Academic Journal of Nawroz University (AJNU), Vol.12, No.4, 2023

https://doi.org/10.25007/ajnu.v12n4a1652

Evaluation of Construction Materials and Environmental Situation Management in School Buildings Throughout a Half-Century (1970 to 2021) in Erbil City

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ABSTRACT: This study conducted on the selected five school buildings to evaluate the Environmental impact and sustainability. School sector is one of the buildings that impacted by several factors such as; Globalization, climate change, technology. Consequently, this research investigated construction materials, environmental conditions and management of the five selected schools that established during 1970 to 2021 in Erbil City, Kurdistan Region, Iraq. Five schools were selected due to using their different construction materials and environmental circumstances during the construction. Quantitative and qualitative data collection were obtained through site visits to the allocated schools. Results revealed that new materials for construction and finishing were used in the schools. Normally, green areas and sports yards in the schools were satisfactory. Window-to-floor ratio (WFR) figures for the chosen schools ranged between 14.9 % and 46.6 %. Accordingly, lighting and ventilation in the classrooms and sanitation were fulfilled. Noise pollution was observed due to the locations of the schools and the kind of materials. Solid waste gathering and cleaning of the schools were sound achieved. A firefighting system was not available in the selected schools. At the end of the study, it is concluded the summarized evaluation of school sustainability based on age and materials used for construction, the environment that provides for the students, and the classroom conditions as well. The findings will contribute to sustainability based on the knowledge and future direction of this research. The study will be the basic plan for development and keep sustainability of the building for future researchers on this subject, which is the goal of this study.

Keywords: Environment, Erbil, Material, School building, Sustainability, Management.

1. Introduction

Nowadays, the need for school building development is increased due to their age and evolving teaching and learning. The population and infrastructure of Erbil City have developed tremendously over the last two decades. The population rises by 2.9% annually (Dizayee, 2014). Erbil is an old city that has experienced rapid increasing and notable growth over different stages and periods following the establishment of Iraq in 1920. Especially after 2003 when the city enjoyed more stability in comparison with the other cities in Iraq. Thus autonomous management of resources and economic and revenue prosperity enabled the area to recent growth in its recovery and development (Al-Shwani, 2011).

Erbil Ula was the first school established in Erbil in 1930 on the castle which is now a museum. With the growing population and cultural level, opening the city to new technology in every field and development, especially in construction sectors was observed, resulting in a rising number of schools with a modern system.

The construction industry is one of the largest users of energy, material resources, and water which is a formidable polluter (Horvath, 2004), it is also consumed approximately 50% of all global resources, representing six billion tons of industrial raw materials each year (Augenbroe et al., 1998; Edwards and Hyeyy, 2005). The term "sustainable development" came into use in the 20th century (Gayevskaya and Rakova, 2014). Environmental building performance assessment is one of the major issues in sustainable construction (Cole, 1998; Cooper, 1999; Holmes & Hudson, 2000), at a stage even before a design is conceptualized (Ding, 2008).

Selecting sustainable building materials and products can improve environmental performance, one of the ways of providing a sustainable approach to the construction industry is using waste materials (Mora, 2007). Materials provide a high potential for energy demand reduction and provide comfortable

thermal conditions (Jaffal, Mohammed et al. 2018). Using renewable or recycled/reusable materials is one of the alternatives to reduce the use of mineral resources and conservation of the life support function of the environment, pertinent selection of materials, and prediction of service life (Sjöström, 2001). Bakhoum et al. (2015) stated that in the construction industry, the selection of sustainable construction materials during the design phase leads to a move towards more sustainable construction. Modern construction materials must provide durable exploitation of energy-efficient objects (Gayevskaya and Rakova, 2014). The greater the material's durability, the lower the time and resources required to maintain it (de Silva et al., 2004; Caffi and Rejna, 2000). There is plenty of scientific literature on the life cycle, durability, and sustainability associated with building materials (Mora, 2007).

In addition to the environmental aspect, sustainable building includes economic and social aspects (Haapio and Viitaniemi, 2008). Environmental sustainability is now viewed as a tactical strategy that serves as an obstacle to excessive use of natural resources, energy use, pollutant emissions, and waste production (Rabbat, Awad et al. 2022). Management and organization are key aspects of sustainable construction, the subject does not engage only technical issues but also includes, economic (Mora, 2007), social, legal, and political matters (Sjöström, 2001). To provide a sustainable building, consideration of some aspects has been proposed by a number of scholars such as; energy efficiency and functional flexibility, with a focus on a range of tasks that integrates living, retail, working, and leisure spaces into a single structure (Baiz and Hoskara, 2021).

The school environment is one of the biggest concerns for sustainable development, and also environmentally one of the reasons for producing CO2 emissions. Therefore, sustainable development of the school building is required for future studies. Sustainability assessment should be based on (Environment, Social, and Economy).

In order to achieve sustainability of the design structures, good design choices at the beginning of construction projects are crucial (Haruna, Shafiq et al. 2021). Civil engineers are encouraged to ensure the maximum lifespan of the projects for their intended use and employ the least amount of natural resources such as (raw materials and energy required for their production) with the agreement of the client, economic, social demands, and code requirements (Baiz and Hoskara, 2021).

In the past two decades, the sudden expansion of Erbil's construction sectors has been a primary driver of economic growth, particularly in the areas of housing and building development. However, this expansion has also resulted in a host of other social, economic, and environmental problems which threaten the long-term sustainability of Erbil City.

In order to address sustainability in construction, it is necessary to take into account three main factors at once: the environment, the economy, and society, as well as the specifications for the technical and functional performance of building work (Le, Park et al. 2021). There are many different points between old and new school buildings, in terms of sustainability, environmental efficiency, and management. This subject is of vital importance in Erbil Province and investigates the top development points during the construction of school buildings from the past to now.

Population, materials, technologies, teaching methods, school environment, administration, curriculum, etc. changed during the past five decades. Therefore, studying the parameters is essential. Consequently, this research aimed to investigate construction materials and environmental condition management of the schools in Erbil City, Kurdistan Region, Iraq from 1970 to 2021. To date, this type of study has not been carried out in this area. Therefore, this investigation is a very important step to consider and be aware of the significance of sustainability in school buildings in the city.

The main important issues that can be determined as weakness and limitation of the study is the cost and financial problems in each of the schools. Most of the directorates provide the fund for the schools based on charity and assistance of the people. However, the authorities must be improving each school annually based on the building requirements. For instance, some of the schools need a library for the students, some of the other need garden, and else need a yard for playing sports games such as football. On the other hand, most of the old school buildings did not construct with environmental materials as it is available today in most of the construction building. Also, it should be mentioned that good quality building construction requires high costs and the best environmental materials. Thus, in order to create an develop the building of school buildings friendly to the environment it should provide a good budget to keep the sustainable.

2. Material and Method

A. Study Area:

Erbil is the capital of the Kurdistan Region, Iraq. It is located 453 m above sea level with latitudes 36.2 North and 44.02 longitudes Eastern Time zone. Five schools were selected for carrying out this research. The nominated schools were Kurdistan High School, Arkhawan Basic School, Mamoun Aldabagh High School, Gashbin Basic School, and Mateen Basic School, Figure 2. The locations of the chosen schools are shown in Figure 1. The selection of the schools was based on the construction years. Due to economic and political situations in the area after 2014, commonly construction of new school buildings in the Erbil City center was not available; That is the way the study period of this research was focused from 1970 to 2012.

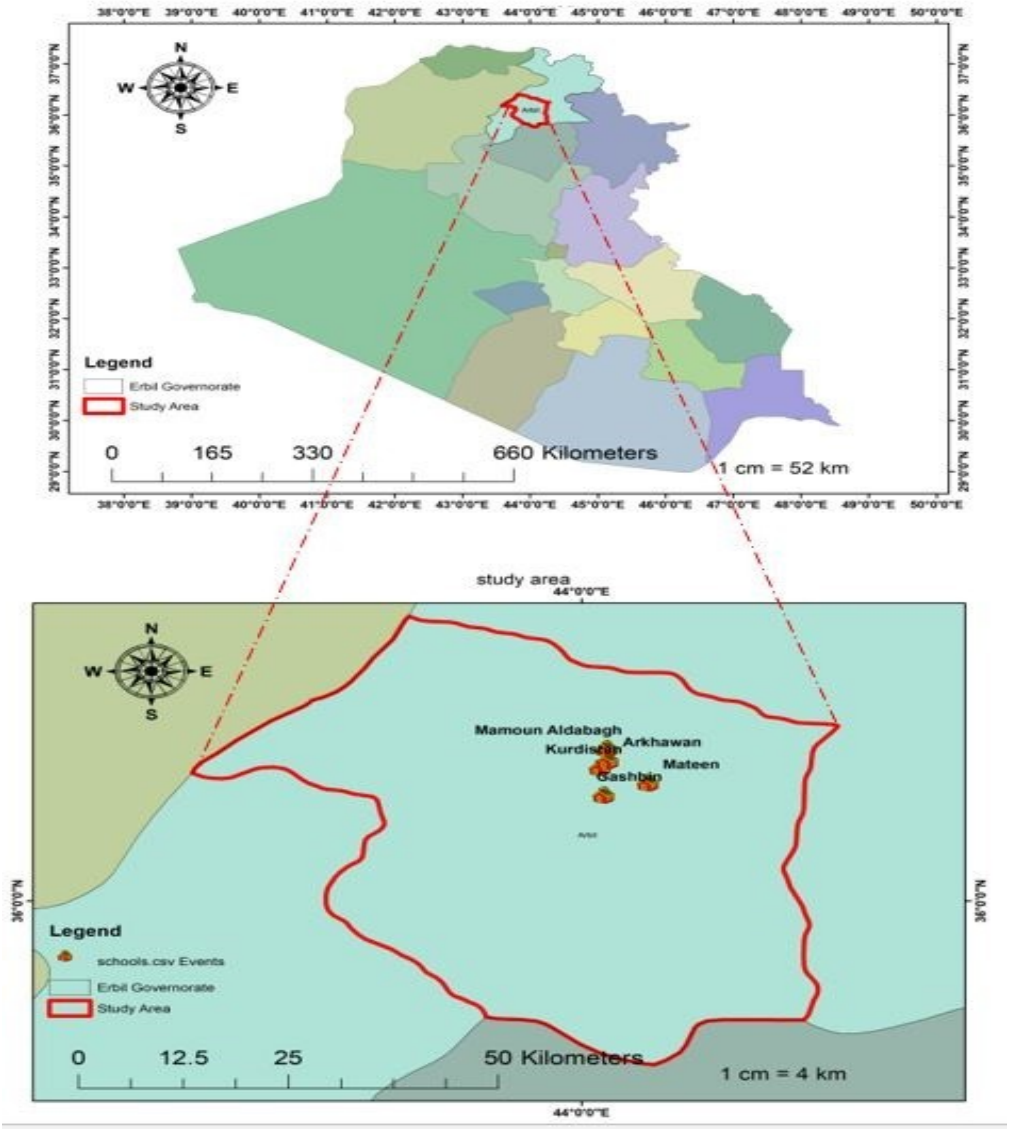

Figure 1: Five selected schools for sustainability assessment in Erbil city

Figure 2: Five Selected schools: a) Kurdistan, b) Arkhawan, c) Gashbin, d)Mamoun Aldabagh, and e) Mateen.

B. Data Collection:

Data were collected in five chosen schools. Site visits to the General Directorate of Education and schools were carried out on 22 September 2021, 30 September 2021, 13 October 2021, 20 October 2021, and 27 October 2021. Both quantitative and qualitative methods were applied during data collection. Quantitate data were related to the type of materials, the total area of the schools, green area, play yards, dimensions of the classrooms, sanitation works, and temperature. While, qualitative information was linked with engineers from the General Directorate of Education in Erbil City, principals, and teachers in the schools.

3. Results and Discussions

A. Information on the schools:

Citation Through site visiting, general information about the selected schools was collected as shown in Table 1, such as; the type and construction years of the schools, availability of classrooms and student numbers, also student services like; scientific laboratory, cafeteria, and firefighting system.

Table 1: Details about the selected schools

No.	Name	Type	Year of construction	E and (N) Values	No. of student	No. of classrooms	No. of students per class	Lab	Cafeteria	Fire fighting system
1	Kurdistan	High school	1970	44.019500° (36.189973°)	1453 (900 one shaft)	14	2 shafts	Yes	Yes	No
2	Arkhawan	Basic school	1980-1981	44.027950° (36.200094°)	445	12	37	No	Yes	No
3	Mamoun Aldabagh	High school	1999-2000	44.026860° (36.217115°)	460	18	26	Yes	Yes	No
4	Gashbin	Basic school	2002	44.023463° (36.15115°)	233	12	20	No	Yes	No
5	Mateen	Basic school	2012	44.070780° (36.168493°)	1425	24	2 shafts	Yes	Yes	No

B. Construction Materials:

Information about materials are given in Table 2. Walls, fences, interior finishing such as floor, wall, and ceiling, exterior finishing, yards and garages, doors, and windows were studied during site visits to the schools.

Table 2: Information about construction materials

No.	School name	Wall	Fence	Interior finishing			Exterior finishing	Yards and garages	Doors	Windows
				Floor	Wall	Ceiling	Wall			
1	Kurdistan	Stone	Stonewall	Mosaic tile	Gypsum plaster	Cement plastering	Stone	Concrete	Steel	Steel
2	Arkhawan	Stone	Wall	Tile/ Shtaiger	Gypsum plaster	Cement plastering	Cement plaster	Concrete	Steel	Steel
3	Mamoun Aldabagh	Cement plastering	Cement plaster	Concrete	Gypsum plaster	Cement plastering	Cement plaster	Concrete and tile	Wood	Steel
4	Gashbin	Stone	Concrete block	Mosaic	Gypsum plaster	Cement plastering	Gypsum plaster+ rendering	Concrete	Wood	Steel
5	Mateen	Cement plastering	Cement plaster	Concrete and tile	Gypsum plaster	False ceiling	Cement plaster and granite	Concrete	Wood	Aluminum

1. Walls and Fencing:

Since the walls carry structural loads, it is required to consider strong materials. Stone and concrete blocks are the most common and strong types of materials used in school walls. It can be seen that stone was used for bearing walls in the schools up to 2000. Later, the stone was replaced by concrete blocks. Of course, construction using concrete blocks is faster and more economical. But, the durability, and isolation of stone walls are superior to concrete blocks. School perimeter fencing has a great role in providing school security and safety. Factors such as location, local environment, and crime rate are considered during choosing the type of fencing. Despite security and safety, aesthetics is also a significant point. The main functions of fencing around schools are to keep students safe inside and stop unwanted visitors. Generally, fencing schools should have an open design in order to provide visibility beyond the perimeter to allow staff to keep an eye on any potential risks outside. In Erbil city, the fence of schools such as Mamoun Aldabagh, Mateen and Gashbin have been created by block walls with some openings of steel. Kurdistan and Arkhawan schools have only continuous block walls in their fencing without any openings, Figure 3. Concrete blocks (with or without openings) are used in the construction of fences in the new buildings. Aziz (2009) studied noise pollution for 30 m Ring Road in front of Kurdistan High school at different times, he concluded that using walls without openings as fences led to a decrease in noise pollution

Figure 3: Type of fencing: a) Kurdistan, b)Arkhawan, c) Mamoun Aldabagh, d) Gashbin, and e) Ma-teen schools.

2. Finishing:

Since Number Plastering is one of the most common and ancient finishing techniques in schools in Erbil City. It is applied to give a visually pleasing smooth surface to the walls and ceilings. It doesn't only enhance beauty, but also acts as a protective cover that protects them from rain and wind; it enhances isolation as well. Cement

plaster is a building-facing material consisting of Portland cement and sand, mixed with water to form a workable mixture. It can be applied to ceilings and walls either interior or exterior. All schools except Mateen school plastered their ceilings with cement while another modern way was used at Mateen which was the false ceiling. Plastering with cement was also applied for exterior walls in Arkhawan, Mamoun Aldabagh, and Mateen schools, but stones were used in the oldest one which was Kurdistan, Figure 4.

Gypsum is a white powder, mixed with water, it sets and hardens. Gypsum plaster is in use in the construction field for centuries due to its excellent properties. It was used by the ancient Egyptians to plaster the pyramids. Gypsum plaster is used only in interiors either for ceilings or walls. It was used on the interior walls of all the schools.

Plaster has proved to be a durable covering in all climates and has great appeal as a surface finish because of its utility, low first cost, and need for minimal maintenance. However, like all building materials, plaster deteriorates with age and exposure to the elements. Repairing of plaster is needed from time to time as the building ages.

Among types of tiles for interior floors, mosaic tiles were used for all the schools except Arkhawan school, in which shtaiger was observed, Figure 5.

Figure 4: Kurdistan school: The wall is finished with stone

A)

B)

Figure 5: A) Arkhawan and B) Mateen school: Different tiles were used.

3. Yards and Garages (floors):

Garages and yards are slabs that take heavy loads such as; cars, and students. Those slabs should have been carefully planned and installed providing a crack-free performance for years in any climate, even under the toughest conditions. For schools, concrete is one of the best materials that can provide a durable floor. Fortunately, the concrete slab was observed in all the selected schools, Figure 6. Commonly, comfortable football yards were absent in the schools. On the other hand, basketball and volleyball yards were available on the concrete yards. In the Mateen school, a small tartan yard was available in the school.

Figure 6: Mateen school: The yard is made of concrete.

4. Doors and Windows:

Doors and windows are necessary features in any building. They perform functions in structures, such as providing light, ventilation, and expanding visibility. Among various types of materials for doors and windows, steel is one of the strongest and most durable types, which is very secure. It was used for windows in all schools except Mateen school. The doors of Kurdistan and Arkhawan schools were also made of steel. The main problem that those schools were facing was the uncomfortable sound of steel doors led to creating a noisy environment. The wooden door is a modern alternative to steel doors which were used in Mamoun Aldabagh, Gashbin, and Mateen schools.

C. Environmental Condition Management:

Table 3 shows the environmental circumstances in the selected schools. Environmental issues such as lighting, water tank, toilets, waste collection, isolation, noise, etc. were studied.

Table 3: Environmental conditions in the schools

School name	**Total Budling Area**	**Water tank**	**No. of WC**	**No. of Students per WC**	**WFR* (%)**	**Isolation**		**Sport yard (m2)**	**Solid waste**	**Noise/ Location of school**
						Interior temperature	Exterior temperature		collection per day	
Kurdistan	1250	10 Nos. (1000 L)	12	75	46.6%	26.3˚C	25.4˚C	No		On 60 m street
Arkhawan	1218	11Nos. (1400 L)	14	32	14.9%	26.6˚C	27.8˚C	No	8 Nos. (60 L) plus 4 Nos. (0.7m^3)	Inside sq.
Mamoun Aldabagh	2982	18 Nos.	6	77	23.9%	23.9˚C	23.7˚C	Yes	4 Nos. (60 L)	On 40 m street

		(1000 L)								
Gashbin	3471	10 Nos. (1000 L)	5	47	16.2%	23.9˚C	21.5˚C	No	5 Nos. (60 L), 5 Nos. (120 L), and 15 Nos. (30 L)	Inside sq.
Mateen	5703.5	3 Nos. (1000 L) plus 1No. (2500 L)	40	24	26.3%	28.1˚C	27˚C	Yes	3 Nos. (120 L) and 2 Nos. (60 L)	Inside sq.

* WFR: Window to Floor Ratio

1. Lighting:

Lighting is one of the most important factors that plays its role in creating interior environmental conditions. During the construction of school buildings, the size of the windows should be critically considered because the window size will have a great role to increase lighting due to natural sunlight during day time. When coming up with the measurements, it must measure the amount of glass and the size of the floor, then determine the ratio between them. This is called the Window Floor Ratio (WFR), and it applies to most standard window installations in extensions. The WFR for each school is illustrated in Table 3. Kurdistan school has the highest ratio which is nearly about 46.6% while the Mamoun Al-da Bagh school has the lowest rate of WFR of 14.9%. as well, the Gashbin school has a low rate of WFR which is nearly about 16.2%. The Arkhawan school and Mateen school have the WFR of 23.9% and 26.3% respectively. The results clearly show that the Kurdistan school even was constructed before all other schools but it has the highest rate of WFR and Mateen school which is the most modern school compared to other schools is located in the second top-ranked of highest WFR. During data collection, the authors found that all classes were bright and comfortable. Normal light is preferable and led to consuming minimum energy and electricity.

2. Isolation:

Another feature of school building is the temperature of the classrooms, which is important to investigate. In this investigation, the interior and exterior temperatures of the classrooms were highlighted and measured. In most schools, the interior temperature of the classrooms is more than the classroom's exterior temperature except for the Arkhawan school, where the temperature of the interior classrooms is lower than the exterior temperature of the classrooms, as shown in Table 3. The separate aspects of Arkawan School from other schools include the lowest WFR and its walls are made of stone, so it is thought that the low rate of windows and the construction of walls in stone are the reason that the temperature of the inside classrooms in this school is lower than the temperature outside the classrooms.

On the other hand, the highest temperature difference between interior and exterior classrooms is seen in the Gashbin school, where the temperature in the interior classroom is 2.4˚C higher than outside the classrooms. It can be concluded that despite having a low rate of WFR but the use of concrete blocks in constructing walls in Gashbin School leads to the temperature in interior classrooms being higher than on the exterior side. The site visits were carried out during the fall season and in this season in Erbil City, the climate is felt a little bit cold. The room temperatures were comfortable without using any heating devices. Stone and concrete block walls with interior and exterior finishing cause good isolation.

3. Sanitation:

All schools should have sustainable sanitation facilities, especially toilets and handwashing facilities because pupils, teachers, and support staff spend a significant part of their day in schools. Based on the data that was collected during visiting the schools after dividing the total number of students per school by the number of toilets, the number of pupils per toilet was calculated as well, and the number of tanks for each school was determined as shown in Table 3. Mateen school has the highest number of toilets, where toilets available were limited (14) since the school's student numbers equal 950 pupils and the rate will be 1 toilet per 24 students. The Kurdistan School and Mamoun Aldabagh School have the lowest number of toilets per student compared

to other schools, Kurdistan school has 12 toilets and the rate will be 1 toilet per 75 students. As well as Mamoun Aldabagh has 6 toilets and the rate will be 1 toilet per 77 students. Regarding water supply, water tanks are used for storing water, and in all schools, there were more than 10 tanks of different sizes. Kurdistan and Gashbin have 10 tanks, each tank can store 1000 liters while Arckhawn School has 11 tanks, and each one can store 1400 liters. The Mateen and Mamoun Aldabagh schools have the highest capacity for storing water, Mateen has three tanks each one can store 1000 liters, with one big tank that can store 25000 liters. As well as Mamoun Aldabagh School has 18 tanks, and each tank can store 1000 liters. Water supply situations for the schools were acceptable; While an increasing number of toilets and continuous cleaning are suggested for the current and newly built schools.

4. Ventilation and Air Conditioning:

During the site visit, researchers found that ventilations in the classrooms were accepted and nasty odors were not felt. Good ventilation reflects the natural good lighting system. As mentioned previously, the WFR ratio was acceptable. On the other hand, kerosene heaters and split systems are applied to the heating system. While cooling systems, fans, air coolers, and split systems were used in the schools. Good isolation results in decreasing energy-consuming during hot and cold seasons. Additionally, inside classrooms and administration staff rooms smell from toiles, cafeteria, and waste degradation was not observed.

5. Waste Management:

Since Daily solid waste collection and transportation are essential because the remaining biodegradable waste results in producing leachate, a nasty smell, a bad view, and the propagation of diseases. Solid waste comprises plastic and glass bottles, papers, garden and yard trimmings, food waste, and room cleanings. Wastes are mixed without separation. All selected schools have plastic waste containers of different sizes, Table 3. Commonly, the schools were clean, and solid waste collections are adequate. Private sector companies by agreement with the Municipality of Erbil City collect the waste regularly.

6. Green Area:

Gardens in school have direct and indirect impacts on learning on academic performance, so this study tried to investigate the availability of greenery according to students and classrooms. After collecting information about schools, the green area rate per student and classroom was determined and shown in Table 4. According to the results, the Mamoun Dabagh school has the highest rate of green area per student at 2.85 m^2/Student and has the highest rate of greenery per class which is 72.94 m^2/Class. The Mamoun Dabagh greenery is shown in Figure 7. Mateen school and Kurdistan school have the lowest rate of green area per student which is 0.52 m^2/Student and 0.50 m^2/Student. The Kurdistan school green area is shown in Figure 8. The results show that although Mateen school is constructed after other schools but has the lowest rate of green area per classroom which is equal to 13.71 m^2/Classroom. Figure 9 and Figure 10 show the greenery of Arkhawan School and Gashbin School.

able 4: Schools Green Area Status

School name	Green area (m^2)	No. of Classroom	No. of Student	Green area per classroom m^2/ Classroom	Green area per student m^2/ Student
Kurdistan	453.12	14	900	32.37	0.50
Arkhawan	316.25	12	445	26.35	0.71
Mamoun Aldabagh	1313	18	460	72.94	2.85
Gashbin	338	12	233	28.17	1.45
Mateen	493.4	36	950	13.71	0.52

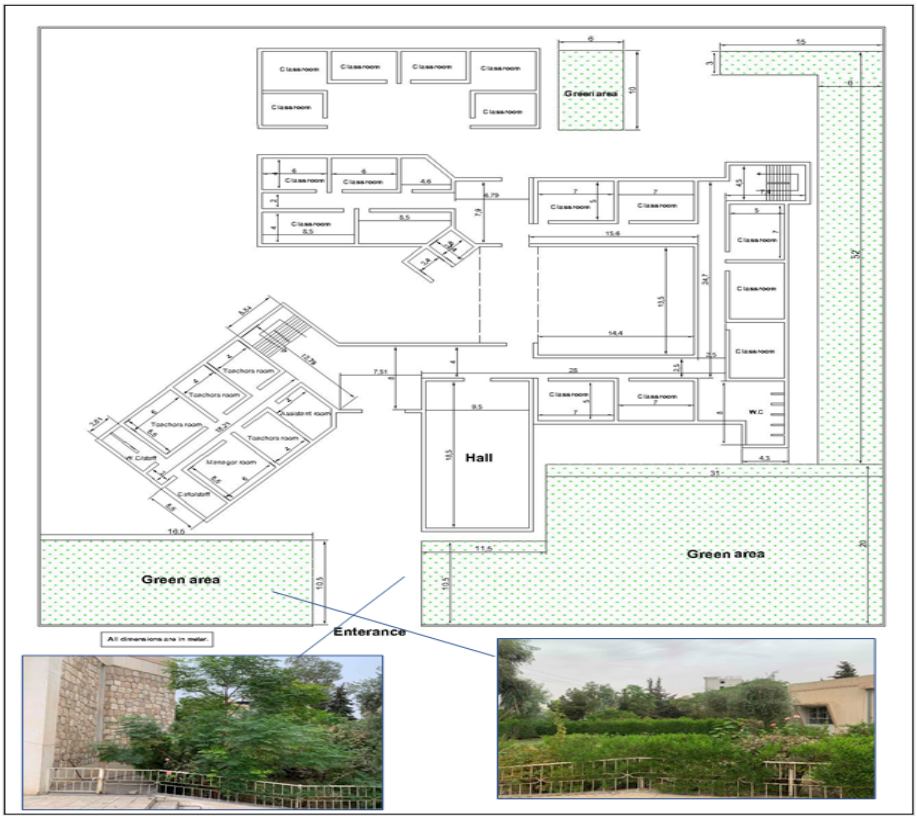

Figure 7: Mamoun Aldabagh school.

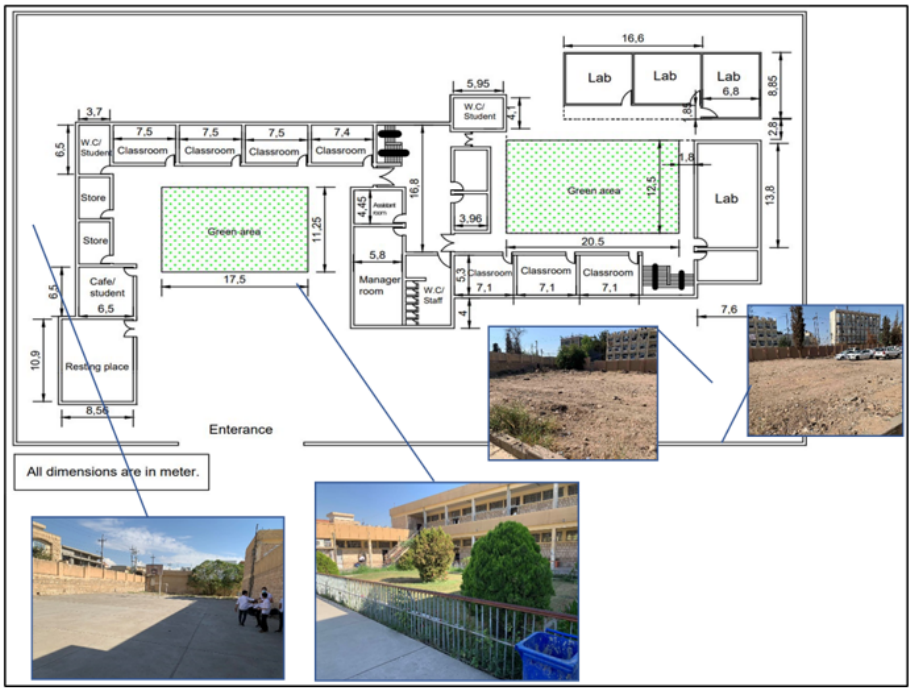

Figure 8: Kurdistan school.

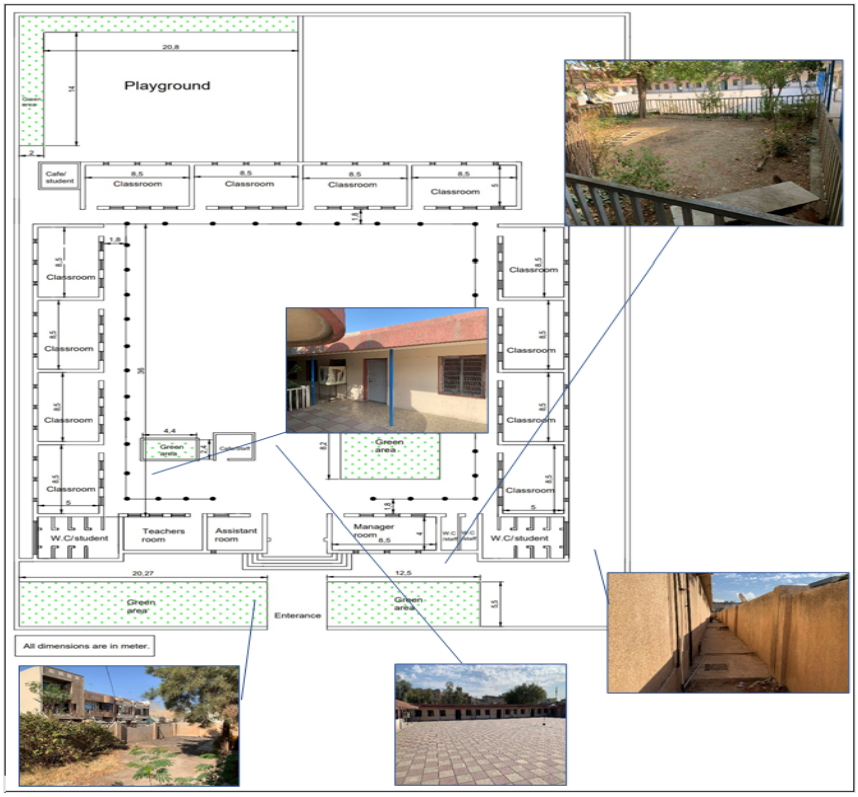

Figure 9: Arkhawan school.

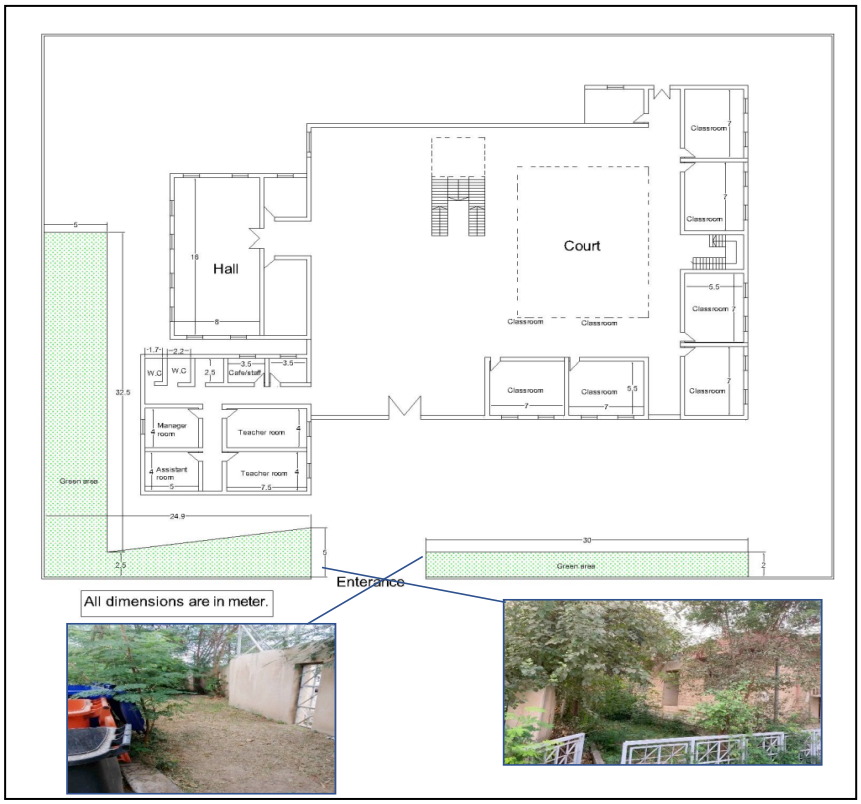

Figure 10: Gashbin school.

D. Problems in the Schools and Potential solutions:

Some structural and technical problems were observed during visiting the schools, Table 5. The major problem in Kurdistan schools was a high number of students which cause to lack of furniture, materials, and resting places for students providing a noisy and crowded environment. The same noisy environment was observed in Arkhawan School, due to the excess number of students in a small area and the location of the school inside the square. In addition, some cracks were seen in the walls and beams. In Mamoun Aldabagh School, the main problem was heating and cooling in classrooms which is relevant to the design assessment. Gashbin school had a problem with settlement in some parts of the building and in water pipes which cause to appear cracks in the walls, Figure 11. The newest one which was studied among those selected schools was Mateen School. It had only one problem with falling off the stones in the building's face. In terms of green areas, almost all of the schools had suitable areas for gardening but they suffered from adequate servicing, resulting in a lack of comfortable resting places for students and providing a non-attractive view, Figure 12. Furthermore, humidity areas appear in some cases. Arkhawan school didn't have sufficient garages for car parking and it is so close to houses. Kurdistan and Mamoun Aldabagh schools are located on 30 m Ring Road and Gulan Street which results in producing traffic noise.

Figure 11: Gashbin school: Cracks due to settlement of the building.

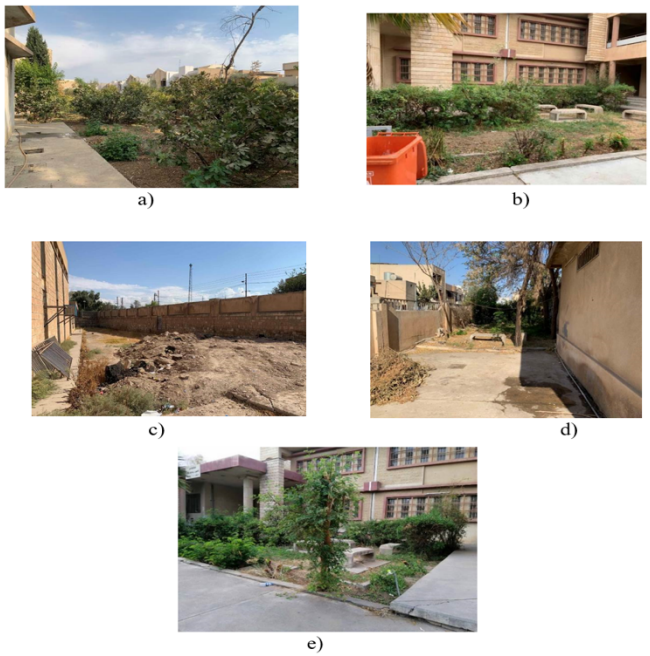

Figure 12: Gashbin school: Unordinary green areas: a) Mamoun Aldabagh, b) Mateen school, c) Kurdistan, d) Arkhawan, and e) Gashbin school.

Table 5: Schools Green Area Status

No.	School name	Major problems	Recommend solutions
1	Kurdistan	1. Lack of No. of student desks. 2. High No. of students per class. 3. Lack of student services such as; playground, garden, cafeteria, and resting place. 4. The noisy environment is due to the sound of doors (they are made from steel). 5. Lack of drink and wash water. 6. Low sound problem in the halls due to the very height of slabs. 7. Lack of lab and library	It is recommended to build a green area and sustainable building especially the classroom and the play yard for students and football. The school building is in a noisy location it is better to be in other places, it is highly recommended to put a budget for school management and requirement.
2	Arkhawan	1. Appear cracks in the walls and beams. 2. The noisy environment is due to the school location.	The settlement of the building required to be improved to avoid school failure in the future. The school needs a larger yard and green area, it is highly recommended to put a budget for school management and requirement.
3	Mamoun Aldabagh	Heat and cool problems due to the height of slabs.	The school required a more sustainable environment, so it is highly recommended to put a budget for school management and requirement.
4	Gashbin	1. Settlement and appearing cracks in the water pipes. 2. Settlement in some parts of the walls. 3. Lack of scientific laboratories. 4. Unordinary gardens.	The settlement of the building required to be improved to avoid school failure in the future. The school required a larger yard and green area, also the tap water should be repaired due to leakage which is the main reason for building settlements and cracks, it is highly recommended to put a budget for school management and requirement.
5	Mateen	Falling off the stones on the exterior face of the building	The school is generally good in performance and sustainable, it is highly recommended to put a budget for school management and requirement.

E. Sustainability:

It also provides a successful school project to collect system, which can be adopted in developing a sustainable strategy for school buildings, then the study proposes the optimal solution to get better and more sustainable results (Le et al., 2018).

On the other hand, the assessment involved the quantitative and qualitative expected, and the physical condition involves the optimal use of enough space and classroom, however, the comfort in the indoor environment such as heating, noise, visual, and energy consumption, and also the building's economic consideration in order to reduce maintenance cost or sustainable development. As well, the efforts to encourage economic development have emphasized the improvements in the educational building system and Several factors complicate efforts to affect these improvements (Alderman et al., 2003)

Based on the site visit to the schools that have been selected, it is important to describe the new building schools as more sustainable than the old schools, depending on the construction of the building and the equipment facilities for instance; doors, windows, walls, ceiling, and floor materials. On the other hand, the play yard and the green area were observed in the new schools. In general, most of the buildings constructed inside the streets and places within houses, are less sustainable, because of noise and absence of the car parking for the teachers and academic staff as well. Despite this, in some of the schools, cracks, and settlements have been observed. The managing system was different based on the serviced staff. The main problems are from the availability of water for students and also from the smaller number of toilets depending on the number of exiting students for each school. At the end of this study, it can say that all

the schools are required to be more sustainable in each building construction especially, green areas, play yards, number of classrooms, car parking, water sanitary system, waste management, cleaning, lab for computer science, a library for students' free time, heating system, cooling system, water supply, and lightning.

According to the existing situation of the selected school building environment and construction materials, management policy sustainability is evaluated. In addition, the older school required the repair of some of the parts of the school and also the creation of a play yard an increase in the green area with trees, and also provide a clean environment with pure and more sustainable classrooms for the students. Despite this, the schools need a quieter area with a good performance this may lead to the cost repairing of the building to use sustainable techniques and provide a better climate for the future, Table 6.

Table 6: Summarized the evaluation of the sustainability development

No.	School name	Environment	Society	Economy
1	Kurdistan	No.	Yes	No.
2	Arkhawan	Yes	No.	No.
3	Mamoun Aldabagh	Yes	Yes	No.
4	Gashbin	No.	Yes	No.
5	Mateen	Yes	Yes	No.

Moreover, the above table can describe the basic principle of school sustainability, it is classified based on the good environment for the student in class, second the suitability of the school building location with the places inside the houses this affect noise in the locations, the third part includes the cost and budget that provided for the school requirement and building repair. Thus, the evaluation of the schools can be decided that the selected schools generally are not sustainable according to the global requirement of sustainable development.

4. Conclusion

Construction and finishing materials in schools changed from 1970 to 2021 in Erbil City. Stone was used in the old buildings, while concrete blocks were used in the new buildings. Generally, gypsum plastering is used in indoor areas and cement plastering is used in outside areas. Isolation in the recently built schools was superior to the old schools. Commonly, green areas and sports yards in the schools were acceptable. WFR values for the selected schools varied from 14.9 % to 46.6 %. Consequently, lighting and ventilation in the classrooms and sanitation were satisfied as well. Noise pollution was noticed due to the locations of the schools and the materials. Solid waste collection and cleaning of the schools were well managed. A firefighting system was absent in the selected schools. Water supply circumstances for the schools were satisfactory; While an increasing number of WCs and continuous cleaning are recommended for the present and newly constructed schools. The main point to consider regarding the sustainability of the school building is that the economy directly affects the two other pillars which are society and the environment otherwise the school building can achieve a good environment. The presented study should be considered as the future challenges for sustainable development of the school buildings, it is important to assess each school before construction based on the environmental impact. Finally, it is highly recommended for future researchers on the sustainability study to select a greater number of buildings in order to better evaluate the subject.

5. Acknowledgment

The authors would like to thank Eng. Mr. Hazhar Abdul Rahman from the General Directorate of Education in Erbil City. Mr. Wishyar (Principal of Kurdistan High School), Mrs. Rezan Faroq Muhammed (Principal of Mamoun Aldabagh High School), and Mr. Dara Mufid Sabr (Deputy Principal of Mateen Basic School).

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