LEED for Existing Buildings

Assessment of the Buildings of Mustansiriyah University

Mustansiriyah University

Faculty of Engineering

LEED FOR EXISTING BUILDINGS

ASSESSMENT OF THE BUILDINGS OF MUSTANSIRIYAH UNIVERSITY

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Introduction

Humans have a powerful and often negative impact on the environment. Awareness of the damage being done to the planet by humans has gradually pushed scientists and policy-makers to find solutions for these problems. Sustainability and sustainable development were the basic approaches to reach the solution. Sustainable development is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1]. The foundation of sustainability is commonly examined through three dimensions: the effect of a phenomenon or system on society (often referred to as *social sustainability*), its impact on the environment (often referred to as *environmental sustainability*), and its economic implications (often referred to as *economic sustainability*). This threefold depiction (Fig. 1) is called the triple bottom line (TBL) of sustainability; it was first introduced by Elkington [2] in 1994 and is still used nowadays.

The aim of the TBL is to consider the impact of resource consumption and the value creation in terms of integration among the three dimensions, assuming that each of them is equally important.

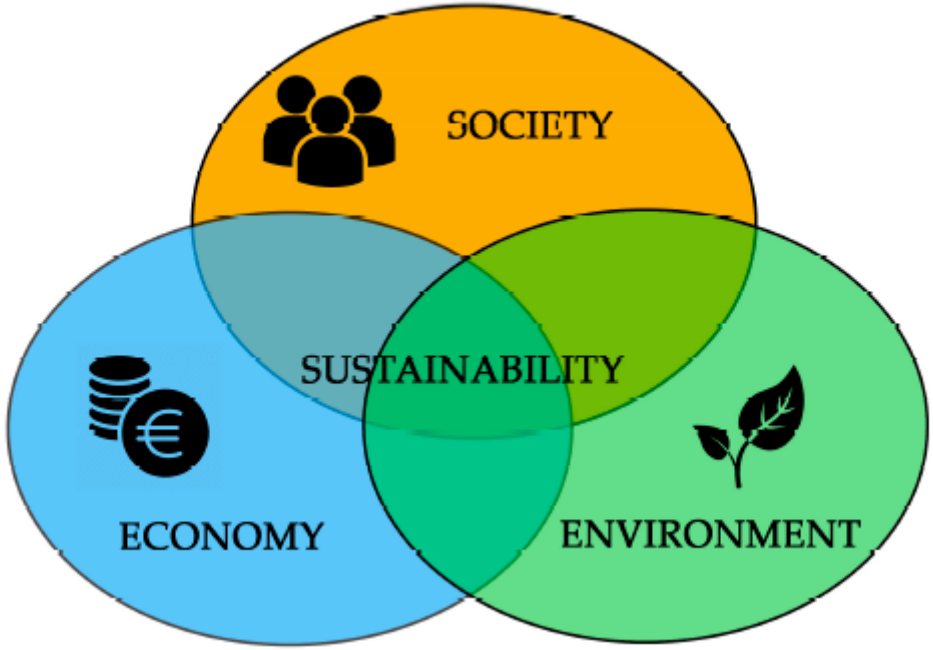


Fig. 1: Triple bottom line of sustainability

1.1 Rating Systems

Rating systems for assessing the environmental impact of buildings are technical instruments that aim to evaluate the environmental impact of buildings and construction projects. In some cases, these rating systems can also cover urban-scale projects, community projects, and infrastructures. These schemes are designed to assist project managers in making the projects more sustainable by providing frameworks with precise criteria for assessing the various aspects of a building's environmental impact [3].

There are six main rating systems available used to assess different types of buildings around the world: the Building Research Establishment Environmental Assessment Methodology (BREEAM), the Comprehensive Assessment System for Built Environment Efficiency (CASBEE), the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), the Haute Qualité Environnementale (HQE™), the Leadership in Energy and Environmental Design (LEED), and the Sustainable Building Tool (SBTool). This research is concerned with the LEED assessment.

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is the U.S. benchmark for the design, build, and operation of energy-efficient and green buildings. LEED projects are currently being carried out in more than 40 countries.

The LEED Green Building Rating System has been developed by the US Green Building Council (USGBC) and officially launched in 1998 in the US. The scheme has been inspired by the UK-equivalent BREEAM scheme which was created in 1990.

LEED certification provides independent, third-party verification that a building project meets the highest green building and performance measures. All certified projects receive a LEED plaque, which is a recognized symbol demonstrating that a building is environmentally responsible and a healthy place to live and work. There are both environmental and financial benefits to earning LEED certification [4].

LEED certification is a certification process aimed at rewarding sustainable and environmentally friendly decisions that are part of your construction process. It is a way to demonstrate to you and your customers, that certain environmental goals have been achieved during the design and construction of the structure or facility that is being certified. To be certified, the

building project needs to obtain certain points and meet green building standards that will, later on, be validated during the certification process [5].

A LEED-certified building can qualify to obtain specific state and local government incentives and can help boost press interest in your project.

LEED is a voluntary sustainability evaluation methodology and covers all types of buildings: Offices, retail, homes, residential high-rise, public buildings, commercial interiors, etc. Different customized adaptations of the scheme are available for various building types, as well as major renovations and minor refurbishments [6].

1.2 The Available LEED Rating Systems [7]

The latest LEED rating system consists of 5 different areas addressing multiple projects:

Building Design and Construction

Interior Design and Construction

Building Operations and Maintenance

Neighborhood Development

Homes

These 5 areas are then broken into smaller components where points are given and depending on a number of points received they can obtain one of the following categories:

CERTIFIED 40-49 Points

SILVER 50-59 Points

GOLD 60-79 Points

PLATINUM 80+ Points

It is very important to highlight that the rating system can be implemented in both, new construction and existing buildings.

1.3 LEED Certification Minimum Requirements [8]

The LEED certification process needs to meet at a minimum these requirements:

1. Be in compliance with environmental regulations and standards.
2. Must meet the threshold of floor area requirements.
3. Meet a minimum of building occupancy in terms of number of users.
4. Maintain a reasonable site boundary.
5. Be a permanent building.
6. Share energy and water usage data.
7. Must have a minimum building to site area ratio.

1.4 LEED Certification Credit Categories

In order to earn credits to achieve one of the above categories, the project must meet certain criteria and goals within the following categories:

1. Location and transportation - You should take into consideration the location of your project and how it can be combined with the transportation option within the area, in other words, how the users of the facility can get in and out of the facility.
2. Materials and Resources- Earn credits by using sustainable and earth-friendly products, while reducing waste promoting better indoor air quality.
3. Water efficiency - The building must be designed in such way that potable water usage is reduced or resources can be reused, minimizing the needs of water inside the building.
4. Energy and atmosphere - The building must enhance energy performance and promote great indoor air and environmental quality.
5. Sustainable sites - Design the project in such way that the natural resources and ecosystems nearby can naturally take part of the design minimizing environmental pollution.
6. Indoor environmental quality - Increase daylight usage and promote natural ventilation.
7. Innovation - Any idea that is not covered under the five LEED main areas.
8. Regional priority credits - Addressing any particular concern based on the regional or geographical location.

LEED for Neighbourhood Development provides for a couple of additional credit categories such as smart location & linkage, neighbourhood pattern & design and green infrastructure & buildings.

1.5 What Benefits Can You Obtain Through a LEED Certification? [9]

Getting certified or having your building certified under LEED will reduce your building operation and maintenance costs while promoting a great working and indoor environment for all building users. Not to mention, that it will create a healthier and more productive workplace and it can also be an excellent selling point for your project. An additional benefit of being LEED certified is that it will:

1. Increased building valuation
2. Reduces liability
3. Promote better employee relationships
4. Reduce energy and water usage
5. Promote better indoor air quality
6. Reduce maintenance and operation costs
7. Triggers innovation and processes to optimize building performance
8. Reduce construction waste during the process
9. Promote and attracts companies with sustainability goals
10. Reduce 'sick building' syndrome in the employees
11. Increase employee performance
12. Promote the usage of recycled material.

1.6 About the LEED Scheme

LEED assesses buildings against a wide range of environmental and sustainability issues, covering the following 6 categories:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation in Design

For each issue, one or more ‘credits’ are available when specific levels of performance or process are achieved. In addition, some pre-requisite credits are mandatory for any level of LEED certification.

The LEED assessment process is characterized by two distinct phases, the Design Phase Review and the Construction Phase Review, whereby the final LEED certification is only granted by the USGBC at end of construction.

Overall, 69 points or credits are obtainable in the previous LEED-NC v2.2 version. In the newly introduced LEED-NC v3, the scale has been revised to 100 credits, with an additional 10 points available either for Innovation in Design credits or for Regional credits (for projects within the US only).

2. About Mustansiriyah University [10]

Being the live expanse of Al-Mustansiriyah school founded in 625 e 1227, AL-Mustansiriyah University considered one of the oldest universities in the world. A remarkable institution is the expertise of a very wide range of disciplines. The superb academic and support come with membership of college communities. Our 790-year history supports our present excellence and future aspirations. In Baghdad, the university provides public and private sectors with staffs and youth energies that help rebuilding Iraq, committing themselves to develop the country and achieve the ambition of a modern state that serves the ultimate goals; stability, growth and prosperity. Fig 2 shows the map of the original Mustansiriyah University, some of the colleges affiliated to Mustansiriyah University were added later in other locations.

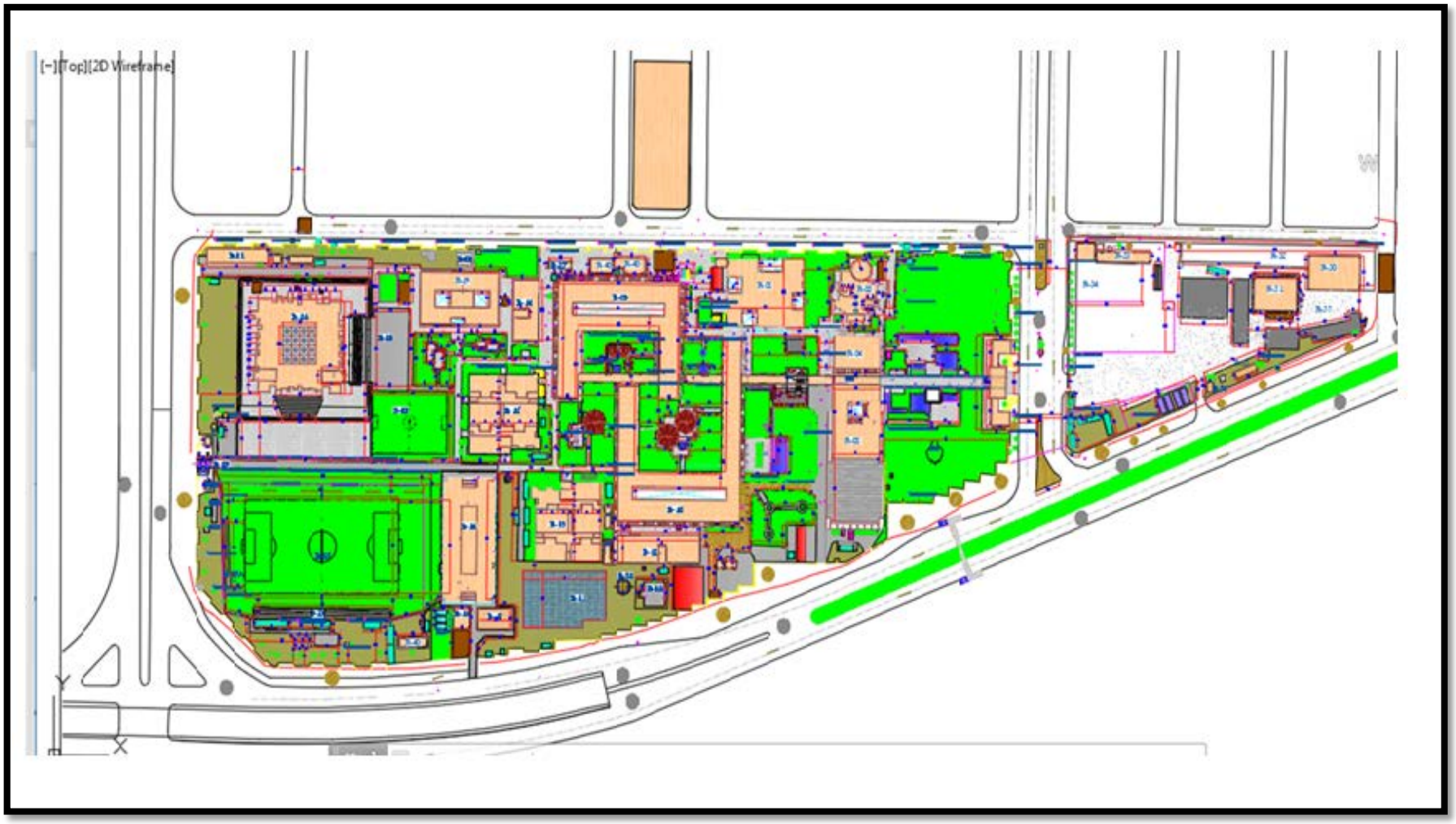


Fig. 2: Mustansiriyah University Map.

2.1 Objectives of Mustansiriyah University

The University has the following objectives:

1. Produce specialized professional staffs.
2. Prepare distinctive educational programs.
3. Achieve a promising learning environment.
4. Develop administrative systems and processes coincided the scientific movement and technical progress.
5. Adopt advanced teaching methods.
6. Create bridges of communication and partnership with regional and international universities.
7. Diversify sources of funding to achieve a sustainable financial future.
8. Produce innovative scientific researches with innovative features.
9. Aspire to affiliate with global rankings and academic accreditation.
10. Provide scientific laboratories with ISO (17025) specifications.
11. Openness to all institutions for community development.

2.2 Vision of Mustansiriyah University

The university is dedicated to being internationally distinguished in educational and scientific researches to stand for its cultural heritage.

2.3 Message of Mustansiriyah University

AL-Mustansiriyah provides a distinctive education; produces accredited researches and commits to values enhance the citizenship spirit in the Iraqi society.

2.4 Colleges and Centers of Mustansiriyah University

The University has 13 colleges and 5 centers; some of the colleges have different departments as listed in Table 1.

Table 1: List of the colleges and centers of Mustansiriyah University

Rank	College or Center	Departments
1	Medical College	———
2	Dentistry College	———
3	Pharmacy College	———
4	College of Engineering	Architectural Eng. Dep.
		Civil Eng. Dep.
		Electrical Eng. Dep.
		Mechanical Eng. Dep.
		Environmental Eng. Dep.
		Computer Eng. Dep.
		Road and Transportation Eng. Dep.
		Materials Eng. Dep.
		Water Resources Eng. Dep.
5	Physical Education and Sports Science	Theoretical Science Dep.
		Applied Science Dep.
6	Political Science	———

Rank	College or Center	Departments
7	Science College	Computer Sciences Dep.
		Atmospheric Sciences Dep.
		Chemistry Dep.
		Physics Dep.
		Biology Dep.
		Mathematics Dep.
8	Law College	———
9	Education College	Computers Dep.
		Mathematics Dep.
		Physics Dep.
		History Dep.
		Arabic Language Dep.
		Geography Dep.
		Psychological guidance and educational direction Dep.
		Educational and psychological science Dep.
		Al-Quran sciences and Islamic education Dep.
10	Basic Education College	Arabic Language Dep.
		Mathematics Dep.
		History Dep.
		Geography Dep.
		Science Dep.
		English Language Dep.
		Computers Dep.
		Kindergarten Dep.
		Physical education Dep.
		Artistic education Dep.
		First class teaching Dep.
		Special education Dep.
		Educational guidance Dep.
		Family education and Artistic work
		Islamic education Dep.

Rank	College or Center	Departments
11	Arts College	Arabic Language Dep.
		Psychology Dep.
		Philosophy Dep.
		Translation Dep.
		English Language Dep.
		French Language Dep.
		Libraries and information Dep.
		Media Dep.
		Applied anthropology Dep.
		History Dep.
12	Management and Economics College	Business management Dep.
		Accounting Dep.
		Economy Dep.
		Statistics Dep.
		Banking and Financial sciences Dep.
13	College of Tourism Science	Hotels management Dep.
		Tourism Dep.
14	Center of Cancer Research and Medical Genetics	———
15	National Center for Diabetes	———
16	National Center for Research and Treatment of Hematology	———
17	Center of Continuing Education	———
18	Mustansiriyah Center for Arab and International Studies	———

3. Cause of the study

With regard to the long period of construction of the buildings at Mustansiriyah University and the urban development taking place in the modern buildings, this encourages us to start the LEED evaluation process in a serious way to see the extent of the eligibility of these buildings to be suitable for higher education within quality requirements.

4. Aim of the Study

The aim of this study is to upgrade the status of the buildings of Mustansiriyah University to suit the requirements of quality and academic accreditation.

4.1 To reach the goal of the study

Achieving the goal is done through the assessment of the problem leading to the identification of the gaps between the actual situation of the buildings and the requirements of academic accreditation and the quality of the building. On account of the gap, policies of recommended solutions are drawn, and thus enable the decision makers at the university to claim the financial allocations necessary for the upgrading of the buildings.

5. Team Work

The committee of this study has developed its own LEED certification by adding two other categories of the original cheek list of LEED in order to make it suitable for the Iraqi environment, these added categories are:

- Structural Requirements
- Sustainable Cultural Heritage Characteristics

The final LEED rating should be determined according to the total number of points obtained for the evaluated buildings and as shown in Table 2. Details of the checklist of the adopted LEED by this team are shown in Table 3.

Table 2: LEED classification according to this research.

Total points	Assessment
0 - 33	Not Certified
34 - 43	Certified
44 - 52	Silver
53 - 70	Gold
71 - 102	Platinum

Table 3: The adopted checklist by this study.

yes	?	No	Sustainable Sites		12 Points
			Credit 1	LEED Certified Design and Construction	1
			Credit 2	Building Exterior and Hardscape Management Plan.	1
			Credit 3	Integrated Pest Management, Erosion Control, and Landscape management Plan	1
			Credit 4.1	Alternative Commuting Transportation, 10%	1
			Credit 4.2	Alternative Commuting Transportation, 25%	1
			Credit 4.3	Alternative Commuting Transportation, 50%	1
			Credit 4.4	Alternative Commuting Transportation, 75% or greater	1
			Credit 5	Reduced Site Disturbance-Protect or Restore Open Space	1
			Credit 6	Storm water Management	1
			Credit 7.1	Heat Island Reduction- Non-Roof	1
			Credit 7.2	Heat Island Reduction- Roof	1
			Credit 8	Light Pollution Reduction	1
			Water Efficiency		**10 Points**
Y			Prereq 1	Minimum Indoor Plumbing Fixture and Fitting Efficiency	Required
			Credit 1.1	Water Performance Measurement - Whole Building Metering	1
			Credit 1.2	Water Performance Measurement - Sub metering	1
			Credit 2.1	Additional Indoor Plumbing Fixture and Fitting Efficiency, 10%	1
			Credit 2.2	Additional Indoor Plumbing Fixture and Fitting Efficiency, 20%	1
			Credit 2.3	Additional Indoor Plumbing Fixture and Fitting Efficiency, 30%	1
			Credit 3.1	Water efficiency Landscaping - Reduce Potable Water Use by 50%	1
			Credit 3.2	Water efficiency Landscaping - Reduce Potable Water Use by 75%	1
			Credit 3.3	Water efficiency Landscaping - Reduce Potable Water Use by 100%	1
			Credit 4.1	Cooling Tower Water Management - Chemical Management	1
			Credit 4.2	Cooling Tower Water Management - Non-Potable Water Source Use	1

			Energy & Atmosphere		**30 Points**
Y			Prereq 1	Energy Efficiency Best Management Practices - Planning, Documentation, and Opportunity Assessment	Required
Y			Prereq 2	Minimum Energy Efficiency Performance	Required
Y			Prereq 3	Refrigerant Management - Ozone Protection	Required
			Credit 1	Optimize Energy Efficiency Performance	15
			Credit 2.1	Existing Building Commissioning - Investigation and Analysis	2
			Credit 2.2	Existing Building Commissioning - Implementation	2
			Credit 2.3	Existing Building Commissioning - Ongoing Commissioning	2
			Credit 3.1	Performance Measurement - Building Automation System	1
			Credit 3.2	Performance Measurement - System-Level Metering, 40%	1
			Credit 3.3	Performance Measurement - System-Level Metering, 80%	1
			Credit 4.1	Renewable Energy - On-site 3% / Off-site 25%	1
			Credit 4.2	Renewable Energy - On-site 6% / Off-site 50%	1
			Credit 4.3	Renewable Energy - On-site 9% / Off-site 75%	1
			Credit 4.4	Renewable Energy- On-site 12% / Off-site 100%	1
			Credit 5	Refrigerant Management	1
			Credit 6	Emissions Reduction Reporting	1
			Materials & Resources		**14 Points**
Y			Prereq 1	Sustainable Purchasing Policy	Required
Y			Prereq 2	Solid Waste Management Policy	Required
			Credit 1.1	Sustainable Purchasing - Ongoing Consumables, 40%	1
			Credit 1.2	Sustainable Purchasing - Ongoing Consumables, 60%	1
			Credit 1.3	Sustainable Purchasing - Ongoing Consumables, 80%	1
			Credit 2.1	Sustainable Purchasing - Durable Goods, electric	1

			Credit 2.2	Sustainable Purchasing - Durable Goods, furniture	1
			Credit 3	Sustainable Purchasing - Facility Alterations and Additions	1
			Credit 4.1	Sustainable Purchasing - Reduced Mercury in Lamps, 90 pg/lum-hr	1
			Credit 4.2	Sustainable Purchasing - Reduced Mercury in Lamps, 70 pg/lum-hr	1
			Credit 5	Sustainable Purchasing - Food	1
			Credit 6	Solid Waste Management - Waste Stream Audit	1
			Credit 7.1	Solid Waste Management - Ongoing Consumables, 50%	1
			Credit 7.2	Solid Waste Management - Ongoing Consumables, 70%	1
			Credit 8	Solid Waste Management - Durable Goods	1
			Credit 9	Solid Waste Management - Facility Alterations and Additions	1
			Indoor Environmental Quality		**19 Points**
Y			Prereq 1	Outdoor Air Introduction and Exhaust Systems	Required
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
Y			Prereq 3	Green Cleaning Policy	Required
			Credit 1.1	IAQ Best Management Practices - IAQ Management Program	1
			Credit 1.2	IAQ Best Management Practices - Outdoor Air Delivery Monitoring	1
			Credit 1.3	IAQ Best Management Practices - Increased Ventilation	1
			Credit 1.4	IAQ Best Management Practices - Reduce Particulates in Air Distribution	1
			Credit 1.5	IAQ Best Management Practices - IAQ Management for Facility Alterations and Additions	1
			Credit 2.1	Occupant Comfort - Occupant Survey	1
			Credit 2.2	Occupant Comfort - Occupant Controlled Lighting	1
			Credit 2.3	Occupant Comfort - Thermal Comfort Monitoring	1
			Credit 2.4	Occupant Comfort - Daylight and Views. 50% Daylight / 45% views	1
			Credit 2.5	Occupant Comfort - Daylight and Views. 75% Daylight / 90% views	1
			Credit 3.1	Green Cleaning - High Performance Cleaning Program	1

			Credit 3.2	Green Cleaning - Custodial Effectiveness Assessment, <3	1
			Credit 3.3	Green Cleaning - Custodial Effectiveness Assessment, <2	1
			Credit 3.4	Green Cleaning - Sustainable Cleaning Products and Materials, 30%	1
			Credit 3.5	Green Cleaning - Sustainable Cleaning Products and Materials, 60%	1
			Credit 3.6	Green Cleaning - Sustainable Cleaning Products and Materials, 90%	1
			Credit 3.7	Green Cleaning - Sustainable Cleaning Equipment	1
			Credit 3.8	Green Cleaning - Entryway Systems	1
			Credit 3.9	Green Cleaning - Indoor Integrated Pest Management	1
			Structural Requirements		**5 Points**
			Credit 1	Stability and safety of building- Cracks, Deflection, Corrosion, buckling, settlement	2
			Credit 2	The Building is Immune to Biological and Chemical effects- Termite, champignon, damp, salts, sulfates, chlorides	1
			Credit 3	The Compatibility between the Original Function and Recent use is Found	1
			Credit 4	Construction materials are Sustainable- Can be Reused or Recycled	1
			Innovation in Operations		**7 Points**
			Credit 1.1	Innovation in Operations	1
			Credit 1.2	Innovation in Operations	1
			Credit 1.3	Innovation in Operations	1
			Credit 1.4	Innovation in Operations	1
			Credit 2	LEED Accredited Professional	1
			Credit 3	Documenting Sustainable Building Cost Impacts	2
			Sustainable Cultural Heritage		**5 Points**
			Credit 1	Aesthetic Values - Elevation design, Local materials, Local architectural elements and characters.	1
			Credit 2	Environmental Values-Using traditional ventilation, Lighting, Acoustic systems.	1

			Credit 3	Space Organization - Compact spaces, Multiple use, Adaptive use.	1
			Credit 4	Access to Social Support - Homelike environment, Small scale approach, Clustering, Mix uses, Common area.	1
			Credit 5	Quality Social Life-Wellness- Wellbeing- Asense of control with respect to Physical -social surroundings, Access to positive distractions in physical surroundings.	1
			Project Totals (pre-certification estimates)		**102 Points**
			Certified: 34-43 points, Silver: 44-52 points, Gold: 53-70 points, Platinum: 71-102		

6. Mustansiriyah Buildings' Assessment

All the Colleges and Centers of Mustansiriyah University have been assessed by the team of this research. For each college, several buildings were assessed (about 50% and sometimes more).

6.1 Summary of Results

A total of 36 buildings from different Colleges and Centers were assessed. Details of the chosen buildings and their scores are depicted in Table 4. While Table 5 represents the final assessment of Mustansiriyah University Buildings. Appendix A shows the maps of the external colleges of Mustansiriyah University, While Appendix B shows pictures taken in different parts of the assessed buildings.

Table 4: Details of choosing buildings and their score

No.	College or Center	Details	Score	Assessment
1	Medical College	———	6	Not Certified
2	Dentistry College	———	13	Not Certified
3	Pharmacy College	———	11	Not Certified
4	College of Engineering	Deanship	23	Not Certified
		Civil Eng. Dep.	23	Not Certified
		Materials Eng. Dep.	24	Not Certified
		Architectural Eng. Dep.	23	Not Certified
		Mechanical Eng. Dep.	13	Not Certified
		Electrical Eng. Dep.	20	Not Certified
		Structural Materials Lab.	15	Not Certified
5	Political Science	———	24	Not Certified
6	Physical Education and Sports Science College	Deanship	14	Not Certified
		Theoretical Science Dep.	11	Not Certified
		Registration Unit	8	Not Certified
		Sports Games Hall	7	Not Certified
7	Science College	Deanship	57	Gold
8	Arts College	Deanship	58	Gold
9	Education College	Deanship	58	Gold
10	Law College	———	8	Not Certified

11	Basic Education College	Deanship	22	Not Certified
		Construction of Japan	22	Not Certified
		Farouq Building	11	Not Certified
		Building of Internal Science Ibn-Al Haytham	5	Not Certified
12	Management and Economics College	Deanship	16	Not Certified
		Accounting Dep.	16	Not Certified
		Library	17	Not Certified
		Sports Activities	17	Not Certified
13	College of Tourism Science	———	16	Not Certified
14	Center of Cancer Research and Medical Genetics	———	12	Not Certified
15	National Center for Diabetes	———	28	Not Certified
16	National Center for Research and Treatment of Hematology	———	12	Not Certified
17	Center of Continuing Education	———	25	Not Certified
18	Mustansiriyah Center for Arab and International Studies	———	28	Not Certified
19	Presidency Buildings	Main Building No.1	25	Not Certified
		Building No. 2	38	Certified
		Building No.3	38	Certified

Table 5: Assessment of Mustansiriyah University Buildings

No.	College or Center	Details	Not Certified	Certified	Silver	Gold	Platinum
1	Medical College	———	√				
2	Dentistry College	———	√				
3	Pharmacy College	———	√				
4	College of Engineering	Deanship	√				
5		Civil Eng. Dep.	√				
6		Materials Eng. Dep.	√				
7		Architectural Eng. Dep.	√				
8		Mechanical Eng. Dep.	√				
9		Electrical Eng. Dep.	√				
10		Structural Materials Lab.	√				
11	Political Science	———	√				
12	Physical Education and Sports Science	Deanship	√				
13		Theoretical Science Dep.	√				
14		Registration Unit	√				
15		Sports Games Hall	√				
16	Science College	Deanship				√	
17	Literature College	Deanship				√	
18	Education College	Deanship				√	
19	Law College	———	√				

20	Basic Education College	Deanship	√				
21		Construction of Japan	√				
22		Farouq Building	√				
23		Building of Internal Science Ibn-Al Haytham	√				
24	Administration and Economics College	Deanship	√				
25		Accounting Dep.	√				
26		Library	√				
27		Sports Activities	√				
28	College of Tourism Science	———	√				
29	Center of Cancer Research and Medical Genetics	———	√				
30	National Center for Diabetes	———	√				
31	National Center for Research and Treatment of Hematology	———	√				
32	Center of Continuing Education	———	√				
33	Mustansiriyah Center for Arab and International Studies	———	√				
34	Presidency Buildings	Main Building No.1	√				
35		Building No. 2		√			
36		Building No.3		√			
	Total points		31	2	0	3	0
	Percentage		86%	6%	0%	8%	0%

7. Conclusions

From all above, the committee has found that almost all the buildings of Mustansiriyah University are **NOT CERTIFIED** (about 86%), while only 6% is considered CERTIFIED and 8% GOLD.

8. Recommendations

The following general recommendations are suggested to upgrade the buildings of Mustansiriyah University, while individual recommendations of the buildings are illustrated at the end of the recommendations.

8.1 General Recommendations

1. Install Indoor Plumbing Fixture and Fitting.
2. Develop a building operating plan.
3. Document the current sequence of operations systems for the building.
4. Install Exhaust Systems, Tobacco Smoke (ETS) Control, and use of Green Cleaning products.
5. Use local and Sustainable material in construction.
6. Plan a Sustainable Purchasing Policy
7. Improve the storm water system of the buildings and install water measurement metering device for the building.
8. Supply the buildings with suitable grey water treatment plant and use treated grey water for landscape irrigation OR reactivate the raw water system for irrigation.

9. Install a drip irrigation system.
10. Construct a renewable energy system for the buildings (solar energy).
11. Supply the building with IAQ measuring detectors for determining the degree of pollution and use the (e-windows, e-doors … etc.) to improve IAQ quality.
12. Stop adding any other buildings within the site as a whole, and stop making divisions to the interior spaces of the buildings.
13. Installation of light sensors to reduce power consumption.
14. Apply the policy of Green Cleaning.
15. Apply thermal comfort monitoring.
16. Reactivate the central cooling and heating systems in the buildings.

8.2 Individual Recommendations

1. Some of the buildings, such as the building of physical education and sports, were found unsuitable to be occupied and used, for which our team strongly recommended starting with design and executing in a new site suitable for the college use.
2. Preserving the site of the university and its buildings, and move the College of Literature to the site of (Sader Al-Qanat) and use the current building of the College of Literature for the College of Science and Education requirements, (depended on the adoptive reuse method).

3. For the College of Low:
   a. The covers of the manholes of the sewer system are destroyed and should be repaired.
   b. Improve the ventilation in the bathrooms.
   c. Remove the tank used for burning wastes found on the roof of the building.
   d. Reuse the building as apartment of students and select another place for the directorate of the College of Law.
   e. Plastic tiles and false ceiling must be repaired.
   f. Remove the incorrect storage room in the building.
   g. Repaired the water closet system.
4. For the College of Basic Education:
   a. The streets around the building must be paved.
   b. The water closed should be repaired.
   c. The false ceiling was damaged and should be rebuilt.
   d. The ventilation and lighting in the most part of the building are insufficient.
   e. The sewer system must be cleaned and repaired.
   f. The furniture is bad and destroyed and should be changed to better one.
5. For the Management and Economic College and the College of Tourism Science:
   a. Improve the car parking by installing the bike racks in a proper place.
   b. Maintenance of the sewer system for the site and the building, in particular, the bathrooms and the outdoor part.
   c. Repair the cracks found in the building.
   d. Treat and remove the traces of termite.

e. Treat the damp found in the building.
f. Repair the corrosive concrete in the building, in particular, the staircase and the parapet.
g. Reconstruct the broken walls of the parapet.
h. Repair the mosaic tiles in the entrances of doors on the ground floor.
i. Repair the ceramic tiles in bathrooms.
j. Repair the flat concrete tiles in the roof and the mastic of joints in the roof.

6. For the Political Science College:
   a. The building is not suitable to be an academic institution where it was noted that the ground floor includes the administration rooms (the Dean's room, the assistant and the director of the administration) as well as the lecture rooms for students.
   b. The building lacks the simplest basics necessary for university buildings, although the college includes an evening study and a morning study.
7. For the Presidency of Mustansiriyah University:
   a. Construct cladding to reduce the light pollution.
   a. Remove the aluminium partitions, to increase the lighting, ventilation, and common area.
8. For the center of Continuing Education:
   a. Rehabilitate the spaces of the Center as a discussion room (as it was designed).
   b. Allocate a building to it, in order to improve the functionality of the Center and its environment.

9. References

[1] Strange T. and Bayley A., 2008, "Sustainable Development; linking economy, society, environment OECD publications may be found on line at: *www.oecd.org/publishing/corrigenda*.

[2] Elkington, J. Cannibals with Forks-The Triple Bottom Line of 21st Century Business; New Society Publishers: Gabriola, BC, Canada, 1997.

[3] Bernardi E., Carlucci S., Cornaro C., and Bohne R. A., 2017, " An Analysis of the Most Adopted Rating Systems for Assessing the Environmental Impact of Buildings", Sustainability, 9, 1226; doi:10.3390/su9071226, www.mdpi.com/journal/sustainability.

[4] Leadership in Energy and Environmental Design, Wikipedia, the free encyclopedia, 2018. https://en.wikipedia.org/wiki/Leadership_in_Energy_and_Environmental_Design

[5] This is LEED; Better Buildings are our Legacy, https://new.usgbc.org/leed , http://leed.usgbc.org/leed.html

[6] Wheeler S.M., 2013, "Planning for sustainability: creating livable, equitable and ecological communities", Second Edition, Rout ledge Taylor and Francis group, London and Ney York, books.google.com.

[7] Benefits>LEED, Green Building Rating System, http://www.concretethinker.com/solutions/LEED-Certification.aspx

[8] LEED 2009, Minimum Program Requirements, Version January 2011, USGBC, https://www.usgbc.org/Docs/Archive/General/Docs6715.pdf

[9] Alanbari M.A., Mohammad L. T. and Habib A. D., 2013, "Assessment of some of the buildings of Babylon University according to LEED", Journal of Babylon University/Engineering Science, Vol. 21(1).

[10] Mustansiriyah University, https://uomustansiriyah.edu.iq

10. Bibliography

1. Brundtland, G.H.; Khalid, M. Report of the World Commission on Environment and Development: Our Common Future; Oxford University Press: Oxford, UK, 1987.
2. Clayton, R. Is sustainable development an oxymoron? Process Saf. Environ. Prot. **2001**, 79, 327–328. [CrossRef]
3. Choi, J.S.; Pattent, B.C. Sustainable development: lessons from the paradox of enrichment. Ecosyst. Health **2001**, 7, 163–178. [CrossRef]
4. Meadows, D.H.; Meadows, D.L.; Randers, J. The Limits to Growth; Universe Books: New York, NY, USA, 1972.
5. Ayres, R.U. Cowboys, cornucopians and long-run sustainability. Ecol. Econom. **1993**, 8, 189–207. [CrossRef]
6. Ayres, R.U.; Ayres, L.W.;Warr, B. Exergy, power and work in the US economy, 1900–1998. Energy **2003**, 28, 219–273. [CrossRef]
7. Hopwood, B.; Mellor, M.; O'Brien, G. Sustainable Development: Mapping Different Approaches. Sustain. Dev. **2005**, 13, 38–52. [CrossRef]
8. Goodland, R. The Concept of Environmentl Sustainability Annu. Rev. Ecol. Syst. **2005**, 26, 1–24. [CrossRef]
9. World Bank. Environmental Assessment Sourcebook; World Bank: Washington, DC, USA, 1992.
10. Crawley, D.; Aho, I. Building environmental assessment methods_applications and development trends. Build. Res. Inf. **1999**, 27, 300–308. [CrossRef]

11. Haapio, A.; Viitaniemi, P. A critical review of building environmental assessment tools. Environ. Impact Assess. Rev. **2008**, 28, 469–482. [CrossRef]
12. Ding, G.K. Sustainable construction: The role of environmental assessment tools. J. Environ. Manag. **2008**, 86, 451–464. [CrossRef] [PubMed]
13. Berardi, U. Sustainability Assessment in the Construction Sector: Rating Systems and Rated Buildings. Sustain. Dev. **2012**, 20, 411–424. [CrossRef]
14. Berardi, U. Beyond Sustainability Assessment Systems: Upgrading Topics by Enlarging The Scale of Assessment. Int. J. Sustain. Build. Technol. Urban Dev. **2011**, 2, 276–282. [CrossRef]
15. Todd, J.A.; Crawley, D.; Geissler, S.; Lindsey, G. Comparative assessment of environmental performance tools and the role of the Green Building Challenge. Build. Res. Inf. **2010**, 29, 324–335. [CrossRef]
16. Abdalla, G.; Maas, G.; Huyghe, J.; Oostra, M. Criticism on Environmental Assessment Tools. In Proceedings of the 2nd International Conference on Environmental Science and Technology, Belgrade, Serbia, 28 September–2 October 2016.
17. Poveda, C.A.; Lipsett, M.G. A Review of Sustainability Assessment and Sustainability/Environmental Rating Systems and CreditWeighting Tools. J. Sustain. Dev. **2011**, 4, 36–55. [CrossRef]
18. Guinée, J. Handbook on life cycle assessment operational guide to the ISO standards. Int. J. Life Cycle Assess. **2002**, 7, 311–313. [CrossRef]

19. Finnvedern, G.; Hauschild, M.Z.; Ekvall, T.; Guinée, J.; Heijungs, R.; Hellweg, S.; Koehler, A.; Pennington, D.; Suh, S. Recent developments in Life Cycle Assessment. J. Environ. Manag. **2009**, 91, 1–21. [CrossRef] [PubMed]
20. Rice, G.; Clift, R.; Burns, R. Comparison of currently available european LCA software. Int. J. Life Cycle Assess. **1997**, 2. [CrossRef]
21. ISO. ISO 14040: Environmental Management—Life Cycle Assessment—Principles and Framework; International Organization for Standardization: Geneva, Switzerland, 2006.
22. Puettmann, M.E.; Bergman, R.; Hubbard, S.; Johnson, L.; Lippke, B.; Oneil, E.;Wagner, F.G. Cradle-to-gate life-cycle inventory of US wood products production: CORRIM Phase I and Phase II products. Wood Fiber Sci. **2010**, 42, 15–28.
23. Ortiz, O.; Castells, F.; Sonnemann, G. Sustainability in the construction industry: A review of recent developments based on LCA. Constr. Build. Mater. **2009**, 23, 28–39. [CrossRef]
24. Podvezko, V. The Comparative Analysis of MCDA Methods SAWand COPRAS. Eng. Econ. **2011**, 22, 134–146. [CrossRef]
25. Sev, A. A comparative analysis of building environmental assessment tools and suggestions for regional adaptations. Civ. Eng. Environ. Syst. **2011**, 28, 231–245. [CrossRef]
26. Retzlaff, R. Green buildings and building assessment systems: A new area of interest for planners. J. Plan. Lit. **2009**, 24, 3–21. [CrossRef]
27. Wong, S.-C.; Abe, N. Stakeholders' perspectives of a building environmental assessment method: The case of CASBEE. Build. Environ. **2014**, 82, 502–516. [CrossRef]

28. CASBEE. Green Book Live. Available online: http://www.greenbooklive.com/page.jsp?id=1 (accessed on 26 June 2017).
29. CASBEE. CASBEE Homepage. Available online: http://www.ibec.or.jp/CASBEE/english/overviewE.htm (accessed on 26 June 2017).
30. IBEC. CASBEE for New Construction. Technical Manual; Institute for Building Environment and Energy Conservation (IBEC): Tokyo, Japan, 2008.
31. DGNB. DGNB OfficialWeb Page. Available online: http://www.dgnb-system.de/en/system/international/ China.php (accessed on 26 June 2017).
32. ISO. Environmental Labels and Declarations—Type III Envronmental Declarations—Principles and Procedures; ISO: Geneva, Switzerland, 2006; p. 25.
33. CEN. EN 15804:2012 + A1:2013. Sustainability of ConstructionWorks—Environmental Product Declarations-Core Rules for the Product Category of Construction Products; European Committee for Standardization (CEN): Bruxelles, Belgium, 2012/2013.
34. HQE. Haute Qualitè Environnementale. Available online: http://www.behqe.com (accessed on 26 June 2017).
35. Cerway. HQE™ Management System for Urban Planning Projects. Requirements Scheme for the Management System of Urban Planning and Development Projects—HQE™ Certified by Cerway; Cerway: Paris, France, 2014.
36. USGBC. LEED for New Construction and Major Renovation; US Green Building Council: Washington, DC, USA, 2009.

37. iiSBE. International Initiative for a Sustainable Built Environment Homepage. Available online: http: //iisbe.org/sbtool-2012 (accessed on 26 June 2017).
38. USGBC. US Green Building Council Homepage. Available online: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220S (accessed on 26 June 2017).
39. Larsson, N. User Guide to the SBTool Assessment Framework; iiSBE: Ottawa, ON, Canada, 2012.
40. Loftness, V.; Haase, D. Sustainable Built Environments—Selected Entries from the Encyclopedia of sustainability Science and Technology; Springer: New York, NY, USA, 2013; Volume XIV, p. 746.
41. GBC. Green Building Council South Africa. Available online: https://www.gbcsa.org.za/green-star-sarating- system/ (accessed on 26 June 2017).
42. CSIR. CSIR eNews OfficialWeb Page. Available online: http://www.csir.co.za/enews/2008_mar/be_02. html (accessed on 26 June 2017).
43. Gibbert, J.T. Sustainable building assessment tool: Integrating sustainability into current design and building process. In Proceedings of the World Sustainable Building Conference, Melbourne, Australia, 21–25 September 2008.
44. Borong, L.; Qin, O.; Daojin, G.; Lei, T. Assessment practices of Gobas in China. In Proceedings of the 2005 World Sustainable Building Conference, Tokyo, Japan, 27–29 September 2005.
45. DGNB. DNGB International Application. Available online: http://www.dgnb-system.de/en/system/ international/ (accessed on 26 June 2017).

46. Wang, Z.Q.; Hu, Q. The Comparative Study on the Sustainable Sites Indicators between ESGB and LEED. Appl. Mech. Mater. **2012**, 253–255, 249–253. [CrossRef]
47. HKGBC. Hong Kong Green Building Council. Available online: https://www.hkgbc.org.hk/eng/BEAMPlus_NBEB.aspx (accessed on 26 June 2017).
48. Korkmaz, S.; Erten, D.; Syal, M.; Potbhare, V. A review of green building movement timelines in developed and developing countries to build an international adoption framework. In Proceedings of the Fifth International Conference on Construction in the 21st Century: Collaboration and Integration in Engineering, Management and Technology, Istanbul, Turkey, 20–22 May 2009; pp. 20–22.
49. IGBC. Indian Green Building Council. Available online: https://igbc.in/igbc/ (accessed on 26 June 2017).
50. CASBEE. CASBEE Official Web Page. Available online: http://www.ibec.or.jp/CASBEE/english/ (accessed on 26 June 2017).
51. Aotake, N.; Ofuiji, N.; Miura, M.; Shimada, N.; Niwa, H. Comparison among results of various comprehensive assessment systems-a case study for a model building using CASBEE, BREEAM and LEED. In Proceedings of the Sustainable Building Conference (SB05), Tokyo, Japan, 27–29 September 2005.
52. Research Center for Life Cycle Assessment. AIST-LCA Ver.4. Available online: https://www.aist-riss.jp/old/lca/cie/activity/software/aist/outline.html (accessed on 13 March 2017).
53. KGBCC. Korean Green Building Certification Criteria. Available online: http://wfi.worldforestry.org/media/posters/kt_park.pdf (accessed on 26 June 2017).

54. BCA. Building and Construction Authority OfficialWeb Page. Available online: http://www.bca.gov.sg/greenmark/green_mark_buildings.html (accessed on 26 June 2017).
55. EEWH. EEWH Assessment System for Building Renovation. Available online: http://twgbqanda.com/english/e_tgbr.php?Type=2&menu=e_tgbr_class&pic_dir_list=0 (accessed on 26 June 2017).
56. CEC. CEC Green Building Library. Available online: http://www3.cec.org/islandora-gb/en/islandora/object/greenbuilding%3A100 (accessed on 26 June 2017).
57. BREEAM. BREEAM OfficialWeb Page. Available online: http://www.breeam.org (accessed on 26 June 2017).
58. SBToolCZ. Národní Nástroj pro Certifikaci Kvality Budov. Available online: http://www.sbtool.cz (accessed on 26 June 2017).
59. Forsberg, A.; von Malmborg, F. Tools for environmental assessment of the built environment. Build. Environ. **2004**, 39, 223–228. [CrossRef]
60. Nibel, S.; Rialhe, A. Implementation and comparison of four building assessment tools. In Proceedings of the Sustainable Building Conference, Maastricht, The Netherlands, 22–25 October 2000.
61. Gerard, C.; Chantagnon, N.; Achard, G.; Nibel, S. ESCALE: A method for assessing the environmental quality of buildings at design stage. In Proceedings of the 2nd International Conference on Decision Making in Urban and Civil Engineering, Lyon, France, 9–11 October 2000.
62. GBC. Green Building Council Italia. Available online: http://www.gbcitalia.org/page/show/-leedleadership- in-energy-and-environmental-design (accessed on 26 June 2017).

63. BREEAM-NL. BREEAM Netherlands Official Web Page. Available online: https://epeaswitzerland.com/fr/2014/10/breeam-nl/ (accessed on 26 June 2017).
64. Castro, M.; Remmerswaal, J.A.; Reuter, M.A. Life cycle impact assessment of the average passenger vehicle in the Netherlands. Int. J. Life Cycle Assess. **2003**, 8, 297–304. [CrossRef]
65. Pettersen, T.D.; Strand, S.M.; Haagenrun, S.E.; Krigsvol, G. EcoProfile—A Simplistic Environmental Assessment Method Experiences and New Challenges. Available online: http://globe2.thaicyberu.go. th/node/2405724 (accessed on 26 June 2017).
66. Mateus, R.; Braganca, L. Sustainability assessment and rating of buildings: Developing the methodology SBTool PT–H. Build. Environ. **2011**, 46, 1962–1971. [CrossRef]
67. Larsson, N.K.; Cole, R.J. Green Building Challenge: the development of an idea Build. Res. Inf. **2001**, 29, 336–345. [CrossRef]
68. Glaumann, M. EcoEffect—A holistic tool to measure environmental impact of building properties. In Proceedings of the International Conference Sustainable Building, Maastricht, The Netherlands, 22–25 October 2000; pp. 1–3. 70. Favre, D.; Citherlet, S. Eco-Bat: A Design Tool for Assessing Environmental Impacts of Buildings and Equipment. Build. Simul. **2008**, 1, 83–94. [CrossRef]
69. EGS-plan. EGS-plan Ingenieurgesellschaft für Energie, Gebäude und Solartechnik mbH. Available online: http://www.stz-egs.de/home/?lang=en (accessed on 26 June 2017).

70. Grace, M. BREEAM—A practical method for assessing the sustainability of buildings for the new millennium. In Proceedings of the Sustainable Building Conference, Maastricht, The Netherlands, 22–58 October 2000.
71. DOE. Energy Efficiency and Renewable Energy, Building Energy Software Tool Directory. Available online: http://www.eere.energy.gov/buildings/tools_directory (accessed on 26 June 2017).
72. CAGBC. Canada Green Building Council—Every Building Greener. Available online: https://www.cagbc. org (accessed on 26 June 2017).
73. GreenGlobes. Green Globes OfficialWeb Site. Available online: http://www.greenglobes.com/home.asp (accessed on 26 June 2017).
74. Meil, J.K. Building materials in the context of sustainable development: an overview of forintek's research program and model. Life Cycle Anal. **1995**, 8, 79–92.
75. Trusty, B.W.; Horst, S. Integrating LCA Tools in Green Building Rating Systems. Available online: https: //www.irbnet.de/daten/iconda/CIB2759.pdf (accessed on 26 June 2017).
76. GBCA. Green Building Council of Australia. Available online: https://www.gbca.org.au/green-star/ (accessed on 26 June 2017).
77. Roderick, Y.; McEwan, D.; Wheatley, C.; Alonso, C. Comparison of energy performance assessment between LEED, BREEAM and Green Star. In Proceedings of the Eleventh International IBPSA Conference, Glasgow, Scotland, 27–30 July 2009; pp. 1167–1176.

78. NABERS. National Australian Built Environment Rating System. Available online: http://www.nabers.gov.au/public/WebPages/Home.aspx (accessed on 26 June 2017).
79. Cole, R.J.; Howard, N.; Ikaga, T.; Nibel, S. Building Environmental Assessment Tools: Current and future roles. In Proceedings of the World Sustainable Building Conference, Tokyo, Japan, 27–29 September 2005.
80. NZGBC. New Zealand Green Building Council. Available online: http://www.nzgbc.org.nz (accessed on 26 June 2017).
81. Byrd, H.; Leardini, P. Green buildings: Issues for New Zealand. Procedia Eng. **2011**, 21, 481–488. [CrossRef]
82. GBC, A. Argentina Green Building Council. Available online: http://www.argentinagbc.org.ar/leed/ (accessed on 26 June 2017).
83. GBCB. Green Building Council Brazil. Available online: http://www.gbcbrasil.org.br (accessed on 26 June 2017).
84. Arup. Ove Arup Official Web Page. Available online: http://www.arup.com/Projects/SPeAR.aspx (accessed on 26 June 2017).

11. Appendix A: Map of the External Colleges of Mustansiriyah University

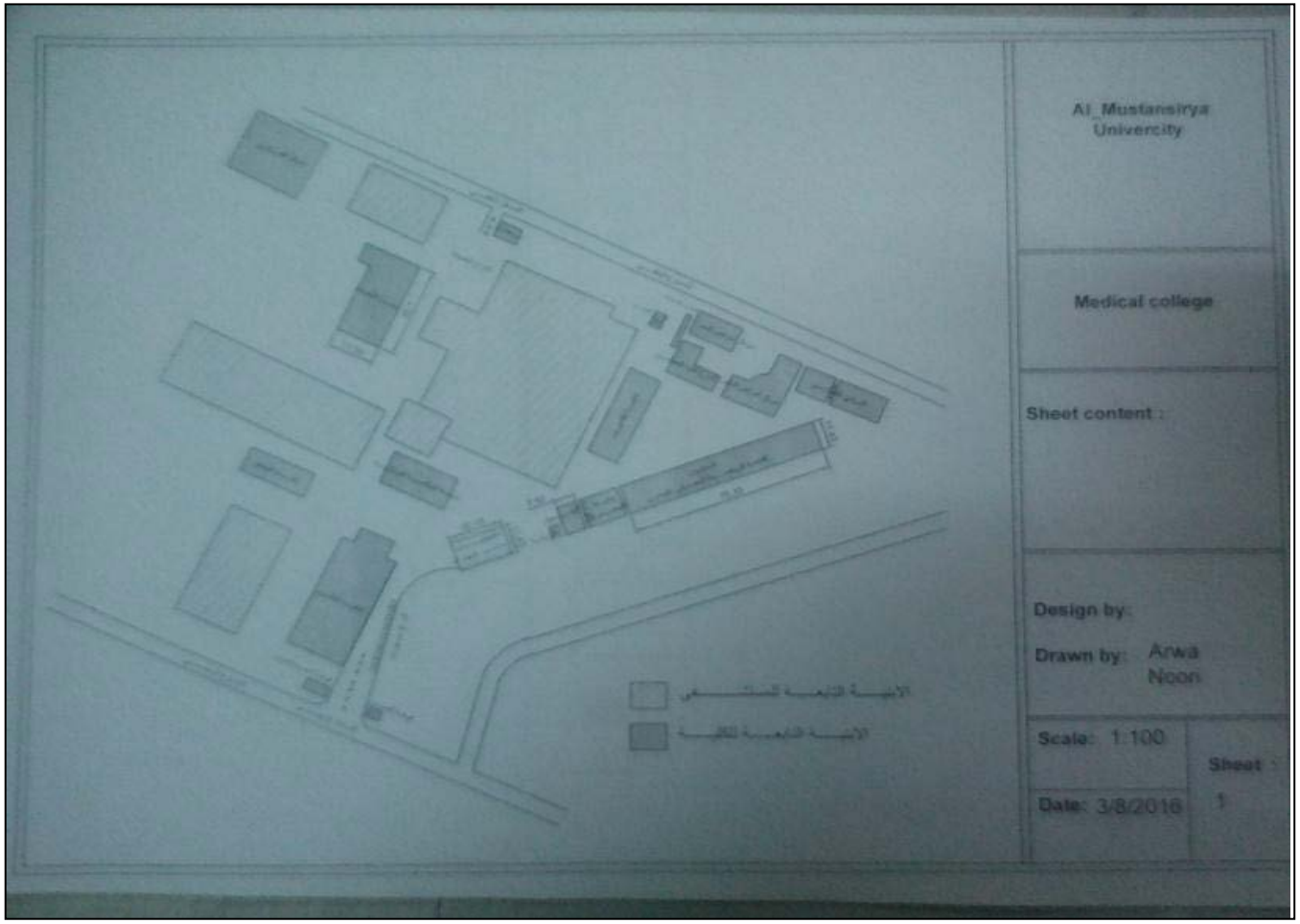


Fig. A1: Map of Medical College

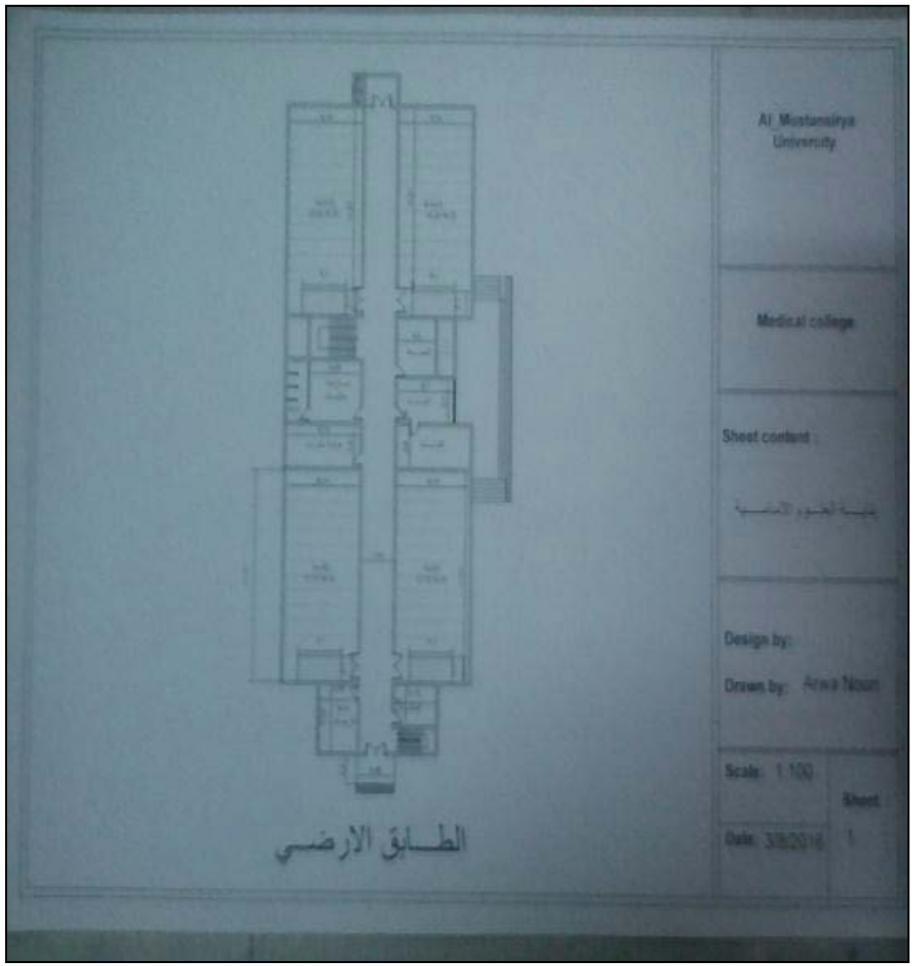


Fig. A2: Medical College / ground floor

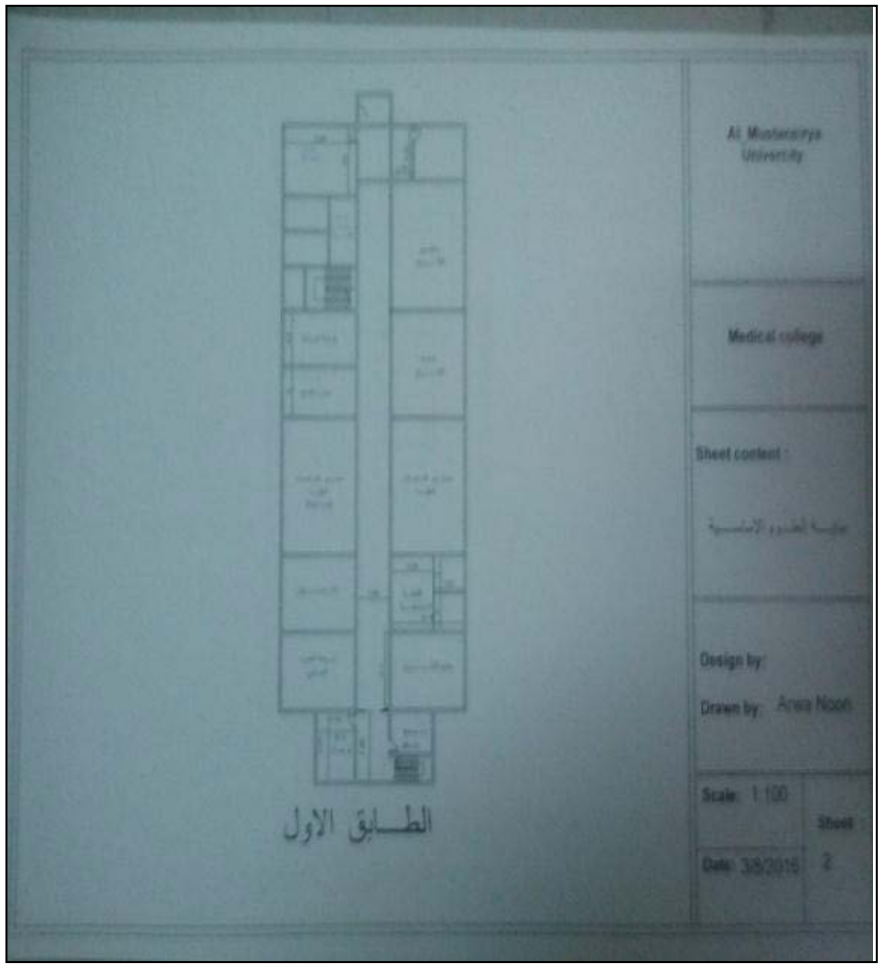


Fig. A3: Medical College / first floor

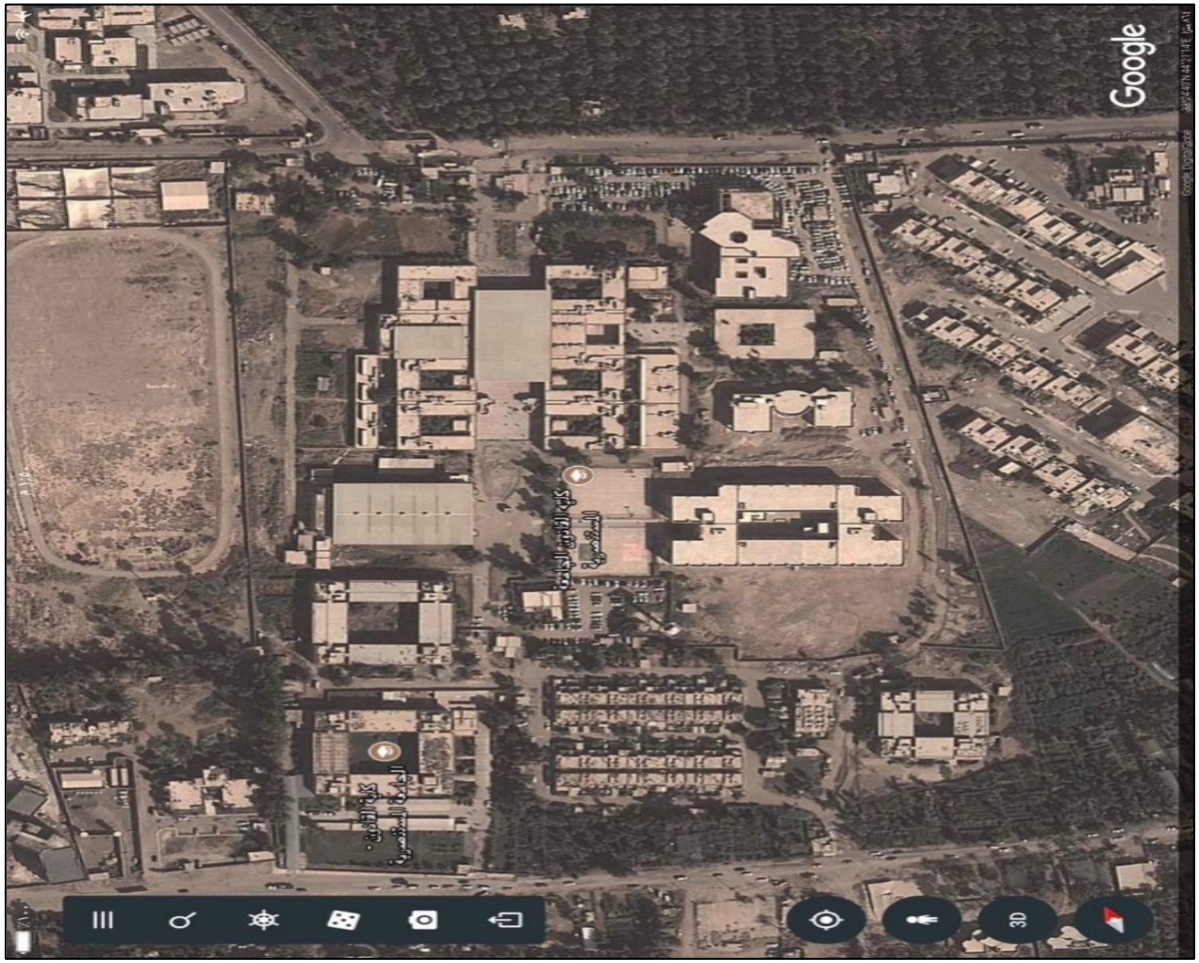
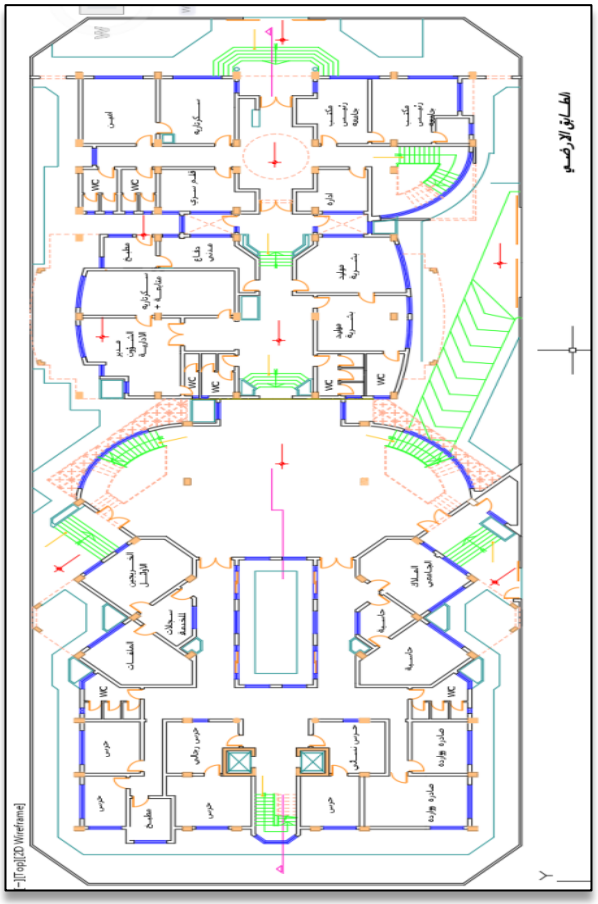
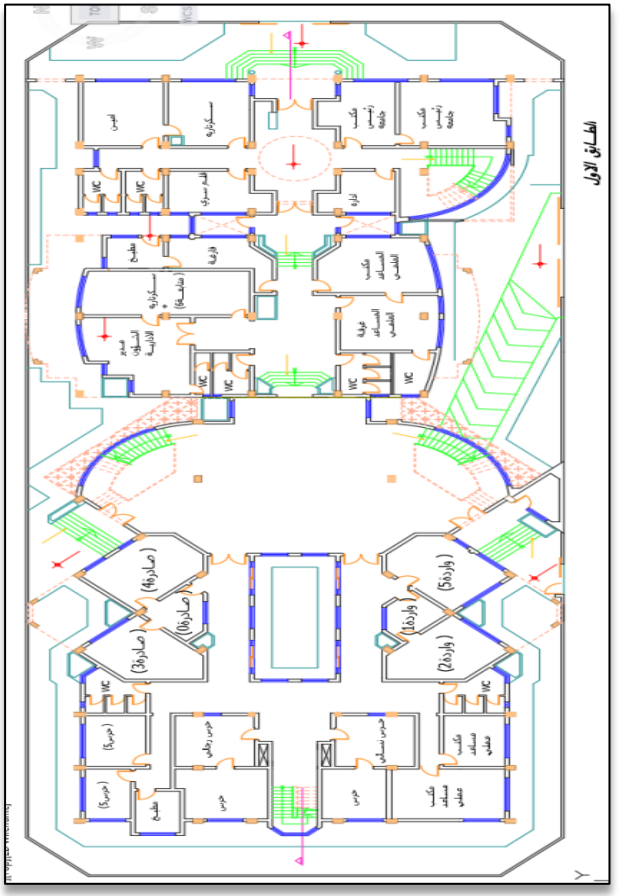


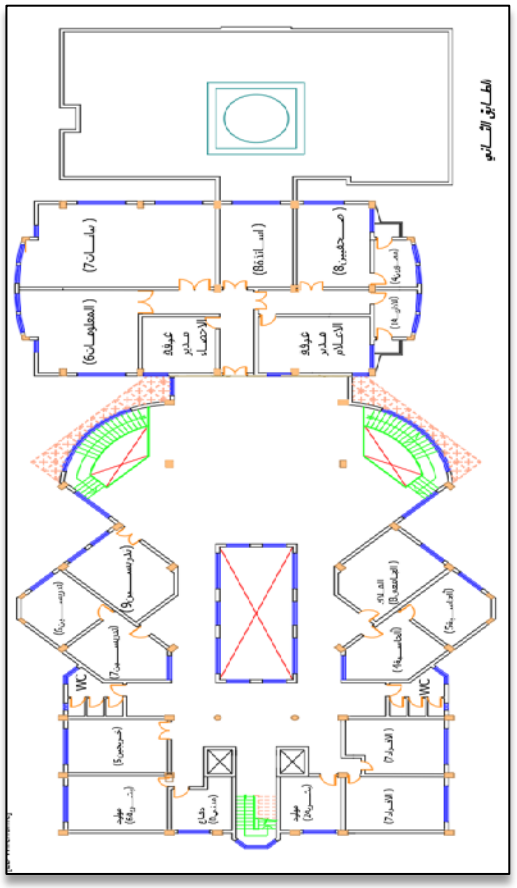
Fig. A4: Colleges of Law and Basic Education



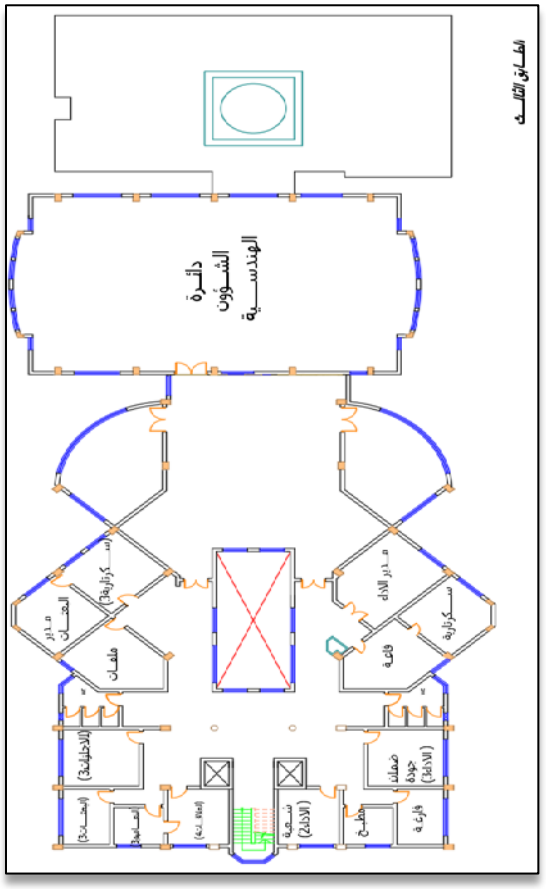
A5: Presidency of Mustansiriyah University/ ground floor



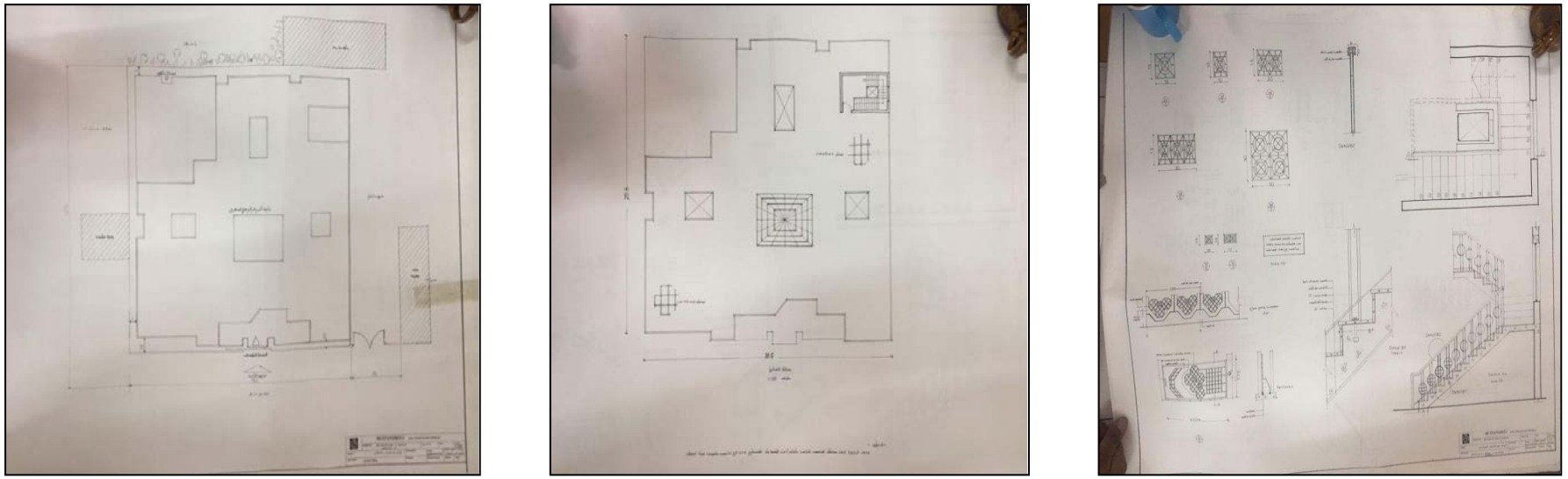
A6: Presidency of Mustansiriyah University/ first floor



A7: Presidency of Mustansiriyah University/ second floor



A8: Presidency of Mustansiriyah University/ third floor



A9: National Center for Diabetes

12. Appendix B: Pictures of the Evaluated Buildings in Colleges of Mustansiriyah University


Fig. B1: Medical College



Fig. B2: Dentistry College

Fig. B3: Pharmacy College

Fig. B4: College of Engineering

Fig. B5: Science College

Fig. B6: Arts College



Fig. B7: Educational College

Fig. B8: College of Law



B9: Basic Education College


B10: Management and Economics College


B11: College of Tourism Science


Fig. B12: College of Political Science.

Fig. B13: Physical Education and Sports Science College.

B14: Presidency of Mustansiriyah University.

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