

**T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**



**DECISION MAKING AND IMPROVING EXTERNAL WALL
TECHNOLOGIES AT REASONABLE PRICES FOR
RESIDENTIAL BUILDINGS (A CASE STUDY IN SAMARRA,
IRAQ)**

MASTER THESIS

Mohammed Ghanim Hammood AL-ABBASI

Engineering Management Department

Engineering Management Master in English Program

**APRIL 2024
ISTANBUL**

**T.C.
ISTANBUL GEDİK UNIVERSITY
INSTITUTE OF GRADUATE STUDIES**



**DECISION MAKING AND IMPROVING EXTERNAL WALL
TECHNOLOGIES AT REASONABLE PRICES FOR
RESIDENTIAL BUILDINGS (A CASE STUDY IN SAMARRA,
IRAQ)**

MASTER THESIS

**Mohammed Ghanim Hammood AL-ABBASI
(2112281020)**

Engineering Management Department

Engineering Management Master in English Program

Thesis Advisor: Assoc. Prof. Dr. Redvan GHASEMLOUNIA

Istanbul 2024



T.C.
İSTANBUL GEDİK ÜNİVERSİTESİ
Lisansüstü Eğitim Enstitüsü Müdürlüğü

Jüri Tez Onay Formu

25/04./2024

LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ MÜDÜRLÜĞÜ

Bu çalışma 25/04/2024 tarihinde aşağıdaki jüri tarafından Mühendislik Yönetimi Anabilim Dalı, Mühendislik Yönetimi (Tezli Yüksek Lisans) Programı Yüksek Lisans Tezi olarak kabul edilmiştir.

TEZ JÜRİSİ

Danışman

Doç. Dr. Redvan GHASEMLOUNIA

İstanbul Gedik Üniversitesi

Üye (İmza)

Dr. Öğr. Üyesi Tuğbay Burçin

GÜMÜŞ

İstanbul Gedik Üniversitesi

Üye (İmza)

Dr. Öğr. Üyesi Mert TOLON

İstanbul Maltepe Üniversitesi

DECLARATION

I'm Mohammed Ghanim Hammood AL-ABBASI, declare that this thesis titled “Decision Making and Improving External Wall Technologies at Reasonable Prices for Residential Buildings (A Case Study in Samarra, Iraq)” is original work I completed this to receive my master's in Engineering Management. I further declare that neither this thesis nor any part of it has ever been submitted to or presented for a research paper or other degree at any other university or institution. (25/04 /2024)

Mohammed Ghanim Hammood AL-ABBASI



DEDICATION

I would like to say at the beginning (thank God) who gave me the knowledge, talents, and opportunities that were necessary to carry out and finish this study. I would like to express my deep appreciation to my father and mother, who have been the driving force behind all the positive events and adventures that have transpired in my life over the past years and my deep appreciation to my supervisor. The fact that there are doctors like you who are willing to take on students like me is truly wonderful. Thank you for your patience, in the classroom, you wore more than just a doctor's hat, you were a listener, helper and coach as well. Thank you for being able to wear all of these hats at once.

Your loyal Student: Mohammed Ghanim Hammood AL-Abbasi

TABLE OF CONTENT

	<u>Page</u>
TABLE OF CONTENT	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
ABSTRACT	ix
ÖZET	x
1. INTRODUCTION	1
1.1 Background	1
1.2 Purpose of Thesis	2
1.3 Decision Making Mechanism.....	2
1.3.1 Purpose	2
1.3.2 Decision making techniques.....	3
1.3.3 Types of decisions	4
1.4 Hypothesis	5
2. LITERATURE REVIEW	6
2.1 Introduction	6
3. METHODOLOGY	18
3.1 Introduction	18
3.2 Research objectives	19
3.3 Research Methodology.....	19
3.3.1 Quantitative research	21
3.3.2 Qualitative research	21
3.4 Type of Sampling	23
3.5 Data Collection Methods.....	24
3.5.1 Questionnaire design	25
3.5.2 Case study.....	26
3.6 Decision Making Mechanism.....	26
3.6.1 Definition of decision making	26
3.6.2 Types of decisions	27
3.6.3 Decision making techniques.....	28
3.6.4 The decision-making process	29
4. DATA GATHERING AND ANALYSIS	30
4.1 Data Collection.....	31
4.1.1 Evaluate decision criteria that influence building technology evaluation and building classification decisions	33
4.1.2 Evaluation of techniques in construction.....	35
4.2 Ranking the construction techniques.....	41
4.3 “Selection- of the construction techniques”	42
4.3.1 Cost analysis for decision making to choose appropriate construction techniques	44

4.3.2 Case studies of successful affordable housing projects from other regions [7]	45
5. CONCLUSIONS AND FUTURE WORK	50
5.1 Conclusions	50
5.2 Recommendations	52
5.4 Future Work	54
REFERENCES	56
APPENDICES	59
RESUME.....	73



LIST OF TABLES

	<u>Page</u>
Table 3.1: Comparison table between the quantitative and qualitative research [8].	23
Table 3.2: Categories of contracting companies in Samarra according to the group of Iraqi companies and contractors.....	24
Table 3.3: Decision criteria that influence decisions to classify and evaluate modern construction technologies.....	25
Table 4.1: Shows the result obtained from the evaluation and analysis of decision-making criteria.....	33
Table 4.2: It turns out that the results obtained from evaluating and making decision criteria.....	34
Table 4.3: Shows the result obtained from the evaluation and analysis of decision-making criteria.....	35
Table 4.4: Evaluation technique: Externally concrete and reinforced walls that are clad in normal stone	35
Table 4.5: Evaluation technique: Externally reinforced the concrete walls with the cast stone cladding	36
Table 4.6: A technology by which to evaluate the slab column system with 20 cm concrete blocks used in external walls	36
Table 4.7: Evaluation techniques for the “slab-beam-column” systems and external walls built of two layers of the concrete blocks, (20) and (7) cm, with insulation materials between them	37
Table 4.8: A technique for evaluating a system consisting of slab columns with external strong masonry walls supported by concrete	38
Table 4.9: Techniques for evaluating the system the Slab columns with strong externally walls built of the concrete, stone and the concrete blocks	38
Table 4.10: Evaluation techniques of the slab column system with the strong external walls built of the concrete, stone, concrete blocks and insulation materials in between them.....	39
Table 4.11: Evaluation techniques for” a strong slab-beam column” system with built-up exterior facades composed of the lightweight stone wall units “Itong” with stone cladding.....	40
Table 4.12: Evaluation techniques for the (a strong column and beam system) using the precast concrete façade panels for external visible walls.....	40
Table 4.13: Ranking list of the construction techniques	41
Table 4.14: Displays the results Selection of the construction technique.....	43
Table 4.15: The average actual cost of construction for each technique	44

LIST OF FIGURES

	<u>Page</u>
Figure 3.1: Methodology flow chart [10].....	19
Figure 3.2: Qualitative vs Quantitative Research [31].....	20
Figure 3.3: The scheme for selecting housing units is taken as a case study” [10]..	26
Figure 4.1: Methodology flow chart for construction techniques [10].....	30
Figure 4.2: Chart for (Scores X) & (Repetition Y).....	34
Figure 4.3: Chart for (Scores X) & (Construction Techniques Y)	42
Figure 4.4: Chart for (Percent) & (Construction Techniques).....	43
Figure 4.5: Chart for the average actual cost of construction for each technique.....	45
Figure 4.6: The source/researchers’ field plan of the house from the work site and drawn by the researchers [7]	46

DECISION MAKING AND IMPROVING EXTERNAL WALL TECHNOLOGIES AT REASONABLE PRICES FOR RESIDENTIAL BUILDINGS (A CASE STUDY IN SAMARRA, IRAQ)

ABSTRACT

The city of Samarra, Iraq, is facing significant housing challenges due to an increasing population and returning residents, coupled with limited land availability, high construction costs, and generally low-income levels. The text emphasizes the importance of finding affordable housing solutions without compromising on construction quality, efficiency, durability, and adaptability to natural and geological conditions. It criticizes approaches that prioritize cost reduction at the expense of these factors, highlighting that such strategies are short-sighted and may lead to greater problems in the future. The study aims to improve the housing situation in Samarra by identifying appropriate construction techniques that balance cost and quality, thereby achieving high-quality, affordable housing through industrialization. It involves reviewing current construction techniques in Samarra, determining the criteria for choosing the optimal construction method, and providing a mechanism for evaluating and selecting construction techniques based on these criteria. The methodology includes both qualitative and quantitative research, involving the distribution of questionnaires to local building contractors, with a significant response rate indicating engagement from the construction community. The findings reveal that while current construction technologies in Samarra meet efficiency and quality standards, they fall short in making housing construction more affordable or reducing production costs. Consequently, the study suggests modifications to existing technologies to achieve the dual goals of cost reduction and maintenance of required construction efficiency. Accordingly, a financial analysis was conducted for each building technology to make the appropriate decision in choosing the appropriate technology. A study in the holy city of Najaf was highlighted that simulates the evaluation of building technology standards, and there is a large discrepancy in construction techniques and quality.

Keywords: *High construction costs, optimal construction, construction efficiency.*

KONUT BİNALARI İÇİN UYGUN FİYATLARLA DIŞ DUVAR TEKNOLOJİLERİNE KARAR VERME VE İYİLEŞTİRME (IRAK, SAMARRA'DA BİR VAKA ÇALIŞMASI)

ÖZET

Irak'ın Samarra kenti, artan nüfusu ve geri dönen sakinleri ile birlikte sınırlı arazi varlığı, yüksek inşaat maliyetleri ve genel olarak düşük gelir seviyeleri nedeniyle önemli konut sorunlarıyla karşı karşıyadır. Metin, inşaat kalitesi, verimliliği, dayanıklılığı ve doğal ve jeolojik koşullara uyumluluğundan ödün vermeden uygun fiyatlı konut çözümleri bulmanın önemini vurgulamaktadır. Bu faktörler pahasına maliyeti düşürmeye öncelik veren yaklaşımlar eleştirilmekte, bu tür stratejilerin dar görüşlü olduğu ve gelecekte daha büyük sorunlara yol açabileceği vurgulanmaktadır. Çalışma, maliyet ve kaliteyi dengeleyen uygun inşaat tekniklerini belirleyerek Samarra'daki konut durumunu iyileştirmeyi ve böylece sanayileşme yoluyla yüksek kaliteli, uygun fiyatlı konutlar elde etmeyi amaçlamaktadır. Samarra'daki mevcut inşaat tekniklerinin incelenmesini, en uygun inşaat yönteminin seçilmesi için kriterlerin belirlenmesini ve bu kriterlere dayalı olarak inşaat tekniklerinin değerlendirilmesi ve seçilmesi için bir mekanizma sağlanmasını içermektedir. Metodoloji, yerel inşaat müteahhitlerine anketlerin dağıtılmasını içeren hem nitel hem de nicel araştırmayı içeriyor ve önemli bir yanıt oranı inşaat topluluğunun katılımını gösteriyor. Bulgular, Samarra'daki mevcut inşaat teknolojilerinin verimlilik ve kalite standartlarını karşılamasına rağmen, konut inşaatını daha ekonomik hale getirme veya üretim maliyetlerini azaltma konusunda yetersiz kaldığını ortaya koymaktadır.

Anahtar Kelimeler: Yüksek inşaat maliyetleri, optimum inşaat, inşaat verimliliği.

1. INTRODUCTION

1.1 Background

Every nation, town, and family is preoccupied with housing. As a major factor in the country's economic growth and the creation of new employment opportunities, it has far-reaching political and economic consequences. On top of providing a social purpose for the community at large, it also offers accommodation and shelter to Iraqi families. Additionally, it is the most valuable possession an Iraqi family can have. Therefore, this industry is critical for the progress of every nation. In order to boost economic growth and increase the supply of homes, the Iraqi government is launching a new initiative to build housing infrastructure. In the Iraqi territories, housing is in high demand, especially the governorates affected by terrorist acts, which is increasing annually. On the other hand, researcher in economics, Nabil Jabber Al-Ali, indicated that there are large numbers of Iraqi families increasing annually due to the population increase, as the number of families was approximately 3.25 million families a year. 2002 and it has greatly increased until it reached more than 8.25 million families now.

The combination of Iraq's low per capita income and skyrocketing housing prices is making home buying an increasingly infeasible prospect. In December 2022, the Iraqi Reform and Development Plan was published (independentarabia.2022). One of its stated goals is the "affordable housing" program, which seeks to generate employment opportunities, address the ever-increasing demand for residential units, and broaden reach a reasonable price, High quality housing middle-income families. Less The gap between supply and demand, where many Iraqi citizens suffer from not owning a home, while some of them live in small rented homes at prices of no less than 300 US dollars, and economic researchers criticize housing policies that are still unable to bridge the gap between supply and demand, and the deficit is still in the sector Housing is high, estimated at three million housing units, in addition to a significant lack of serviced residential land that can be distributed and built. It was planned that a public-private

partnership would be formed to carry out this program. A large-scale housing initiative spearheaded by the private sector was to be supported by the Iraqi government, which was to invest either its own funds or those of donors in order to build the required infrastructure. The private sector is now working on a plethora of low-cost housing projects that might use some attention and resources.

1.2 Purpose of Thesis

The relevance of the subject matter that is being examined is the reason for the weight that this research carries; decision making is one of the management principles that has been applied and accepted by the greatest number of individuals over the course of the many years that have passed. The decision-making process involved in selecting the proper building approaches is the primary topic of this study. The objective of this study is to attain the goal of acquiring housing that is both affordable and of top-notch quality. Using Samarra, Iraq, as a case study, this research will give the framework for future housing sector development and technique evaluation. Samarra is located in Iraq. Located in Iraq is the city of Samarra.

1.3 Decision Making Mechanism

1.3.1 Purpose

Every single person will, at some point in their lives, be obliged to make choices that demand a great amount of consideration and consideration. In the event that, on the other hand, decisions are made in a rush, there is a significant possibility that they will not bring about the desired results. When it comes to avoiding issues of this sort, it is absolutely vital to make judgments in a thorough manner. It would be a good idea to take the first step of ensuring that there is a foundation of common knowledge on the process of decision preparation. According to decision making may be described as the act of picking an alternative while taking into consideration better values individual who is to make the decision [30]. In the case we find ourselves in a circumstance in which we are compelled to make a decision, it is in our best advantage to take into consideration all of the options that are available to us and choose the individual option that seems to have the most potential. This option is

the one that (1) has the highest likelihood of being successful or effective and (2) is the one that most closely corresponds with the desired goals, preferences, Lifestyle, evaluation, etc. It is the alternative that we have chosen. According to one definition, decision making is "the mental (cognitive) processes leading to a choice of a path of action from among multiple different situations." All of these procedures are referred to as "decision making" in the term. Every single decision-making process concludes in the selection of a single alternative between the available choices. As a consequence of this, one can settle on a conclusion or select a particular course of action" [28].

1.3.2 Decision making techniques

Many approaches to the process of decision-making there is a wide range of easy ways to decision-making from which you can choose an appropriate one. The application of investigative techniques is the primary topic of this discussion:

This is a comprehensive model of decision making that is comprised of five stages. One that walks you through each step of the decision-making process and provides you with direction. The decisions that you make will be strengthened by your activities, which are of a perfectly sensible and straightforward nature.

A decision matrix is a useful tool to have at your disposal when comparing and contrasting the various possible courses of action that you could take. Use might be made of components that are considered to be important. The ability to communicate your opinions regarding the relative value of each of these components can be achieved through the process of giving a weight to each of these components. You are able to make use of this in order to clear the fog that has been obstructing your ability to make decisions.

There is a possibility that the SWOT analysis, which is an acronym that stands for strengths, weaknesses, opportunities, and threats, could be of beneficial assistance. One of the most typical uses of this highly specialized method to decision-making is in the context of commercial partnerships. This is one of the most interesting applications. Through the process of visualizing the situation's SWOT (strengths, weaknesses, opportunities, and threats) [29], it is possible to exert influence on future decisions.

During the course of this research project, the idea of a decision matrix will be applied in order to produce a decision profile that will compare and contrast a variety of various construction technologies.

Composing a Telephone Call is Covered in Section 3.5

For the purpose of this inquiry, the method of decision-making that was applied consisted of the development of choice criteria and the presenting of potential answers. The table that is presented below is utilized in the process of carrying out this procedure:

1- Take into account the various options that are available to the researcher as well as the particular choice that they would like to go with.

2-This is taking into account the factor in question.

3-Identify the factors that are considered to be the most significant.

In order to reach a conclusion, you should give each of the criteria a priority ranking.

4-Determine the number of specific criteria that are connected to each of the available choices.

5-The fifth step is to discover which option has the highest score by multiplying the scores for the criteria by the scores for the alternative. This will allow you to establish which alternative has the highest score. Making a decision and then carrying it out are not the final steps; constant monitoring of your decision is required. Now is the time to keep an eye on how the solution is doing and make note of whether or not it has produced the desired outcomes” [29].

1.3.3 Types of decisions

According to decisions can be broadly divided into a range of different categories. This hypothesis has been put out by Harris [30]. This is what we have here:

1. Determinations concerning sentences that start with the word "whether" You are unable to move forward with the process of picking an alternative until you have supplied a response to this question that is either yes or no or either or. Before making a decision, it is necessary to consider both the positive and negative aspects

of the circumstance. Assuming that a decision has already been made, it is simple to fall into the trap of thinking that the first step in the process of making a decision is to generate a list of potential options. When it comes to making decisions, however, it is really necessary to have a strong sense of self-awareness because it is so simple to commit this error.

2. Two distinct "which" choices are available. In this scenario, you will be expected to choose one of several potential responses, and the ultimate decision that you make will be based on how each of these replies compares to a set of criteria that have been established beforehand.

And last but not least, decisions that were made during a period of stress. A choice has been made, but it is now on hold until certain conditions are met. This is despite the fact that something has already been decided upon.

3. This type of decision is referred to as "decisions that" because the purpose of this research is to set local standards for evaluating the effectiveness of the building methods that are presently being utilized in Iraq and selecting the most successful one. The decision that takes place is referred to as "decisions that." Taking into consideration the following, the procedure for making decisions is as follows: The process of making a decision that begins with the specification of criteria, then carries on to the discovery of alternatives, and lastly ties the criteria to the choices that have been made from the beginning of the process.

1.4 Hypothesis

1. Modern construction materials and technologies can be used to promote sustainable development in the local construction sector, especially in housing projects implemented by advanced construction companies in Iraq.

2. Residential unit production costs Samarra, Iraq is witnessing a somewhat increase Compared to other families and households' ability to afford a home.

3. In Samarra, Iraq, the methods of construction that are currently in use. When compared to other initiatives, these do not meet expectations for lowering production costs or making house construction more affordable.

2. LITERATURE REVIEW

2.1 Introduction

In order for a wide range of different sorts of businesses to be successful, the building and construction industries are very necessary. The policies that regulate development have the potential to have either a positive or a negative impact on a wide range of different development sectors. In recent years, the construction sector in Arab countries has experienced a period of rapid rise. Nevertheless, in spite of the fact that this growth has taken place, the technological and economic significance of this area has not been recognized in an adequate manner. This is because the industry is distributed throughout a number of nations, it does not achieve cohesion and unity, and there is no connection within the Arab market. All of these factors contribute to the current situation.

The organizational structures of countries with a lower population. For it to be able to make a substantial contribution to the development of society, it is required for it to become an integrated system. For this reason, it is necessary for it to become integrated. The prior research that was carried out on the And the construction industry process in the Arab regions Iraq's construction sector, and Building materials trade in Iraq are all topics that are covered in this chapter. In conclusion, a comprehensive discussion will be held regarding the construction methods that are typically applied in Iraq. Instructions for the construction of buildings and other structures Building and construction systems that are effective in the procedures they carry out It is necessary to manage construction sites in a manner that is not only safe but also efficient, while simultaneously ensuring that large-scale projects are completed on schedule.

The quality standards are constantly being raised to higher and higher levels, and this is something that must be done in order to keep up with them. When compared to other areas of the economy, the construction industry employs a workforce that is significantly larger than that of other industries. This is as a result

of the fact that the construction industry is very dependent on its workforce. In the process of deciding whether or not to employ cutting-edge building and construction technologies. It is the objective of these studies to investigate the costs of employing highly qualified personnel in relation to the costs of the technology and equipment that is already available, taking into consideration whether or not these investments will require a large amount of money. It is especially important to keep this in mind while taking into account the earliest stages of putting these technologies into action, in addition to the specific requirements of the project. It is possible that this is the reason why certain businesses favor a business plan that requires a significant amount of cash. The simultaneous reduction of building costs while simultaneously increasing investments in cutting-edge construction techniques. Some companies favor this approach over others since it enables them to make use of the available workforce while simultaneously decreasing the amount of money they invest in new technologies. This is the reason why this method is recommended.

On the other hand, there is a growing tendency to resort to technologies that satisfy these goals, particularly in the infrastructure sector where there is an urgent need to improve the speed at which projects are implemented. This is especially notable in the context of the infrastructure industry. The League of Arab States (2005) has proposed that a more efficient approach to introduce cutting-edge construction technology to the Arab world would be for significant Arab and foreign enterprises to partner on megaprojects such as tunnels and sewage stations. This would be a more effective manner of introducing groundbreaking building technology to the Arab world. Research that is referenced in the text There is no exception to the premise that every field is dependent on technology to some degree, and the field of architecture is absolutely not an exception to this norm. Technology not only has an effect on the vision and direction of the profession, but it also offers solutions that are directly applicable to the problem of raising the value and efficiency of architectural facilities. This is a significant contribution that technology makes to technology. It is of the utmost significance that the usefulness of technology be examined because of the far-reaching ramifications that it has. The real estate industry is one in which technological advancements can have both beneficial and negative effects on the industry. This is especially true in the real estate company.

There are a number of construction technologies that offer architectural solutions within the limitations of this framework, particularly in the realm of housing. Prefabrication technology is an example of such a process. This technology makes use of cold-formed galvanized steel panels as its means of production. The housing problem can be solved with this technique, which not only offers a feasible answer but also one that is effective, cost-efficient, and economical. As a consequence of this, it was decided that the main objective of the research would be to analyze the characteristics of this technology and assess its efficiency in relation to the benefits that it provides to the housing industry.

Rapid urbanization in the field of construction is considered a major challenge in accommodating a larger number of residents with limited income, specifically in developing countries such as (China) and other countries. Work on affordable housing began a few years ago and will continue to be developed in the coming years. Two main factors in affordable housing programs are cost and time, as the ability to meet the needs of low-income families is the main goal of these programs. However, addressing the shortage of affordable housing by adding and incorporating sustainability features is not a common strategy. One important factor is the lack of a sustainability framework for integrating sustainability into affordable housing. This idea aims to identify the most important sustainability performance indicators (KSPIs) that are important for improving and developing affordable housing. An initial list of 42 key sustainability performance indicators for affordable housing has been identified through an extensive literature review. This was indicated by a questionnaire to obtain professional opinions from three groups of stakeholders, namely the government, developers and academics in the Chinese construction industry. Through fuzzy set theory and variance analysis, the 24 KSPIs were finally highlighted so these results provide useful references for policy makers as well as industry personnel to develop affordable housing programs in a better and sustainable way. This theory helps achieve sustainable development at the regional level as a whole [1].

Opposition to affordable housing is often driven by homeowners' fear that the value of what they own will decline. In response to these concerns, affordable housing advocates state that there is little evidence from studies on the subject that suggest that affordable housing will significantly impact property values. . Is this

correct? Does this mean that affordable housing has no effect on reducing the value of citizens' real estate? This review discusses 17 studies that have attempted to measure the impact of affordable housing on property values in an attempt to limit it and answer this question. Analysis of these studies indicates that property value decline (depends on a variety of influencing factors): the design and management of affordable housing, the fit between affordable housing and the host neighbourhood, and the concentration of affordable housing [2].

This article discusses the problem of the affordable housing gap in the United States and efforts to address this gap. The issue refers to the problem of federal support for affordable housing, and the relative roles of private sector providers - profit-seekers, local public housing corporations, and non-profit community developers - in providing housing. Affordable and available. The primary method of producing affordable housing in the United States currently is the Citizens Low Income Housing Tax Credit. Although this system has produced approximately 350,000 housing units for those with limited incomes, it may suffer from inherent shortcomings compared to the Grant. Direct capital currently requires pooling mortgage financing from several different sources. As Congress and the Clinton administration sought to encourage a great deal of additional development by public housing agencies, the capacity of unprofitable community developers would remain limited. A variety of credit-enhancing and risk-sharing methods are now being experimented with [3].

The spread of environmentally polluting forces on a large scale in the city may limit the widening of the gap between organic energy sources and renewable energy that are used in buildings, especially administrative buildings, as they consume a large amount of energy during their implementation and operation. The problem of the energy crisis and its consumption in administrative buildings indicates the primary motivation that encouraged the researcher to study the building techniques used in the exterior coating of these buildings in an attempt to rationalize the energy used. It is considered an idea (to reduce effort) by using mechanical methods for cooling in the summer and heating in the winter. In this context, the research addresses the construction techniques used in creating the exterior coatings of administrative buildings and their impact on energy conservation in very hot tropical regions, as well as the appropriate architectural treatment for these areas as a

beginning for developing the construction process and its construction in a better way [4].

The researcher's goal is to help decision makers start thinking completely differently at the beginning of the occupancy phase in making the decision to choose between alternatives in the early design stages. Therefore, the research evaluates and compares a more energy-efficient building model with the addition of a traditional building, in terms of differences in specifications, thermal performance, and energy efficiency. Operational CO₂ emissions, comprehensive energy trade-off cost and thermal performance modeling. The results of the study indicated a clear decrease in energy and heat, as well as in carbon dioxide emissions that produce the energy consumed in the most widespread traditional building model. Compared to a typical energy-efficient building. A complete study of the cost of energy exchange indicated that the initial cost of the typical building is 35% higher than the available traditional building. Based on modeling the thermal performance of the many alternatives, the research presents proposals for the obstacles that have been revealed by the results of the study. Accordingly, a framework of interim levels has been developed to improve the efficiency of energy use in youth housing buildings. The framework developed by this research includes several responsibilities for the concerned parties during the stages of empowerment, planning, design, implementation, follow-up, and also continuous improvement, in addition to relying on efforts to restore Self-build [5].

A previous study indicated that the Al-Saleh Housing Project was a new model for providing affordable housing for the low-income group in Yemen. The first phase of the project included the construction of 5,018 housing units (apartments) with a total building area of 430,890 square meters, distributed over eight governorates. To shed light on the housing solutions that appear on the project, the research methodology included the analytical and evaluation study of the project, in terms of collecting and analyzing data related to the current housing situation, as well as previous public housing projects and government agencies in this project, as well as the private sector in housing activities. This demonstrated that the Al-Saleh Housing Project provided multiple practical solutions to make housing units affordable and suitable for the majority of beneficiaries with limited income in terms of (technical and financial, as well as quality and suitability, low cost, ease of payment), etc. The project has a broader and more comprehensive housing phase

than its predecessors and has measures for continuity. The study pointed out the importance of continuing to provide affordable housing through a housing policy, which needs to take into account the integration and empowerment of the private sector as a primary partner in providing housing, to establish a regulatory framework for affordable housing, and important national engineering standards to guide and monitor quality and safety in the implementation of residential buildings that are low cost. Ultimately, the goal of these arrangements is to develop the housing trade, to be important for sustainable development in many Yemeni cities, and thus solve the housing problem [6].

There were four stages involved in the process, the first of which was to provide an explanation of the cognitive frameworks of the structure, its particular goals, as well as the technical dimensions and components of prefabrication using light galvanized iron billet. This was carried out in a manner that was consistent with the objective of the study. The crystallization of a theoretical framework for the acceptable qualities and performance elements of building technologies ought to be the focus of the second part of the project. This will allow for the establishment of a foundation that will be used for the goal of evaluating the qualities of the technology that was chosen to be the primary focus of the inquiry. After that, we will do an analysis of the components that are described in the theoretical framework, and then we will apply it to a number of projects that have been given the go-ahead for this technology. As part of the third phase of the procedure, this step will be followed by a technical and field study. This step will be carried out as part of the procedure [20].

Referring to the other study this scientific study seeks to shed light on the first academic study of sustainable housing projects designed by fourth-year students at the University of Baghdad - Department of Architecture in 2015. The other study indicated in a location within the city of Baghdad that was chosen because of its environmental and locational potential that achieves urban sustainability. The idea of this academic project lies in adopting the principles of sustainable urban housing, starting with the planning and development level, multi-use housing strategies, applying housing design mechanisms directed towards green transport and transportation contracts, preserving the natural green land, reaching the design level by designing compact housing within clusters. Contemporary housing that applies green building techniques from employing renewable energies such as solar cells,

green roofs, and recycled water, all the way to detailed designs in the design of ecological housing in the urban orchards area. As a conclusion, the researcher seeks to evaluate the selected projects using the LEED system for sustainable residential areas to measure the level of sustainability in some of the best selected academic projects with the aim of studying the possibility of achieving the principles of global sustainability in local projects.

The results were many innovative academic projects that showed two basic results. The first is the possibilities of applying international principles for sustainable urban housing in Iraqi cities in general and Baghdad as a case study for achieving urban sustainability. The second is the necessity of developing standards and systems for evaluating local urban sustainability that are compatible with the Iraqi environment and work within the local climate [21].

Research that runs counter to the findings that were discovered When it comes to the expenses that are directly related to the operation of a building, the consumption of energy is the second most significant expense. The utilization of renewable energy sources, such as solar power, wind power, building insulation, and glazing systems, is the foundation of the technology that underpins sustainable energy. It is possible for designers to take into consideration a variety of factors in addition to heating, ventilation, and air conditioning (HVAC) systems in order to select the building that is the most economically and environmentally responsible. Methods of construction, the exploitation of new materials, the quality of sensors and monitoring systems, and the level of sophistication of simulation tools are some examples of the factors that may be included in this category. The purpose of this study is to investigate the impact that insulation has on the amount of energy that is consumed by buildings in Iraq and to ascertain the amount of energy that is saved as a result of insulating the walls, ceilings, floors, and windows of these structures.

In addition, the study will quantify the amount of energy that is saved. For the purpose of determining the thermal loads and the energy requirements, a program known as the Hourly Analysis Program was deployed. It has been demonstrated through research that it is feasible to significantly cut down on the amount of energy that is required for air conditioning in a building by installing double-glazed windows and insulating the walls, floors, and ceilings of the building [22].

Research that runs counter to the findings that were discovered the collected knowledge and wisdom of many generations of people who have learned to meet their material and spiritual demands through the careful management of natural resources consists of the traditions of environmentally responsible construction. These traditions have been passed down from generation to generation. With the passage of time, these individuals have acquired the knowledge necessary to satisfy their desires. Throughout the course of several centuries, all of these time-honoured approaches have been refined and improved upon as a result of a wide range of diverse causes. The purpose of factor analysis is to identify and characterize the common relationship that exists between the variables that are being studied on. The identification and examination of a wide range of variables, the interpretation of statistically significant correlation coefficients, and the identification of common elements are the means by which this objective is accomplished. Through the application of factor analysis, more specifically the main factor technique, the objective of this study is to determine which aspects of environmentally friendly construction methods (traditional bricks) have the most significant impact on the economic success of housing in Erbil. The primary focus of this inquiry is on ecologically responsible building techniques, specifically the utilization of conventional bricks, which have subsequently been replaced by more modern materials. Another aspect of this investigation is the utilization of other materials. The research applied a factor analysis that was appropriate with the environment (traditional bricks), as well as the interpretation of their correlation coefficients, in order to analyze and evaluate the factors that impact building approaches. This was done with the objective of analyzing and evaluating the aspects that influence builders. The purpose was to uncover common characteristics that explain the relationship between these factors and their interpretation through the process of classifying the link between these variables and their interpretation [23].

The other study indicated Prefabricated construction was introduced into Iraq not long ago, using direct modern technology without the gradual stages that were supposed to begin, which led to confusion in production and implementation. Therefore, scientific bodies in Iraq should study the problems facing the production and implementation processes, perhaps we will reach successful solutions in this matter. There is scope for the prefabricated construction method to proceed steadily

and quickly to be implemented in plans for development in Iraq and to eliminate the housing crisis that has worsened over time. The study examines the possibility of developing appropriate prefabricated construction in Iraq in terms of the nature of the building systems, raw materials, and local needs to give Iraqi specificity to this desired development. The problem of the research is summarized in the presence of a cognitive deficiency in the direction of prefabricated construction as a prevailing building system by default. It is investigated that there is an effect between the design of prefabricated building pieces and the speed of their completion according to the flexibility of their design and their external form [24].

It is vital for the construction sector in Iraq to have construction supplies that are essential. Hollow concrete blocks, stone, steel, aluminium, wood, and concrete are the most popular types of building materials. Other typical types include concrete and steel. Stone is another material that is frequently used. It is possible to construct the frames for structures by utilizing these construction components either alone or in combination with one another. The roofing system underwent a transformation as a result of the utilization of solid concrete slabs and steel beams, namely section I beams. The invention of flat roofs that were able to include columns, balconies, and other ornamental components was made possible as a result of this revolution. In this method, steel was initially utilized in the construction sector for the very first time. Beginning in the later half of the twentieth century, steel was incorporated as a structural component for walls. This trend continued until the present day. In addition to this, it was discovered that various Iron sections and bars are used as a building components. to discover this phenomenon occurred at the same time that a different kind of roofing system was being implemented. Because of this, it became necessary to transition from using bearing walls to using a skeleton (columns) system. This was a consequence of the situation. In place of lime, cement was utilized, and it served not only as a binding agent but also as a component important to the structure. When it came to working with steel, this was especially appropriate [16].

The other study indicated Visual identity has an important role in the fields of trade, industry and advertising in our current era, so that every product or service can distinguish itself and differ from its peers and competitors in the world, especially in the era of information and international trade that is widespread among everyone in

various means of advertising, and in light of the spread and diversity Trademarks It has become necessary for the company to have a clear and specific visual identity, in order to achieve a distinct mental image for its current and prospective customers. Therefore, advertising designers rely in achieving the visual identity on building the mental image through analyzing and creating a specific concept, of what operations can be related to.

The recipient's mental image is in attempts to build a mental image that is part of a distinct identifiable identity for the institution based on the product or service. In light of the fact that there is a dearth of published material on the topic, it was of the utmost importance to acquire a grasp of the ways in which contemporary packaging techniques have the potential to improve the public's perception of the relevant institution. Let's talk about the following topics: For the purpose of this study, the objective was to investigate the various ways in which modern packaging techniques, which are an essential part of the identity of an institution, could be applied to improve the mental picture of the institution. Visual identity, the concept of mental images, the different sorts of mental images that are developed towards institutions, the components of those images, the tools that are used to make them, the procedures that are required to build them, and what is required to build them successfully were all topics that we discussed in order to arrive at this conclusion. After that, we carried out a study of that image by making use of models that are designed to assist in the improvement of mental images of institutions. The brand life cycle, the AIDA model, Maslow's Hierarchy of Needs, and the SWOT Analysis are some of the models that fall under this description. In the next section, we throw light on contemporary developments in packaging, which are an essential component of the identity of the institution. Not the least of our accomplishments was the fact that we connected and utilized the models in a way that co, through the use of data and information resulting from those models and advertising analyzes and exploiting the complementary relationship between them to maintain the continued loyalty of customers to the institution [25].

The other study indicated Sustainable and structurally safe mud architecture in the Jericho area. The study concluded with a number of results, the most important of which are: The clay material is not uniform in its specifications, due to the different types of soil and its compounds. Clay building techniques have been

numerous in Palestine, and have spread throughout wide areas of it since the Stone Ages, but were later concentrated in dry areas such as the Jordan Valley, led by Jericho. The traditional mud buildings were compatible with their environment, and were distinguished by their sloping and flat roofs, while domes were rare. In the last five years, a number of attempts have appeared to revive this architecture again, but these attempts still need development. Especially due to the lack of technical expertise in this field, and the scarcity of local research and studies, therefore, the success of rebuilding in clay in Jericho depends on the extent of its structural safety, its meeting the needs of its users, its low cost, and its consideration of the environmental conditions present in it, which can be achieved based on successful international experiences. By taking advantage of the factors that ensured the continuity of this architecture for many centuries, and by making use of the traditional heritage, which is represented by a large number of architectural models in Jericho, the compressed brick technique is considered more suitable for contemporary architecture. Due to its wide construction features. The researcher recommended a number of recommendations to those concerned, the most important of which are: establishing specialized laboratories to conduct precise tests on clay, introducing this material into the educational curricula in engineering colleges in local universities, the necessity of cooperation with international universities in this field, and the need to create a building code specific to clay construction. And establishing a factory for pressed clay bricks according to international standards, in addition to the need to spread awareness among people about the sustainable advantages of clay, through holding seminars and holding exhibitions [26].

Research that runs counter to the findings that were discovered When it comes to the Building Information Modelling (BIM) industry, one of the most essential variables that will decide your level of success is how well you make use of the resources that are at your disposal. It is possible for difficulties to arise due to the fact that applications of information technology are often relatively complicated. When it comes to selecting a technology that will serve as the next spearhead tool for a company, the process can be a challenging and time-consuming undertaking. With regard to the client, corporate organization, social behavior, and immature technology, this study makes an effort to concentrate on these categories. In order to accomplish this, it presents and analyzes a wide variety of difficulties that are now

being faced by the construction engineering business operating in Finland. The results of this research indicate that there are a total of twenty-three main obstacles that could potentially impede the successful adoption of building information modeling (BIM) technology. According to [9].

The findings of this study will be used as a basis for the creation of a future solution that will assist in the administration of BIM technology applications in a manner that is more effective. research that runs counter to the findings that were discovered We have arrived at a fork in the road in terms of the quest for opportunities to purchase affordable housing. In every region of the world, there is a growing need for housing of this kind, and there is also an increasing awareness of the significance of promoting and supporting sustainable development. Within the scope of this essay, about seventy-five different building technologies are taken into consideration and evaluated simultaneously. This piece offers the preliminary findings of a method that was used to identify, assess, and provide recommendations for the technologies that have the most potential for low-cost housing initiatives. The method was used to identify, evaluate, and provide suggestions for these technologies. For the purpose of keeping a record of all the specific technical particulars that are related with each technology, a database has been built. A system for ranking and categorizing building technologies that are ecologically friendly and have the potential to be successful has been developed in order to identify these technologies. We were able to identify the most significant assessment indicators as well as the most significant problems associated with its production by conducting an analysis of the relevant literature, having conversations with specialists in the sector, and sitting down for face-to-face meetings. A comparison was made between the ten indications and the eight problems that we found, which resulted in the creation of an evaluation system that is based on indicators. Several different technologies, ranging from biomaterials like bamboo and timber to industrial technologies like concrete, achieve good overall performance, as can be seen in the final ranking. These technologies include both biomaterials and industrial technologies. To add salt to injury, there is a tremendous amount of scope for advancement, with the integration of multiple technologies proving to be the prospect that holds the most promise [11].

3. METHODOLOGY

3.1 Introduction

The Iraqi government is attempting to address the rising housing crisis in the country as a whole and in Samarra in particular. This is due to the fact that the population is expanding and there is an expected influx of people who have returned from Iraq. The fact that there is a shortage of land, there is exorbitant pricing, there are expensive building expenses, and there are relatively poor revenues all contribute to the escalation of this situation.

It is one of the many aspects that plays a role in determining whether or not affordable housing is successfully delivered. One of these factors is the effectiveness of construction technologies in lowering the price of building. During the course of the construction process, it is not acceptable to make concessions on aspects such as sustainability, longevity, resistance to natural and geological elements, and other relevant aspects in order to save costs. The idea of providing affordable housing without taking into account the lifespan of the building or the quality of the construction is a quick solution to an urgent problem; however, it will result in more challenges in the future. The findings of appear to be accurate [12].

To establish local standards for the purpose of construction, the primary focus of this thesis is on the most efficient method of construction that is currently being utilized in Iraq. This is done with the objective of establishing local standards.

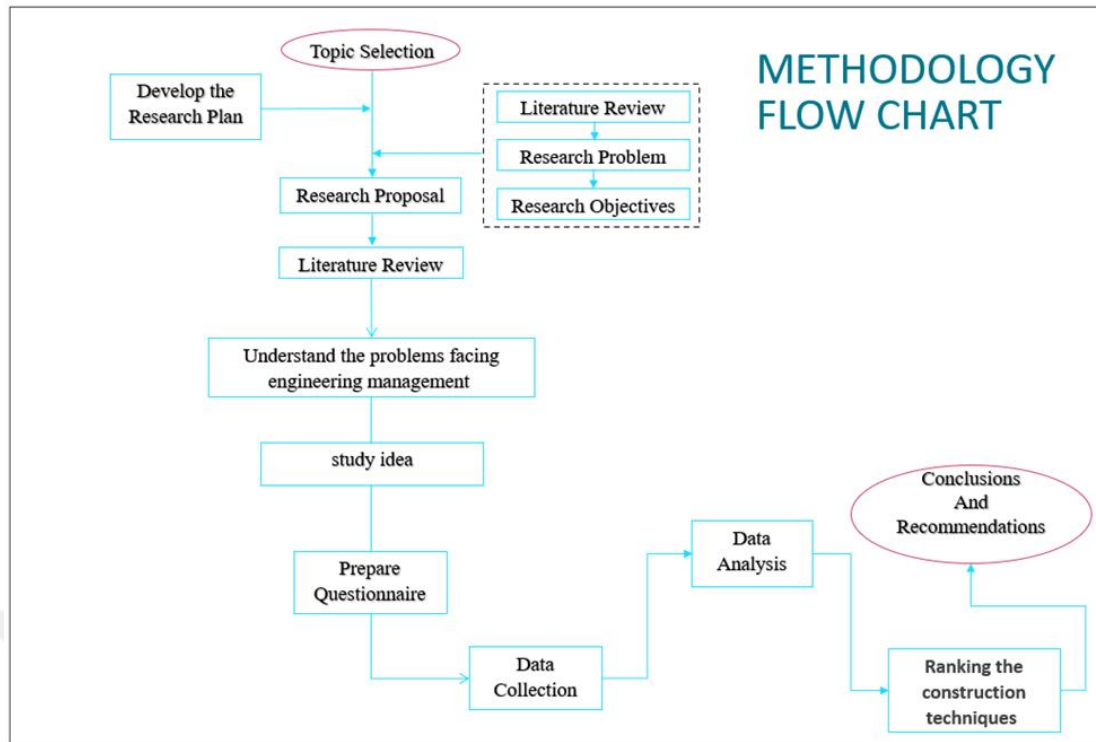


Figure 3.1: Methodology flow chart [10]

3.2 Research objectives

The primary objective of this thesis is to help improve Iraqi housing projects by identifying and implementing methods that are cost-effective, strong and durable, aesthetically pleasing, etc. To accomplish this, we will use:

- An analysis of the present state of construction in Samarra, Iraq
- Create a system to assess these methods
- Use of modern sustainable building materials and techniques in local architecture.

3.3 Research Methodology

In addressing the problem of the study, the research relied on the descriptive analytical approach by adopting the appropriate theoretical framework for the study and on the field study and data analysis in the comparison between modern building materials and techniques in contemporary sustainable architecture and local construction. Materials used in the city of Samarra, Iraq. Furthermore, it is of the utmost importance that the study strategy that is chosen is in conformity with It is

necessary to make a number of important decisions at this time. Taking into account the research technique enables the researcher to examine the ways in which various approaches influence the design of the study, despite the fact that the technique itself will not have any effect on the design of the study itself. Moreover, it has the potential to assist in narrowing the scope of the study, which is a great way for reaching particular objectives and generating an effective research plan [13]. In addition, it has the potential to help in reducing the overall size of the study.



Figure 3.2: Qualitative vs Quantitative Research [31]

For the purpose of conducting the research, the investigation makes use of a quantitative approach rather than a qualitative analysis. According to , this is not the case; rather, researchers should make use of a variety of methods based on the circumstances rather than relying entirely on a single method exclusively[12]. This is because the conditions can alter the methods that are used. In this section, we will discuss the challenges that are associated with quantitative and qualitative research, as well as the characteristics that each method possesses, and the elements that led to the decision to use both approaches in this particular study. Moreover, we will also discuss the reasons that led to the decision to employ both approaches.

3.3.1 Quantitative research

On the basis of the definition that was supplied by Cornford and Smithson (1996), quantitative research is described as studies that "rely on the development of measures. The numbers we use to describe all phenomena (things and relationships) are content and under study."

In accordance with [16], quantitative research is conducted in accordance with a logical process, which can be defined as reasoning that is founded on rules, models, and laws. As part of this procedure, measurements and evaluations are made on the interaction between the factors of interest. In accordance with Denzin and Lincoln (2017), quantitative research has the potential to shed light on the "how" and "how often" of human behavior; yet, it does not provide an answer to the question of "why" human conduct happens. According to Straub et [14], quantitative researchers may use a variety of research approaches, such as field and laboratory investigations, in order to acquire a more comprehensive comprehension of the subject matter that is the subject of their investigation. In quantitative research, the conclusions that are obtained from the analysis of the data collected are frequently generated through the utilization of statistical methods such as those described in the previous sentence. There is a possibility that these findings either validate or invalidate the assumption of the study [16].

3.3.2 Qualitative research

There is a specific difference between the two different kinds of sampling. On the other hand, sampling should be executed in a manner that is both random and deliberate. According to [17], in order to gather the specific data and information that is required, the target sample must be made up of persons who have a variety of traits that are considered to be desirable. Types of purposive sampling that are known as judgment sampling and quota sampling are: also included in this category. Both of these types of sampling are examples of the same idea.

According to research and study are dependent on judgmental sampling when just a small percentage of the population possesses the relevant data and knowledge regarding the topic at hand. This investigation made use of judgment samples as a result of the aforementioned circumstance. [17] defines purposive sampling as a method Through which the sample is selected specified criteria that are ideal for the

individuals who are serving as the sample populations. The research makes use of this strategy, which is referred to as purposive sampling. Because the members of the target group are specific, specifically building contractors, and only they are able to offer the necessary information, this method is applied in this inquiry. The rationale for this is due to the fact that the members of the target group are specified. Additionally, the purpose of this study was to analyze a number of different building approaches in accordance with a set of criteria that had been developed in advance.

This was done in addition to establishing and measuring the characteristics that are most relevant when choosing on a certain strategy. For the purpose of achieving this goal, we carried out preliminary screenings and then circulated 81 questionnaires to area construction enterprises. The Iraqi Contractors Union has designated these businesses as Category I participants because they are members of the union. According to [18], the contractor classification offered by the Iraqi Contractors Union is the most significant service that is offered.

It has been suggested that each of the five categories of contractors— Roads, residential buildings, electromechanical, potable water, sanitation, industry and maintenance —be further subdivided into a number of other disciplines. The maximum possible score for each field is five, with one being the lowest possible score and five being the highest possible score [18]. As a result of the significant part that contractors play in the execution of building projects through oversight, they were chosen to produce a sample that is representative of the population that is the subject of the research.

As of the month of January 2011, the Iraqi Contractors Union had a total of 419 companies on its list of registered or considered to be classified as building contractors. There are five basic categories of building contractors that have been recognized. These contractors are distinguished from one another by their financial resources, level of expertise, track record, and individual technical personnel. Table 3.2 provides an overview of the number of construction contractors that are employed during the various seasons in the construction business.

Table 3.1: Comparison table between the quantitative and qualitative research [8]

Quantitative	Qualitative
How many (X)	What is (X)
Deductive Processes	Inductive Process
Sampling is random	Sample is selective (non-random)
Concepts and hypotheses are chosen before starting the research	Researcher looks for patterns and Concepts
Measurement tools are used for variables in this study	Most theories are developed and compared with patterns and with remaining theories

3.4 Type of Sampling

There is a specific difference between the two different kinds of sampling. On the other hand, sampling should be executed in a manner that is both random and deliberate. According to [17], in order to gather the specific data and information that is required, the target sample must be made up of persons who have a variety of traits that are considered to be desirable. The types When taking purposive samples, they are known as judgment samples and quota samples also included in this category. Both of these types of sampling are examples of the same idea. According to Sekaran (2003), research and study are dependent on judgmental sampling when just a small percentage of the population possesses the relevant data and knowledge regarding the topic at hand. This investigation made use of judgment samples as a result of the aforementioned circumstance[17]defines purposive sampling as a method Through which the sample is selected specified criteria that are ideal for the individuals who are serving as the sample populations. The research makes use of this strategy, which is referred to as purposive sampling. Because the members of the target group are specific, specifically building contractors, and only they are able to offer the necessary information, this method is applied in this inquiry.

The rationale for this is due to the fact that the members of the target group are specified. Additionally, the purpose of this study was to analyze a number of different building approaches in accordance with a set of criteria that had been developed in advance. This was done in addition to establishing and measuring the characteristics that are most relevant when choosing on a certain strategy. For the purpose of achieving this goal, we carried out preliminary screenings and then circulated 81 questionnaires to area construction enterprises.

The Iraqi Contractors Union has designated these businesses as Category I participants because they are members of the union. It has been suggested that each of the five categories of contractors— Roads, residential buildings, electromechanical, potable water, sanitation, industry and maintenance —be further subdivided into a number of other disciplines. The maximum possible score for each field is five, with one being the lowest possible score and five being the highest possible score [18]. Since contractors play an important role in the execution of building projects through supervision, they were chosen to produce a sample that is representative of the population that is being discussed in the research. This was done in order to ensure that the sample is representative of the population. Furthermore, in control of it.

As of the month of January 2011, the Iraqi Contractors Union had a total of 419 companies on its list of registered or considered to be classified as building contractors. There are five basic categories of building contractors that have been recognized. These contractors are distinguished from one another by their financial resources, level of expertise, track record, and individual technical personnel. Table 3.2 provides an overview of the number of construction contractors that are employed during the various seasons in the construction business.

Table 3.2: Categories of contracting companies in Samarra according to the group of Iraqi companies and contractors.

Group	1st	2nd	3rd	4th	5th
Contractor's sequence	82	93	88	75	76

3.5 Data Collection Methods

Reviewing the present construction approaches employed in the research environment was the next step after establishing the research objectives. During the second semester, you should collect pertinent subjects that will serve as the research's foundation. So, to accomplish the aforementioned goal of choosing suitable construction techniques in Samarra, Iraq, the following is the process.

3.5.1 Questionnaire design

In order to gain a better understanding of the rationale behind the study into the aims that the questionnaire was designed to accomplish, please refer to Appendix A. During the period of time that before the distribution of the final questionnaire, testing was carried out, and ideas were thoroughly investigated. Furthermore, we got the opinions of a number of additional specialists who evaluated the questionnaire, and we carefully reviewed the responses that they provided. During the course of the research project, we made an attempt to get in touch with each and every member of the population that was being investigated. This was accomplished through in-person meetings, emails, and informal interviews.

The questionnaire featured a weighted grading system with ten total points in order to evaluate the numerous various construction processes that were available. The term "judgmental evaluation metric" refers to the evaluation metric that takes into account judgment while making judgments regarding how to organize and evaluate the activities involved in building. The criteria were derived from a survey as well as informal interviews conducted with professionals who were responsible for the execution of construction projects. Additionally, the criteria were generated from documentation of initiatives that were similar to those that had already been brought into action. The consideration of extra aspects is also something that could be done. Table 4.4 presents the aspects that influence the decision-making process, despite the fact that this is the most important consideration.

Table 3.3: Decision criteria that influence decisions to classify and evaluate modern construction technologies

1- durability and Strength	6- Speed of construction
2- Cost of construction	7- Cost of future maintenance
3- Safety during construction	8- Thermal insulation
4- Aesthetically	9- Fire resistance
5- Environmental factors and their resistance	10- specialized skills

Estimates are also made and known for this questionnaire using the value technique. The decision-making process's relative relevance as measured by the respective weights of these criteria.

3.5.2 Case study

To get a feel for how much each technology actually costs, I used the house as a case study. So that I could compare the technologies and see how much they would cost to build, I had four independent contractors estimate the same bills of quantities for each technology and then average their prices.

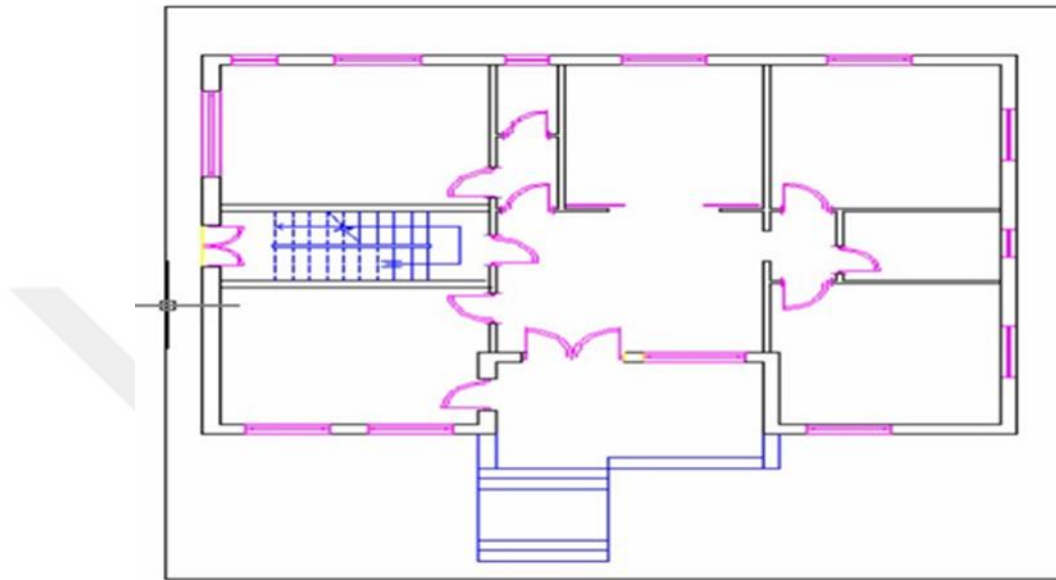


Figure 3.3: The scheme for selecting housing units is taken as a case study” [10]

3.6 Decision Making Mechanism

Important decisions must be made by every person at some point in their lives. On the other hand, failure is a real possibility with hastily made decisions. Taking a methodical approach to decision-making is key to avoiding such issues.

3.6.1 Definition of decision making

It would be a good idea to take the first step of ensuring that there is a foundation of common knowledge on the process of decision preparation. According to [30], decision making may be described as the act of picking an alternative while taking into consideration Values and preferences of the individual who makes the decision. In which case we will find it ourselves in a circumstance in which we are compelled to make a decision, it is in our best advantage to take into consideration all of the options that are available to us and choose the individual option that seems to have the most potential.

This option is the one that (1) has the highest likelihood of being successful or effective and (2) is the one that most closely corresponds With goals, preference lifestyle values, etc. It is the alternative that we have chosen.

According to one definition, decision making is "the mental (cognitive) processes leading to a choice of a path of action from among multiple different situations." All of these procedures are referred to as "decision making" in the term. Every single decision-making process concludes in the selection of a single alternative between the available choices. As a consequence of this, one can settle on a conclusion or select a particular course of action” [28].

3.6.2 Types of decisions

According to decisions can be broadly divided into a range of different categories. This hypothesis has been put out by Harris. This is what he has here:

1. Determinations concerning sentences that start with the word "whether" You are unable to move forward with the process of picking an alternative until you have supplied a response to this question that is either yes or no or either or. Before making a decision, it is necessary to consider both the positive and negative aspects of the circumstance. Assuming that a decision has already been made, it is simple to fall into the trap of thinking that the first step in the process of making a decision is to generate a list of potential options. When it comes to making decisions, however, it is really necessary to have a strong sense of self-awareness because it is so simple to commit this error.

2. Two distinct "which" choices are available. In this scenario, you will be expected to choose one of several potential responses, and the ultimate decision that you make will be based on how each of these replies compares to a set of criteria that have been established beforehand.

3. And last but not least, decisions that were made during a period of stress. A choice has been made, but it is now on hold until certain conditions are met. This is despite the fact that something has already been decided upon.

This type of decision is referred to as "decisions that" because the purpose of this research is to set local standards for evaluating the effectiveness of the building methods that are presently being utilized in Iraq and selecting the most successful

one. The decision that takes place is referred to as "decisions that." Taking into consideration the following, the procedure for making decisions is as follows: The process of making a decision that begins with the specification of criteria, then carries on to the discovery of alternatives, and lastly ties the criteria to the choices that have been made from the beginning of the process.

3.6.3 Decision making techniques

There is a wide range of easy ways to decision-making from which you can choose an appropriate one. The application of investigative techniques is the primary topic of this discussion:

1. When it comes to planning and carrying out decisions, the Five-Step Decision Making Model is a helpful methodology that may be applied for the goal of making decisions. The decisions that you make will be strengthened by your activities, which are of a perfectly sensible and straightforward nature.

2. The utilization of a choice matrix is a valuable tool that can be utilized in situations when there are multiple viable options from which to select. Use might be made of components that are considered to be important. The ability to communicate your opinions regarding the relative value of each of these components can be achieved through the process of giving a weight to each of these components. You are able to make use of this in order to clear the fog that has been obstructing your ability to make decisions.

3. The SWOT analysis, which is an acronym that stands for advantages, disadvantages, opportunities, and threats, is another term for this phrase. One of the most typical uses of this highly specialized method to decision-making is in the context of commercial partnerships. This is one of the most interesting applications. Through the process of visualizing the situation's SWOT (strengths, weaknesses, opportunities, and threats) [29], it is possible to exert influence on future decisions.

4. As part of this inquiry, the decision matrix method will be applied in order to develop a decision profile that compares a variety of alternative construction technologies. This will be done in order to facilitate the investigation.

3.6.4 The decision-making process

For the purpose of this investigation, the decision-making method that was applied consisted of developing selection criteria and providing possible answers. The table shown below is used in the process of performing this procedure:

1- Consider the different options available to the researcher as well as the specific choice he or she wishes to pursue. This is keeping in mind the factor involved.

2- Identify the factors that are considered the most important.

3- In order to reach a result, you must give each criterion priority in the ranking.

4. Determine the number of specific criteria associated with each of the available options.

5. The fifth step is to discover the option that received the highest score by multiplying the criteria scores by the alternative scores. It will allow you to select the highest priority and value.

Surrounding these limitations is a wide range of circumstances. The technologies chosen for the study, which include insulating materials, concrete blocks, etc., meet the highest insulation requirements imposed by the Engineers Syndicate. They also reduce manufacturing costs by preserving building materials and have the ability to reduce electrical energy expenditure, which is important. It is extremely important within the city of Samarra, Iraq, due to the lack of electricity supply, so it is considered very important technologies

4. DATA GATHERING AND ANALYSIS

A questionnaire was sent out to construction companies in Samarra, Iraq, with the intention of gathering information about their operations. A number of organizations, including the Iraq Contractors Union, the Engineers Union, the Iraqi Central Bureau of Statistics, the Iraqi Housing Council, and the Ministry of Public Works and Housing, were among those that contributed to the compilation of the statistics. Additionally, direct interviews were carried out with a significant number of consulting engineers and contractors as a component of the research project. Following the completion of the examination, the construction industry technology that is most suitable will be identified. The technological advancements that are currently available and have the potential to be employed in construction projects. It was through the administration of a survey that the researcher was able to successfully accomplish this purpose.

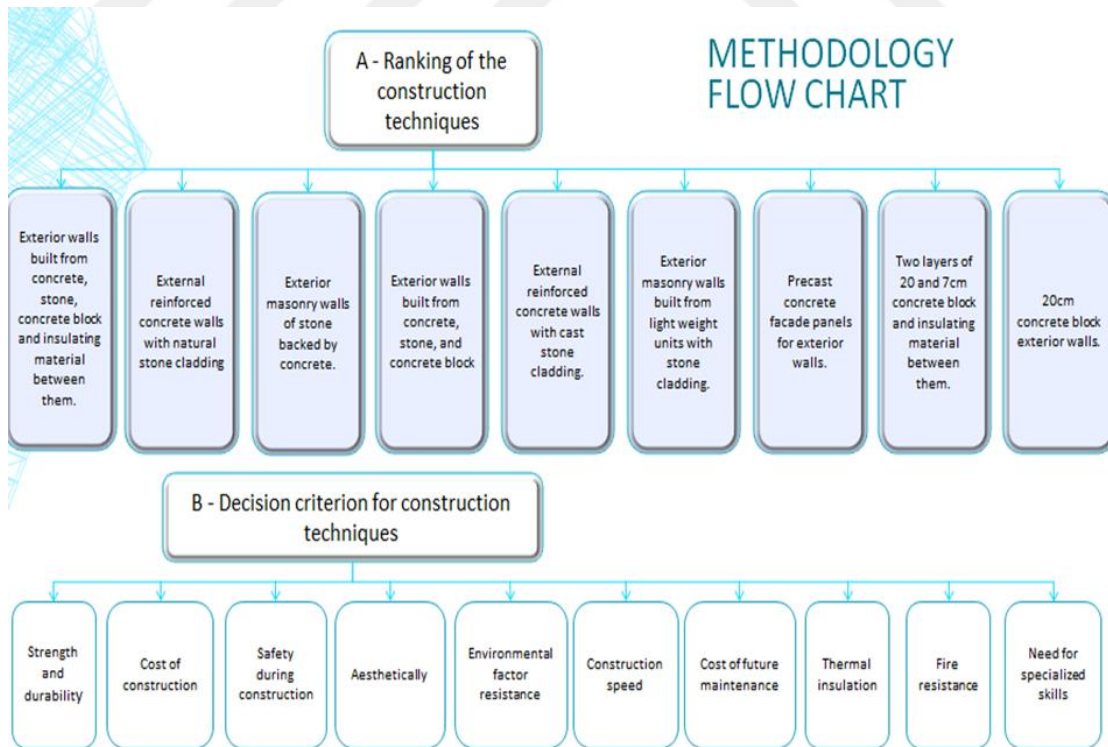


Figure 4.1: Methodology flow chart for construction techniques [10]

Contractors were chosen as a representative sample for the purpose of this inquiry because of the significant role that they play in the execution of building projects. This investigation was carried out in order to gather information. Individuals were called upon to fill out a questionnaire that was distributed to them. For the purpose of arriving at the results that are reported in this chapter, these are the 56 answered questions that were obtained in their entirety. Within the scope of this section, we will talk about the findings of the study in connection to the research questions, Research objectives and problem statement. After that, we will gather some findings by conducting an analysis of the data that we have collected.

4.1 Data Collection

As was said earlier, the questionnaire was sent out to a great number of local contracting companies in Samarra, which is located in Iraq. According to the standards of the construction industry, these businesses are the most important institutions that are considered to be of the highest quality.

The researchers came to the conclusion that this particular sample would be utilized for the experiment that they were proceeding with. Due to the fact that micro and small businesses are not large enough to warrant the kind of scrutiny that was applied to them, research was carried out on major corporations. At least eighty-one responses were going to be collected from the participants, according to the researcher at the time. It has been established that it is a valid sample that is now functioning, and it satisfies the standards that were stated about the research. Beginning on July 13, 2023 and finishing on August 9, 2023, the researcher had a total of seven weeks to collect questionnaires that had been filled out voluntarily by the participants. After the seven weeks had passed, there were 63 surveys that had been completed by the time the time period was done. Following an analysis, it was determined that seven of the participants did not meet the criteria necessary to be included in the study because they did not possess the necessary information. A response rate of 69% was determined as a consequence of this, and only 56 inquiries were permitted to be taken into further consideration.

A technique to evaluation that was weighted and utilized a scale with ten points was utilized in this study in order to evaluate the various construction processes. The evaluation was carried out in line with the selected criterion, which

includes a factor that influences the arrangement of the techniques and the evaluation of those methods. In this section, the findings of the survey are dissected in greater detail than in the previous sections. An evaluation of the decision criteria that had an impact on the decisions that were taken to arrange and evaluate the manufacturing processes was one of the outcomes that was achieved. Analyzing the many structural techniques that are available.

Determining the method of construction that will be applied for the production of a low-cost housing is an important step. To what extent do the companies that were included in the research sample actually make use of the technologies that were examined for the purpose of carrying out housing projects?

The following construction methods were explored in this study that was carried out in Samarra, Iraq, based on the findings that were obtained in the previous research that had been done. The second chapter offers a discussion on the activities that are associated with research. These activities, which include review and monitoring, take place during field visits and are called field visits. In order to illustrate a system, the following is an example:

Covering the exterior walls of the building with natural stone and reinforced concrete as the material of choice. The outside of the building is characterized by the presence of two reinforced concrete walls that are covered in cast stone. Concrete blocks with a thickness of twenty centimeters are used in the construction of the exterior walls of the vertical girder column structure that consists of three slabs.

Four-A slab-column structure that is stacked two stories high and is made up of concrete blocks that measure twenty and seven centimeters in thickness. A layer of insulating material is positioned in the space between the walls and the floors.

There is a column system consisting of five slabs, and the walls are made of stone and are bordered by concrete. Structure consisting of slabs and columns where the exterior walls are made of concrete, stone, and block bricks. Outside walls constructed of stone, concrete blocks, and insulating materials surround the seven-slab column structure that is surrounded by these walls. These walls also contain insulating materials. The construction of the exterior stone walls, which also include an 8-slab column system, is accomplished by the utilization of a lightweight "ytong" unit that

is embellished with stone cladding. Structure that is made of precast concrete and is utilized for the purpose of providing support for external slabs and walls.

4.1.1 Evaluate decision criteria that influence building technology evaluation and building classification decisions

Both the decision criterion that influences arrangement decisions and the evaluation of construction technologies were reviewed with the help of the weighted assessment technique, which is a scale with ten points. The actions taken were carried out in accordance with the information that was provided earlier in the questionnaire. The criteria were derived from a survey as well as informal interviews conducted with professionals who were responsible for the execution of construction projects. Additionally, the criteria were generated from documentation of initiatives that were similar to those that had already been brought into action. The consideration of extra aspects is also something that could be done. The primary purpose of the survey, on the other hand, was to establish the factors that individuals take into consideration when picking a construction style. With relation to the process of making a decision, as evidenced by the example that is presented in the following paragraphs (10 means very important).

Table 4.1: Shows the result obtained from the evaluation and analysis of decision-making criteria

Strength and durability	(Scores) (X)	1	2	3	4	5	6	7	8	9	10	55
	(Repetition) (Y)	1	2	3	0	0	0	2	1	7	40	56
	X*Y	1	4	9	0	0	0	14	8	63	400	499
											499/55= 9.07	

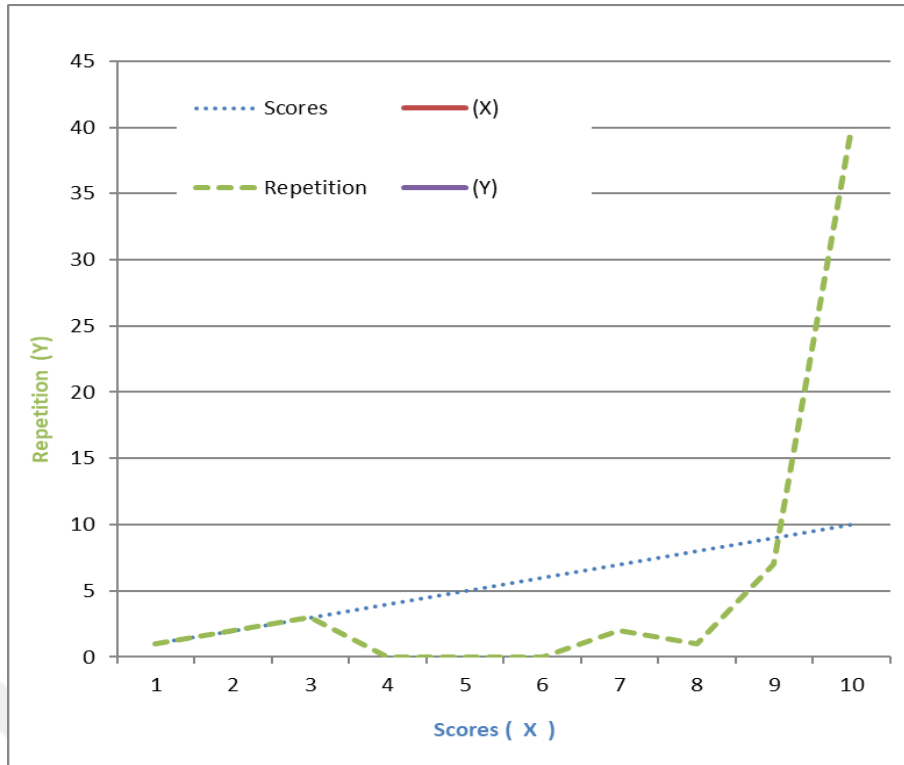


Figure 4.2: Chart for (Scores X) & (Repetition Y)

Table 4.2: It turns out that the results obtained from evaluating and making decision criteria

	Decision Criterions	Percentages			Decision Criterions	Percentages
1	Durability and, Strength (9.07)*	15% **		2	Cost of the construction (9.48)	15%
3	Safety during the construction (8.07)	15%		4	Aesthetically (8.1)	10%
5	Environmental factor and their resistance (6.52)	10%		6	speed of Construction (6.95)	10%
7	Cost of the future maintenance (7.67)	10%		8	Thermal insulation (4.98)	5%
9	Fire resistance (3.98)	5%		10	Specialized skills (4.2)	5%
The sum of total scores =69.02						
The sum of total percentage =100%						

The weighted average score for a choice criterion is represented by the number between them. Demonstrates the evaluation of criteria and decision-making factors used to evaluate construction techniques. In Table (4.2), during the analysis and evaluation procedure, it was found that the “Cost of the Construction”

technology, which has a percentage of (9.48), is the highest and has priority, and that the percentage (9.07) represents the second technology, “Durability and Strength.”

4.1.2 Evaluation of techniques in construction

The second reason for creating the survey was to assess the methods used in building. The following example shows how the weighted assessment approach, which uses a 10-point scale to make judgments in choice criteria, has been used to evaluate the construction techniques. (10: mean very positive).

Table 4.3: Shows the result obtained from the evaluation and analysis of decision-making criteria

Durability and Strength E.F(15)*	(Scores) (X)	1	2	3	4	5	6	7	8	9	10	55
	(Repetition) (Y)	1	2	3	0	0	0	2	1	8	39	56
	X*Y	1	4	9	0	0	0	14	8	72	390	498
	WAS = 9.05									(9.05*15)/10 =13.57		**Score 14

The calculated weighted average scores = $\Sigma (X*Y) / \Sigma (X)$ (weighted average score*E.F)/10

E.F is a factor to evaluate the decision in criterion which is taken from the Tabl“4.3”

4.1.2.1 Evaluation methods for external concrete and reinforced walls that are clad in normal- stone

Table 4.4: Evaluation technique: Externally concrete and reinforced walls that are clad in normal stone

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and Strength (14)*	14		2	Cost of the construction (9.58)	8.9
3	Safety during construction (14)	9.4		4	Aesthetically (11)	8.4
5	Environmental factor resistance (11)	7.8		6	Construction speed (10)	5.8
7	Cost of the future Maintenance (11)	7.5		8	Thermal insulation (6)	3.3
9	Fire resistance (6)	4.0		10	Need for specialized skills (5)	3.2
The sum of total percentage =72.3						

*The number between () is the evaluation factor for a decision criterion

In Table (4.4), during the analysis and evaluation procedure, it was found that the “durability and strength” technology, which has a percentage of (14), is the highest and has priority, and that the percentage of (9.4) represents the second technology, “Safety during construction.”

4.1.2.2 Evaluation method for external concrete and reinforced walls clad in cast stone.

Table 4.5: Evaluation technique: Externally reinforced the concrete walls with the cast stone cladding

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and Strength (15)	10.5		2	Cost of the construction (15)	8.6
3	Safety during the construction (15)	10		4	Aesthetically (10)	6.9
5	Environmental factor their resistance (10)	7.3		6	Speed of the Construction (10)	6.0
7	Cost of the future maintenance (10)	7.2		8	Thermal insulation (5)	2.9
9	Fire resistance (5)	2.5		10	specialized skills (5)	4.1
The sum of total percentage =66						

In Table (4.5), during the analysis and evaluation procedure, it was found that the “durability and Strength” technology, which has a percentage of (10.5), is the highest and has priority, and that the percentage of (10) represents the second technology, “Safety during the construction.”

4.1.2.3 Evaluation techniques for a column system consisting of slab beams with external walls made of 20 cm thick concrete blocks

Table 4.6: A technology by which to evaluate the slab column system with 20 cm concrete blocks used in external walls

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and Strength (15)	7.3		2	Cost of the construction (15)	11.2
3	Safety during the construction (15)	10.9		4	Aesthetically (10)	3.8
5	Environmental factor Their resistance (10)	4.2		6	Speed of Construction (10)	8.9

Table 4.6: (Cont.) A technology by which to evaluate the slab column system with 20 cm concrete blocks used in external walls

	Decision Criteria	Percentages			Decision Criteria	Percentages
7	Cost of the future maintenance (10)	4.9		8	Thermal insulation (5)	1.9
9	Fire resistance (5)	2.1		10	specialized skills (5)	3.9
The sum off total percentage =59.1						

In Table (4.6), during the analysis and evaluation procedure, it was found that the “Cost of the construction” technology, which has a percentage of (11.2), is the highest and has priority, and that the percentage of (10.9) represents the second technology, “Safety during the construction.”

4.1.2.4 Evaluation techniques for the “slabs-beam-column” systems with external walls built of two layers of the concrete blocks of (20) and (7) cm and insulating materials between them

Table 4.7: Evaluation techniques for the “slab-beam-column” systems and external walls built of two layers of the concrete blocks, (20) and (7) cm, with insulation materials between them

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and Strength (15)	6.9		2	Cost of the construction (15)	9.8
3	Safety during the construction (15)	11		4	Aesthetically (10)	3.9
5	Environmental factor their resistance (10)	6.1		6	speed of Construction (10)	6.9
7	Cost of the future maintenance (10)	6.2		8	Thermal insulation (5)	4.1
9	Fire resistance (5)	2.8		10	specialized skills (5)	4.2
The sum of total percentage =61.9						

In Table (4.7), during the analysis and evaluation, it was shown that the technology “Safety during the construction”, which has a percentage of (11) that is the highest and has priority, and a percentage of (9.8) represents the second technology "Cost of the construction".

4.1.2.5 Evaluation technique Systems Columns with slab beams installed with external strong masonry walls supported by concrete.

Table 4.8: A technique for evaluating a system consisting of slab columns with external strong masonry walls supported by concrete

	Decision Criteria	Percentages		Decision Criteria	Percentages	
1	durability and the Strength (15)	11.5		2	Cost of the construction (15)	7.9
3	Safety during the construction (15)	11		4	Aesthetically (10)	7.9
5	Environmental factor their resistance (10)	8		6	Speed of the Construction (10)	6
7	Cost of future the maintenance (10)	5.8		8	Thermal insulation (5)	4
9	Fire resistance (5)	4		10	specialized skills (5)	5
The sum of total percentage =71.1						

In Table (4.8), during the analysis and evaluation procedure, it was shown that the “durability and the Strength” technology, which has a percentage of (11.5), is the highest and has priority, and that the percentage of (11) represents the second technology, “Safety during the construction.”

4.1.2.6 Evaluation techniques for the column and beams system with the strong external walls built of concrete, stone and the concrete blocks

Table 4.9: Techniques for evaluating the system the Slab columns with strong externally walls built of the concrete, stone and the concrete blocks

	Decision Criteria	Percentages		Decision Criteria	Percentages	
1	durability and the Strength (15)	10.8		2	Cost of the construction (15)	8.5
3	Safety during the construction (15)	8.8		4	Aesthetically (10)	7.6
5	Environmental factor their resistance (10)	8		6	Speed for the Construction (10)	5.7
7	Cost of future the maintenance (10)	8.2		8	Thermal insulation (5)	4.1
9	Fire resistance (5)	4		10	specialized skills (5)	4.2
The sum of total percentage =69.9						

In Table (4.9), during the analysis and evaluation procedure, it was found that the “durability and the Strength” technology, with a percentage of (10.8), is the highest and has priority, and that the percentage (8.8) represents the second technology, “Safety during the construction.”

4.1.2.7 Evaluation techniques for a systems of the strong columns and beams with externall walls built up of the concrete, stone, concrete blocks and insulation materials in between

Table 4.10: Evaluation techniques of the slab column system with the strong externall walls built of the concrete, stone, concrete blocks and insulation materials in between them

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and the Strength (15)	10.9		2	Cost of the construction (15)	8.9
3	Safety during construction (15)	13		4	Aesthetically (10)	7.9
5	Environmental factor their resistance (10)	8.2		6	Speed for the Construction (10)	6
7	Cost of the future maintenance (10)	6.8		8	Thermal insulation (5)	3.8
9	Fire resistance (5)	3.9		10	specialized skills (5)	4
The sum of total percentage =73.4						

In Table (4.10), during the analysis and evaluation procedure, it was shown that the technology “Safety during construction”, whose percentage (13) is the highest and has priority, and the percentage (10.9) represents the second technology "durability and the Strength".

4.1.2.8 Evaluation techniques for the strong (slab-beam column) system with the built-up exterior facades composed of lightweight stone wall units “Itong” with the stone cladding

Table 4.11: Evaluation techniques for a strong slab-beam column system with built-up exterior facades composed of the lightweight stone wall units “Itong” with stone cladding.

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and the Strength (15)	9.1		2	Cost of the construction (15)	9
3	Safety during the construction (15)	9.8		4	Aesthetically (10)	8.2
5	Environmental factor their resistance (10)	6.8		6	Speed for the Construction (10)	6.1
7	Cost of the future maintenance (10)	7.1		8	Thermal insulation (5)	2.9
9	Fire resistance (5)	4		10	specialized skills (5)	2.5
The sum of total percentage =65.5						

In Table (4.11), during the analysis and evaluation procedure, it was shown that the technology “Safety During construction”, whose percentage (9.8) is the highest and has priority, and the percentage (9.1) represents the second technology “durability and the Strength”.

4.1.2.9 Evaluation techniques for the strong column and beam system using the (precast concrete) façade panels for the external visible walls

Table 4.12: Evaluation techniques for the (a strong column and beam system) using the precast concrete façade panels for external visible walls

	Decision Criteria	Percentages			Decision Criteria	Percentages
1	durability and the Strength (15)	10.9		2	Cost of the construction (15)	7.9
3	Safety during the construction (15)	9		4	Aesthetically (10)	6
5	Environmental factor their resistance (10)	5.6		6	Speed for the Construction (10)	7.5
7	Cost of future the maintenance (10)	5.8		8	Thermal insulation (5)	2.5
9	Fire resistance (5)	4		10	Specialized skills (5)	3
The sum of total percentage =62.2						

In Table (4.12), during the analysis and evaluation procedure, it was found that the “durability and the Strength” technology, which has a percentage of (10.9), is the highest and has priority, and that the percentage of (9) represents the second technology, “Safety during the construction.”

4.2 Ranking the construction techniques

In order to assess the construction techniques in relation to these criteria, as mentioned earlier, and to identify the factors that impact decision-making when choosing the right approach, the questionnaire was administered.

Here is a table that ranks the construction procedures based on how the research sample was evaluated.

Table 4.13: Ranking list of the construction techniques

	Construction techniques	Score
1	Exterior walls built from concrete, stone, concrete block and insulating material between them.	73.4
2	External reinforced concrete walls with natural stone cladding.	72.3
3	Exterior masonry walls of stone backed by concrete.	71.1
4	Exterior walls built from concrete, stone, and concrete block	69.9
5	External reinforced concrete walls with cast stone cladding.	66
6	Exterior masonry walls built from light weight units with stone cladding.	65.5
7	Precast concrete facade panels for exterior walls	62.2
8	Two layers of 20 and 7cm concrete block and insulating material between them.	61.9
9	20cm concrete block exterior walls.	61.4

In the table above, there is a list of the construction technologies used in covering external walls in terms of the best classification, as it was shown that the best technologies are (external walls built of concrete, stone, concrete blocks, and insulating materials in between), which constitute a percentage of (73.4).

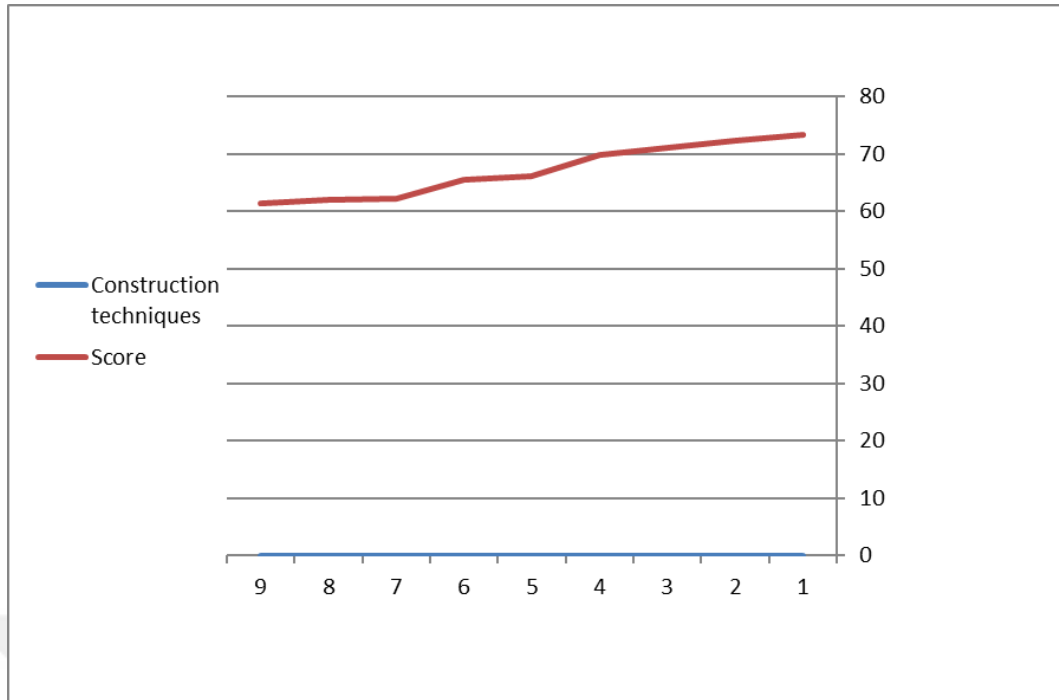


Figure 4.3: Chart for (Scores X) & (Construction Techniques Y)

According to the last conclusion mentioned above, the following technologies obtained the highest total- of points:

- The external walls are built of the concrete, stone, concrete blocks and insulating materials between them.
- The externally reinforced the concrete walls are clad in natural stone.

4.3 “Selection- of the construction techniques”

Choosing a construction technology In order to properly establish an affordable housing project for citizens, the research sample was asked to choose one of the-nine methods mentioned previously in the research.

Table 4.14: Displays the results Selection of the construction technique

	Construction techniques	Repetition	Percent
1	Exterior walls built from concrete, stone, concrete block and insulating material between them.	31	55.4%
2	External reinforced concrete walls with natural stone cladding.	11	19.6%
3	Exterior walls built from concrete, stone, and concrete block	3	5.4%
4	Exterior masonry walls of stone backed by concrete.	5	8.9%
5	Exterior masonry walls built from light weight units with stone cladding.	1	1.7%
6	External reinforced concrete walls with cast stone cladding.	0	0.0%
7	Precast concrete facade panels for exterior walls	0	0.0%
8	Two layers of 20 and 7cm concrete block and insulating material between them.	3	5.4%
9	20cm concrete block exterior walls.	2	3.6%
Total Summation		56	100%

Through the questionnaire, it was found that the number of responses was 56, most of which supported Model 1, with a percentage of 55%. This indicates that the construction using Exterior walls technology is built from concrete, stone, concrete block and insulating material between them. He is the best. It was also found that the second model had a rate of 19%, as shown in the table for the remaining techniques

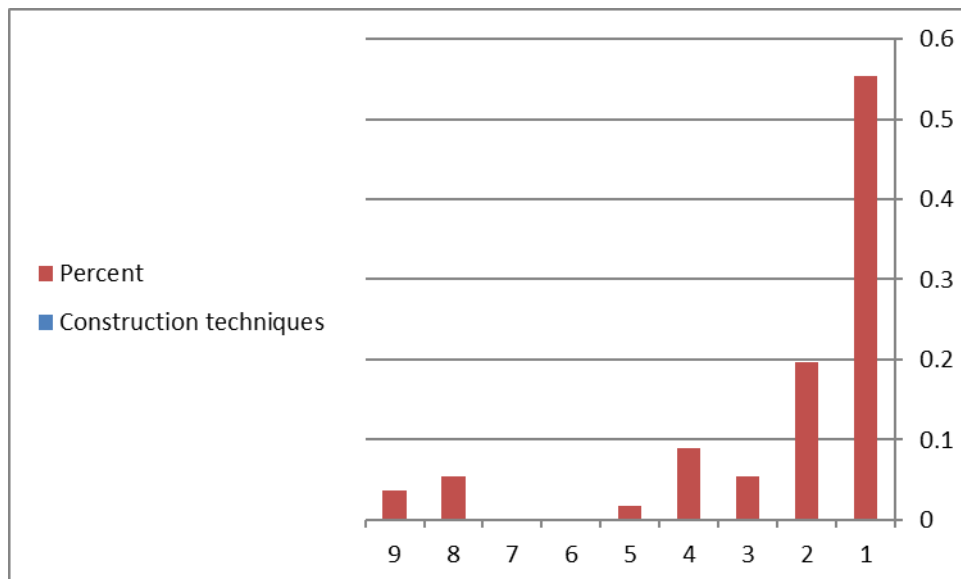


Figure 4.4: Chart for (Percent) & (Construction Techniques)

As the results that were discussed earlier reveal, there is a correlation between the selection and evaluation of the nine approaches that were included in the study when it comes to selecting the suitable construction technology for a residential

project. This correlation was found to exist when it comes to the selection of the appropriate construction technology. As an illustration, more than half of the individuals who took part in the research selected the approach that had the highest ratio total points (73.4) for affordable housing developments. This technique involved the construction of outside walls made of concrete, stone, and concrete block, with insulating materials being inserted in between the walls.

4.3.1 Cost analysis for decision making to choose appropriate construction techniques

The research hypothesis considered that the construction used in residential projects in Iraq and in Samarra in particular is unsatisfactory in terms of achieving cheap construction at a low cost. A case study was used to verify this hypothesis, as a housing unit was taken as a case study in order to estimate its actual cost. The area of the proposed residential unit is 190 square meters, see Figure (3.3). It required analysing the table of quantities for each technology (Appendix B). Each technology was compared in terms of construction cost, and Table 4.15 shows the actual cost of each construction technology.

Table 4.15: The average actual cost of construction for each technique

	Construction techniques	cost per m2 (IQD)
1-	System wall Bearing cladding stone natural with walls concrete reinforce External	126,981,000
2-	Slab-beam-column Exterior masonry walls built from light weight units with stone cladding	123,721,205
3-	System Slab-beam-column concrete by backed stone of walls masonry Exterior	116,403,000
4-	System Slab-beam-column Precast concrete facade panels for exterior walls	110,903,000
5-	System Slab-beam-column Exterior walls built from concrete, stone, concrete block and insulating material	108,879,205
6-	System wall Bearing cladding stone cast with walls concrete reinforced External	108,531,000
7-	Slab-beam-column system Two layers of 20 and 7 cm concrete block and Insulating material	102,338,000
8-	Slab-beam-column system Exterior walls built from concrete, stone, and concrete block	100,966,000
9-	Slab-beam-column system 20 cm concrete block exterior walls	61,496,000

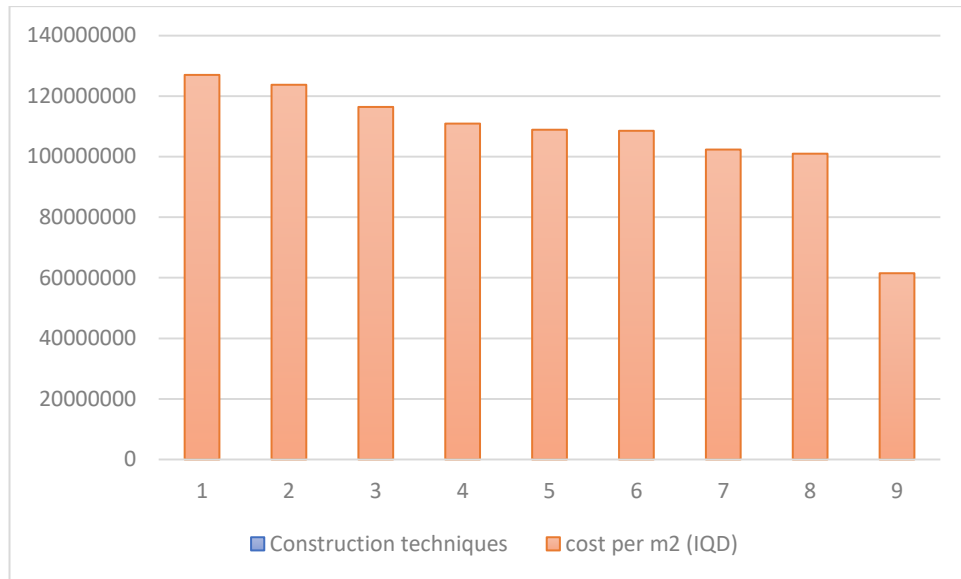


Figure 4.5: Chart for the average actual cost of construction for each technique

4.3.2 Case studies of successful affordable housing projects from other regions [7]

In this study, a residential complex will be studied, which is (Al-Nour Village), as it is a project that aims to establish low-cost homes in the Bahr al-Najaf desert area for people with limited income. In such a project, the principles of sustainability are of special importance, and therefore it was nominated to be a field study project.

“Al-Nour Village” is located about 1 km south of the center of Najaf district, and it is a desert area in the part

The southwest of the district center has soft, sandy, fragile ground that is weak in terms of bearing capacity for construction, and is relatively close to the center of the old city and the Wadi Al-Salem cemetery, and also close to the polluted and unpolluted industrial zone, where construction factories abound, and natural resources, groundwater, and agricultural lands are available in areas Certain ones, and close to the Najaf Sea, and with the security stability that the region enjoys, its proximity to the city center, and the low cost of land there, led to the interest of the local government and the establishment of residential projects in it and its rehabilitation by opening and paving streets and providing infrastructure projects for it, represented by the delivery of water and electricity, and building schools. And 8 dispensaries, police stations and markets.

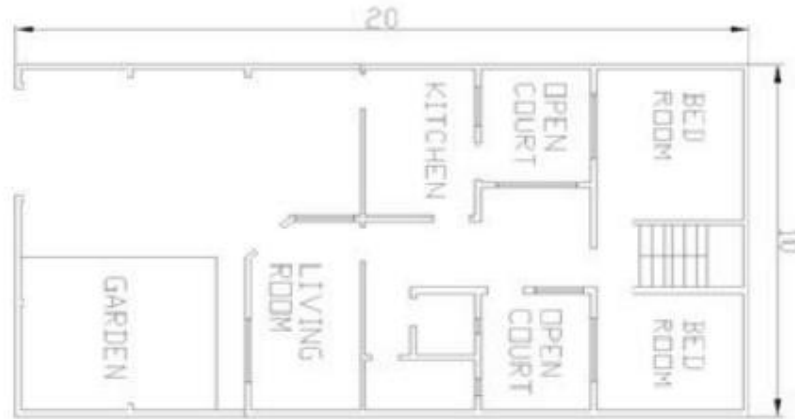


Figure 4.6: The source/researchers' field plan of the house from the work site and drawn by the researchers [7]

The "Al Noor Village" project aims to accommodate the housing need resulting from the increase in population growth rates in the governorate for those with limited income. It is a residential complex that includes the construction of 711 residential floors. The area of each home is 111 m² and the building area is 611 m² with a ground floor only. The residential floors have been arranged. In the form of floor blocks with 9 floors connected on both sides, noting that the predominant orientation of the floor is east-west, which is an inappropriate direction for residential floors in the east, as the best orientation in this area is 373 from the south direction. One house consists of two bedrooms, a kitchen, and services, with a hall on the ground floor.

How to implement the role in the project by using two metal molds manufactured outside Iraq* to be completed The house was poured on site with concrete, to achieve speed in implementation, as the implementation of each residential unit takes about two days, and the width of the concrete wall was about 67 cm, with one layer of reinforcement and without insulating material, and because clean building materials and techniques overlap with other paragraphs in the guide, so all were evaluated. Paragraphs within the table, indicating in the comments box the paragraphs that are outside the scope of the research, as shown in Appendix D.

From the tables shown in Appendix D, the study project does not apply many of the sustainability vocabulary and that the evaluation of the project as a whole within an integrated vision according to the table above was very weak and reached 61.1 degrees out of 611 degrees, while the evaluation of the paragraphs related to the

research topic from the same table is 1.7 out of The original score is 31, which is a very weak evaluation and indicates the lack of compatibility of building materials and construction techniques for this project and its environment, which, as a project designated for people with limited income and implemented by the state, should have taken into account its economic feasibility and chosen materials appropriate to the local environment in integration with other sustainable architecture components to achieve To provide a healthy environment for the population, comfortable housing suitable for the living of its residents, protect the surrounding environment, and plan such projects through relevant designers, technicians, and specialists, and adopt design ideas and trends that allow for the provision of the internal and local environment and exploitation.

A comparison was made of case studies of successful affordable housing projects from other areas in the holy city of Najaf to identify the challenges in establishing such projects. Therefore, the ideas and innovations that contribute to the development of research were taken into account and the appropriate decision was taken according to the evaluation of the appropriate technology for construction. Optimization of available resources. This can be achieved by adopting sustainable urban design concepts that make the best use of the natural environment and the comfort of users. Especially since our natural environment in our country has suffered from various types of destruction and sabotage as a result of wars, continuous acts of violence and administrative corruption. This is also the case with our urban environment in our cities and their central buildings that It suffered massive damage that had and continues to have the greatest impact on the safety of Iraqi society, the safety of citizens and public health, which means that sustainable architecture has become an urgent necessity as it is environmentally friendly and that building its vocabulary to suit the Iraqi local environment will have

A significant and significant impact in creating a model that can contribute to providing many advantages in a sustainable manner and with architecture that mimics the nature of the environmental, social and urban architectural conditions and in a way that serves the cities and their residents alike in our dear Iraqi cities. [7]

Conclusions for case studies

1. Building materials are one of the important elements that influence architectural production in any era
2. Any building materials used must be appropriate to the environment of that place so that the greatest desired benefit can be achieved from them.
3. Many building materials have properties and qualities that are either negative or positive if used in a manner inconsistent with the climate present in the environments of its use, which has a significant impact on the specifications of the building in which it is used.
4. There is a proven relationship between the technological development available in every era and the resulting architecture Architecture of that era
5. Advanced scientific innovations and high-tech specifications in the building materials industry have led to a revolution It is widely used by developed countries.
6. The most common materials used in Iraq are bricks, followed by stone Block, and to a lesser extent stone and other materials
7. We find new sustainable materials to be highly efficient in thermal insulation compared to building materials Common ones, especially thermos tone and air bricks
8. The use of building materials techniques that are appropriate to the Iraqi environment will have a significant and significant impact in creating a model that can It contributes to providing many advantages in a sustainable manner and with architecture that mimics the nature of the environmental, social and urban architectural conditions in a way that serves the cities and their residents alike in our dear Iraqi cities.
9. Lack of use of new sustainable building materials in the building sector.
10. Failure to adopt standards for applying sustainability principles in new residential projects.

11. Sustainable building materials constitute 44% according to (MSDG) and are therefore a very important factor that must be taken into account in construction projects of all types.

12. The world is moving towards producing and manufacturing better materials to be used in construction projects.

13. Relying on locally made building materials that are efficient in construction and have little impact on the surrounding environment provide a built environment suitable for human comfort and that meets the needs of his life through positive employment and the use of renewable energies in sustainable urban construction with the aim of producing construction that is friendly to the natural environment and contributes to the preservation of The Earth's environment is healthy over generations [7].

5. CONCLUSIONS AND FUTURE WORK

5.1 Conclusions

The findings of this dissertation set the groundwork for a novel strategy for the manufacture of low-cost housing, which is the selection of the building methods that are the best suitable for the creation of such housing. A presentation of the study objectives was made by the researcher at the beginning of the thesis. The objective of the study was to meet the goal of reaching the lowest possible cost while simultaneously increasing the efficiency of the dwelling unit. In order to provide a condensed description of these objectives, it is possible to conduct a review of the construction approaches that are now being applied in environmental research (Samarra, Iraq). The researcher then went on to discuss the relevance of boosting the organization's economics, service capability, and safety. This was done after the previous point was made. Develop a system that is capable of evaluating these technologies according to standards that have been established in advance.

A cost analysis was conducted to make the decision to choose appropriate construction techniques in the city of Samarra, Iraq. There is a large variation in the prices of raw materials and according to the appropriate quality, as shown in Table (4:15) and in Appendix (B). During the course of the study endeavor, both quantitative and qualitative methods were utilized. Information was gathered from about eighty-one different companies by means of a questionnaire that was distributed to them. There was a response rate of 69% from those who were asked to participate in the survey. Personal observations and interviews were two additional methods of data collection that were implemented in this study. Interviews were also taken into consideration. Therefore, as a result of technological improvements, we are now able to create homes at prices that are affordable, with external walls that are composed of concrete, cast stone, concrete blocks, and materials that provide insulation.

The usage of precast concrete facade panels is an example of an alternative technique that can be utilized. The construction of ways to divide them is facilitated by the utilization of walls as a means of separation. The costs involved with research are given a higher priority when compared to the expenses that are linked with manufacturing in other countries. It is not currently possible to support this technology because the necessary infrastructure has not yet been established. Both a lack of investment in the technology that is already available and a reliance on labor that is freely accessible are to blame for this situation. In order for individuals to be able to accept this new technology, there needs to be a shift in the culture that constitutes their society. Building codes, for example, enforce a variety of restrictions for the utilization of stone in the construction of exterior walls.

A wide range of circumstances are encompassed by these constraints. The technologies that were chosen for the study, which comprised insulating materials, concrete blocks, cast stone, and concrete walls, obtained the highest overall evaluation ratings. Furthermore, the technologies were picked because they were the most reliable. These technologies not only fulfill the requirements for insulation that were mandated by the Engineers Union, but they also lower manufacturing costs by preserving building materials and have the ability to keep the beauty of stone, which is crucial from a cultural standpoint. A variety of structures can be seen within the city of Samarra in Iraq.

Both theory and practice will be impacted by the behaviours that you demonstrate. The results of this study make available a variety of novel points of view on the topic that is currently being discussed. Given all that has been taken into account, the contribution can be described in the following manner:

1. The first thing that needs to be done in the framework of research is to provide a description of the current scenario that exists within the housing and building industries.

2. In line with the criteria that have been defined, devise a system that will allow for the evaluation of the methods that were utilized in the process of designing the research environment environment.

3. A collection of principles that must be kept to during the building process in order to make the house more secure, more energy efficient, and more economic.

4. Providing aid in determining which housing projects will acquire financing and be developed is one way to lay the groundwork for the vital growth that this company will experience in the future.

5. Building materials are one of the important elements that influence architectural production today. The materials used must be suitable for the environment of the place so that the greatest benefit can be achieved from them. The most common materials used in Iraq are primarily brick, followed by stone, then block, and to a lesser extent, refractory stone and other materials.

The use of building materials techniques appropriate to the Iraqi environment will have a significant and significant impact in creating a model that can contribute to providing many advantages in a sustainable manner and with architectural engineering that mimics the nature of the environmental, social and urban architectural conditions in a way that serves the cities and their residents in Iraq. The world is moving towards producing and manufacturing better materials for use in construction projects and relying on locally made building materials that are efficient in construction, have a minimal impact on the surrounding environment, and provide a suitable urban environment for human comfort and meeting their life needs. Needs and the use of renewable energies in urban construction over generations.

5.2 Recommendations

In light of the discoveries that were addressed previously and the presentation of the conclusions on the construction technology that was adopted, the following observations and recommendations can be summarized as follows:

1. In order for individuals to be able to afford a property, one of the key reasons is to make it more affordable. A sum that is far larger than forty percent of his monthly wage, which is a very substantial amount Reduce the amount of money you spend on building supplies and bulk production in order to bring down the costs of your manufacturing operations.

2. Converting people's ways of thinking into something different in order to persuade them to embrace novel materials like splints the use of stone-based construction techniques that significantly cut down on the cost of production is gaining more and more popularity.

3. In order to provide aid to the formation of the building and construction sector in the region, we are encouraging the establishment of cast stone factories.

4. There is a reduction in the amount of money that is necessary to produce each individual unit of a comparable residential unit as a result of mass manufacturing. Molds make it possible to manufacture a wide range of construction components in large quantities, such as columns, beams, and panel modules, which helps to keep prices at a minimum.

5. The establishment of a production line for the purpose of cutting doors, windows, and other tasks that are related with carpentry projects is made feasible by the presence of units that are near to one another. A lower amount of money was spent. The practice of performing the same thing over and over again without any variation at the end of the day, the completion of residential units can be performed more quickly and with less effort by engineers and contractors, which eventually results in a decrease in prices.

6. In light of the significant progress that has been made in the Iraqi construction industry over the course of the past few years, the immigration of engineers who are well-versed in the techniques that are utilized in the Gulf region, and the possibility of a rapid increase in construction activity, the city of Samarra needs to make the implementation of contemporary construction techniques a top priority. Samarra, Iraq, will be able to make use of cutting-edge building techniques in the years to come as a result of the ongoing development initiatives that are taking place in the city.

7. Make it simpler for the construction company to acquire the raw materials it needs at a price that is more convenient for them.

8. A greater amount of attention should be paid to the selection of proper construction approaches when it comes to construction. This is because it is necessary for saving expenses.

9. From that point forward, the selection of the formwork system ought to be afforded a greater degree of significance than it was previously. There are a lot of factors that should be taken into consideration when choosing a formwork system. Some of these factors include the cost, the quality, the safety, and the delivery time.

When it comes to choosing a formwork system, there are a number of considerations that need to be taken into account.

5.4 Future Work

- The requirements for the chosen construction technology to increase efficiency and build affordable housing must be approved and validated through its implementation in the real and actual situation in the research environment in Iraq.
- The basic mechanism developed in this thesis can become useful to researchers. Conduct further studies to evaluate other construction techniques inside or outside Iraq.
- There are other elements of the building that have an impact on cost reductions and will enable cheaper housing construction such as the infrared structure, flooring systems, interior walls, and formwork system. The choice of formwork system is crucial and serious for its consequences. Due consideration must be given to factors such as: system productivity, safety, durability, and many other variables that may be specific to the site or job at hand. Because this thesis Covering used external walls, so more studies and research must be conducted Efforts made in this regard.
- Some building regulations can affect the total cost of external construction, and can be modified (forming an evolving technical perspective), for example. Requirements about using steel stones on exterior walls.
- To encourage the use of sustainable materials and technologies in appropriate sites and projects and research and development of local building materials in a way that improves their properties towards the principles of sustainability.
- Adopting standards for evaluating residential projects when issuing building permits and encouraging the use of recyclable and reusable materials, as well as materials that contain recycled materials.
- Creating recycled building materials and products from waste, as well as their ability to be recycled more than once Without affecting the environment and benefiting from these materials in a way that meets the needs of our

environments and in a sustainable manner due to the advantages of these materials and technologies High-quality features can contribute to obtaining sustainable buildings and housing that are low in energy use and waste and have high-quality technologies and properties.

- 4The state must apply principles in its current housing projects and within its approach to increasing the housing stock Green construction and sustainable design are included in the feasibility studies for these projects, given the country's great potential It enables them to use new technologies and materials that achieve savings in energy and resources.



REFERENCES

- [1] **Gan, X., Zuo, J., Wu, P., Wang, J., Chang, R., & Wen, T.** (2017). How affordable housing becomes more sustainable? A stakeholder study. *Journal of Cleaner Production*, 162, 427-437.
- [2] **Nguyen, M. T.** (2005). Does affordable housing detrimentally affect property values? A review of the literature. *Journal of Planning Literature*, 20(1), 15-26.
- [3] **Wallace, J. E.** (1995). Financing affordable housing in the United States. *Housing Policy Debate*, 6(4), 785-814.
- [4] **Al-Khayyat, & Khaled Salah Al-Din Ali.** (2014). Construction techniques used in the outer shell of buildings and their impact on energy conservation. *Journal of Engineering Sciences*, 42(6).
- [5] **Dr. Lina Adeeb Khaddour.** (2020). A multi-criteria strategic framework for improving the operational energy efficiency of residential buildings in light of reconstruction (a case study of youth housing buildings in Damascus). *Damascus University Journal of Engineering Sciences*, 36(1).
- [6] **Al-Julhi, & Abdul-Malik.** (2016). Providing affordable housing for people with limited income in Yemen. Studying the Al-Saleh housing project as an experimental model. *Journal of Engineering Sciences*, 44(6).
- [7] **Ban Ali Abboud, & Ammar Abdel Azim Shukr.** (2016). Sustainable building materials and technologies in Iraq. *Journal of planner and development*, 21(1), 17-17
- [8] **Miles & Huberman.** (1994). *Qualitative Data Analysis*, Sage Publications: London,.
- [9] **Tulenheimo, R.** (2015). Challenges of implementing new technologies in the world of BIM–Case study from construction engineering industry in Finland. *Procedia Economics and Finance*, 21, 469-477.
- [10] **Mohammed Ghanem.** (2024) Researcher.
- [11] **Wallbaum, H., Ostermeyer, Y., Salzer, C., & Escamilla, E. Z.** (2012). Indicator based sustainability assessment tool for affordable housing construction technologies. *Ecological Indicators*, 18, 353-364.
- [12] **Ismail, Ghassan:** (2012). Towards a national policy for housing in Palestine (Master's Thesis). AnNajah National Universit . Nublus. Palestine..
- [13] **Creswell. J.** (2014). *Research Design, Qualitative,quantitative and Mixed method Approaches* [Book]. caleifornia : sage Publication..
- [14] **Straub, D. Gefen, D. & Boudreau, MC.** (2010). *The IS World Quantitative, Positivist Research Methods.*, <http://dstraub.cis.gsu.edu>.

- [15] **Denzin, N.K., & Lincoln, Y.S:** (2017). Handbook of Qualitative Research, (2nd Ed) pp.509535. Thousand Oaks, CA: Sage.
- [16] **Easter by Smith, M. Thorpe, R & Lowe, A:** (2002). Management Research, Second Edition. London: sage.
- [17] **Zikmund, W.G.** (2013). Business research methods. (6th Ed.). Orlando, FL: The Dryden Press.
- [18] **Palestinian Contractors Union (PCU),** (2011). classification of contractors. available at: http://www.pcu.ps/e/index.php?action=s_categories.
- [19] **Miles & Huberman.** (1994). Qualitative Data Analysis, Sage Publications: London.
- [20] **Aboud, O. A., Shouk, M. A., & Mahmood, H. M.** (2019). Techniques and Their Role in Residential Efficiency Cold Formed Steel Sheet Technology-A Model. The Iraqi Journal of Architecture and Planning, 18(2), 55-70.
- [21] **R Abaas, Z.** (2016). The Mechanisms of achieving and rating urban sustainable neighborhood projects in Baghdad city (Hypothesis academic vision). Engineering and Technology Journal, 34(4A), 797-815.
- [22] **Alsaffar, A., & Alwan, Q. A.** (2014). Energy Savings in Thermal Insulations for Sustainable Buildings. Journal of Engineering, 20(06), 63-76.
- [23] **Kanem, M. A. E., & Maarroof, M. K. D.** (2019). Identification of the most important factors affecting the quality of building techniques compatible with the environment (traditional bricks) using the method (factor analysis) in the city of Erbil. Journal of Administration and Economics, (120).
- [24] **Al-Ayoubi, W. W. S.** (2021). Possible Developments of the Industrialization of Appropriate Building Subsystem for Iraq. Al-Esraa university college journal for Engineering Sciences, 3(3).
- [25] **Ahmed, Muhammad, Abdel Aziz, Magdy, & Abu Donia.** (2022). Enhancing the mental image of the institution through modern packaging technologies as one of the branches of corporate identity. Journal of Architecture, Arts and Humanities.
- [26] **Jabbara, & Maysaa Muhammad Abdel Khaleq.** (2015). Developing mud construction techniques in contemporary housing, "A Case Study of Jericho" (Doctoral dissertation, An-Najah National University).
- [27] **Iraqi Ministry of Planning,** (2023). Central Bureau of Statistics, Annual Statistical Collection for the year
- [28] **Wikipedia.** free encyclopedia, Decision_making. August, 2011, available at: http://en.wikipedia.org/wiki/Decision_making..
- [29] **Kartha, Deepa: Steps to Decision Making Process,** April, 2010, available at: <http://www.buzzle.com/articles/6stepstodecisionmakingprocess.html>.
- [30]] **Harris, Robert.** Introduction to Decision Making, December 2, 2009, available at: <http://www.virtualsalt.com/crebook5.htm>.

[31] [https://media.licdn.com/dms/image/C4E12AQEXm4oZ29AYLg/article
cover_imageshrink_720_1280/0/1633088539382?e=2147483647&v=beta
a&t=9 d30QhBxKCampiQhTUmQThGmKo5_m5Swoy-Xc-b7x4](https://media.licdn.com/dms/image/C4E12AQEXm4oZ29AYLg/article_cover_imageshrink_720_1280/0/1633088539382?e=2147483647&v=beta&t=9 d30QhBxKCampiQhTUmQThGmKo5_m5Swoy-Xc-b7x4)



APPENDICES

Appendix A: The Questionnaire

After Greetings:

The researcher is conducting a study on (the decision-making mechanism in choosing the system for constructing external walls in affordable housing buildings in Samarra, Iraq). This is to complete a master's thesis. Your cooperation in filling out the form is a contribution to the development of scientific research and is appreciated and grateful. The information that will be your submission will only be used for scientific research purposes.

With great respect

Researcher: MOHAMMED GHANIM HAMMOOD AL-ABBASI

Istanbul Gedik University/Master of Engineering Management

▪ Section One:

Work nature: **Engineer** **contractor** **Contractor engineer**

Qualification:

Years of Experience:

Region/Governorate:

- **Second section:**

This section includes 9 construction systems in Samarra, Iraq, to compare them from several aspects. Please put an evaluation of each technology in the box below each comparison item in accordance with your opinion. Note that the evaluation is a score from 1 to 11 given to each item. The score (1) indicates that the technology is very negative in this aspect, while (11) indicates that the technology is very positive in this regard. The technology is very positive. For example, the speed of implementation is a positive thing. The technology that achieves the maximum speed in completion takes 11, and thus the scores range from 11 to 1, where 1 means that the technology is very slow compared to others. While, for example, increasing the cost of construction is a negative thing, so the technology that achieves the lowest cost takes 11. And the one whose cost is higher receives a lower mark, and so on.

	Comparison item External wall Construction technology	Speed of implementation	Construction cost	Strength and durability	Future maintenance costs	Safety during construction	The need for specialized skills	Resistance to weather influences	firefighting	thermal insulation	Aesthetic aspect
	External walls of reinforced concrete It was clad with natural stone concrete										
	The external walls are made of reinforced concrete and faced with artificial stone										
	The external walls are made of 20 cm brick										
	The external walls are made of two layers of 20.7 cm brick, with insulating material between them										
	The external walls are made of stone and concrete with a mold behind the stone										
	The external walls are made of stone, concrete and brick										

The external walls are stone, concrete, brick, and insulating material between them												
The exterior facades are made of light brick and clad with natural stone												
External facades are concrete panels Precast Concrete is precast												

- **Section Three:**

Please rate the comparison items according to the importance of achieving them in any construction technology that will be used to create a housing project, noting that the evaluation is a score from 1 to 11, where the number 11 means it is very important to achieve it, and the number 9 is less important, and so on... knowing that it is possible to take Two items with the same numbering.

- **Section Four:**

Which of the following techniques would you choose to create an affordable housing project in the form of residential homes and explain why?

- 1 **The external walls are made of reinforced concrete and faced with natural stone**
- 2 **The external walls are made of reinforced concrete and faced with artificial stone**
- 3 **The external walls are made of 20 cm brick**
- 4 **The external walls are made of two layers of 20.7 cm brick, with insulating material between them**
- 5 **The external walls are made of stone and concrete with a mold behind the stone**
- 6 **The external walls are made of stone, concrete and brick**
- 7 **The external walls are stone, concrete, brick, and insulating material between them**
- 8 **The exterior facades are made of light brick and clad with natural stone**
- 9 **External facades Precast Concrete panels**

Numbering according to Importance	Clauses Comparison	Speed of implementation	Construction cost	Strength and durability	Future maintenance costs	Safety during construction	The need for specialized skills	Resistance to weather influences	firefighting	thermal insulation	Aesthetic aspect

The technology number that you chose as the most appropriate in implementing the project of affordable housing buildings in the form of residential homes, according to your opinion

.....

Reason for choice

.....

Have you ever designed or implemented a housing project on the ground?

Yes

No

If the answer is yes, write the number of the technology that was adopted in implementing the housing project

.....

Mention the name and location of the housing

.....

Thank you very much / eng. Muhammad Ghanim Hammoud

Appendix B

1- System wall Bearing cladding stone natural with walls concrete reinforce External					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				
A	Site excavations	M3	50	9000	450000
B	Excavations for column bases “Continuous foundations”	M3	105	18000	1890000
2	Concrete				
A	Blinding concrete for column bases	M3	17	130000	2210000
B	B250 Concrete: Concrete for the floor and stairs and their facades. Price includes work "Bricks and reinforcement	M3	26	280000	7280000
C	B300 Concrete for Column Bases, Floor Bridges and Roofs “Price” It does not include businesses "Bricks and reinforcement"	M2	135.5	300000	40650000
D	Concrete incline duration B200	M2	190	18000	3420000
E	B250 Concrete External facades “The price includes brick and iron works	M3	55	280000	15400000
3	Brick				
A)Brick (20*40*14	number	960	950	912000

B	Brick 10” internal partitions“	M ²	83	18000	1494000
C	Brick 20” internal partitions“	M ²	30	27000	810000
4	Stone works “The price includes covering the external facades with natural stone”	M ²	275	85000	23375000
5	Cutting works				
A	Cutting roof	M ²	190	7000	1330000
B	Cutting interfaces	M ²	540	9000	4860000
C	Lining natural stone facades	M ²	275	5000	1375000
6	Tile work				
A	Floor tiles	M ²	120	25000	3000000
B	Bathroom and kitchen floor tiles	M ²	25	25000	625000
C	Bathroom and kitchen wall tiles	M ²	100	30000	3000000

D	Internal and external stair tiles	M ²	30	65000	1950000
7	Windows and doors				
A	Aluminum windows	M ²	24	185000	4440000
B	Iron doors	M ²	10	185000	1850000
C	Wooden doors	M ²	14	150000	2100000
8	Finishing work				
A	Window works and finishing	M ²	60	50000	3000000
9	Guard work				
A	Guarding your windows	M ²	24	65000	1560000
total					126,981,000

2-System wall Bearing cladding stone cast with walls concrete reinforced					
External					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick				3216000
4	Stone works "The price includes covering "the external facades with artificial stone	M ²	275	65000	17875000
5	Cutting works				7565000
6	Workers: "slabs, windows, doors, finishes, guarding"				8575000
total					108,531,000

3-Slab-beam-column system 20 cm concrete block exterior walls					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				
A	Site excavations	M ³	50	9000	450000
B	Excavations for column bases "Continuous foundations"	M ³	31	18000	558000
2	Concrete				
A	Blinding concrete for column bases	M ³	5.5	130000	715000
B	B250 Concrete: Concrete for the floor and stairs and their facades. Price includes work "Bricks and reinforcement"	M ³	22.5	280000	6300000
C	B300 Concrete for Column Bases, Floor Bridges and Roofs "Price" It does not include businesses " Bricks and reinforcement"	M ²	76	290000	22040000
D	Concrete incline duration B200	M ²	190	18000	3420000
3	Brick				
A	Brick (20*40*14)	number	960	900	864000
B	Brick 20	M ²	305	28000	8540000
C	Brick 10	M ²	83	18000	1494000
4	Cutting works				
A	Cutting roof	M ²	190	8000	1520000
B	Cutting interfaces	M ²	780	9000	7020000
5	Workers: "slabs, windows, doors, "finishes, guarding				8575000
total					61,496,000

4- System Slab-beam-column concrete by backed stone of walls masonry Exterior					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick				
A	Brick (20*40*14)	number	960	900	864000
B	Brick 20	M ²	305	28000	8540000
C	Brick 10	M ²	83	18000	1494000
4	Stone work (the price includes the concrete behind the stone and the (stone with the work)	M ²	275	65000	17875000
5	Cutting works				
A	Cutting roof	M ²	190	8000	1520000
B	Cutting interfaces	M ²	540	9000	4860000
C	Lining natural stone facades	M ²	275	5000	1375000
6	Workers: "slabs, windows, doors, "finishes, guarding				8575000
total					116,403,000

5-Slab-beam-column system Exterior walls built from concrete, stone, and concrete block					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick (20,10)				3216000
4	Stone work (the price includes the concrete behind the stone and the stone with the work)	M ²	275	65000	17875000
5	Workers: "slabs, windows, doors, "finishes, guarding				8575000
total					100,966,000

6-System Slab-beam-column Exterior walls built from concrete, stone, concrete block and insulating material					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick (20,10)				3216000
4	Stone work (the price includes the concrete behind the stone and the stone with the work)	M ²	275	65000	17875000
5	Workers: "slabs, windows, doors, "finishes, guarding				8575000
6	Plastering works, roof plastering Facades, stone repair				7913205
total					108,879,205

7-Slab-beam-column system Two layers of 20 and 7 cm concrete block and Insulating material					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick				
A	Brick (20*40*14)	number	960	900	864000
B	7.20 cm brick, two layers for external facades, with placement insulating material between them	M ²	305	45000	13725000
C	bricks (10) for internal partitions	M ²	83	18000	1494000
4	Cutting works				
A	Cutting roof	M ²	190	8000	1520000
B	Cutting interfaces	M ²	540	9000	4860000
5	Workers: "slabs, windows, "doors, finishes, guarding				8575000
total					102,338,000

8-Sub-beam-column Exterior masonry walls built from light weight units with stone cladding					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick				
A	Brick (20*40*14)	number	960	900	864000
B	Hollow bricks, 20 cm thick	M ²	30	35000	1050000
C	bricks (10) for internal partitions	M ²	83	18000	1494000
4	Stone work (the price includes the concrete behind the stone and the stone with the work)	M ²	275	115000	31625000
5	Plastering works, roof plastering Facades, stone repair				7913205
6	Workers: "slabs, windows, doors, finishes, guarding				8575000
total					123,721,205

9- System Slab-beam-column Precast concrete facade panels for exterior walls					
Item No	Statement of work	Unit	Quantity	Price IQD	Total IQD
1	Excavations				2340000
2	Concrete				68960000
3	Brick				
A	Brick (20*40*14)	number	960	900	864000
B	Brick 20	M ²	305	28000	8540000
C	Brick 10	M ²	83	18000	1494000
4	Stone work (the price includes the concrete behind the stone and the (stone with the work)	M ²	275	45000	12375000
5	Cutting works				
A	Cutting roof	M ²	190	8000	1520000
B	Cutting interfaces	M ²	540	9000	4860000
C	Lining natural stone facades	M ²	275	5000	1375000
6	Workers: "slabs, windows, doors, finishes, guarding				8575000
total					110,903,000

Appendix C

Construction materials price rates for the year 2023 in Iraq [27]

معدل أسعار المواد الأبنائية حسب المنشأ وتوفرها في الأسواق المحلية لشهر كانون الأول ونسبة التغيير مقارنة بشهر تشرين الثاني لسنة 2023

ت	اسم المادة	الوحدة القياسية	عراقي المنشأ			عربي المنشأ			اجنبي المنشأ	
			شهر تشرين الثاني	شهر كانون الأول	نسبة التغيير بين شهر كانون الأول وشهر تشرين الثاني	شهر كانون الأول	شهر تشرين الثاني	نسبة التغيير بين شهر كانون الأول وشهر تشرين الثاني	شهر كانون الأول	شهر تشرين الثاني
1	طابوق عادي	الف	176	177	1	-	-	-	-	-
2	طابوق جمهوري	الف	213	218	2	-	-	-	213	0
3	ترمسون	الف	1892	1953	3	2654	2654	0	2870	0
4	قرميد	م	27	28	4	35	30	-14	32	0
5	بلوك حجم كبير	الف	662	675	2	-	-	-	-	-
6	بلوك حجم متوسط	الف	546	550	1	-	-	-	-	-
7	بلوك حجم صغير	الف	456	466	2	-	-	-	-	-
8	حجر خام	3م	30	29	-3	-	-	-	-	-
9	حجر تغليف	2م	37	37	0	-	-	-	36	6
10	رمل اسود	3م	16	16	0	-	-	-	-	-
11	رمل احمر	3م	19	19	0	-	-	-	-	-
12	حصو عادي	3م	21	21	0	-	-	-	-	-
13	سمنت مقاوم	طن	125	126	1	-	-	-	153	9
14	سمنت ابيض	طن	230	228	-1	267	268	0	241	0
15	سمنت عادي	طن	113	113	0	-	-	-	-	-
16	جص فني	طن	95	96	1	-	-	-	180	0
17	بورك	طن	143	141	-1	-	-	-	165	1
18	كاشي عادي	2م	13	12	-8	-	-	-	25	0

19	كاشي موز انيك	2م	15	15	0	18	18	0	20	0
20	موقعي	2م	54	54	0	-	-	-	-	-
21	مرمر	2م	47	45	-4	30	29	-3	35	0
22	سير اميك	2م	11	10	-9	9	9	0	14	-7
23	صينات درج	عدد	29	30	3	25	25	0	38	0
24	زجاج	2م	8	8	0	-	-	-	12	0
25	ثيل مانع الحشرات	2م	3	3	0	5	5	0	4	0
26	حديد شيلمان	م	22	21	-5	20	20	0	17	0
27	حديد شيش	طن	1091	1089	0	-	-	-	1079	-1
28	مشبك	2م	10	11	10	-	-	-	16	-6
29	جينكو	2م	10	9	-10	14	14	0	17	-6
30	ابواب خشب جام	2م	95	96	1	-	-	-	156	-1
31	ابواب خشب صاج	2م	145	144	-1	-	-	-	167	-1
32	ابواب حديد	2م	90	91	1	220	220	0	200	0
33	شبابيك حديدية	2م	76	75	-1	-	-	-	65	8
34	شبابيك المنيوم	2م	87	86	-1	93	93	0	108	0
35	كاتب للشبابيك	2م	44	44	0	-	-	-	-	-
36	مبيدات	لتر	9	11	22	19	19	0	22	5
37	فلنكوت عازل	لتر	3	3	0	4	4	0	5	0
38	مجاري هوائية تبريد	م	31	30	-3	-	-	-	22	0
39	قير عادي	طن	410	412	0	-	-	-	-	-
40	قير سائل	طن	481	473	-2	1530	1530	0	-	-
41	محجر حديد	م	73	71	-3	-	-	-	95	1
42	طبقات خشبية تغليف البناء	2م	38	38	0	-	-	-	32	0
43	خشب	3م	525	528	1	-	-	-	544	0
44	سخان ماء	عدد	129	130	1	179	187	4	219	0
45	شباك مكيف	عدد	38	38	0	-	-	-	-	-
46	مانع رطوبة	لتر	3	3	0	4	4	0	5	0
47	سويج رئيسي	عدد	-	-	-	61	62	2	70	1
48	سركت بريكر	عدد	150	150	0	120	119	-1	114	0
49	انابيب اهين	م	-	-	-	62	62	0	-	-
50	اقفال انابيب (صمام)	عدد	4	4	0	9	9	0	9	-10
51	مغسلة فروري	عدد	43	42	-2	70	69	-1	90	-3
52	نايو	عدد	300	300	0	296	296	0	321	0
53	مرحاض	عدد	28	25	-11	34	33	-3	51	0

0	23	23	5	20	19	0	6	6	عدد	مشطفة	54
0	200	200	-	-	-	0	137	137	م3	خزان ماء حديد	55
-3	84	87	-3	66	68	0	60	60	عدد	سنك سنبل	56
-9	10	11	-11	8	9	0	4	4	عدد	حنفية سنبل	57
-1	958	967	0	450	450	-	-	-	عدد	حمام كامل ملون	58
0	8	8	20	6	5	0	4	4	لتر	اصباغ زيتية	59
0	6	6	-20	4	5	0	4	4	لتر	مائية	60
-8	12	13	0	17	17	0	10	10	م	سياج حديدي prc	61
0	5	5	-	-	-	0	17	17	م	اعمدة كونكريتية (سياج)	62
-	-	-	-	-	-	-5	40	42	م2	جملون حديدي (طبقات)	63
-	-	-	-	-	-	0	16	16	م2	كونكريت اسفلتي	64

- 1 - (-) علامة على عدم توفر منشأ المادة في الأسواق المحلية.
- 2 - يعزى سبب تذبذب أسعار المواد الأثنائية في الأسواق المحلية بسبب ارتفاع وانخفاض أسعار صرف الدولار تارة والعرض والطلب تارة أخرى .
- 3 - الارقام مقربة الى اقرب مرتبة عشرية .
- 4 - مادة الحديد الأكثر استخداماً ذات منشأ (إيراني- تركي) بالنسبة الى المنشأ الأجنبي .

Appendix D

A digital system for evaluating building materials and construction techniques used in a case study project in the city of Najaf [7]

جدول (4) التقييم لدلائل التصميم بواسطة MSDG

ت	المشروع	وزن الفقرة	التقييم	الملاحظات
1	الموقع			
1-1	التنمية المباشرة لبيئة المشروع المختار	3	2	اعتمد التقييم على ان المشروع السكني بخدماته التحتية والرصيد السكني قد عمل تنمية مباشرة للمكان الا ان هذه الفقرة خارج نطاق البحث
1-2	صيانة وتعزيز التنوع البيولوجي و نظم البيئة الطبيعية	3	0	لا توجد وهذه الفقرة هي خارج نطاق البحث
1-3	التلائم مع المناخ المحلي و استراتيجيات الاستجابة البيئية في تصميم الموقع.	2	0	ضمن اهتمام البحث
1-4	استخدام الأشجار الأصلية والشجيرات و النباتات	2	2	خارج نطاق البحث
1-5	استخدام نظم موارد كفاءة في النقل	2	0	خارج نطاق البحث
2-1	إدارة المياه في الموقع	5	0	خارج نطاق البحث
2-2	استخدام نظم المياه الرمادية ¹³	2	0	خارج نطاق البحث
2-3	استخدام النظم البيولوجية لمعالجة النفايات	1	0	خارج نطاق البحث
2-4	حفظ المياه في المباني (ترشيد الاستهلاك)	1	0	خارج نطاق البحث

خارج نطاق البحث	-	1	الحفاظ على استهلاك المياه في ابراج التبريد	2-5
لان شكل الموقع مستطيل فهناك دور سكنية بتوجيه مقبول بحسب خارطة تصميم الموقع وهذه الفقرة خارج نطاق البحث	0.5	2	توجيه المبنى	3-1
ضمن نطاق البحث	0	2	تحسين أداء الغلاف الحراري للمبنى	3-2
خارج نطاق البحث	2	2	توفير ضوء النهار الطبيعي المتكاملة مع نظم الإضاءة الموفرة للكهرباء	3-3
خارج نطاق البحث	0	2	توفير أنظمة كفاءة للتحكم بالإضاءة	3-4
خارج نطاق البحث	0	2	زيادة كفاءة الأنظمة الميكانيكية	3-5
خارج نطاق البحث	0	1	استخدام معدات كفاءة	3-6
ضمن نطاق البحث	0	3	استخدام المصادر المتجددة للطاقة	3-7
ضمن نطاق البحث	0	12	تكامل كل الأنظمة لتقليل الطاقة	3-8
خارج نطاق البحث	1	3	توفير بيئة صحية ونظيفة	4-1
تم مراعاة هذه الناحية في التشييد في المساكن الكونكريتية، وهذه الفقرة خارج نطاق البحث	2	3	السيطرة على الرطوبة لمنع انتشار الميكروبات	4-2
كانت هناك تهوية لكل فضاء الا ان هذا الموضوع لم يراعى باسلوب علمي وعلى مستوى التصميم العام والخاص، وهي ايضا خارج نطاق البحث	2	6	التهوية	4-3
ضمن نطاق البحث	0	3	توفير الظروف الحرارية المناسبة	4-4
لم تستخدم منومات اضاءة ذكية (خارج نطاق البحث)	2	3	كفاءة الإضاءة	4-5
ضمن نطاق البحث	0	3	العزل الصوتي ومنع الاهتزاز	4-6
خارج نطاق البحث	1	3	الارتباط مع الطبيعة وتوفير المناظر الطبيعية	4-7
ضمن نطاق البحث	1 ¹⁴	3	استخدام المواد قليلة الضرر على البيئة خلال عمر المبنى Use Materials with Low Impact During Cycle Their Life	5-1
ضمن نطاق البحث	0	2	قابلية إعادة التدوير Use Salvaged and Remanufactured Materials Cycle	5-2
ضمن نطاق البحث	0	1	استخدام منتجات البناء القابلة للتدوير Use Recycled Content Products and Materials	5-3
ضمن نطاق البحث	0	1	استخدام مواد من مصادر متجددة Use Materials from Renewable Sources	5-4
ضمن نطاق البحث	0.5	1	استخدام مواد مصنعة محليا	5-5
لم توضع دراسة لاختيار مواد	0	3	استخدام مواد منخفضة انبعاثات المركبات العضوية	5-6

المتطايرة Use Low VOC-emitting Materials				
ومنتجات (دهانات، صمغ، الخ) يكون فيها معدل المكونات العضوية المتطايرة VOCs صفرًا وذلك للتحكم بمعدل الغازات السامة داخل المنزل (ضمن نطاق البحث).				
استخدام مواد متينة Use Durable Materials Use Durable Materials	1	1	ضمن نطاق البحث	5-7
مواد قابلة لإعادة الاستخدام والتدوير Use Materials that are Reusable, Recyclable	0	1	ضمن نطاق البحث	5-8
إعادة استخدام المباني Reuse Existing Buildings	0	3	ضمن نطاق البحث	6-1
التصميم لترشيد استخدام المواد Design for Less Material Use	0	2	ضمن نطاق البحث	6-2
تصاميم التكيف Design Building for Adaptability	0	2	ضمن نطاق البحث	6-3
قابلية التفكيك Design Buildings for Disassembly	0	2	ضمن نطاق البحث	6-4
إعادة تدوير نفايات الهدم Salvage and Recycle Demolition Waste	0	1	ضمن نطاق البحث	6-5
خفض وإعادة تدوير نفايات البناء Reduce and Recycle Construction Waste	0	1	ضمن نطاق البحث	6-6
خفض وإعادة تدوير نفايات التغليف Reduce and Recycle Packaging Waste	0	1	ضمن نطاق البحث	6-7
خفض وإعادة تدوير نفايات الناتجة عن البناء Reduce and Recycle Waste from Building	0	1	ضمن نطاق البحث	6-8
تخفيض والتخلص السليم للمواد الخطرة Reduce and Properly Dispose of Hazardous	0	1	ضمن نطاق البحث	6-9
المجموع	17.0	100		

RESUME

Mohammed Ghanim Hammood

EDUCATION:

- • Bachelor : 2018, Dijlah UN, Faculty of Engineering, civ
- • Master : 2024, Istanbul Gedik University, Department of Engineering Management (English)

