ZHINDAR HUSSEIN TAMUR

THE EFFECT OF INCORPORATING FEATURES OF SUSTAINABLE ARCHITECTURE IN PRIMARY SCHOOLS IN DOHUK, NORTHERN IRAQ

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A THESIS SUBMITTED TO THE INSTITUTE OF GRADUATE STUDIES
OF
NEAR EAST UNIVERSITY

By
ZHINDAR HUSSEIN TAMUR

In Partial Fulfilment of the Requirements for the Degree of Master of Science
in
Architecture

NICOSIA, 2021

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Approval of Director of Institute of Graduate Studies

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I hereby declare that all information in this thesis is attained and presented in accordance with academic regulations and ethical behaviour. I correspondingly declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original in this work.

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To my family…

ABSTRACT

The world's ecological footprints are causing a lot of sustainability issues. Man and his activities is attracting critical problems which may lead to land degradation, air pollution and generating tons of waste into the sewage treatment plant. However, these sustainability issues around the world may result from urbanization issues. In this thesis, sustainable problem of primary schools was discussed and analysed. A review was conducted in order to have better understanding of the sustainable issues of primary schools in Duhok. The research focusses on three schools as samples which were picked from 221 governments' primary school in Duhok city. The method of selection used in this research is cluster random sampling techniques, which result is the selection of Hakar, Nuhat and Bilind primary schools. The data was fetched using a data survey forms through personal filed observation exercise. The data was then processed and analysed using BREEAM and LEED assessment criteria.The results show that Hakar,Bilind and NohatPrimary School overall assessment was unsatisfactory having a score of 1/8 (12.5%),0/8 (0%) and 1/8 (12.5%) respectively. It is recommended that both Duhok government and ministry of education in Iraq should join efforts and reshape, reconstruct and restructure the schools around Duhok to meet up with the green sustainable goals acceptable by any green building assessment criteria acceptable in the world.

Keywords: Sustainability; green building; global warming; Duhok; primary schools.

ÖZET

Dünyanınekolojikayakizleribirçoksürdürülebilirliksorununanedenoluyor. İnsanvefaaliyetleri, arazibozulmasına, havakirliliğinevekanalizasyonarıtmatesisinetonlarcaatıküretilmesineyolaçabilecekkritiksorunlarıçekiyor. Ancak, dünyadakibusürdürülebilirliksorunları, kentleşmesorunlarındankaynaklanabilmektedir. Bu tezdeilköğretimokullarınınsürdürülebilirliksorunuelealınmışveanalizedilmiştir. Duhok'takiilkokullarınsürdürülebilirsorunlarınındahaiyianlaşılabilmesiiçinbirincelemeyapılmıştır. Araştırma, Duhokilindeki 221 devletilköğretimokulundanseçilenörneklemolaraküçokulüzerindeodaklanmaktadır. Bu araştırmadakullanılanseçimyöntemi, kümetesadüfiörneklemetekniklerioluşup, sonuçolarakHakar, NuhatveBilindilköğretimokullarınınseçimiyapılmıştır. Veriler, kişiseldosyalanmışgözlemalıştırmasıyoluylabirverianketformukullanılaraktoplandı. Verilerdahasonraişlenerek, BREEAM ve LEED değerlendirmekriterlerikullanılarakanalizedildi. Sonuçlar, Hakar, BilindveNohatİlköğretimOkulu'nungeneldeğerlendirmesininsırasıyla 1/8 (%12.5), 0/8 (%0) ve 1/8 (%12.5) puanlarıileyetersizolduğunugöstermektedir. Hem Duhokhükümetinin hem de Irak'takieğitimbakanlığınınçabalarakatılmasıveDuhokçevresindekiokulları, dünyadakabuledilebilirherhangibiryeşilbinadeğerlendirmekriteritarafındankabuledilebiliryeşilsürdürülebilirhedeflereulaşmakiçinyenidenşekillendirmesi, yenideninşaetmesiveyenidenyapılandırmasıtavsiyeedilmektedir.

AnahtarKelimeler:Sürdürülebilirlik; yeşilbina; küreselısınma; Duhok; ilkokul.

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LIST OF ABBREVIATIONS

BREEAM: Building Research Establishment Environmental Assessment Method

°C: Degree Celsius

Ca^{-}: Calcium Ion

CHPS: California high-performance school

CO2: Carbon Dioxide

CPU: Central Processing Unit

EIA: Erbil International Airport

GMT: Greenwich Mean Time

GPS: Global Positioning System

IDP: Integrated Design Process

Km: Kilometre

KRG: Kurdistan Regional Government

LCD: Liquid Crystal Display

LED: Light-Emitting Diode

LEED: Leadership in Energy and Environmental Design

Na_2CO_3: Sodium Carbonate

NGO: Non-Governmental Organization

TV: Television

UIA: Union of International Association

UNESCO: United Nations Educational, Scientific and Cultural Organization

US: United States

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Ecological methods in buildingsadoptsprinciples of sustainable architecture and this includes environmental sensible design techniques. This can be attained byselecting the correctmaterials during construction and environmental-friendlyplans. Ecological architecture mustattainssocioeconomic and environmental considerations, friendly to the environment and achieve the people's housing demands(Olotuah, Olotuah, Olotuah, & Adedeji, 2018).The Improvement ofthe environment's public cognizance and technologies available will remain highlighting the significance of sustainable housing in the future. Despite this potentials, major new development of housing is still ''project homes'' having little concrete sustainable measures. Many stakeholders tend to have dissimilarpriorities and perceptions on sustainability. To encourage the acceptance of sustainable architectural products, a research of the multi-dimensional problemsconcerning the application of sustainable architecture is essential(Yang & Yang, 2015).The Northern region of Iraq Construction sector has received a very big gap of development in the last decade. Nevertheless, the need of strong legislation and awareness concerning sustainable architectural construction within the building sector(Wirya Shawkat, Salah Muhy Al-Din, & Kuzovic, 2018). Climate forces and nature were vital factors considered in the ancient history of man's early shelters. The history architecture in local constructions wereexcellent in providing comforts withinthe building's interiorspaceconsidering the constraints of the local climate and needs of the occupants in Northern Iraq. Usually, the ways of living in the regions Iraq is shown in the household'sstructure, volumetric formation, and customs of thelocalities they give raise to. Architectural elements were sturdilyornamented, producing distincttraditional and typological buildings. Shadows arerequired to provideconducive atmosphere in the buildingthrough sustainable architectural design, and this becomes a landmark of the native architecturalprecise character, and using natural features (e.g. water, vegetation, sun, etc.). However,north

orientation of buildings is good during summer making the indoor environment conducive with breeze of cool airthrough the openings (Al-musaed, Almssad, Harith, Nathir, & Ameer, 2007).

1.2 Statement of the Problem

The growing environmental concerns with ecological situations where the issues that led to the arguments and searching for efficient-energy, Eco-friendly, energy-conscious, in designs of buildings. The future growth relies upon the environment interrelated problems, the principal aim of an architect is sustainable development through the provision of environmentally friendly designed building using the available local environmental resources (Ghani, 2012). Design professionals like Architects canpractise their perception and creativity to associate these ideologies to produceappropriate localpolicies, methods and materials consideringthe fact that each region employsdissimilarstrategies in achieving their green objectives (Bergstrom, 2002; Sinha, 2002;Jani, 2003).

Most of the schools in Iraq suffers problems of sustainability regarding the architectural elements and techniques. In the reconnaissance survey we had in the schools around Duhok, it was found that most of the schools has widows in one side of the building and some school were landscaped with solid cement material throughout, ignoring the incorporation of greeneries and proper ventilation in the schools, an example of this is given in the picture taken from Ordikhan Primary School below (Figure 1.1a and 1.1b). This is not sustainable as the schools were lacking cross-ventilation and greeneries which also serve a significant purpose in achieving the sustainable architecture in the schools. In this research these sustainable problems of architecture will explored deeply, analysed and suggest possible suggestion to these problems.

(a) (b)

Figure1.1: a. and b. Showing classes and windows on one side of the wall, along with solid landscape in Ordikhan PrimarySchool

1.3 Aim and Objectives of the Study

The purpose of this research is to determine the effect of incorporating natural environmental elements in achieving sustainable architecture in primary school buildings in Duhok city of Iraq.

Objectives of the study are:

- To identify the green features of sustainable architecture used in Duhok's primary schools.
- To assess the indoor user-comfort of the classes in the primary schools.
- Evaluation of the best measures to use in achieving sustainable architecture in the primary schools around Duhok city.

The research questions are:

1. What are the green features and techniques used in attaining sustainable architecture in Duhok?
2. What is the user comfort of the classes in the schools chosen?
3. What are the measures when put in place can help in attaining sustainable architecture in the primary of Duhok?

1.4 Scope of the Study

This thesis research will be conducted in Iraq, which currently has 19 governorates (in Arabic it is called Muḥāfażah, while in Kurdish it is called parêzga, "provinces" in English language). The constitution of Iraqi comprises of more than 3 governorates which were joined together to create an autonomous region. Kurdistan region was subdivided into 6 provinces, each having different governorates, out of which 3 were controlled by the Regional Government of Kurdistan. Duhok city was among the 6 provinces of the Kurdistan region. This study will explore only 3 schools, which are: Hakar, Bilind, Nohat Primary schools in Duhok city, Iraq.

1.5 Methodology

Both descriptive and inferential statistics will be adopted in this research, using both primary and secondary data. Primary data will be collect from the selected schools in Duhok city by visiting each school at their respective location. Data such as coordinates will be collected using GPS device, pictures and measurements will also be required on the site and many other relevant primary information necessary. On the other hand, secondary data was collected from both internet sources, the General Education office in Duhok city North Iraq and other relevant government and non-governmental parastatals. However, computer application was also devised to fetch both raw and processed data, which will be analysed and presented in this research. These applications were Google Earth, Mat Lab, excel etc.

1.6 Significance of the Study

The environmentalcatastrophenowadays is very big, currently there is several debatesfocusing on the indicationsinstead of the sources. This resultsincrucialprerequisite to work out and emphasize the optimal approach possible in enlighteningthe protection of the environmentin an attempt to reduceland degradation further. Presently, architecture adoptsexclusiveglobal challenge sustainably. Considering the construction projects like new school construction might consume hugenumber of resources, yieldheaps of waste, and frequentlycontains weighing the buildings preservation whichpossessessignificance historicallycontrary to the development need of modern and newer designs. Sustainability is a development measure that

givesamethod that can mainlyhelp inprotection of the environment. Thebalance striking amongstsustainable development and environmental protection is a delicate and difficult work. Design that are sustainable are the considerateincorporation of architecture with other fields likemechanical, structural and electrical engineering. Concerning the aesthetics traditionallyscale, massing, texture, proportion, light, and shadow, the team of building design requiresto pay attention to thefuture costs: economic, human, and environmental (Figure 1.2).

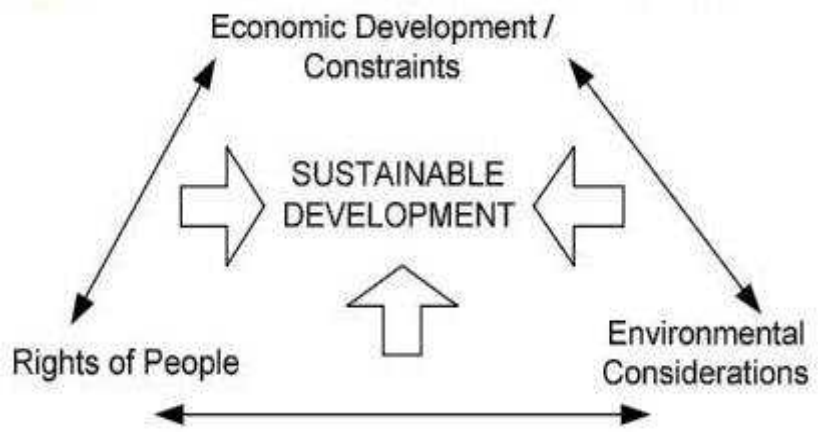


Figure1.2: Sustainable development

1.7 Limitations of the Study

This research is limited to various factors, these are: lack of previous research studies on the topic, limited access to data, time limitations, problem arising from personal issues and cultural bias. Lack of past publications on sustainable architecture in Duhok makes the research having limited knowledge on the past and existing situation on the sustainable architecture in Duhok city. Data access was limited by the education government body in the state, each state governs and direct education system of their locality in Iraq. Some secondary data were almost impossible to get due international and local conflict and security issues of the country. Also limited time has a great challenge to this study, as the research was only limited to one semester (approximately 4 months).

1.8 Research structure

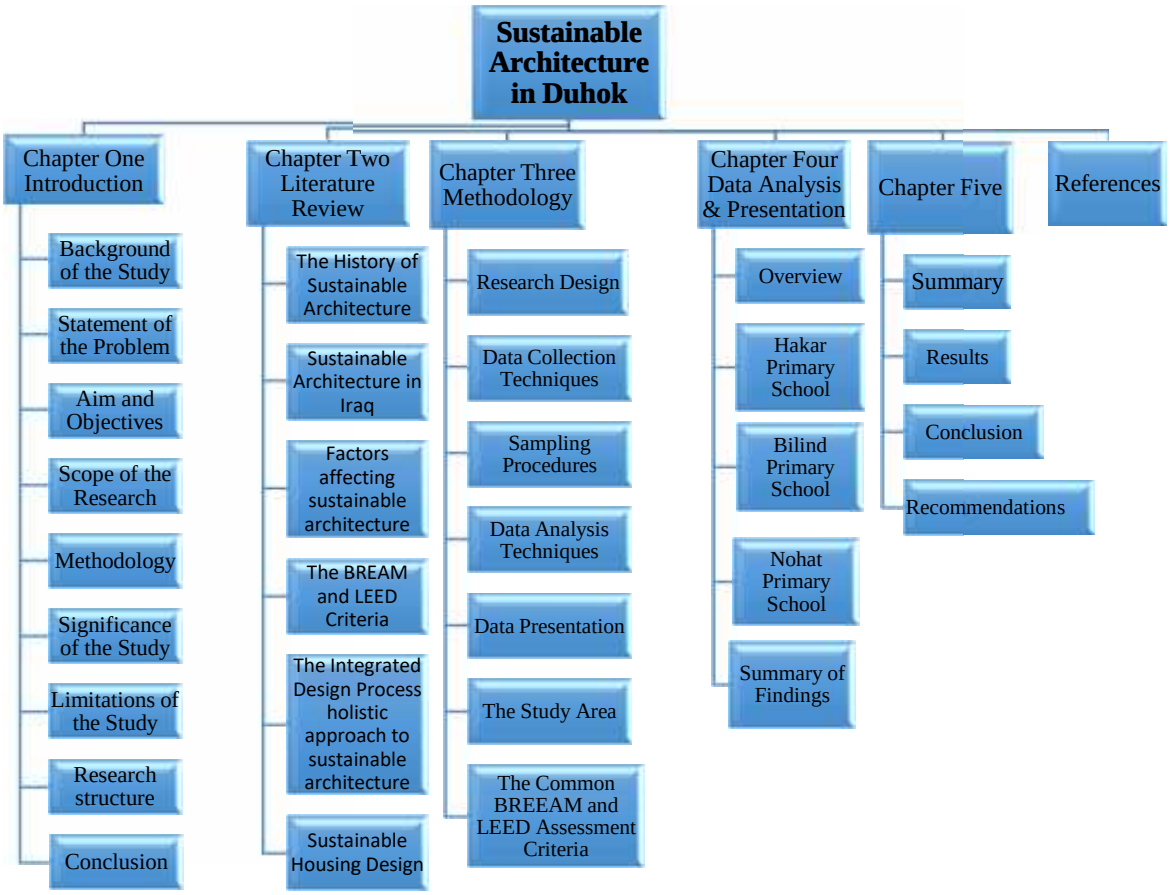


Figure1.3: The research structure

1.9 Conclusion

Chapter one gives a summary of the entire thesis, aim and objectives of the research, research question, scope of the study etc. the chapter gives a clear and precise direction of the research work. The research structure displays a tree branches of the research showing the major titles of the research.

CHAPTER TWO

LITERATURE REVIEW

2.1 The History of Sustainable Architecture

Considering the sustainability of the constructed building and other forms from the past helps in recognize the variations of architectural building, urban sites and all architectural aspects of the present time. The current architectural practice that is being perceived is formed by five main stages. Reductionist standard has greatly affected most of the phases, four out of the five stages where it is defining the maintainability of architectural design. Reductionist architype is in search of mostly on decrease undesirable house influence on surrounding effectiveness. Nevertheless, the change is on the edge in having different function paradigm. The chapter defines historic advancement also the various stages of up-to-date maintainable architecture while exploring the sustainability standards related with the stages (Attia, 2017).Five important paradigms have influenced architecture and construction since the beginning of the 20th century. A survey over the last 120 years demonstrates that the architectural discourse was greatly impacted by industrialisation's economic and ecological problems. It is a study of categorisation of thinking that strives for a greater knowledge of evolution and linkage between sustainability as well as creating a constructed climate and is not strict and should not be taken as a hard classification that sets limits. We thus differentiate seven perspectives for thinking about sustainability. The first paradigm, Bioclimatic Architecture, was dominated by Wright in 1906 Aalto in 1935 on health and precautionary principle until formulation of the Bioclimatic Architecture paradigm by the Olgyay Brothers in 1949 and Olgyay (1953)(Porteous, 2013; Banham, 1984; Uechi, 2009; Braham, 2000; Mertins, 2007; Anderson, 2010).

2.2Sustainable Architecture in Iraq

Sustainable architecture is a means of extending the aged progression of remaining architecture. The sustainability in emerging nations is in the primary phases related to advanced countries. Several research attempts in carrying the conscious to some frequent

applied matters, also offer uncomplicated resolutions in making structures extra effective, practical, also relaxed (Zebari & Ibrahim, 2016). The increasing relevance of sustainability theory and principles, and its strong impact on architecture and educational practices, is extremely obvious, and the term "sustainability," as referenced on numerous occasions in the UNESCO Charter of the Union of International Association (UIA) (UIA, 2015). It is explicitly indicated as one of its purposes for architectural education (Architecture for a Sustainable Future). A survey of the teaching books of every architecture-teaching institution, many teaching institutions in the West has developed instruments for identifying influences from the teaching process, the (STAUNCH tool) is used to monitor the level of commitment to sustainability principles within the teaching program in the Salahaddin University. Researchers have succeeded to generate an assessment of Salahaddin University's architectural status as to the availability of sustainable principles and have provided some remarks on how teaching programs might be developed in line with UIA/UNESCO objectives (architecture for a sustainable future).

In recent decades, Northern Iraq, as part of Iraq, has seen a considerable increase in population. Housing hardship has increased in Northern Iraq. In the march towards an efficient built environment and community today environmental, economic and social sustainability became vital. Several study efforts aim to assess the existence of environmental, economic, and social factors of sustainability in the housing sector that enable them to be obtained and affordable in Northern Iraq to low-income people. In Erbil, the capital of northern Iraq, housing developments as case studies were studied. The study assessed the existence of factors of sustainability. The results show that the application of sustainability factors to buildings in Northern Iraq is poor and not fully known. The housing initiatives which concentrate on case studies were reportedly unsustainable. The results indicate that sustainable principles are extremely poorly applied to the housing projects in northern Iraq. The researchers advocate sustainability as an important strategy to generate acquired and cheap homes and tackle social, ecological, and economic housing concerns. Recommendations were proposed to provide new ways of adopting the principles of sustainable housing in Northern Iraq to reduce house stress(Mohammed Amin & Salah Muhy Al-Din, 2019).

Courtyard is an effort to somewhat regulate the forces of nature. As pockets of open space, patios promote certain climatic elements, such as daylight, and attenuate others, such as heat. With existing shade, water and plant, the courtyards may operate fine. The courtyard with two stories is crucial for the walls of the patio to be shaded sufficiently. The primary guideline of thermal comfort in hot-air courtyard dwellings is to shade or otherwise minimize heat input. Although the courtyard is, by definition, exposed to the sky, there are other reasons besides the scorching sun, which include dusty wind, bats or other intruders, to screen this area at the very least temporarily. The courtyard shade greatly decreases its effective temperature by neutralizing the radiation element and keeping relatively low heat on the external wall surfaces of the courtyard. The outcome is a courtyard, which is highly functional for most of the year, with a lot of activities of the residents. Shading in the courtyard can be made by the building itself, but it is also better to create trees (Al-musaed et al., 2007).

2.2.1 Factors affecting sustainable architecture

Yalçın & Acar, (2017)conducted research in Iran studied approximately 120 architects reply to the survey, which was qualitative analysis to name out the issue that affected sustainability of related choices. The results indicate that client's economic and legal factors are mandatory to accomplish the goal, in construction business acceptance and narration of sustainable resolution entails a detailed grasp of personal connections, country aspects and organizations. The accountable authorities of planning sustainable strategies and navigating mechanisms in construction business aspect can benefit from those connections. Resolutions for Sustainability are chiefly the results of complicated connection among people, corporations, companies and country aspects. It is necessary to grasp the surrounding context around the practical features of sustainable architecture, even though distribution of practical idea regarding resolution of sustainability is at different stage encouraging influence in decreasing the bad insight of people, community and building business. The concern cannot be ignored from the bigger image, in different countries including Turkey, after the accomplishment of different kinds of structure involvement polices, focused on altering situations where sustainable decisions are considered, it is reliant on the shared capacity to get agreement on insistence of environmental difficulties, in political act of strong involvement of electing in many stages

while creating consciousness in customers and community of the effect of building business on manmade environment and nature.

Developing building in Iraq can be one of difficult matters in sustainability aspect. Due to the building having extended life span also the primary and subsidiary influence on individuals. In spite of these, the development of buildings has great significance in achieving the aim of sustainability. Winston & Eastaway, (2008) states there exists more abandoned features of sustainability. It is essential to build sustainable construction. Sustainable houses character is comfortable, environmentally friendly, and price friendly. Sustainable houses have the insurance of healthy environment for occupant and lesser influence on nature. The three major features of sustainability should be achieved in order to have sustainable building:

a) Social,
b) Environmental and,
c) Economic sustainability (Mcconville, 2006).

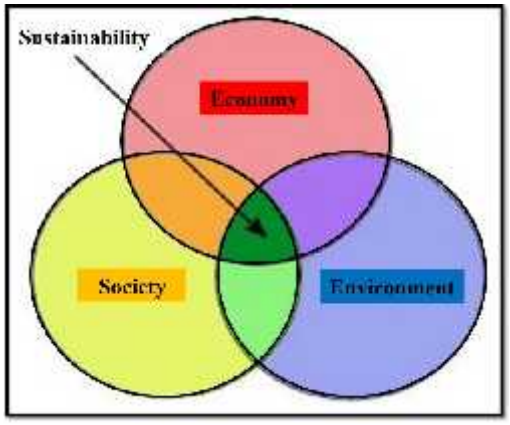


Figure 2.1: Three main factors of sustainability
(Wirya, Salah, & Kuzovic, 2017)

Figure.2.1 above, indicates major aspects that should be well-thought-out to attain sustainability in seeing 3 features of sustainability i.e., financial, public, and surrounding. Buildings, participates in socio-economic grounds and ecological ground in addition, over

creating outstanding practise of natural assets and growth of years of greenhouse gasses due to buildings (Asif, Muneer, & Kubie, 2005). Abidin & Pasquire, (2005), in his study regarding the application of security and well-being to inhabitants in addition to the environment and community is the core values in sustainable building. Various definitions of construction have been stated by researchers and thus its complicated subject (Plessis, 2007). Where some explained it as a business that includes constructing and planning of buildings (Bosher, Carrillo, Dainty, Glass, & Price, 2007). Plessis, (2007), stated the explanation of construction can be done in 2 ways. Those are, firstly the stage of activity within the site; it is utmost slim description of construction, that describes growth as just site movement to progress the services of construction. The next definition is entire plan cycle: it is wider outlook, which indicates the participation of numerous attributes similar, constructers, benefactors and managers that accept vital portion in the growth business. Though, the relative subjects to economy of building and the procedure of creating social reimbursement are tangled as well. It is the point of concern of the study that relates sustainability (Wirya et al., 2017).

Most of the elements of sustainability are mentioned below:

a. Greeneries
b. Sun-shading
c. Evaporative cooling system
d. Indoor lighting
e. Portable water supply
f. Renewable energy supply
g. Effective Refuse management system

Enshassi, Kochendoerfer, & Ghoul, (2016) also reported that there exist 5 issues within the major 10 influences which are affecting performance of sustainability in building developments, categorized within the stage of construction, agreeing in the aspect of projects process are mainly affected in construction. In incepting stage there are 3 features, that approve the project inception has significant role. Also, beneath procedure stage and demolition stage there is one category classified. Sustainable project in building development

is affected by overall mutual sustainability basics influence: water contamination evaluation, water fee, energy ingesting, purveying of facilities, and recycling essentials.

2.3 Problems of Sustainable Architecture inIraq

In countries that are developing, the cities are growing in unrestrained and unplanned way to fit rapid increment of population and relocating from rural places(Yildiz, Kivrak, & Arslan, 2017). The structure and houses part are the utmost energy-wasting areas, being responsible for the world's one third entire energy ingesting also one-third of the world's CO2 discharges, taking it to ecological, well-being and mental reparations for individuals and society, and intensification of further city difficulties in country. It is the outcome of dependence on fossil energies, building materials and extreme feeding of natural sources which can origin in escalating of greenhouse gas productions. Perception of green constructions have occurred with maintainable movements in areas of architecture and urban planning. An integrated architecture with surrounding and nature landscape decreasing contamination ratio to 1:6 of world's CO2 releases. Delivers a harmless, easy and well atmosphere for individuals also decreases intake and conservation of natural sources, for upcoming age group through reprocessing leftover, effluent, rooftops and green frontages, also practice of appropriate construction materials with the surrounding, as well as combined plan with houses and city background in relations with establishment and path of houses and practice of maintainable house materials and usage of renewable energy. Summer season in Iraq, is considered hot, reaching 50°c and above, and in winter times it drops in temperature, and this is unequal difference between the seasons, due to this reason it is mandatory to have buildings that contemplate the necessities of social thermal comfort, decrease energy feeding and natural sources, also deliver well mental surrounding, to decreases harmful discharges to the surrounding. There exists various barriers in order to develop green building in cities of Iraq most significantly the rules and regulation that need its regulation to fit the high-tech development in architecture, also mechanical, and communal restraints (Nabil T. Ismael & Hussain, 2019).

2.4 The Sustainable Architecture in DuhokCity

There have been numerous quick changes and developments in the Kurdistan area today. The economy is developing and people are growing. A contemporary way of living influences people and societal behaviour. The architecture styles and construction processes are affected by these variables altogether. The disappearance of the locality resulted in abandon of the vernacular architecture. Consequently, certain designs and methods of old architecture may be implemented in modern structures with the existing constructive laws with the correct management (Khoshnaw, 2019). In recent decades, Northern Iraq, as part of Iraq, has seen a considerable increase in population. Housing hardship has increased in Northern Iraq. In the march towards an efficient built environment and community today environmental, economic and social sustainability became vital. The results show that in Northern Iraq the use of sustainability elements for buildings is poor and unknown. The study indicated that housing schemes that are not viable via case studies. The results indicate that sustainable principles are extremely poorly applied to the housing projects in northern Iraq. Sustainability is strongly suggested since it is the important approach to build cheap housing and tackle social, environmental and financial housing challenges. The proposals were proposed to develop innovative approaches to integrate sustainable principles to the housing sector in northern Iraq in order to address housing stress.

2.5 The Problems of Sustainable Architecture in DuhokCity

Modernity has its roots in several places of Kurdistan, affecting traditional design. The history and topography of Kurdistan must be understood, therefore, to assist resolve the many difficulties since then. The advantages of vernacular architecture assist to comprehend the advantages and comforts that are provided by climate adaptation. New Western crops have been adopted in the region which do not conform to the ecology of the area. In traditional places, the application of western culture can only function against the environment. The architects, researchers and municipal decision-makers have to cope with this. The use of traditional housing arrangements and practices in Kurdistan helps to reduce the challenges in the region(Khoshnaw, 2019).

KRG's population growth estimates in 2015 to be over 5.5 million, with 1.8 million refugees placing excessive energy demand. The overall power production is projected to be between 55,000 and 80,000 private diesel generators in Irak, producing an estimated 21 TWh or 30%. Operators are generally licensed by the LC, but otherwise weakly controlled. Where more than 1000 generators are located in Duhok. They lead to chronic air and noise issues, yet offer much-needed power, at high local health costs. Thus, air pollution in Iraqi cities in particular is well over the World Health Organization and the local directives of private diesel generators. The difficulty with Duhok's ancient urban center is traffic owing to the growth in automobiles, which is substantial and unexpected, over a short period of time, compared to other provinces across the entire area. In the city, especially around schools, KGs and hospital markets, there is a lot of driving momentum during rush hours and car park at certain specified areas. Parking is particularly significant since the little spaces provided cannot absorb today's enormous number of automobiles and the substantial shortage at all junctions(Malaika, Hasan, & Hassan, 2018).

2.6 The Application of Sustainable Architecture toPrimary Schools in DuhokCity

The buildings and campuses of primary and secondary schools that have been constructed today are future schools. Architecture of sustainable schools is a guiding principle for the development, construction and architecture of healthy, stimulating schools, and the conservation of energy and resources. The book is a road map for sustainable planning, design, building and operations, written with the needs of architects, construction experts, educators and scholastic management in mind.A school is frequently, by its nature, a cornerstone of its community and, thus, ideally positioned to lead the environment. Based on this, the Architecture of Sustainable Schools illustrates how green practice for the design of schools may create an atmosphere that young pupils copy and bring about across the world. This book was written by specialists on sustainable school design:

- Concentrate on the interconnections between best practices and educational institutions' special demands.

- Has 9 worldwide case studies of finest current sustainable schools situated in template, tropical, and harsh climates urban, suburban, and rural regions.
- Includes essential California high-performance school collaborative (CHPS) and energy and environmental design leadership (LEED) grading system information.
- Acts as a resource for progressive upgrading, operational strategies and overall transformation.
- It provides guidance on the implementation of an integrated, community-based design process with support information on sustainable school materials and systems.
- Includes professional input on site methods, systems, maintenance and sustainable school operations.

This significant book offers architects thorough information for building more healthy learning contexts, with a practical overview of how sustainability may be accomplished in new and current schools and how to maintain this momentum in future years (Gelfand & Freed, 2010).

2.7 The BREEAM and LEED Criteria

2.7.1 The BREEAM

Building Research Establishment Environmental Assessment Method (BREEAM) is the largest and most commonly used sustainable assessment criterion in the world in the field of construction and infrastructure in master project planning. The importance of the high-performance resources in the developing context, starting from new and renovated structures, was expressed by the usage of a set of BREEAM rated buildings are therefore sustainable environments which enhance people's value of life, protect raw materials and increase the allure of property investment. This is done through the definition and assessment of a wide range of scientific and strict criteria beyond existing policies and procedures. BREEAM strives to encourage continual development in performance and advancement in facilities that employ five fundamental categories of governance, economic welfare, conservation of resources, renewable energy, land and ecological protection, transportation and local

management. However, it enables owners, commissioners and suppliers, maintains and uses the communities to achieve their sustainable development goals, therefore creating confidence and value via certification, which shows to be beneficial to the society as a whole. Currently in the globe, there are 591 822 certificates, 2 310,077 registered buildings in eight nations (Table 2.1) (BREEAM, 2020).

Table 2.1: The BREEAM grading criteria for the BREEAM Community Scheme 2012(BREEAM, 2017).

BREEAM Rating	**Score %**
Exceptional	≥ 85
Brilliant	≥ 70
Very good	≥ 55
Good	≥ 45
Pass	≥ 30
Unclassified	< 30

Table 2.1 presents the BREEAM grading criteria or guidelineswhen assessing a building and if the total score was found to be≥ 85% it signifies excellent green building performance, ≥ 70 means brilliant, ≥ 55 is very good, ≥ 45 is good, ≥ 30 is pass, while < 30 score is unclassified green building performances. This is the standard sustainable green building assessment that is acceptable worldwide, and is used as guideline when issuing a certificate to the buildings that met their requirements.

2.7.2 The LEED

Leaders throughout the globe have developed Leadership in Energy and Environmental Design (LEED), a green building system that has been used the most commonly, around 1.85 million ft^2 of certified constructed spaces per day. LEED certification provides an independent

assurance of green features of the house and the entire neighbourhood, promoting the construction, planning, maintenance and management of cost-effective, energy-saving, safe, high-performance buildings. The third bottom line is LEED, which helps people and the globe to benefit from it. Available for almost full building types, LEED provides a sustainable, highly effective and cost-effective framework in the green building. International LEED certification is recognized as a trademark of achievement and sustainability direction. All LEED buildings, complete building phases, including new interior and buildings, core and core, working and repair. Millions of people live, work and study in LEED-certified buildings across the world. Get additional information about the value of LEED qualifications. In order to design, produce and operate high-performance green buildings, the certification program exists since 2002. This distinction is recognized around the world and there are four degrees of excellence. LEED certification is designed to achieve cleaner, more production-oriented locations, a lower environmental stress via supporting buildings that are resource-efficient and energy-efficient. By 2018th Growth Domestic Product buildings certified by LEED may direct $29.8 billion towards the US economy(LEED, 2021).

The certification is divided into four, namely:

1) Platinum (80 points scores)
2) Gold (Golden) (scores between 60 to 79.99 points)
3) Silver (scores between 50 to 59.99 points)
4) Certification (scores between 40 to 49.99 points)

The LEED grading criteria of building assessment is stated above and when the total score was found to be ≥ 80% points signifies platinum, ≥ 60 means gold, ≥ 50 is silver, ≥ 40 is certified, while <40 score is not certified and therefore is not regarded as green building according to LEED rating criteria.

Table 2.2: Characteristics of sustainable building compared to user requirements

S/N	User benefits and needs of green buildings	
1.	Minimum energy consumption (efficient applications)	Fewer bills and cost reduction.
2.	Renewable energies from natural sources	Environmentally friendly and less risky.
3.	Indoor ventilations and creation of natural light	Natural light and ventilation free of the nature.
4.	The use of cheap local resources during building	Costs are reduced by the usage of local materials.
5.	Reduce waste generation	Less garbage production and disposal, recycling, reuse etc.
6.	Environmentally sound and sustainable	It is easy to achieve sustainable goals.

Table 2.2 above explains the benefits that a sustainable green building gives to its user, these set six (6) benefits listed in the table were picked among the forefront of sustainable millennium development goals. When a building has minimal energy consumption, it means that the building is energy efficient, through the use appliances that do not use high electricity to operate. Examples of these energy-saving appliances are LED bulbs and TVs, rechargeable fan and lantern etc. Renewable energy sources also help achieve sustainability through the production of energy sources from the natural features surround us like solar (photovoltaic), wind (windmill), water (hydro), organic matter (biogas and biodiesel) etc.These sources reduce the overall load of energy on the public supply, saves both electric and heating bills and most importantly they do not produce toxic substance to the environment. Indoor ventilation and lighting can have created through openings in a building, like windows and

doors. To cross-ventilation is the aim of having an efficient natural ventilation system, which can be done through two or more openings on two different walls of the building. Having one window in a room can produce natural light, but not cross-ventilation. The importance of cross ventilation is that it will reduce the rate at which other electric appliance used in cooling down the room will be regulated and sometimes not necessarily used, hence the electric consumption will be saved as well. Waste generation and management are the major problem that most countries face nowadays, therefore, when the waste generated by the buildings can be reduced through sorting, reuse, recycle of the waste produced it will slow down the environmental hazard and global warming.

2.8 The Integrated Design Process holistic approach to sustainable architecture

Global warming concerns and new regulatory requirements for building energy usage have necessitated the development of sustainable architectural approaches. Currently, mainstream architects are having difficulty delivering long-term success in their projects. Solar panels, glassed verandas, and low-flushing toilets are frequently used in finished sustainable projects to ensure their long-term viability. However, this does not guarantee long-term viability, as the building's systems do not always function together, and users frequently do not use the facility as planned. As a result, approaches that enable more comprehensive, long-term architecture are required. New approaches to sustainable architecture have evolved in the previous five years. However, many of them focus on specific aspects of sustainable design, making it difficult for mainstream architects to apply sustainability. As a result, holistic approaches to sustainable architecture continue to be necessary.

2.8.1 The Interaction of the parameters in the Integrated Design Process

The interplay between the process's many tools and products contributes to the Integrated Design Process's complexity. The theoretical master project "The Integrated Design Process Focused on Sustainability and Method" (Hansen, Madsen, & Madsen, 2003) examined and explained this. An illustration of how the tools and products interact when sketching on the. Below is a climate screen.

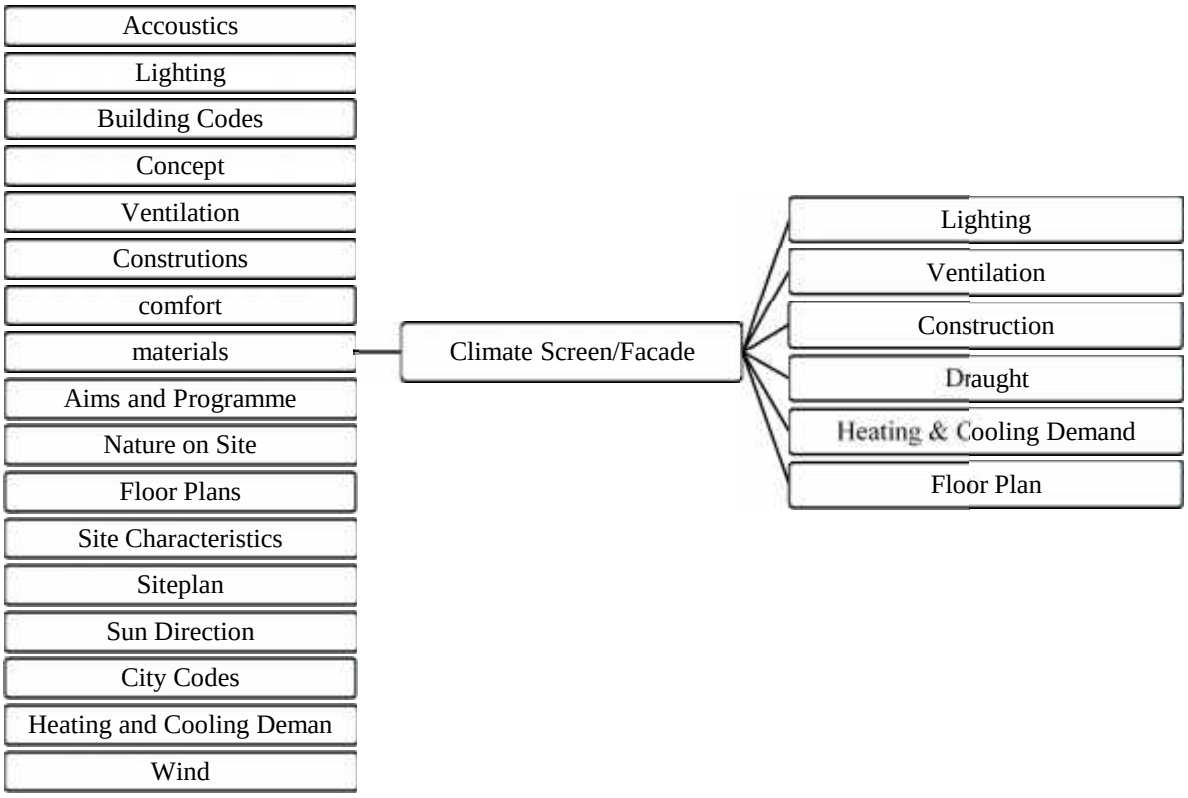


Figure 2.2: Example of the interaction of the parameters in the integrated design process, whensketching on the climate screen.

Although the IDP may be used for environmental or sustainable efforts, more specialized methods, such as in connection to a specific function in a given climate, are still required. Some have concluded that specific approaches in sustainable architecture are needed based on the growth of environmental and sustainable architectural techniques in general, because most methods focus on elements of sustainable design. They're both essential. These are important, but they also need a comprehensive approach that encompasses all subdivisions while also ensuring architectural sustainability. IDP does not guarantee aesthesia or sustainable solutions, but allows the designer, since all various elements are taken into account during process, to manage the numerous parameters that need to be addressed and incorporated in the project in order to create excellent, sustainable solutions. The virtual design project is still in the early stages of development; if allowed, the project's level of sustainability might be increased further. The main goal is to integrate all of the variables since this is viewed as the key to

creating a more holistic and long-term design. Controlling and integrating so many various aspects in a project ensures that the systems and, as a result, the building interact more sustainably(Cand. & Maa, 2005).

2.9 Sustainable Housing Design

Another study focused on essential principles, approaches, applications and lessons gained in sustainable architecture, design and housing. Sustainable architecture challenges innovative architectural design at several levels. The following examples are:

a) Increasing building efficiency and reducing the consumption of materials, energy, and development space to reduce the negative environmental effect of buildings.
b) Creating strategies to connect form and adapt the design to the location, area, and climate.
c) By addressing the essence of excellent form-giving, residents and their surroundings may establish a happy, long-lasting relationship (S. Z. Abidin, Sigurjonsson, Liem, & Keitsch, 2008).

In summary, a good, user-friendly, and attractive ecological architecture should be built. Because of their novel theoretical contributions or their use of techniques, measurements, and tactics, the selected articles stress certain areas of architecture, design, and housing sustainability. Sustainable design study aims to improve knowledge and discuss solutions to specific issues that architects and designers face. This may also be characterized as the relevance of research on sustainable design to the overall discussion on sustainable development. the dynamic process of Sustainable design includes normative, strategic, designerly, and technological elements(Nigel, 1982). This special edition focuses on three themes.

1. A broad view of sustainable architecture and design, as well as its effect on long-term development.
2. Sustainable design methodologies and technologies.
3. Developing policies and strategies to evaluate and execute sustainable design (Keitsch, 2012).

CHAPTER THREE

METHODOLOGY

3.1 Research Design

This study is designed to conduct research based on the sustainable architecture of primary schools in Duhok city. Currently there are 221 governmentsprimary school and only 3 school were combined with both secondary and primary in the city.Some sample was drawn and tested based on sustainable green features of architecture from these primary schools. The research outlined the problems of these primary school designs and suggest a suitable solution to it. However, the research methodology discusses the sources of data used in detail, the sampling procedure, sample frame and the relevant instrument that is adopted in this research, alsodata analysis and data presentation are used to assess the sustainable architecture of the schools around Duhok city in thisthesis.

3.2 Research Methodology

Both primary and secondary data was adopted in this research, this is due to fact that they were both necessary instruments required to fetch adequate data for the analysis of this research. Primary data was collected from the selected schools in Duhok city by visiting each school at their respective location. Data such as coordinates was collected using GPS device, pictures and measurements is required on the site and many other relevant primary information necessary. On theother hand, secondary data was collected from both internet sources, the General Education office in Duhok city North Iraq and other relevant government and non-governmental parastatals. The General Education office is the local state government body that is directing education affairs in Duhok city alone.

Table 3. 1 Data collection

S/N	Objectives	Type of Data	Method of Data Collection	Method of Data Analysis
1)	To identify the green features of sustainable architecture used in Duhok's primary schools.	a) Primary data using. b) Secondary data using internet map.	i. Personal observation and, google map.	Descriptive
2)	To assess the indoor user-comfort of the classes in the primary schools.	a) Evaluation of cross-ventilation. b) Functionality of the projects.	i. Field observation.	Descriptive
3)	Evaluation of the best measures to use in achieving sustainable architecture in the primary schools around Duhok city.	a) Analysing past and existing projects. b) Comparative analysis of the provision of sustainable infrastructure and Standards. c) Level of efficiency of the projects.	i. Observation, textbooks, journals, internet sources etc.	Descriptive

This table explains the relevant information that was used in this research. To identify the green features of sustainable architecture used in Duhok's primary schools, both primary and secondary data is necessary. Personal observation was devised to evaluate the existing sustainable features in the schools. While, google maps will also show site layout and all the sustainable elements placed in the school.

To assess the indoor user-comfort of the classes in the primary schools, there is need to examine if there is cross-ventilation in the schools. Cross-ventilation is achieved when there is windows in two different walls of the school. However, the functionality of every features in the school building and surrounding compound may provide comfort to the students and staffs in the school. The best method of achieving this is by visiting the school site in person, which personal observation was carried out.

Evaluation of the best measures to use in achieving sustainable architecture in the primary schools around Duhok city. This objective was in-form of suggestions made to overcome the

problems found that were linked to these schools in Duhok city. Analysing past and existing projects, comparative analysis of the provision of sustainable infrastructure and Standards, level of efficiency of the projects were the process to which this objective can be achieved. Observation, textbooks, journals, internet sources etc. was used to achieve the objective.

All these objectives were finally analysed using descriptive method, because quantitative data analysis was the only method in this research.Table 3. 2below shows the types of thedataused.

Table 3. 3 Data types used

S/N	Data	Sources
1.	Maps	Secondary
2.	Measurements e.g. windows and doors sizes	Primary
3.	Names, coordinate locations and hierarchy of infrastructures	Both Primary &Secondary
4.	School assessments on sustainable features	Primary

3.3 Data Sources

This paper uses both primary and secondary data sources to fetch all the significant data concerning the research. Secondary sources of data were the internet, government offices regulating education sector in Duhok city (General Education Office of Duhok) etc. while the primary data involve data received from the ministry personnel, measurements on-site and personal observation among others.

3.3.1 Primary data

This data was acquired by administering personal observations using BREEAM and LEAD together (measurements and physical observations) in the study area and personal observation of the school building was conducted in this research to acquire the various information required to achieve the objectives of this study.

3.3.2 Secondary data

This data was gathered from sources such as past literatures,magazines and general education office of Duhok city so as to assess the existing and new school projects and its sustainable nature.

3.4.2 Sample frame/population

The research work focuses on primaryschools within Duhok metropolitanregion as the target population, which the samples will be drawn from the 221 primary and secondary schools. Because some school in Duhok city combines both primary and secondary schools in one school location some few secondary school will be involved.

3.4.4 Sampling techniques

Personal observation formwill beused to examine the school buildings which were selected using Cluster Random Sampling Techniques in the study area. That means there are three (3) clusters chosen which will be examined using random sampling technique. This makes it easier to get the target aim, objectives and goals of this research work.

3.5 Sampling Procedure

Simple random sampling technique is devised here to examine theselected schools to be tested in Duhok city. These samples will be drawn randomly from different areas of the city to enable a bias free research.A stratified sampling technique will be used in picking random samples of schools chosen for personal observations.

3. 5.2Data presentation

The data collection in this research is done mostly by personal observation, other sources of data will include photographs, coordinates, measurements etc. This information will be analysed and presented using tables and pictorial forms (like charts and photographs)to explain the research work.

3. 5.3Data analysis

The data presented will be analysed using descriptive statistical analysis in this research. This method was chosen because it is a good method of analysing the data and easily draw conclusion and recommendations out of it.

3.6 Study Area

3.6.1 The city of Duhok as the study area

Metropolis of the Kurdistan Region, Iraq, there exists a city called Duhok that is in the northern Iraq at the center of an intersection between Turkey, Syria and Iraq. It is the tactical way that is linking Kurdistan to the rest of the world. Because of its placement and its growth, the metropolis is profiting the region from commerce and economic gain. Duhok have a population size of 1.5 million most of them being Kurds and rest are Armenian, Assyrians, Arab, Chaldeans living together. In contrast with the rest of Iraq Kurdistan, the city Duhok is more diversified in terms of ethics and religion. Christianity and Yezidism are adopted in the city, where various churches and Yazidi shrines can be seen with in Duhok, while most of the population are Muslim. In recent years the city has encompassed for many refugees from various countries such as Mosul, Syria and Shingal. The locals speak the language Bahdini parlance of Kurdish, that is the under the language family of Indo-European and is widely verbalized in Syrian Kurdistan and Turkey. Because of the vast minority groups found in Duhok the second spoken languages are Aramaic and Arabic. Recent immigration outlines are demanding for a bridge language where they chose English to help increase more communication with in the people (Shukri & Ameen, 2019).

Located in between two mountains the city that is in the valley along the river Tigris got its nameDuhok where it is interprets as two mountains. Having narrow outline, the city consists a square shape affecting the development to spread into the mountain foot. It contains abundant sources of water, dam of Duhok situated at the northern edge of old settlement and two minor waterways that join each other in the South-west angle of the urban.

Figure 3.1: Duhok city(AUK, 2021)

3.6.2 Security conditions

Duhok in specifically is nonviolent, the safety situation in Kurdistan, tranquil and particularly differs from the other part of Iraq. This is in explicit distinction to the reflection shown by medias covered by foreigners, that erroneously signifies Kurdistan as a hazardous, ungovernable site. On the other hand, developed and large military is found in Kurdistan, *Peshmerga*, and its peculiar forces and safety services to defend its present day and old inhabitants. Duhok houses many of worldwide NGOs and overseas stakeholders and remains to grasp its vacation industry flourish between courageous foreign tourists. To retain the safety level as high and guard the harmony in Kurdistan, steady barriers are situated sideways to boundaries and city edges.

Figure 3.2: Water resources in Duhok
(AUK, 2021)

Figure 3.3: Showing Duhok cliff town
(AUK, 2021)

3.6.3 Weather and climate conditions

Duhok is enclosed by highlands and produces a desert weather of severe summer season and slight, rainy winter time, as is distinctive in the Mesopotamia northern parts. Spring and autumn are attractive, pleasant, and slightly petite than other periods. Temperature at evening will differ extremely. The Kurdistan Province and all of Iraq are 3 hours in advance of Greenwich Mean Time (GMT).

Approximately 170 km away, the nearby airport to Duhok is in the Erbil, province's capital. Numerous European countries suggest straight trips to Erbil International Airport (EIA), also despite centralized Iraq and adjacent nations, populations of the U.S. and utmost Western nations can securely transport to Kurdistan. The journey to Duhok is on a surfaced street, but some zones are still below building and can be transferred. The journey takes roughly 2 hours reliant on road time and situations of day.

3.6.4 City of Duhok strategy (cultural engagement and lifelong learning)

Civilization has an excessive requirement for spaces where individuals of various ages can encounter and study collectively and where sense is shaped over the information, considering and gratitude of treasured items to influence social meeting. This type of education situation previously was present unrestricted from the prejudice formed by trade or policies. In these logics of non-formal interventions counting with exhibition hall, libraries and galleries in encouragingknowledge within their societies must act an important role as knowledge environments.

Academic and colleges organizations should act as their part to banquet ingenuities and optimistic thoughts which carried everlasting teaching, culture and arts to the front of communal and social growth. This can be complete, for example, by supporting teamwork amongst colleges and social establishments. Some of these main educating refrains, such as harmony and social safety, participatory decision-making, human rights, cultural diversity and gender equality, are pure socio-cultural tests which are essential to the maintainable growth outline, but also censoriously applicable to culture strategies and programmers. Whilst

additional main supportable expansion themes are well-thought-out to be fragment of the financial and ecological dimensions of sustainability, their relations to principles are unavoidably recognized. In Kurdistan region of Iraq and especially in Duhok it is essential such a social appointment as the urban is a multi-race and religion, urban which public middles must do their part alongside the non-formal activities to influence justifiable growth of public, chiefly in this time as the district is in a delicate condition due to spiritual unacceptance and some sandy philosophies.

3.6.5 City of Duhok plans as a learning city

Learning wasemphasized on the part of schooling and philosophy, mass media, cloistered sector NGOs and massacre cases which is been continuing in Kurdistan parts. Also to non-formal activities counting galleries, museums and public library in endorsinglearning within their groups, and there are some parts that have been selected to pact with:

- Social strategies as a mediator for communal alteration;
- By means of social sources in a comprehensive style to make a culture of knowledge through life;
- Meeting the encounter of entrance, education and originality through ancient art collections.

The character of libraries, community and museums aims at the growth of lifetime knowledge are mutually diverse and rich: Libraries, community and museums centers can deliver educating chances, and inspire and cares knowledge of societies to reach cultural meeting.

To attain additional growth in lifetime knowledge, it is essential to encourage social equality. This needs that heritage that are cultural institutions, museums and libraries be familiarized as spaces which replicate civilization in all its complication and variety. Endorsement encouraging cultural equality by the following means:

- Making it obtainable to every student as an equality;

- Emerging numerous types of social institutes as participating, practical learning surroundings;
- Inspiring better contribution and social attachment;
- Recognizing the inter-relatedness of culture, learning and contribution.

3.6.6 Climate in Iraq

The temperature in Iraq is typically more than 48^{o}C reaching from July to August, the temperature chills to beneath 0^{o}C around January. Precipitation starts typically during November to April, occurring typically during winter season times around December to March. The remaining six months are scorching, June to August is very dry and scorching. While in northeastern and north Iraq has a yearly average precipitation reaching to 133.0mm per square meter around equivalent to 5.24in. There are 2 kinds of breeze throughout summer period, these are; southeasterly Sharqiand southern dehydrated and sandy wind with uncommon draughts of about 80km/h speed, starts around April reaching to start of June and later near the ending of September to November. The wind comes with grimy dust increases high overhead the ground up to about thousand meter producing most airfields shut for a petite while. From mid-June to mid-September the usual breeze, called the shamal, is from the northwest and north. It is a stable breeze, inattentive only irregularly throughout this time. The actual parched air carried by this shamal access concentrated sun boiler of the land external, but the wind has some chilling result. Coarsely 90 % of the annual precipitation happens between November and April, utmost of it in the winter months from December through March. The lasting 6 months, mainly the hottest ones of June, July, and August, are dry. Excluding in the north and northeast, average yearly precipitation varies among 10 and 17 centimeters. Information existing from places in the hills and plains south and southwest of the highlands propose average yearly precipitation among 32 and 57 centimeters for that zone. Precipitation in the highlands is more plentiful and may scope 100 centimeters a year in some spaces, but the landscape excludes widespread farming. Farming on no irrigated terrestrial is restricted basically to the highland valleys, hills, and grasslands, which have 30 or more centimeters of precipitation yearly.

3.7 The Common BREEAM and LEED Assessment Criteria

The criteria used in this research combines both BREEAM and LEED assessment tools, though they have slight differences but their criteria are more alike than being different. These criteria that were common to both BREEAM and LEED are the one that were picked and implemented during the school assessment in this research. These common criteria may include:

a. Cross-ventilation;
b. Indoor lighting;
c. School electric non-energy saving and energy saving appliances;
d. School garden, sun-shading and evaporative cooling system;
e. Electric and water supply;
f. Waste management system;
g. Common school utilities;
h. Wall and roof insulation.

These eight criteria were found common to both BREEAM and LEED assessment guidelines. Therefore, the three school buildings (Hakar, Bilind and Nohat) were assessed by these criteria mentioned above.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Overview

In this chapter, three (3) primary schools (namely Blind, Hakar, and Nohat) that were chosen will be analyzed based on a set of 8 criteria that were common to both BREAM and LEED were chosen to be used in this analysis and the data will be presented step by step. The data was fetched using an observation form (one for each school), pictures were taken using mobile phone camera, while map and coordinates were also written using GPS device and Google Earth computer software respectively. The data here will be presented later using tables, charts and description using descriptive method of data analysis.

4.1.1 The study area

The study area was chosen to be primary schools around Duhok city, more detail about the city was discussed in chapter one. However, there are 3 government school selected around city, which coordinates, maps and pictures were added to enhance the quality and originality of this research work. The map of each and every school will be provided and demarcated with a rectangular shape and reference pegs (A, B, C & D) which these pegs (A-D) were later reference in a table of coordinates in the analysis section of this research. Likewise, map locating every school will be provided to enable easy access to the visible features of the sustainable features each school. The names of the schools and their location names will be provided in the Table 4.1 below.

Table 4. 1: Names and location of schools

S/N	School name	Location name
1)	Hakar Primary School	Grebas
2)	Bilind Primary School	Serheldan
3)	Nohat Primary School	Masik

4.1.2 Hakar Primary School

The school was established in Grebas area of Duhok City, it was built in 1970, located on a new purpose-built campus, created by the Kurdistan Regional Government (Ministry of Education, Duhok Governorate, 2021). The school building was renovated around 2005, the land area covered by the school is 2500m^2 with 2 floors (i.e. ground floor and 1 suspended floor). The 1st floor is administrative offices (5 admin offices) and student classrooms (13 classes), while Second floor has only 5 classrooms.The school has 58 administration staffs; 1 manager, 2 associate directors, 50 teachers, 5 typists. There exists 468 total number of students in the whole Hakar Primary, before covid-19 world pandemic there are 34 students per class while after the pandemic the population of students was reduced to 20 students per class in an effort to curve the spread of the virus.

Figure 4.1: Location of Hakar primary school (peg A-D)

4.1.3 BilindPrimary School

This school is located in Sarheldanarea of Duhok province, it is physically situated in a “T” junction of Zanesty Street by Sarheldan road. It also has the access door facing west on Zanesty Street to provide safety to the children attending the school because the road has less traffic. This is because Sarheldanraod is a high speed road with high volume traffic, therefore it is not safe for the school to face Sarheldan road.

Figure 4.2: Location of Bilind primary school (peg A-D)

4.1.4 Nohat Primary School

This school was built in 2015-1016, and it was originated in 2004-2005 located at Masik area in a new purpose-built campus, created by the Kurdistan Regional Government (Ministry of Education,Duhok Governorate, 2021).

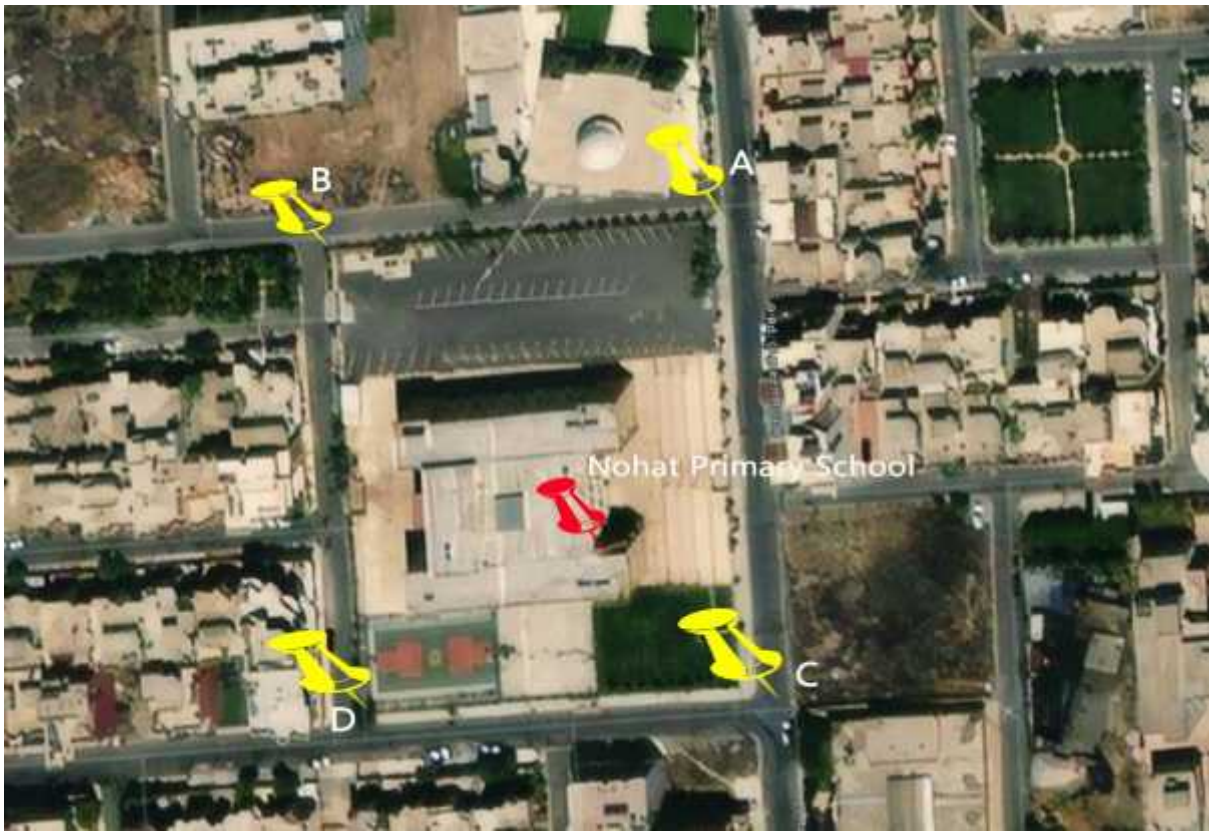


Figure 4.3: Location of Nohat primary school (peg A-D)

The rectangular boundary of the coordinate pegs (A, B, C & D) of each school maps shown above (Figure4.1, Figure4.2 andFigure4.3) are presented in Table 4.2 below.

Table 4.2: The coordinates of the three (3) primary schools

	School name	**Coordinates**				
		A	**B**	**C**	**D**	
1	Hakar Primary School	36°52’13.62"N 42° 59’36.54"E	36°52’13.49"N 42° 59’38.31"E	36°52’11.39"N 42°59’36.22"E	36°52’11.16"N 42° 59’38.16"E	**N** **E**
2	Bilind Primary School	36°51’13.04"N 43°1’34.99"E	36°51’11.39"N 43°1’34.71"E	36°51’13.27"N 43°1’32.63"E	36°51’11.74"N 43°1’32.28"E	**N** **E**
3	Nohat Primary School	36°52 17"N 42°57’4"E	36°52’18"N 42°57’0"E	36°52’15"N 42°57’4"E	36°52’15"N 42°57’0"E	**N** **E**

4.2 HakarPrimary School

- *Cross-ventilation*

The windows of each classes and offices in the school are found in one-side of the wall, this results in failure to provide cross-ventilation in the classes of the school. According BREEAM, a cross ventilation is achieved when a room has two or more windows in two different walls of the building. This is not healthy to keep students in a one-side window class, because it will result to rise in the overall temperature of the class by keeping stagnant-air and it may lead suffocation and other breathing difficulties or ailments. To alleviate this problem, the school provides some electric appliances to help improve the ventilation system of the school. These appliances are ceiling-fan and air-condition A/C. This is not sustainable as it attracts high energy demand and several health complications.

- *Indoor lighting*

The indoor lighting is fair looking at the fact there is no curtain on the windows and the windows were made-up with glass which allows enough penetration of light through the interior space of the classes and offices in the building. Also the glass windows gives control over rain, storms and strong wind, which is good and sustainable. Nevertheless, the absence of the curtain makes it difficult to control direct sun-rays which might be facing the building in the early morning (around 6am – 9am) and late evening (around 4:30pm - 6:30pm). Considering the comfort and avoiding distraction of the students from outside the class, the curtain will be very useful to provide conducive atmosphere for the student to concentrate on their studies.

(a) (b)

Figure 4.4:(a) Showing three windows and (b) showing the light intensity

- *School electric non-energy saving and energy saving appliances*

There are many electric appliances in the school which include electric bulb, ceiling fan, Air-conditioner, speakers (for making announcement), televisions, surveillance camera, and water-heater among others. The researcher focusses on the most frequently used appliances that were basic for every building to function. These basic electric appliances are: Bulb, ceiling fan, television, air-condition and others (specify) were the options chosen by the researcher to test their energy consumption in the school. All the option stated above excluding some were available in the building and can be found in almost every room (both classes and offices) in the school. Energy-saving appliance in the school were also recorded in the observation form, which stated that only electric bulb was found to be energy-saving appliance in the school. This indicates that there is high energy consumption in the Hakar Primary School.

Figure 4.5: A class showing electric fan and fluorescence light bulb.

F**igure 4.6**: Water heater

- *School garden, sun-shading and evaporative cooling system*

There is no existing garden in the school, this is shown in the pictures below, almost all the exterior of the school were paved with solid cement floor. The only existing vegetation were very few and not enough to be considered as a garden. Similarly, sun-shading and evaporative cooling system were not in provided in Hakar Primary School. This shows that the sustainable features in this school were lacking.

Figure 4.7: Hakarprimary school solid-paved compound

Figure 4.8:Showing the only unpaved area with dried tree and scattered grass

- *Electric and water supply*

According to the field survey conducted, it was indicated in the survey form that the only electric source was public electric supply and fossil fuel (the use of hazardous combustion engines). While public water supply is the only water source in the school, which clearly shows that borehole, rain harvest and commercial vendors among many other water supply sources were not implemented in the school. The public electric supply in Duhok city is generated from diesel combustion engines and also the school use both alternative and public power supply. This is really critical problem in an aim to attain sustainable goals in Duhok city. This method of electric supply causes hazardous material emission to the environment (i.e. combustion electric generators produces harmful gas to the atmosphere, generates unpleasant noise, land and water pollution from the oil spillage). According to LEED and

BREAM the sustainable method required to slow down the global warming can be achieved by the use of environmental-friendly energy sources that were harmless to both plants, man and animal ecosystem.

- *Waste management system*

The waste management system used in the school is central waste collection system, where by the school management collect the waste from different parts of the school and disposes them on the street waste-bin designed to serve the school purposely. This is fair method of waste disposal, though, compared with BREAM and LEED assessment criteria it is highly recommended that Recycle and Reuse of some waste materials is practiced. However, most Central waste collected were taken to sorting area were items that can be recycled and reused are selected, treated and sold-out for further use in the society.

Figure 4.9: The waste-bin used in the school

Figure 4.10: Another type of waste-bin in Hakar primary school

- *Common school utilities*

These common school utilities are toilet, kitchen and dining halls. These parts of the school are shared by both the students and the staffs; though the staff has separate kitchen toilet and dining halls in theschool. The importance of analyzing these parts of the building is to predict the approximate amount of water required for the toilets to function, expected liquid waste to be generated, the energy used regularly in heating and warming both water and interior surround air in the school. There are over seven entities of toilets in the building for both staffs and student's latrine in different location. The staff toilet is separated from students latrine, which each group of toilets has at least two wash-hand basin. All these facts gathered were obvious that the amount of water required to run the school will be much. Water-saving is also among the criterion to be considered when assessing any building based on BREEAM and LEED assessment criteria.

(a) (b)

Figure 4.11: (a) Student toilet, (b) Wash-hand basin

Figure 4.12: Staff toilet

The kitchen was also separated between the student's and teacher's kitchen. However, the kitchen is also being merged with the dining hall in a single room. This is not healthy, as the energy used in cooking is called cooking gas (i.e. Propane) which extracted from fossil fuel. This gas produces a toxic gas when burning and Nitrogen dioxide is produce, the principal pollutant of gas stove which is created at the cooktop. However, the oven possess the potential to cause many health problems, even to children, these health effects may include high risk of asthma in childhood (both lifetime and current), serious respiratory symptoms (e.g. chest tightness, coughing, difficulty breathing, wheezing,airways irritated, IQ deficits in learning, amplifiedlung susceptibility infections, removedantioxidant tissue defenses (which protect the respiratory tract), lung function changed, effects of cardiovascular, allergies susceptibility increased. Most of these symptoms mentioned before can occur even when the stove is not in use (Sarah, 2020). Efforts were needed to provide sustainable solutions to these problems by avoiding the use of fossil fuel and switching to renewable energies in cooking and heating. These renewable energies may include Jatropha Jelly, solar cookers among many others.

Figure 4.13: A kitchen mixed along with dinning in single room in Hakar primary school Duhok

- *Wall and roof insulation*

The insulation of wall and roof does not exist in this school.

4.3 Bilind Primary School

Bilind primary school was built in 1984by the Kurdistan Regional Government. It was renovated in the year 2008, painted only around 2015. The school building has a square shape of 2000m^2 (the built area) and has 4000m^2 of the total land area. It comprises of 2 floors with only one suspended floors, 3 administration room and 2 WC toiletswith a single staffroom for the teachers and one kitchen in the administrative section. There are 56 teachers in number, 2 cleaning staffs, 2 security personnel, and a total number of 644 students. The number ofstudents per class is expected to be around 25-30 students per class. The school laboratory is placed in the 1st floor of the school building. Ground floor also has 2 room one for art, one for Kurdish education.Second floor: also have a 2 room one for Biology lab and one for Arabic

education.Students'classroom is placed in two floorswhich ground floor has 6 classrooms,and 1st floor also has 6 classes, and 10 WC students' toilets, resulting to 5 toilets for each genders.

Figure 4.14: The logo of Bilind primary school along with national flag

- *Cross-ventilation*

With reference to data recorded during the field survey, the widow positions in the rooms are placed in one-side of each class. While cross-ventilation means to have two or more windows in two different walls of the room (BREEAM, 2017). This means that Bilind primary school building does not has cross-ventilation in the school. It also indicates that the classes will not be cool using natural air surrounding the school. Hence, other electric or mechanical devices or gadgets has to be provided to make the interior surrounding of the rooms cool in the school. These appliances may include electric fan, air-condition etc. which will increase the rate energy consumption of the school.

-Indoor lighting

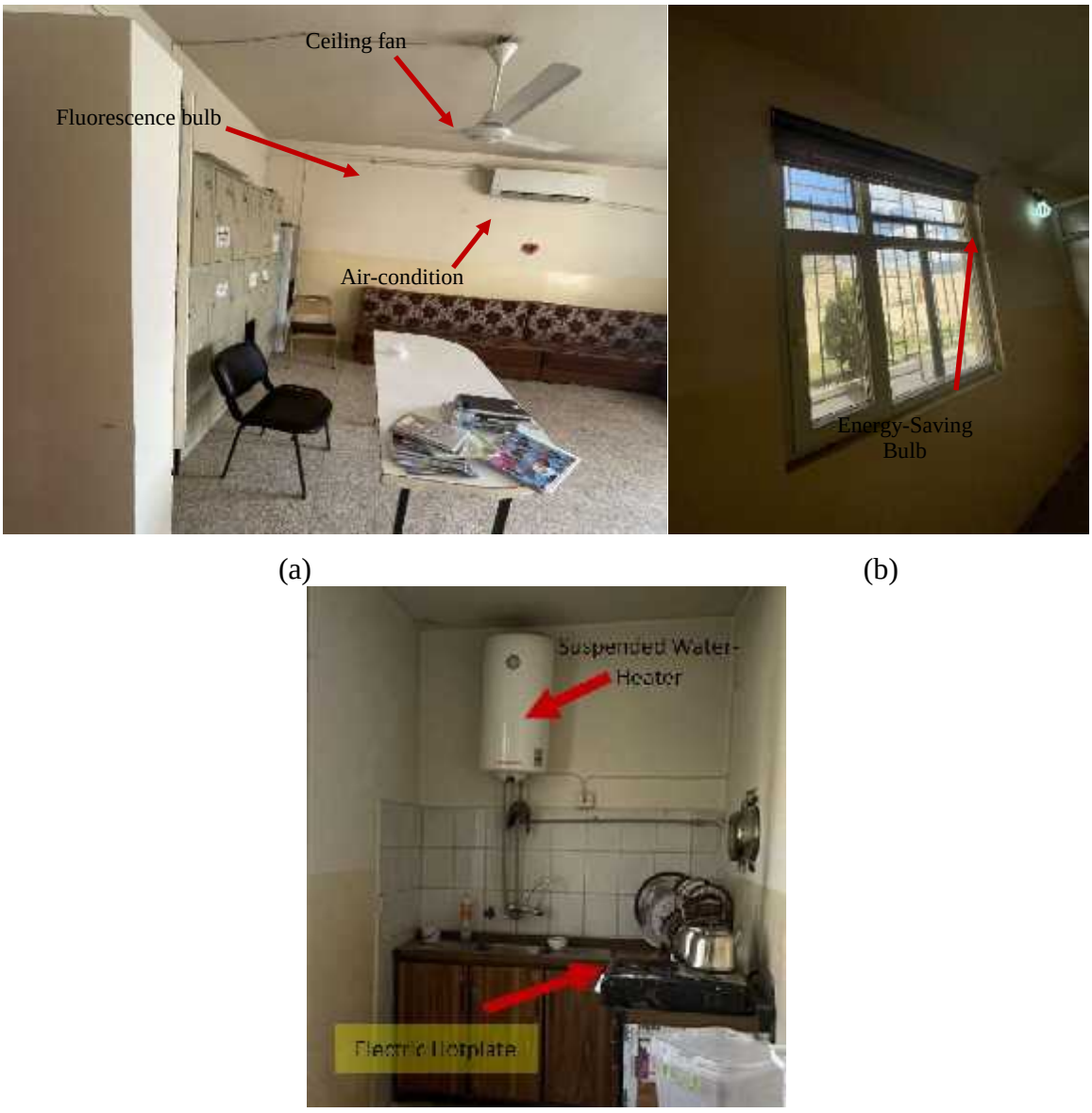
The indoor lighting will be enough if the curtain is opened, there will be no further need to turn the electric lights on. Unfortunately, the curtain of the windows was closed which makes the room dark and raise the need to use the electric lights on even during the bright-day-time. It is therefore recommended to open the curtain so as to allow outside light-rays inside the interior of the school and the electric light remains off during the day light around 7am – 7pm.

(a) (b)

Figure 4.15 Showing the light intensity of the room during the day (a) when lights are turned on, (b) when it is off.

- *School electric non-energy saving and energy saving appliances*

All the basic appliances like television, air-condition, electric bulb and fan are used in the school. Though there are other devices of high energy consumption that were in use within the school. These devices include room-heaters, refrigerator, computer,electric hotplate, electric jug for making tea and suspended electric water heater in the kitchen (Figure 4.16a-c).



(a) (b)

(c)

Figure 4.16: Showing the electric appliances in the Bilind primary school, only the bulb isenergy saving in the school

The result from the data recorded on-site it is obvious that there is lack of energy-saving devices in the school. The use of electric and heating energy-saving devices in the school will help save cost on the overall bills from the use of public electric supply. However, it will help in saving the overall energy demand of a city, also the use of fossil fuel and other energy sources that are hazardous to our planet will be reduced.

- *School garden, sun-shading and evaporative cooling system*

Bilind primary school has a small garden which is located at the front of the school. The garden comprises of lots of trees and shrubs. The shrubs lack regular irrigation with reference to the picture below, the leaves of the grass were not green but pale yellow color instead (Figure 4.17). Though some of the trees survives and did not show any form of deformation in them, but some of the trees are still leave-less and showing clear lack of regular watering.

Figure 4.17: School garden

- *Electric and water supply*

The electric supply here is connected from the main public electric supply by the government. The school has no alternative electric supply, though the electric power of the whole city is generated from fossil fuel (specifically Diesel Engine) as stated earlier in Hakar primary school electric sources (i.e. section 4.2.5). To achieve sustainability in this school it to generate electric sources from the nature around the school, like solar, wind and biogas (methane gas) from the septic tank of the building (Wirya et al., 2017).

Likewise, the water source in the school is coming from the public water boar. The main water supply sources in the province of Duhok are pumped from underground water (spring and wells) and Khapor-River; these problems supply a recurrent water resources for drinking purposes and many other daily activities (Al-Mezori & Hawrami, 2014). The public supply is portable which means it can be used in both cooking and safe for drinking. Unfortunately, the public water is not reliable as the water stops flowing for about one day and continue to flow the next day. That makes it necessary for the Bilind School to use a water reservoir for storing the water. The stored water can sustain the school for a day, which invariable was the duration the public water flow is off. The assessment regarding water supply is fair provided the water remain flowing interchangeably, though it is better if the school is independently supplying the water needed by the student and the staffs with the nature surrounding the school like well, borehole and rain harvest.

- *Waste management system*

The waste collection in the school is central waste collection. This shows there is no consideration towards sorting, re-use and recycle of the waste. The central waste collection is managed and controlled by Duhok government. This method of waste disposal is fair in comparison with the other waste disposal methods like incineration and landfill which both emits hazardous material that pollutes the air (atmosphere) and land. It is also fair considering the fact the government engage in sorting of the waste and recycle it.

-*Common school utilities*

These utilities may include toilet, kitchen and dining hall. There are more than 7 toilets in the school. Considering the school is a public space comprising of 644 studentsand 56 teachers the school provides 10 toilets; 5 for boys and 5 also for girls, while staffs has 2 toilets. This is fair looking at the number of students in the school, though, having plenty of it may attract high maintenance cost and invites high of amount water demand in the school. There is only 1 kitchen in the school, which is comprising of water-heater, hot-plate, gas cooker and a tap placed at the kitchen sink(Figure 4.16c). This kind of kitchen has less consideration of

sustainability. This is because there is high electric energy demand, burning of fossil fuel and no single window for ventilation in the kitchen. There is no existing dining hall in the school.

4.4 Nohat Primary School

This school originated in 2004 and it was built in 2016. Building form has“H” shape from the site plan, while the total plot size is 9,926m^2 and total building size is 2000m^2 having 3 floors (Figure 4.18). Ground floor is comprised of administrative offices,cafeteria for teachers, mixed with few classrooms, art workshop, student announcement room and data-show in the corridor. There are 27 total number of classrooms, when divided every floor has 9 classes per floor. There are 48 toilets in the whole school, while each floor has 16 toilets, making 8 toilets for each student genders. The first floor has a shop, computer room (with 15 computer), sports hall, and some classrooms for student. While the 2nd floor has exam-hall, book store, science laboratory and some classes. There are two shifts in which this school operates, morning shift was the first working hours that begins 8:00 am and stops 12:00 pm and the second shift begin 12:30pm and ends 4:45 pm in the evening.

There are 143 staffs in this school which is comprised of a manager, 4 associate directors, 130teachers for the two shifts, 4 typists, and 4 security personnel. Lastly, there are 1724 total number of students, which the first shift has 436 boys and 460 girlsmaking a total of 896students in morning shift and the second shift has 398 boys and 430 girls, having a total of 828 evening shift students.

Figure 4.18: Nohatelementary school façade

- *Cross-ventilation*

There is no cross-ventilation in Nohat Elementary School building, because most of the classes and office in this school has only one window in one side of the classroom wallas shown in Figure 4.19 (a).This makes the class interior environment hot, which makes it necessary to use additional ventilation electronic devices like electric fan and air-conditioner. Additional effort is required here to provide enough ventilation within the indoor environment of the school.

-*Indoor lighting*

The indoor lighting is fair within the interior of the classes, though the hallways of the buildings has less light intensity as in Figure 4.19 (b) below. This shows that an energy is required to light the hallway during bright day-light. This energy required was found to be an electric energy which powers the electric bulbs that was already placed in the ceiling. This is

against sustainable goals because it adds up to overall load of the public electric energy required to power the city during the day.

(a)

(b)

Figure 4.19: Showing the light intensity between the classrooms and the hallways in Nohatschool, Duhok.

-School electric non-energy saving and energy saving appliances

The basic electric devices that were found to be energy-saving are light bulb and plasma television (some were shown in the picture below, Figure 4.20). Other non-basic energy saving used in the school may include devices that naturally do not consume high electric energy to operate. These devices may include the LCD computer screen, surveillance cameras, and speakers among others. The devices that require high electric energy to operate in NohatElementary School includes room and water heater, air-condition, ceiling fan among the basic ones. Other devices that are non-energy-saving which are used in the school includes refrigerator, laser printers and copiers, desktop computer CPU, amplifiers among the non-basic ones. Comparing the number of energy-saving devices were not as much as the non-energy-saving devices shows that there is need to involvethe sustainable measures in the appliances used in the school so as to reduce cost on the overall bills consumed by the school monthly. This will also help the public in adequate electric energy supply provision, as the city is expanding due to city growth and urbanization problems.

Figure 4.20:Showing TV and bulb as energy-saving in Nohatschool, Duhok.

-School garden, sun-shading and evaporative cooling system

The school has small school garden by the left corner of the school site. The garden in the school is poorly managed (lack of regular irrigation) and does not contain any tall trees, neither relaxation chairs. It only possesses grass and short shrubs as decoration. This makes the garden not functional as the greeneries were not open for neither the students nor the teachers, because there is a fence to prevent people from using it. There is also one staff responsible for watering the plants in the garden who says that the water tank may spent days without water, the soil also lack fertilizer as it is not fertile as shown in Figure 4.21.

Figure 4.21: The school garden

- *Electric and water supply*

The school only depends upon public electric supply to operate, which means that there is no alternative source of electric supply. Likewise, the water source of the school is coming the general public water board of the city. Both the public electric and water sources are not reliable. The electric supply of the city suffers from unexpected electric distribution failures, while also the water supply can read up to a day without a drop of it from the public sourceas state in section 4.3.5 above. This shows that there lack of reliable sources of electric energy and water supply from renewable sources, to sustain the school and overcome such problems.

Figure 4.22: The water pump of the school

- *Waste management system*

The waste collection system of the school is the central waste collection system. However, the school does not engage in any reuse and recycle which was the main focus of this study. The image abovein Figure 4.18 shows the garbage container the school uses in collecting the waste generated from the school by the school users and kept in-front of the school gate, while awaiting the garbage truck from the government. Sustainable feature like reuse and recycle

will minimize the waste produced when considered. This makes recycle and reuse the best method of waste management to slow down the rate at which the global warming speeds.

- *Common school utilities.*

Kitchen and dining hall were also combined here in this school. This part of the school can only be used by the staffs. This shows that students have no dining hall. There is enough lighting from both the natural and artificial sources. The floor tiles will enable cleanliness and healthy environment for both cooking and eating. But the absence of chimney or exhaust fan may cause accumulation of unwanted gastrapped in the room. This may cause other health ailments like suffocation, nausea, vomiting among others. For safety the exhaust or chimney is necessary to be placed in this room.

(a) (b)

Figure 4.233: The kitchen and dining hall shares one room in the Nohatelementary school

- *Wall and roof insulation*

In this building only the roofs have insulation, while the walls were left not insulated. This is why the rooms in the school cooling and heating devices in the school. The heating gadgets used in the school is a kerosene stove, as shown in the picture below. This is sustainable as the wall insulation will help prevent exchange of temperature between inside room and the outside temperature. The kerosene stove also emits harmful gas into the rooms, especially when

windows are closed tightly it may cause serious health problems to both the students and staffs in the school.

Figure 4.24: Kerosene stove used to warm the classes and offices during winter

4.5 Summary of Findings

4.5.1 Hakarprimary school assessment

Table 4.3: Hakarprimary school assessment table

S/N	Sustainable Element	**Assessment**(Good = ✓, Fair = F, Bad/Poor = X)
1.	Cross-ventilation	X
2.	Indoor Lighting	✓
3.	School electric non-energy saving and energy saving appliances	X
4.	School garden, sun-shading and evaporative cooling system	X
5.	Electric and Water supply	X
6.	Waste management system	F
7.	Common school utilities.	X
8.	Wall and roof insulation	X

4.5.2 Bilindprimary school assessment

Table 4.4: Bilindprimary school assessment table

S/N	Sustainable Element	**Assessment**(Good = ✓, Fair = F, Bad/Poor = X)
1.	Cross-ventilation	X
2.	Indoor lighting	X
3.	School electric non-energy saving and energy saving appliances	X
4.	School garden, sun-shading and evaporative cooling system	F
5.	Electric and water supply	X
6.	Waste management system	F
7.	Common school utilities.	X
8.	Wall and roof insulation	X

4.5.3 Nohatelementary school assessment

Table 4.5: Nohatelementary school assessment table

S/N	Sustainable Element	**Assessment** (Good = ✓, Fair = F/Bad/Poor = X)
1.	Cross-ventilation	X
2.	Indoor lighting	✓
3.	School electric non-energy saving and energy saving appliances	X
4.	School garden, sun-shading and evaporative cooling system	F
5.	Electric and water supply	X
6.	Waste management system	F
7.	Common school utilities.	F
8.	Wall and roof insulation	X

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1Conclusion

Sustainability is a very huge aspect that cannot be determined by just analysing school building. It is clear that sustainability can be achieved when all the human activities and properties are in conformity with the sustainable goals. School building is one these human properties that can be shaped and transformed to be less harmful to human, animals and plants surrounding us. Being to the fact that public school are one of the basic human need nowadays, it therefore became critical to consider the activities going on in schools in an effort to make them safe, healthy, protect nature, produce minimal waste. Sustainable design is a method that can attain the needs of the people without endangering the nature in our environment and continual protection endlessness in the future (Illonoids, 2021). Design Category, Indoor air quality, Energy consumption, Construction materials, Education materials, Water use, Waste management, Transportation, Community interaction, Landscaping and building envelope.

In this research, BREEAM and LEED were the criteria used in assessing these school buildings. The criteria used in this research were 8 in number, these includes Cross-ventilation, Indoor Lighting, non-energy saving and energy saving appliances, School garden, sun-shading and evaporative cooling system, Electric and Water supply, Waste management system and Common school utilities. These 3 schools; Hakar, Bilind and Nohat primary schools were analysed based on the criteria mentioned above. The schools were found lacking sustainable measures because of the way these school buildings operate is very poor and may cause critical damage to the sustainable goals of the city.

Hakar primary school was found lacking in Cross-ventilation, energy saving appliances, School garden, sun-shading and evaporative cooling system, reliable Electric and Water supply, and standard common school utilities. While natural indoor lighting is the only option that was assessed as “good” criteria used in Hakar primary school. This shows that the school

overall assessment was unsatisfactory having a score of 1/8 (12.5%). According both BREEAM and LEED assessment criteria this is unclassified (<30, BREEAM) and unsatisfied (<40 LEED).

Bilind Primary School also was assessed using the same criteria used in assessing Hakar Primary School, which was also found lacking having a score of 0/8 (0%). This is highly unsatisfactory as well, which indicates that even Hakar Primary is closer to sustainability when compared with Bilind School.

Lastly, Nohat Primary also have similar score with Hakar Primary (i.e. 1/8) resulting to 12.5%. This is also below expectation of sustainable goals, because it has not reached the minimal percentage found in both BREEAM and LEED criteria.

It is therefore concluded that the primary schools around Duhok were not sustainable and more efforts are required to uplift these school to achieve these goals. As the electric sources of the school was generated from combustion engines, and the school also suffers electric supply outage (On/Off) which leads to unstable electric flow in the schools. Similar thing with water supply also is not reliable, and there is less utilization of natural resources in the schools. Natural ligh intensity is low within most of the offices and classes around the school which adds load to the electric power supply to provide light within the interiors. Likewise, cross-ventilation, wall and roof insulation is absent in the schools examined. The Duhok government, Duhok education ministry and other related bodies should join efforts here to provide sustainable measures around the schools in Duhok.

5.2Recommendations

Sustainability can be achieved through various implementation of green approaches. These green approaches may include renewable energy to sustain the electric supply of the schools. Energies like solar, wind, hydro and biodiesel can be used to generate the electric supply to the schools around Duhok city. This will make the school provides independent electric supply that is safe from any environmental harm.

Water supply to the school is also unreliable, this can be solved through the provision of borehole water, well and rain harvest were the major natural water supply that would help resolve the unreliability of water supply from the public source. Though, well and borehole water may result in hard water supply; proper clinical method through filtration and chlorine dis-infecting may convert the hard water to soft water and safe for drinking. Na_2CO_3 (also known as Sodium carbonate, or washing soda) can purify and soften water that has both temporary and permanent hardness. The calcium ions (Ca^-) that is found in the hard water and the carbonate ions found in the washing soda (Bitesize, 2021). Na_2CO_3 is a water soluble and enhances the quantity of carbonate ions into the water, which reacts with it and dissolve the calcium ions to form a calcium carbonate precipitate.

Cross-Ventilation is highly recommended here because it will help aimlessly in the provision of healthy cool indoor environment. This can be achieved through changing the structure of the class; instead of having the windows on one side of the room, it will be two windows on any two sides of the classrooms and offices around the school. Likewise, indoor lighting could be enhanced if the windows were from two different directions. Also, wall and roof insulation will provide cool environment and prevent exchange of heat or cool with the external environment. Garden and sun shading provision makes the environment cool also, therefore, it should be encouraged to plant more trees, plants and introduce sun-shading to the building, to prevent excessive sun heating the building.

Energy-saving devices used instead of high energy consumption devices, this will help in saving about 50% of the total energy consumption of the schools. This energy saving devices may include white LED bulbs, Fluorescence, energy-saving fan and air-conditioners/refrigerators, solar heaters and LED televisions among many others. While, avoiding the use of heaters both water heater and electric hot-plate and many other non-energy saving devices.

In waste management system here it is highly recommended to encourage reuse and recycle in an effort to minimize waste produce by the schools. This is done through sorting of the waste materials (i.e. metals, plastic and wood or plants remnant) separated from each other before

finally disposing it off. Incineration and landfill should be discouraged as they both are not good sustainable disposal method.

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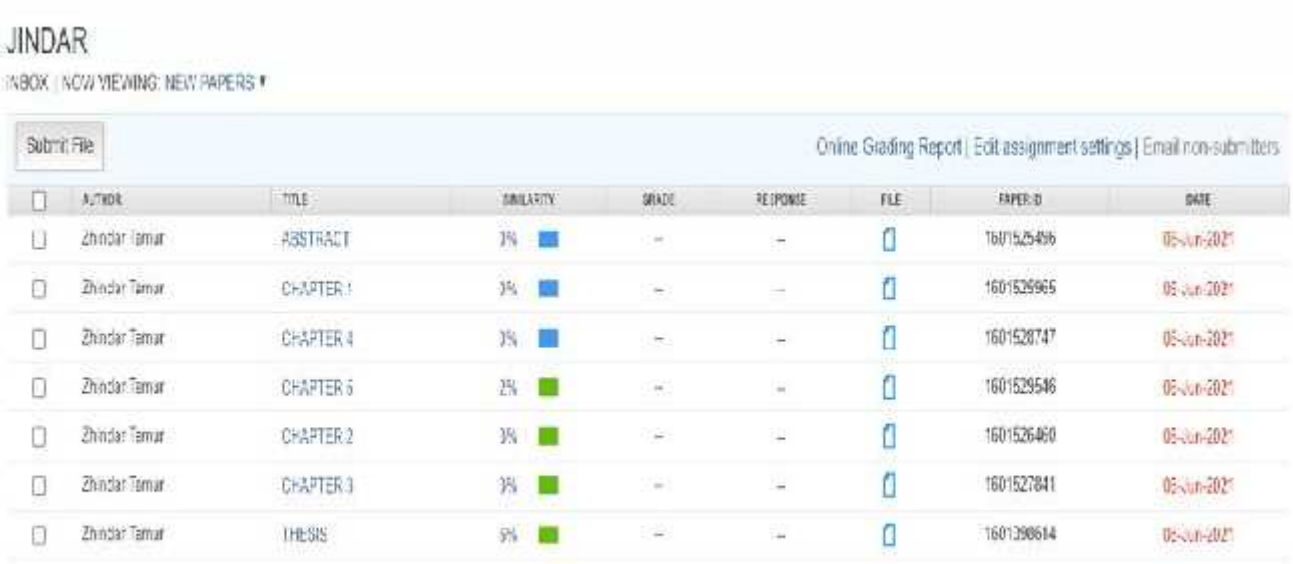
APPENDICES

Appendix 1: Turnitin Report



Appendix 2: Ethical Approval Document

Date: 13/02/2021

To the **Graduate School of Applied Sciences**

The thesis titled “The Effect of Incorporating Features of Sustainable Architecture in Primary Schools in Duhok, Northern Iraq’’ has been evaluated. Since the researcher will not collect primary data from humans, animals, plants or earth, this project does not need to go through the ethics committee.

Name Surname: Assist. Prof.Dr.ÇiğdemÇağnan

Signature: 

Role in the Thesis: Supervisor