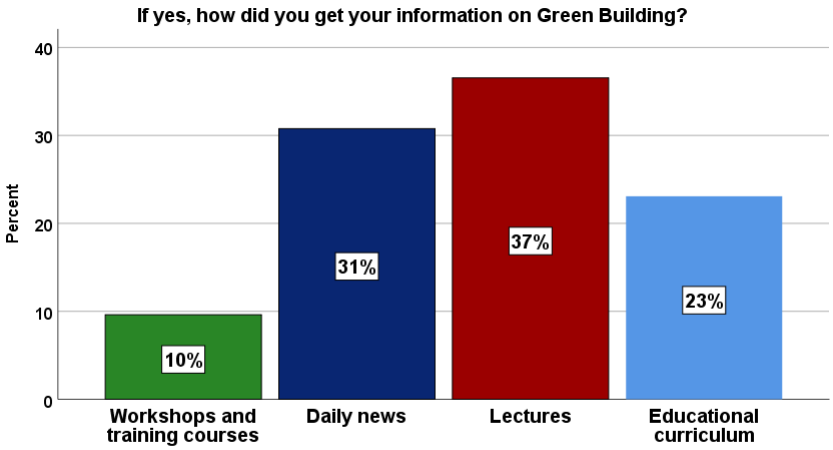

Figure 5.8: participants' responses about, how did you get your information on Green Building

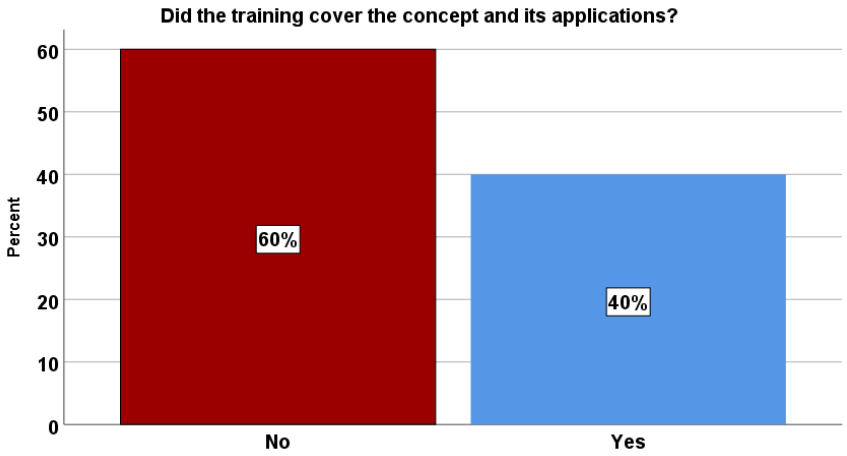

Figure 5.9: participants' responses about if the training cover the concept of sustainable building

According to the question on the status of sustainable buildings in Syria, only 5% of respondents seem to know of two sustainable buildings in Syria and most respondents are not aware of these buildings in Syria, where they are 38%. But it is surprising that 42% of the respondents had no idea about the status of sustainable buildings in Syria and as indicated in figure 5.10.

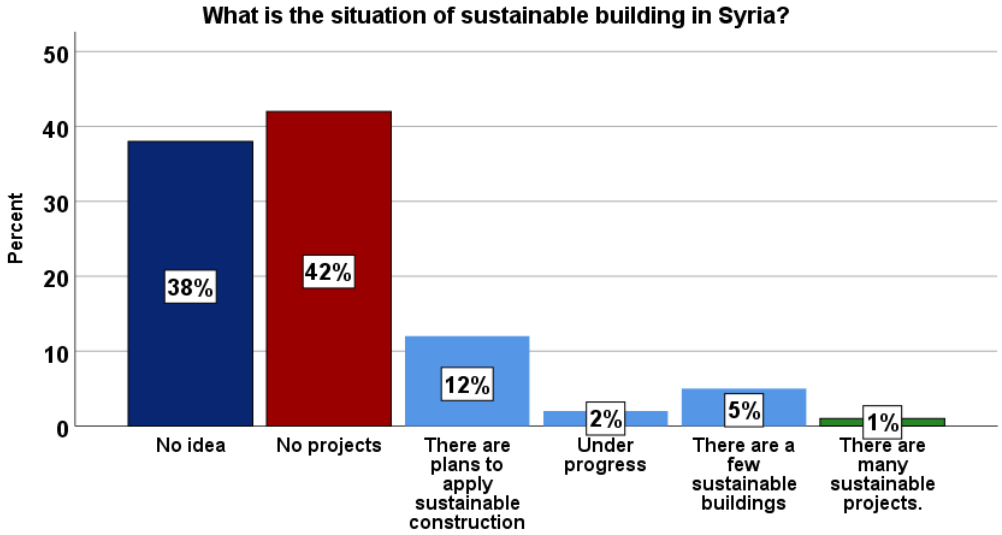

Figure 5.10: participants' responses about the challenges facing the implementation of sustainable buildings in Syria

The results showed the challenges facing sustainable buildings in Syria. Most participants are aware of these challenges. 72% of respondents agreed with these challenges and the challenges were as the following: There is a lack of awareness and knowledge of people in sustainable buildings. There are also economic and financial challenges that limit sustainable buildings, and there are not many engineers with sufficient experience in this area. , And there are challenges related to the lack of laws relating to sustainable buildings and it as indicated in figure 5.11.

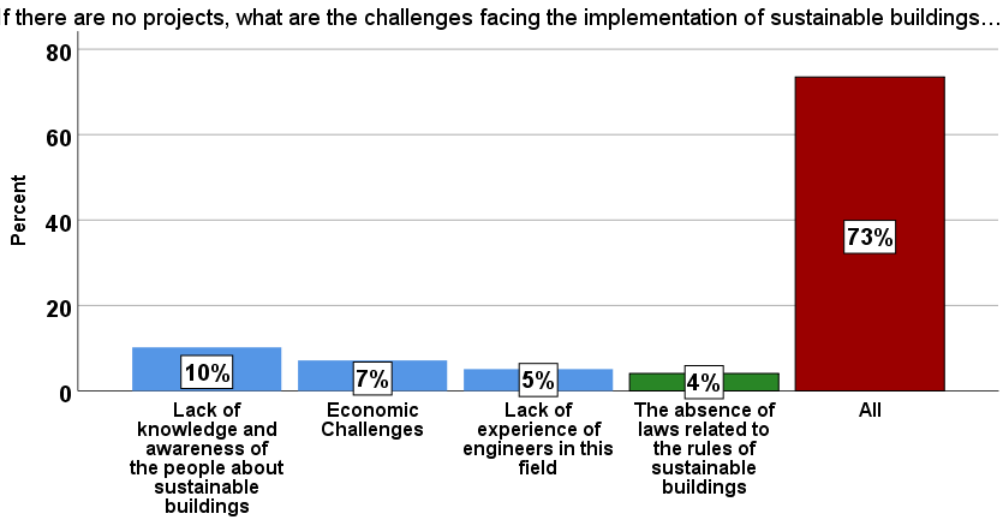

Figure 5.11: participants' responses about the challenges facing the implementation of sustainable buildings in Syria

The results showed that 42% of the respondents are not aware of any laws related to sustainable buildings in Syria, indicating that the concept of sustainability and sustainable buildings is new in Syria. 27% of the respondents said that there are no laws related to sustainable buildings. However, there were positive responses, with 26% of respondents saying that there are studies to implement laws related to sustainable buildings and it is showing in figure 5.12.

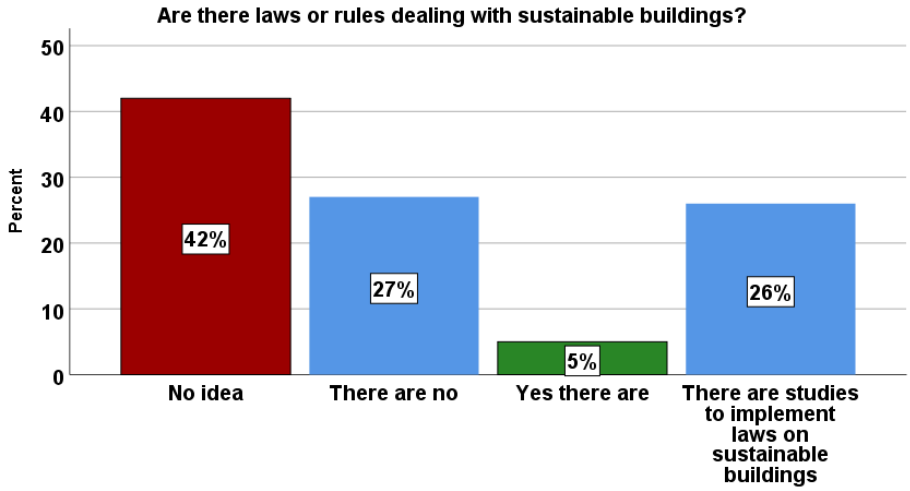

Figure 5.12: participants' responses about the laws or rules dealing with sustainable buildings in Syria

The majority of respondents had a good knowledge of energy and water saving technologies in construction, which was 71%. This is a positive indicator to promote the concept of sustainability as shown in Figure 5.13. Despite these positive results, 82% of respondents said that the energy and water technologies in the building are not used in Syria.

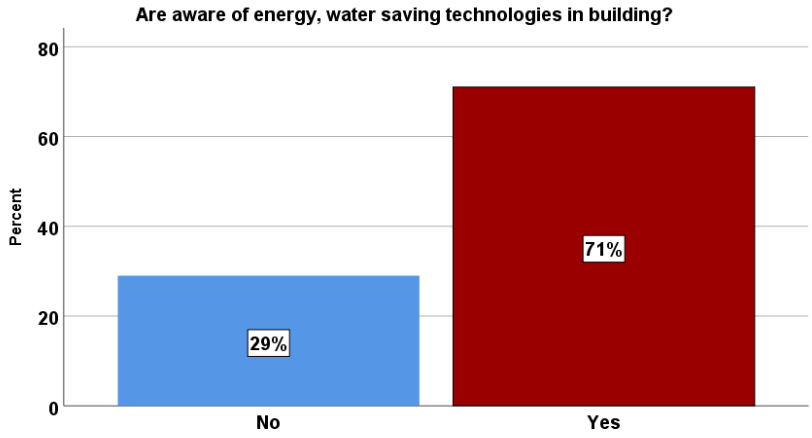

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Figure 5.13: participants' responses about the water saving technologies in construction

On the other hand, 85% of the respondents stated that they did not work in the field of sustainable construction before and that most of the participants who worked in sustainable buildings have worked outside of Syria and the result was about 80%. The results also showed that 73% of the respondents worked in a sustainable building between years of 2016 and 2018.

5.3 Discussions

According to the survey, the concept of sustainability and sustainable buildings is still not widely known in Syria, especially in the age group over 40 years, with insufficient awareness of sustainable buildings. Most engineers seek huge profits from their investments without realizing the benefits of sustainable buildings to people, health and the environment, some of these benefits that sustainable buildings reduce wastewater through the use of water-saving plumbing fixtures and rainwater harvesting systems. People who live or work in sustainable buildings also enjoy better indoor air quality as well as a number of health and wellness benefits. In addition, sustainable buildings use environmentally friendly building materials, many of which are recycled or reused. However, awareness of sustainable buildings is known in the 20-40 age groups and this gives hope for the spread of green buildings among people in Syria.

There are other things that encourage the expansion of sustainable buildings in Syria, which is the knowledge and awareness of people about energy technologies and water supply in the building. Syria will now begin the reconstruction phase. Therefore, this phase should be used to raise awareness and disseminate knowledge about sustainable buildings.
Through the analysis of the survey, it is possible to identify the challenges facing sustainable buildings in Syria, which are the lack of knowledge and awareness of people about sustainable buildings, economic challenges, lack of experience of engineers in this field, and absence of laws related to sustainable buildings. The government should provide laws and regulations to facilitate, encourage and support investors to use green concepts.

The government, investors, the public sector and the construction industry must become more aware of this issue so that the concept of green buildings on public buildings is initially applied to encourage people to adopt green buildings rather than traditional

buildings. Now is the appropriate time to start in Syria with this type of construction after the long war Improving the environment and infrastructure where it is. The construction and many of its operations can have direct and indirect impacts on the environment, society, and economy, and sustainable buildings seek to reduce these impacts during the construction process and beyond and reduce natural resource, energy consumption, and water consumption.

5.3 Conclusion

The concept of sustainability and sustainable buildings is a very important concept for the world and should be focused on an increased awareness about this concept for worldwide diffusion, while there are many countries that are making a lot of works to apply and spread sustainability in all regions such as the United States and the European Union, Other countries, such as developing countries, lack awareness and knowledge of the idea of sustainability, and Syria is one of them.

This study showed that the concept of sustainable buildings was present in Syria before the war but the implementation was slow and now it needs to raise awareness about the concept of sustainability and develop laws related to sustainable construction and environmental aspects to make this type of building widespread in Syria. . This study found the challenges that may face the implementation of sustainable buildings in Syria and found appropriate solutions and recommendations. The biggest challenge facing the implementation of sustainable buildings in Syria is the high cost of sustainable buildings, but this study showed that the first cost of sustainable buildings can be high but these costs will return over time by providing maintenance costs and ventilation expenses, cooling and lighting as it depends on energy The implementation of sustainable buildings in Syria can take a long time, but there is a great opportunity to have fully sustainable cities after the war. The reconstruction phase in Syria will start soon, and we hope that this new phase of construction will begin on the basis of respect for the environment and natural resources.

5.4 Recommendations

Significant steps must be taken to support and raise awareness about the concept of sustainability and sustainable buildings in Syria.

1. One of the most important steps to be taken in Syria is the establishment of a Syrian Green Building Council and may be affiliated to non-profit associations such as Lebanon and Jordan to encourage people to join it to increase the spread of sustainable buildings.
2. Training courses, workshops, and lectures should be held to raise awareness of the importance of sustainable buildings. Future generations can also be made aware of the importance of preserving the environment and its impact on individuals through awareness campaigns in schools and universities and emphasizing the benefits of sustainable buildings related to the environment.
3. Since Syria is recovering from the long-term war, there may be significant financial challenges that may prevent the implementation of sustainable buildings. But there are proposals that can help to avoid these financial challenges. For example, foreign and international companies can be given an opportunity to invest in the country and implement sustainable projects at the beginning of the reconstruction phase. These projects can be primarily commercial rather than residential, such as schools, hospitals, and shopping malls. There can be a significant role for banks in supporting sustainable projects by offering special loans to investors who wish to build environmentally friendly buildings. The State can also play an active role in the development of sustainable institutions by exempting or reducing taxes on persons wishing to implement sustainable buildings.
4. Because the exploitation of excessive natural resources in the wrong ways leads to a defect in the environment, the number of destroyed buildings in Syria must be considered and try to take advantage of the rubble of these buildings and work on recycling and use them again in the construction of new buildings to reduce the consumption of natural resources.

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APPENDIX

A Sample of a Questionnaire

Title: The challenges of sustainable construction

First part: General information

1. Respondent's Gender: Female ☐ Male ☐

2. Respondent's Age:

18-20 ☐

20-30 ☐

30-4 ☐

40-50 ☐

More than 50 ☐

3. Respondent's status: ☐ Under graduate ☐ Graduate

4. Respondent's Specialization

Civil Engineer ☐

Architecture ☐

Other Specialization: Please specify ……

Second part: information about the construction industry in Syria

1. Respondent's Experience:

   From 1-5 Years ☐ from 5-10 Years ☐

   From 10-20 years ☐ more than 20 Years ☐

   No experience ☐

2. Do you have any information regarding Syria building codes?

   Yes ☐

   No ☐

3. If yes, is there any information in these building codes regarding sustainable construction?

   Yes ☐

   No ☐

4. Do you think the construction industry is developing in Syria?

   Yes ☐

   No ☐

5. If No, what are the challenges of the construction industry in Syria?

   ☐ Financial challenges

   ☐ Challenges related to building codes

   ☐ Challenges related to building materials

   ☐ Lack of new construction techniques

   ☐ All these challenges

   ☐ Other challenges Please specify ……

6. What are the building materials used in Syria?

   ☐ Local Building materials

   ☐ Non-local building materials

7. What types of building materials are used in Syria?

   ☐ Steel

   ☐ Concrete

   ☐ Reinforced concrete

   ☐ Stone

   ☐ All

   ☐ Others: Please specify …….

8. Are building materials used in Syria environmentally friendly?

   ☐ Yes

   ☐ No

Third part: green and sustainable construction

1. Do you have any information regarding green and sustainable building?
   - ☐ Yes
   - ☐ No

2. If yes, how did you get your information on Green Building?
   - ☐ Workshops and training courses
   - ☐ Daily news
   - ☐ Lectures
   - ☐ Educational curriculum

3. If your source of information was Workshops and training courses:

   Training Executing Agency: ……..

   Training Location: ……

   Last received training: …….

4. Did the training cover the concept and its applications?
   - ☐ Yes
   - ☐ No

5. What is the situation of sustainable building in Syria?
   - ☐ No idea
   - ☐ No projects
   - ☐ There are plans to apply sustainable construction
   - ☐ Under progress
   - ☐ There are a few sustainable buildings
   - ☐ There are many sustainable projects.

6. If there are no projects, what are the challenges facing the implementation of sustainable buildings in Syria?
   - ☐ Economic Challenges
   - ☐ Lack of knowledge and awareness of the people about sustainable buildings
   - ☐ Lack of experience of engineers in this field
   - ☐ The absence of laws related to the rules of sustainable buildings

☐ All

☐ Other Challenges: Please specify ……

7. Are there laws or rules dealing with sustainable buildings?

☐ No idea

☐ There are no

☐ Yes there are

☐ There are studies to implement laws on sustainable buildings

8. Are aware of energy, water saving technologies in building?

☐ Yes

☐ No

9. Are these technologies used in Syria?

☐ Yes

☐ No

10. Have you worked in a sustainable building before?

☐ Yes

☐ No

11. If yes, specify the location of the work

☐ In Syria

☐ Outside Syria

12. In which year you participated in this work?

☐ 2000 -2004

☐ 2011-2015

☐ Before 2000

☐ 2005-2010

☐ 2016-2018

First Part: Engineering characteristic and specialization

The responses to question 1 show that 64% of the respondents were male and 36% female.

Table 5.1: Respondent's Gender

Respondent's Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	64	64.0	64.0	64.0
	female	36	36.0	36.0	100.0
	Total	100	100.0	100.0	

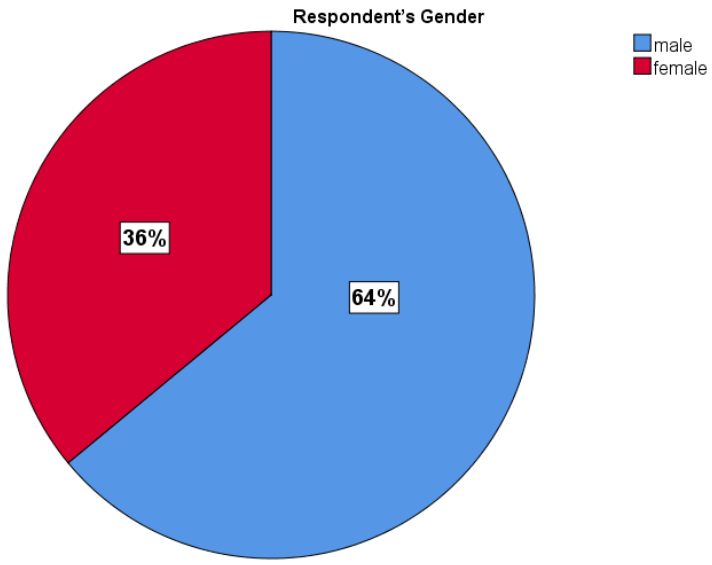

Figure 5.1: Respondent's Gender

Table 5.2: Respondent's Age

Respondent's Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30	59	59.0	59.0	59.0
	30-40	17	17.0	17.0	76.0
	40-50	11	11.0	11.0	87.0
	more than 50	13	13.0	13.0	100.0
	Total	100	100.0	100.0	

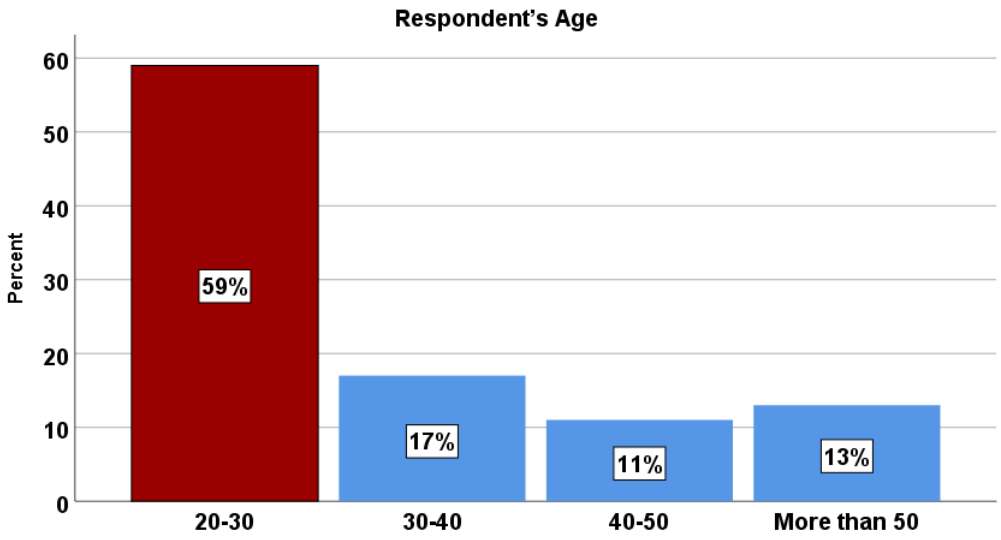

Figure 5.2: Respondent's Age

Table 5.3: Respondent's Specialization

Respondent's Specialization					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Civil Engineer	57	57.0	57.0	57.0
	Architecture	37	37.0	37.0	94.0
	Agricultural engineer	1	1.0	1.0	95.0
	contractor	5	5.0	5.0	100.0
	Total	100	100.0	100.0	

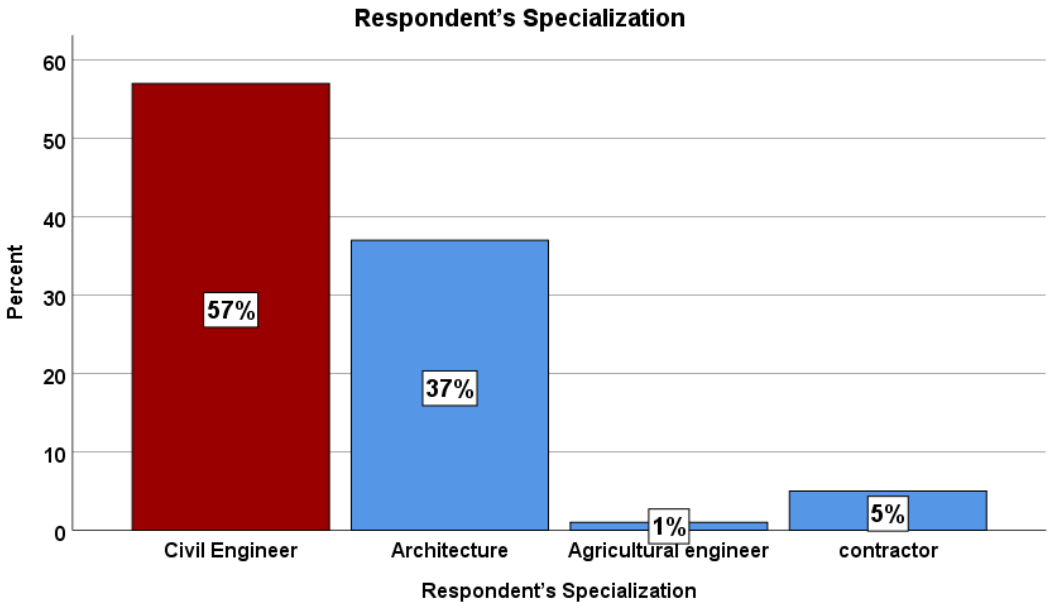

Figure 5.3: Respondent's Specialization

Second part: Engineers experience and construction industry

Table 5.4: Respondent's Experience.

Respondent's Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	from 1-5 years	42	42.0	42.0	42.0
	from 5-10 years	12	12.0	12.0	54.0
	from 10-20 years	14	14.0	14.0	68.0
	more than 20 years	16	16.0	16.0	84.0
	no experience	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

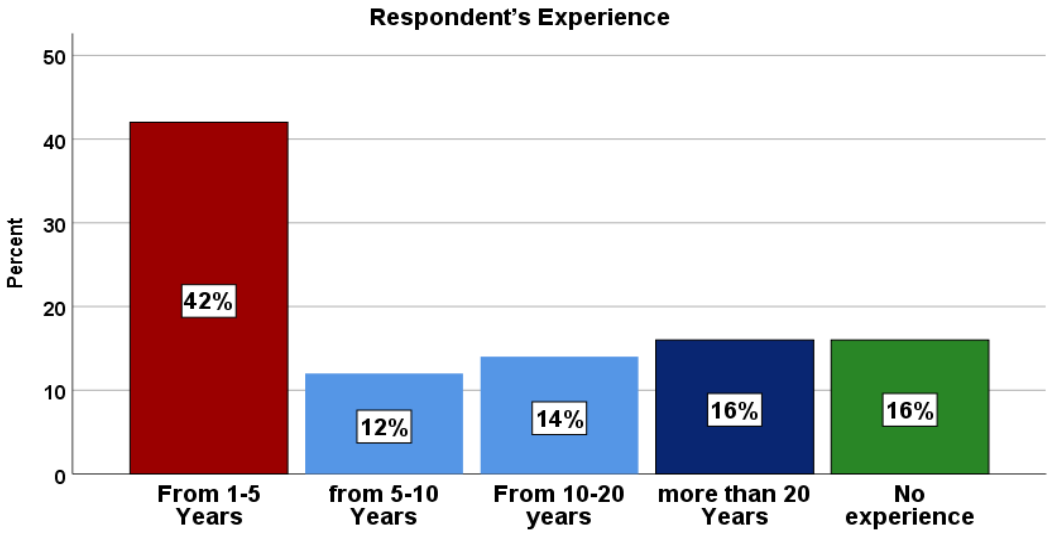

Figure 5.4: Respondent's Experience

Table 5.5: participants' responses about Syria building codes

Do you have any information regarding Syria building codes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	34	34.0	34.0	34.0
	Yes	66	66.0	66.0	100.0
	Total	100	100.0	100.0	

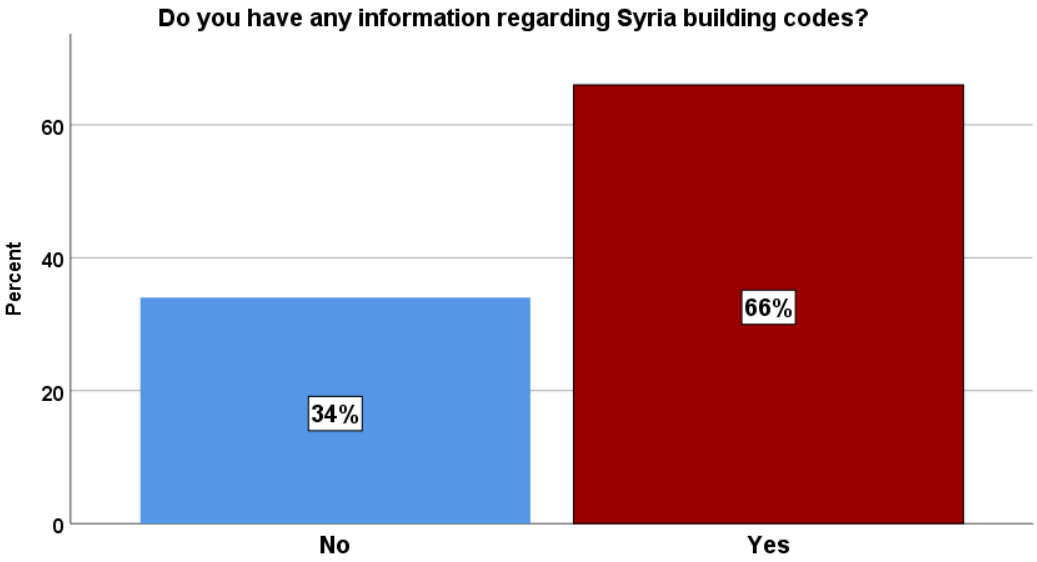

Figure 5.5: participants' responses about Syria building codes

Table 5.6: participants' responses about Syria building codes

If yes, is there any information in these building codes regarding sustainable construction?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	63	63.0	82.9	82.9
	Yes	13	13.0	17.1	100.0
	Total	76	76.0	100.0	
Missing	System	24	24.0		
Total		100	100.0		

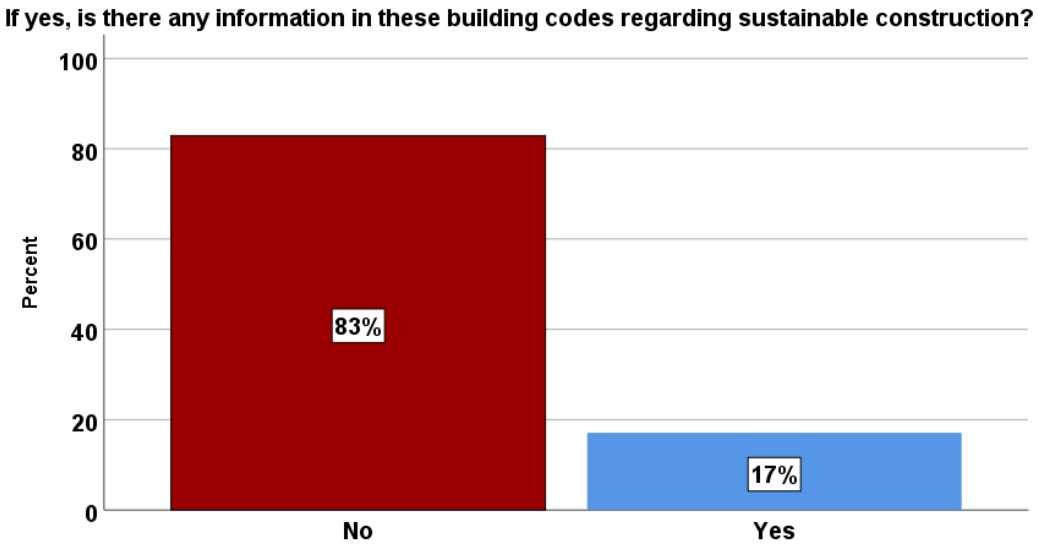

Figure 5.6: participants' responses about Syria building codes

Table 5.7: participants' responses about construction industry in Syria

Do you think the construction industry is developing in Syria?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	83	83.0	83.0	83.0
	Yes	17	17.0	17.0	100.0
	Total	100	100.0	100.0	

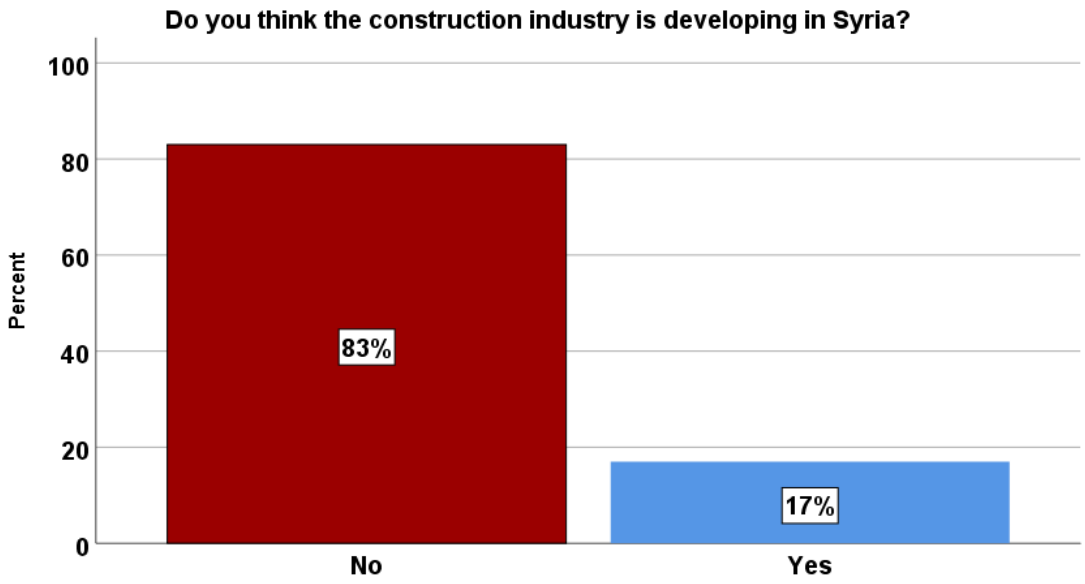

Figure 5.7: participants' responses about construction industry in Syria

Table 5.8: participants' responses about the challenges of the construction industry in Syria

If No, what are the challenges of the construction industry in Syria?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Financial challenges	10	10.0	11.1	11.1
	Challenges related to building codes	5	5.0	5.6	16.7
	Challenges related to building materials	2	2.0	2.2	18.9
	Lack of new engineering techniques	11	11.0	12.2	31.1
	All these challenges	62	62.0	68.9	100.0
	Total	90	90.0	100.0	
Missing	System	10	10.0		
Total		100	100.0		

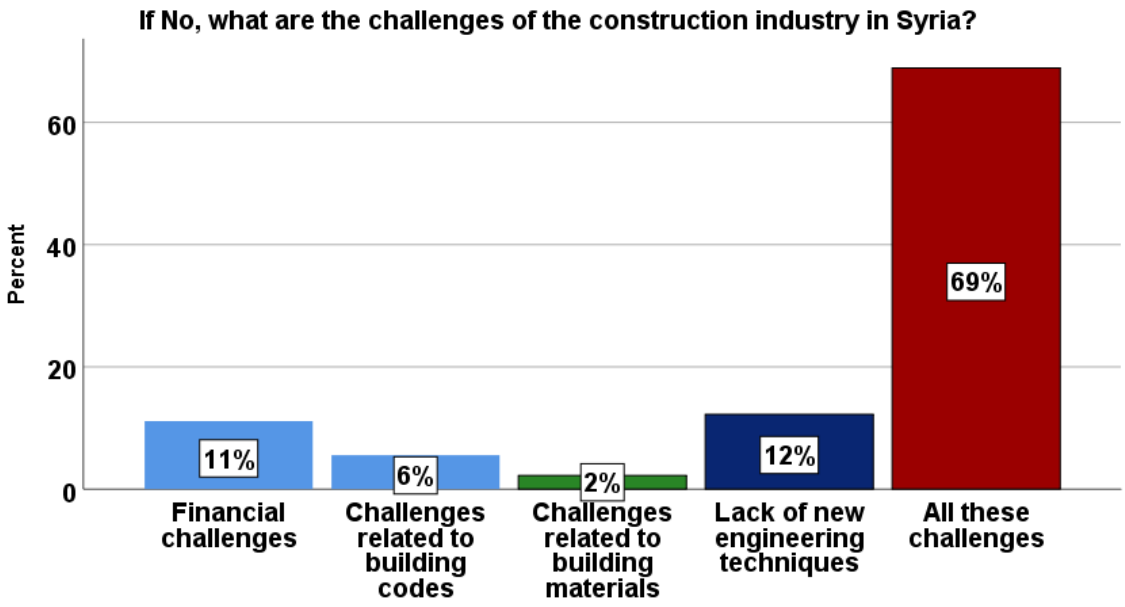

Figure 5.8: participants' responses about the challenges of the construction industry in Syria

Table 5.9: participants' responses about building materials used in Syria

What is the building materials used in Syria?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Local Building materials	80	80.0	80.0	80.0
	Non-local building materials	20	20.0	20.0	100.0
	Total	100	100.0	100.0	

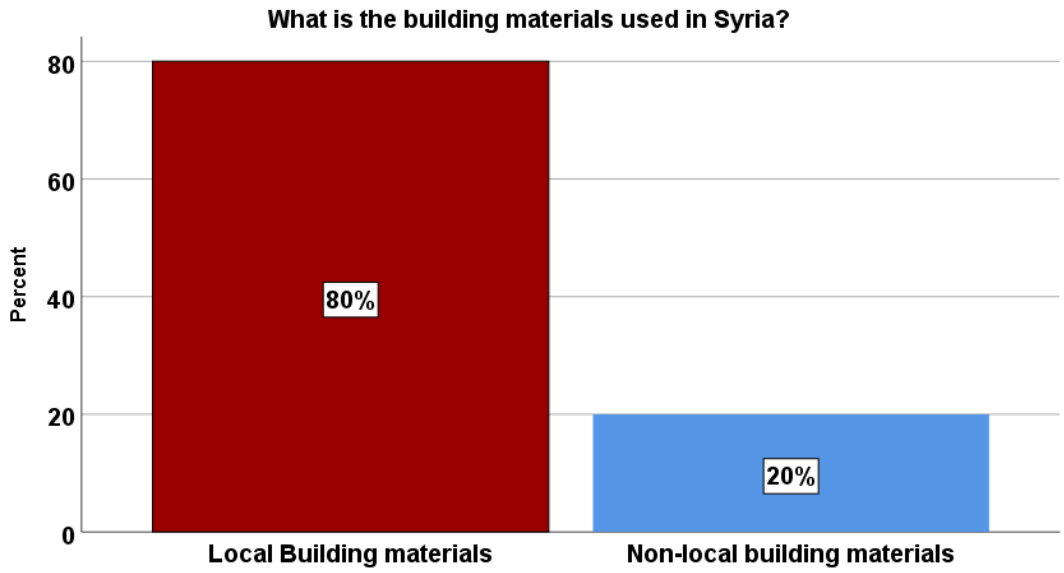

Figure 5.9: participants' responses about building materials used in Syria

Table 5.10: participants' responses about types of building materials are used in Syria

What types of building materials are used in Syria?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Concrete	5	5.0	5.0	5.0
	Reinforced concrete	21	21.0	21.0	26.0
	all	74	74.0	74.0	100.0
	Total	100	100.0	100.0	

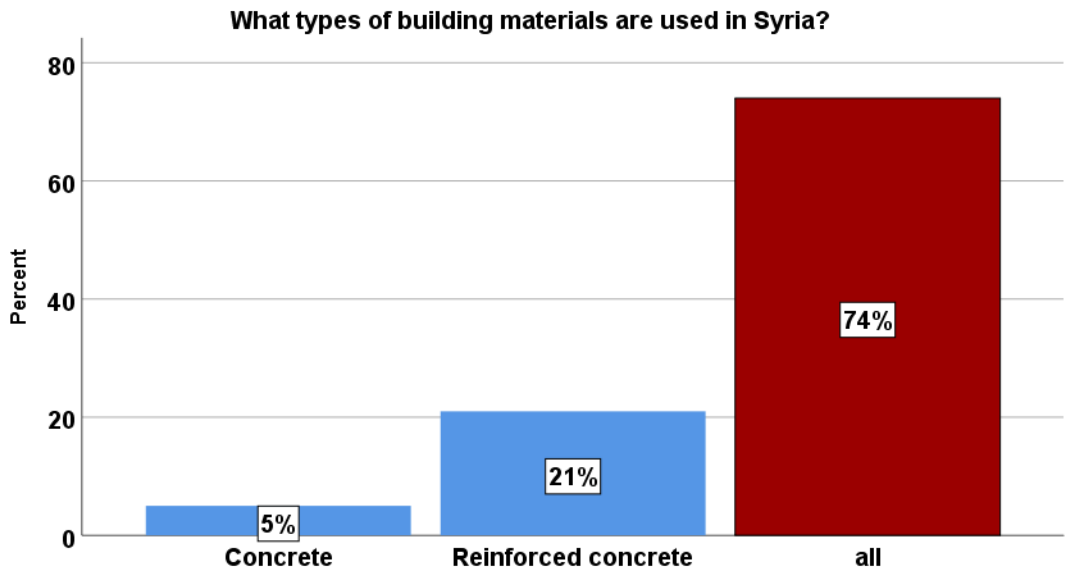

Figure 5.10: participants' responses about types of building materials are used in Syria

Table 5.11: participants' responses about building materials used in Syria if environmentally friendly or not

Are building materials used in Syria environmentally friendly?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	75	75.0	75.0	75.0
	Yes	25	25.0	25.0	100.0
	Total	100	100.0	100.0	

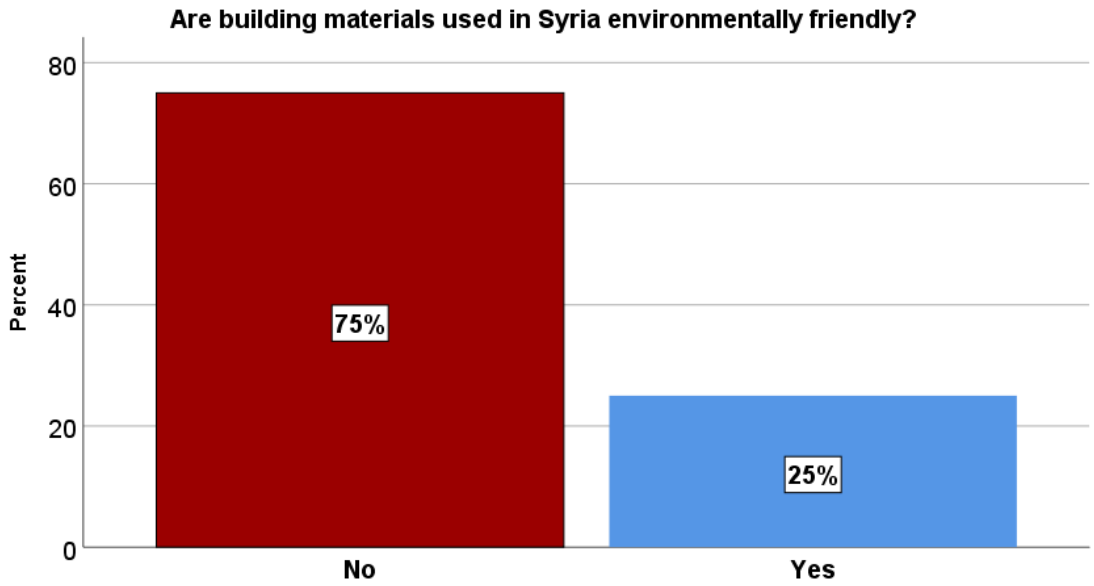

Figure 5.11: Participants' responses about building materials used in Syria if Environmentally friendly or not

Third part: green and sustainable construction

Table 5.12: participants' responses about green and sustainable building in Syria

Do you have any information regarding green and sustainable building?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	45	45.0	45.0	45.0
	Yes	55	55.0	55.0	100.0
	Total	100	100.0	100.0	

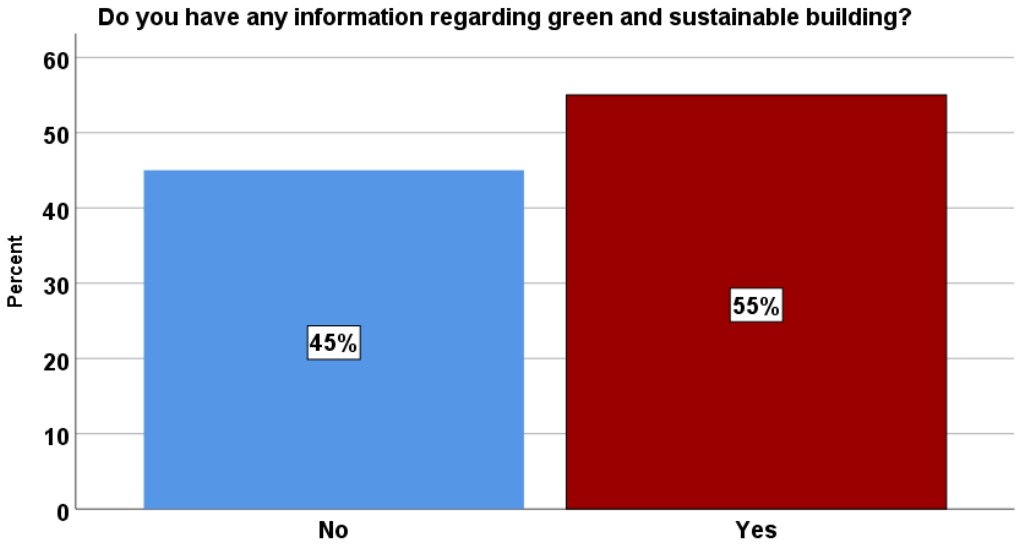

Figure 5.12: participants' responses about green and sustainable building in Syria

Table 5.13: participants' responses about, how did you get your information on Green Building

If yes, how did you get your information on Green Building?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Workshops and training courses	5	5.0	9.6	9.6
	Daily news	16	16.0	30.8	40.4
	Lectures	19	19.0	36.5	76.9
	Educational curriculum	12	12.0	23.1	100.0
	Total	52	52.0	100.0	
Missing	System	48	48.0		
Total		100	100.0		

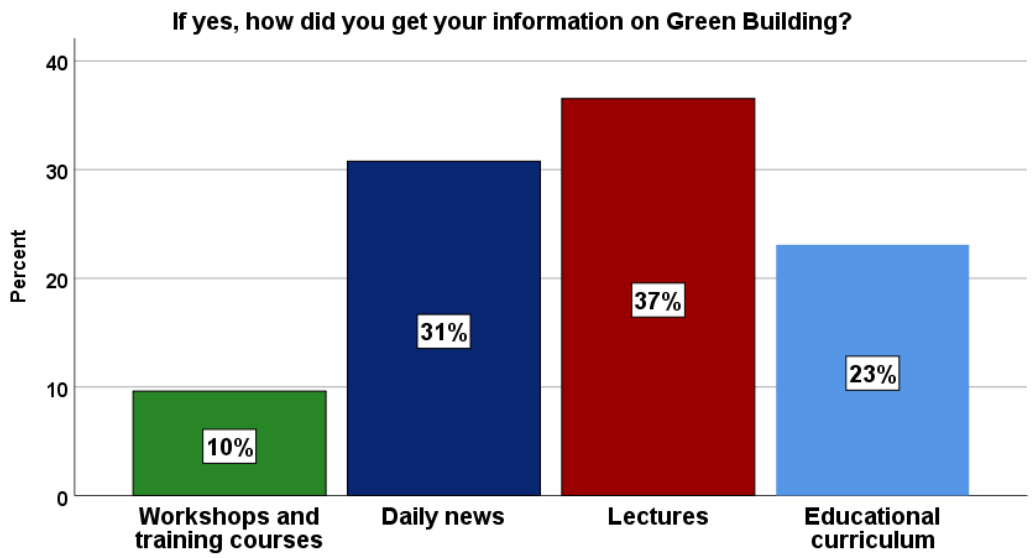

Figure 5.13: participants' responses about, how did you get your information on Green Building

Table 5.14: participants' responses about if training cover the concept and its applications

Did the training cover the concept and its applications?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	3	3.0	60.0	60.0
	Yes	2	2.0	40.0	100.0
	Total	5	5.0	100.0	
Missing	System	95	95.0		
Total		100	100.0		

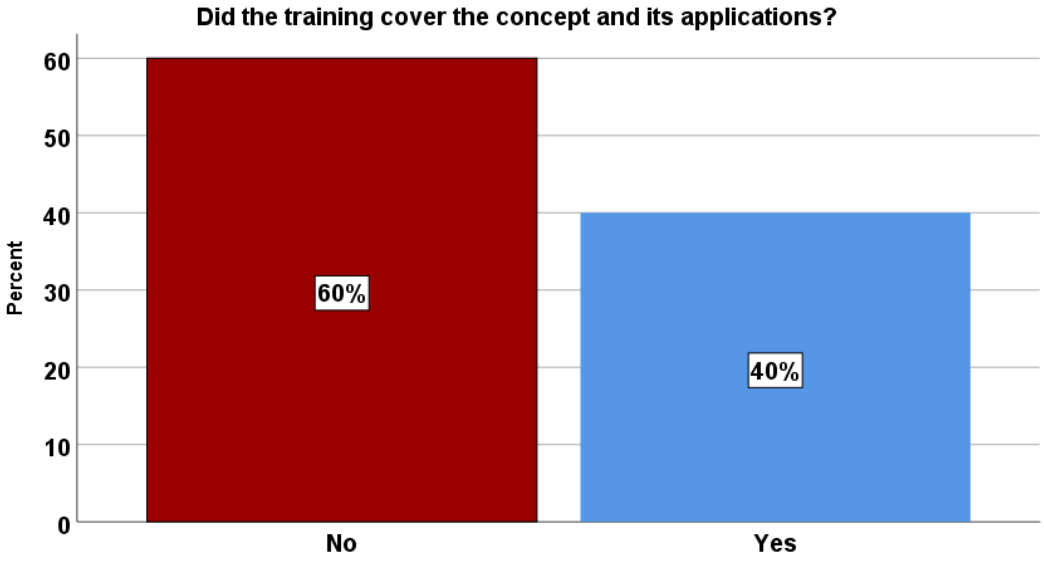

Figure 5.14: participants' responses about if training covers the concept and its applications

Table 5.15: participants' responses about the situation of sustainable building in Syria

What is the situation of sustainable building in Syria?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No idea	38	38.0	38.0	38.0
	No projects	42	42.0	42.0	80.0
	There are plans to apply sustainable construction	12	12.0	12.0	92.0
	Under progress	2	2.0	2.0	94.0
	There are a few sustainable buildings	5	5.0	5.0	99.0
	There are many sustainable projects.	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

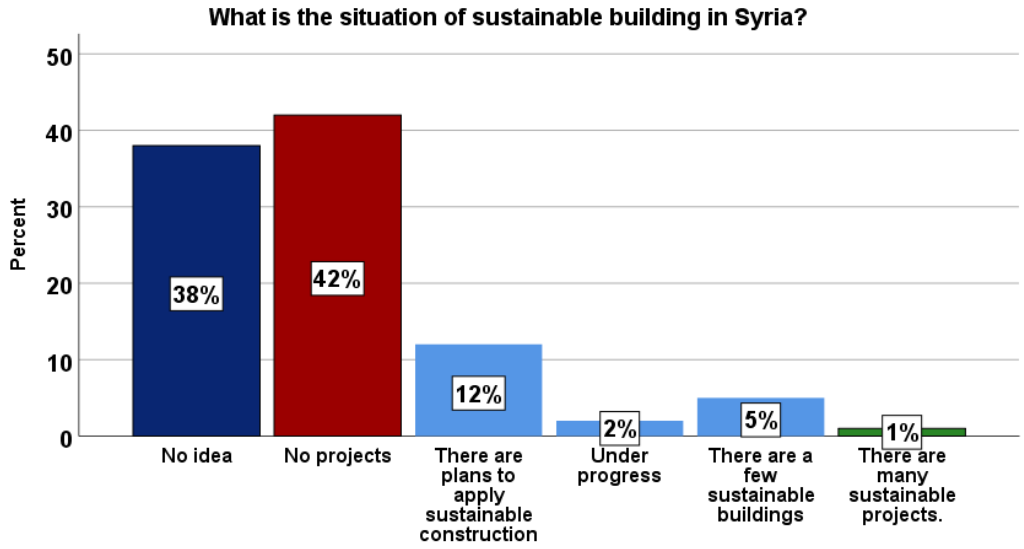

Figure 5.15: participants' responses about the situation of sustainable building in Syria

Table 5.16: participants 'responses about the challenges facing the implementation of sustainable buildings in Syria

If there are no projects, what are the challenges facing the implementation of sustainable buildings in Syria?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lack of knowledge and awareness of the people about sustainable buildings	10	10.0	10.2	10.2
	Economic Challenges	7	7.0	7.1	17.3
	Lack of experience of engineers in this field	5	5.0	5.1	22.4
	The absence of laws related to the rules of sustainable buildings	4	4.0	4.1	26.5
	All	72	72.0	73.5	100.0
	Total	98	98.0	100.0	
Missing	System	2	2.0		
Total		100	100.0		

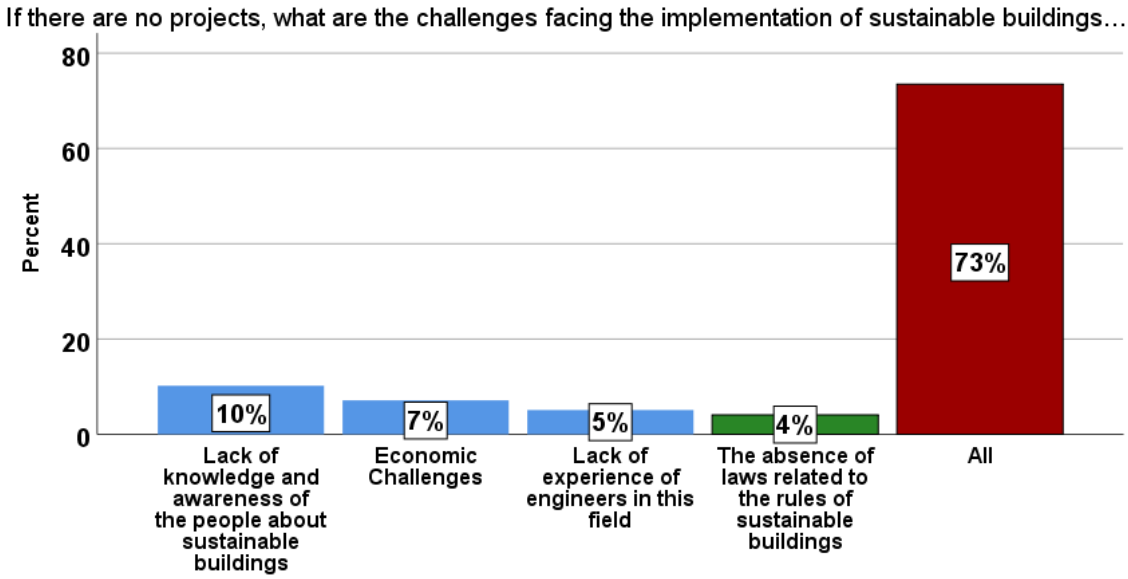

Figure 5.17: participants' responses about the challenges facing the implementation of sustainable buildings in Syria

Table 5.18: participants' responses about the laws or rules dealing with sustainable buildings in Syria

Are there laws or rules dealing with sustainable buildings?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No idea	42	42.0	42.0	42.0
	There are no	27	27.0	27.0	69.0
	Yes there are	5	5.0	5.0	74.0
	There are studies to implement laws on sustainable buildings	26	26.0	26.0	100.0
	Total	100	100.0	100.0	

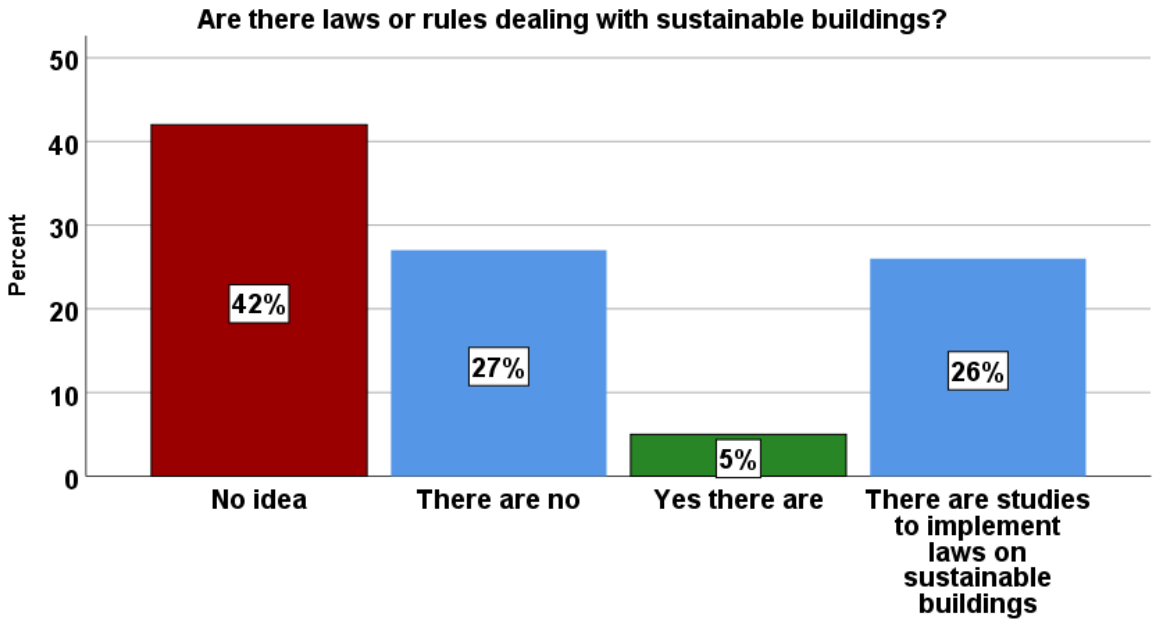

Figure 5.18: participants' responses about the laws or rules dealing with sustainable buildings in Syria

Table 5.19: participants' responses about of energy, water saving technologies in building

Are aware of energy, water saving technologies in building?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	29	29.0	29.0	29.0
	Yes	71	71.0	71.0	100.0
	Total	100	100.0	100.0	

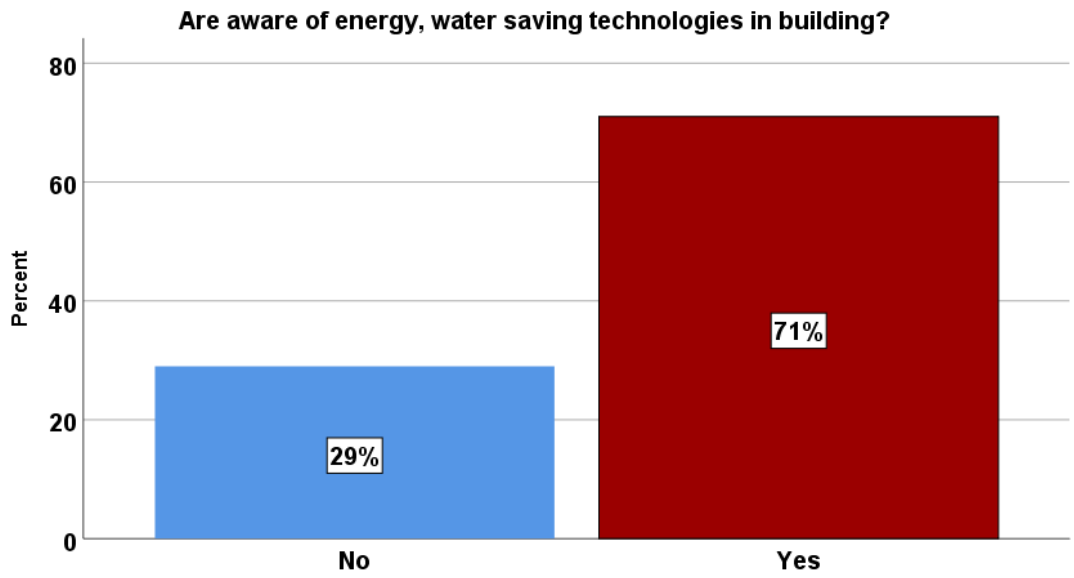

Figure 5.19: participants' responses about of energy, water saving technologies in building

Table 5.20: participants' responses about if the water saving technologies in building used in Syria

Are these technologies used in Syria?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	82	82.0	82.0	82.0
	Yes	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

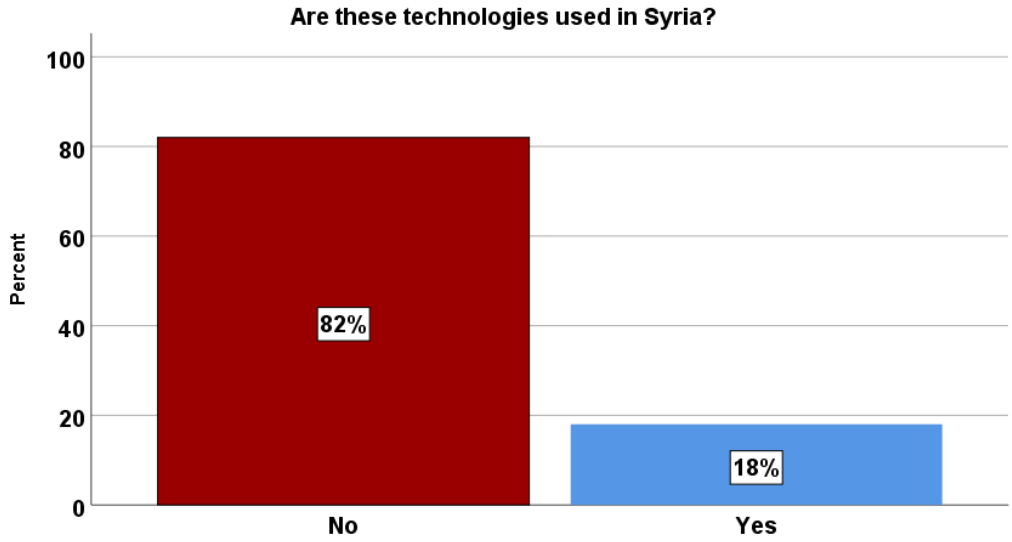

Figure 5.20: participants' responses about if the water saving technologies in building used in Syria

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Table 5.21: participants' responses about if they worked in a sustainable building before

Have you worked in a sustainable building before?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	85	85.0	85.0	85.0
	Yes	15	15.0	15.0	100.0
	Total	100	100.0	100.0	

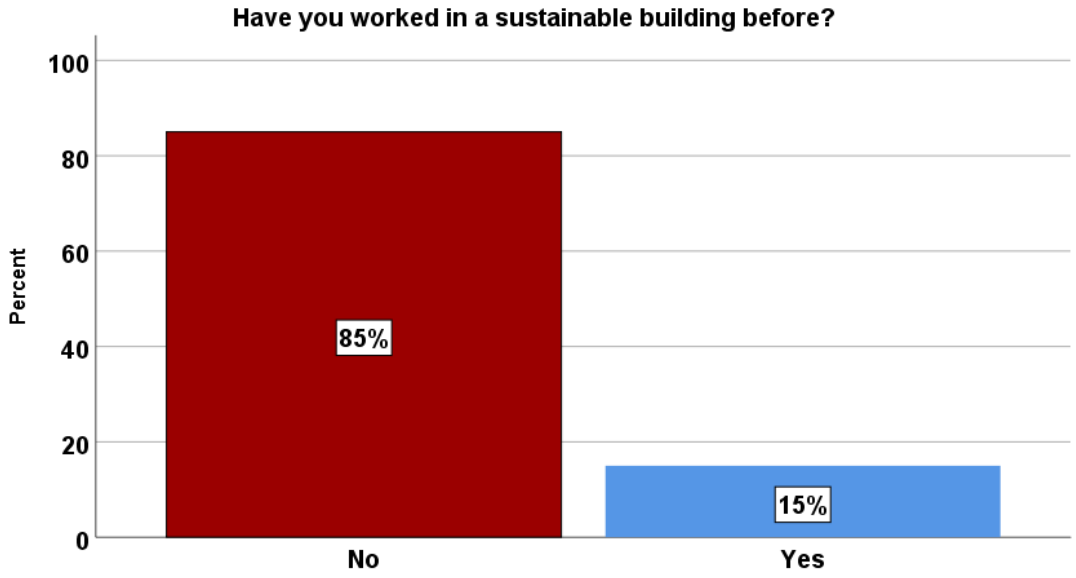

Figure 5.21: participants' responses about if they worked in a sustainable building before

Table 5.22: participants' responses about the location of the work

If yes, specify the location of the work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	In Syria	3	3.0	20.0	20.0
	Outside Syria	12	12.0	80.0	100.0
	Total	15	15.0	100.0	
Missing	System	85	85.0		
Total		100	100.0		

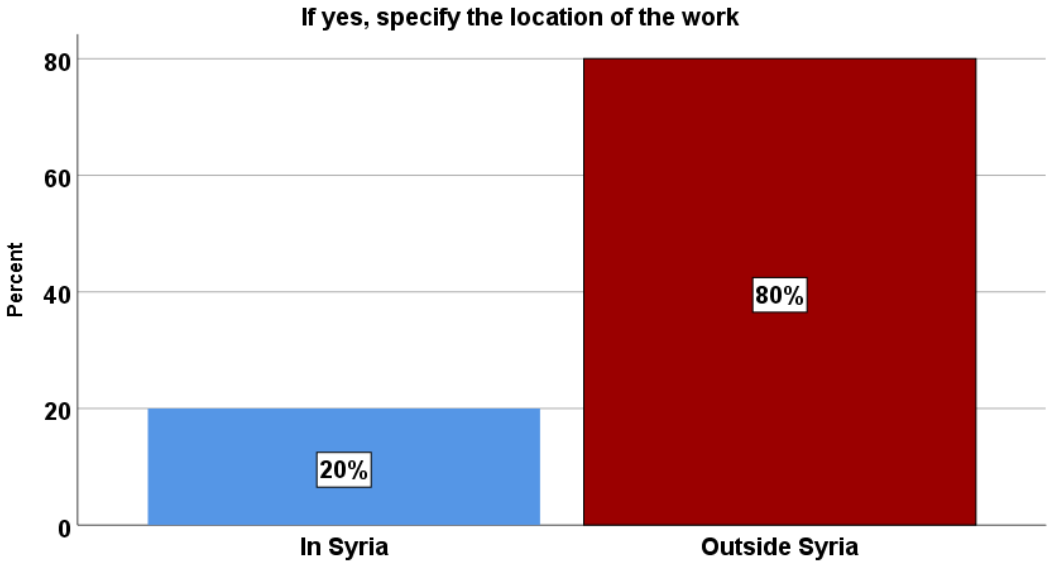

Figure 5.22: participants' responses about the location of the work

Table 5.23: participants' responses about in which year they worked in a sustainable building

In which year you participated in this work?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2011-2015	4	4.0	26.7	26.7
	2016-2018	11	11.0	73.3	100.0
	Total	15	15.0	100.0	
Missing	System	85	85.0		
Total		100	100.0		

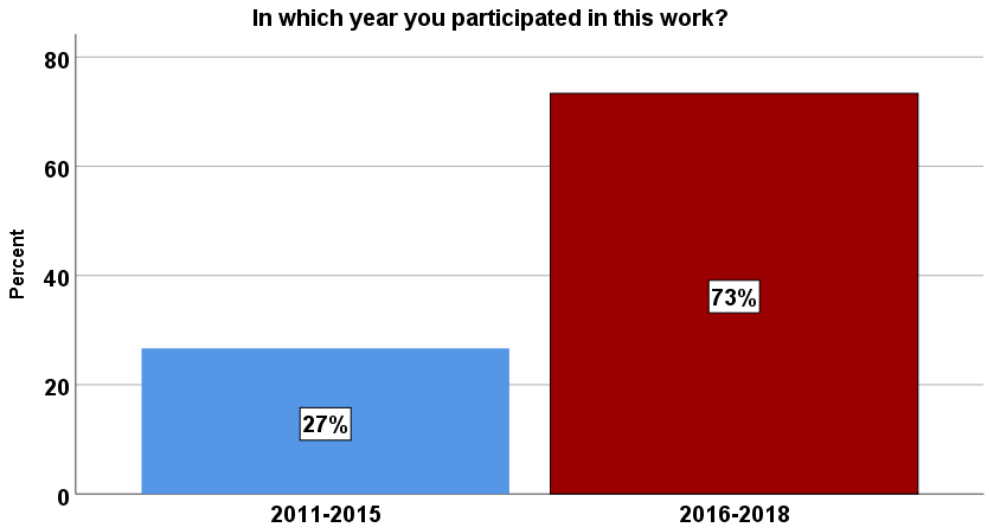

Figure 5.23: participants' responses about in which year they worked in a sustainable building