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Consultancy Firms Role to Improve Construction Industry in Egypt towards Sustainability through Engineering Educational Programs

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Abstract

Engineering education is not only done through universities, but also consultancy firms have its big role in it. For example, medical education should have an actual hospital with real patients. Medical students should see practically surgeries and patient way of treatment. Engineering education is the same, for example in architectural, structural, mechanical, and electrical education; the students should practice on actual projects. That is the reason consultancy firms are starting to set up educational programs and training for students. One of the best examples in Egypt for that is UTW (University to Work) program, which is organized by ECG "Engineering Consultancy Group" and will be the case study of this paper.

Also, sustainability as one of the main objectives for construction industry not only in Egypt, but also all over the world. The engineering training and educational programs should set up this goal as one of the main objectives to train new architects and engineers to produce a real sustainable project.

The research objective is to push consultancy firms in Egypt towards engineering educational and training programs. The methodology will be focused on presenting the UTW (University To Work) activities and its benefits on engineering education towards certain goals and specially sustainability. The outcome will be focused on presenting the main objectives that any firm can focus on to enhance young engineer's capabilities towards sustainability.

Keywords: Sustainability, Consultancy firms, Construction industry, Engineering educational programs.

1. Introduction

There are three factors in the background of an architect:

Educational background: which is related to the preliminary knowledge of architecture taught both theoretically and practically, and this is the role of universities and architectural schools.

Work experience: where the previous knowledge is put to practice and faced with the challenges of the construction phases.

Competitive market: on both national and international levels where the architect needs to be always updated with the technologies and trends such as green architecture and its role in the environment to achieve building sustainability.

Before presenting the role of training in enhancing the background experience with green architecture, it was necessary to investigate the learning techniques, which are covering the education process to ensure getting the benefits of those techniques and feedback.
Therefore, starting with the global meaning of training in the business world, it could be defined as follows:

- It is an organized activity aimed to imparting information and/or instructions to improve the recipient's performance or to help him/her attain a required level of knowledge or skill.
- It is an educational process. People can learn new information, re-learn and reinforce existing knowledge and skills, and most importantly have time to think and consider what new options can help them improve their effectiveness in their work. Effective trainings convey relevant and useful information that inform participants and develop skills and behaviors that can be transferred back to the workplace.

Training can be offered as skill development for individuals and groups. In general, trainings involve presentation and learning of content as a means for enhancing skill development and improving workplace behaviors.
Concluding from the previous description, there shall probably be an aim for that training:

- To create an impact that lasts beyond the end time of the training itself.
- To focus on creating specific action steps and commitments that focus people's attention on incorporating their new skills and ideas into work.

2. Literature Review Incorporating Problem-Based Learning in Engineering Education [(5)] to Foster Sustainability

Transformation of educational systems to support sustainable thought equates to a redesign of engineering curricula. The question then becomes, not how can we improve the current education system, but how can we create a more effective and efficient educational system through educational programs created by consultancy firms. We examined a number of accredited engineering programs to determine the level of student's knowledge and sustainability integration within their curricula. [6] All previous push ECG tp create the University to Work (UTW) program.

3. University to Work UTW - Initiated by ECG as a Case Study:

The process of building UTW (University to Work) training program:

1. Analyze and identify the training needs.
2. Design and provide training to meet identified needs.
3. This phase requires listing the activities in the training program that will assist the participants to learn, selecting a delivery method, examining the training material, validating information to be imparted to make sure it accomplishes all goals & objectives.
4. Implementing is the hardest part of the system because one wrong step can lead to the failure of a complete training program.
5. Evaluating each phase to make sure it has achieved its aim in terms of subsequent work performance. Making necessary amendments to any of the previous stages in order to remedy or improve failure practices.

In the case of an architect, we can reformulate the steps to be:

1. Training an architectural student is divided into four main stages. First, one is a theory that is an educational approach. The student is introduced to the principles in the field of building and construction. This stage is mainly introduced for the first time in the university's curriculum, and then its main founding points are represented through a different point of view in the training stage.
2. Second stage is prototypes. The student examines projects where the theoretical principles are applied and tested, through enhancing research capabilities of the student and site visits. This stage is a very important key in building up the architectural perception in the mentality of a young architect.
3. A third stage is (Implementation). The student gets the chance to implement his previous experiences of both theory and built up mental library. This is the actual goal of the training, to

prepare the young architect to make the right decisions to produce sustainable user-friendly projects.

The final stage is (Result Tracking and Evaluation), which is a regular checkpoint to make sure the student is on the right track and correctly applying the information they receive and it is also a key method in evaluating the didactics of the offered education and training program

3.1. Definition

Engineering Consultants Group (ECG) launched the University to Work (UTW). ECG initiative in April 2010 as an initiative approach to integrate the practical field with the role of universities, private sectors and community institutes to provide the market with high-quality, efficient vocational education and skill development to induct engineering students to be qualified for the labor market in accordance with the national Egyptian goals and priorities.

This initiative focused on producing excellent skilled students in Egyptian universities by developing their technical and soft skills to be ready for the market.

Under the umbrella of corporate responsibility, ECG, The Egyptian European Organization for Training and Development (EEOTD), The Egyptian Corporate Responsibility Center (ECRC) agreed to implement the UTW initiative. The list of universities and faculties participating in the UTW initiative includes Cairo University, Ain Shams University, Banha University, Helwan University, AUC, El – Sherouk Academy, The 6th of October Higher Institute for Technology, Faculty of Fine Arts, and Faculty of Applied Arts.

3.2. Program Description

This initiative aims to bridge the gap between the academic education and the market needs in the field of engineering. It is based on providing group of selected students with technical skills. The Program is divided into different phases; phase one is the recruitment of trainees for the program, phase two is the technical on the job and professional skills training. The final stage is the recruitment of the best performing team to be UTW's instructors.

The cup for the best performing University is also given to the University with the top performing teams. In addition, the top ranked students during the UTW training are offered job opportunities to join the ECG team.

3.3. Program Outlines

1. 100 hours for technical sessions for each department covering: The technical sessions consist of six modules focusing on Structure, Electrical, Mechanical, Infrastructure, Interior Design, and Architecture engineering fields.
2. 50 hours for technical workshop for all departments: The workshop coordinates meetings between all departments to make students aware of a particular application.
3. 80 hours for professional skills sessions covering: The professional sessions consist of ten modules. These modules focus on leadership, communication, team building, negotiation, innovation, strategic planning, interviewing (grooming), and writing professional CV, mail writing, and presentation skills.
4. 20 hours for community service: The community service targeted to encourage UTW students to help others by participating in the charity services like Ramadan packing, painting poor houses, blood donation,… etc.
5. 25 hours coordination meetings: for the first time, it had arranged a coordination meeting between all departments to be aware of the real work between disciplines by designing an administration / public buildings.
6. International interim opportunity: (two weeks): the alumni of UTW is offered a chance of receiving two weeks of practical training at the United States' construction firms within the agreement of the United Nations.

3.4. Advantages of Joining UTW

- Developing students' communication, interpersonal and leadership skills.
- Being exposed to real life situations and problems student might face in the future.

- Making new friends with students of the same profession and different universities.
- Turning all their theoretical studies into actual work where they can see how things are done in practical life.
- Being trained on using all the state-of-the-art software and techniques to prepare students for the labor market.
- Facilitating and supporting program graduates in finding jobs through our CV pool on UTW website and through the different chambers of commences in Egypt and outside Egypt.

3.5. The Problems Facing UTW Program

- The increasing number of applying students, with the limited number of places available each round.
- Some students are not keen about learning, they just seek to take a certificate and deprive students that are more qualified.

3.6. Procedure of Joining the Program

All students from the targeted universities have the chance to apply for the program. Qualified students have to pass technical, English, and PST tests (Problem Solving Test). Qualified students will attend professional and technical sessions. The best 10 students have the chance to attend advanced training courses, and the number of vacancies at ECG will be offered to the top students.

3.7. Program Phases

The program is divided into different phases; phase one is the recruitment of trainees for the program, phase two is the technical part and professional skills training. The final stage is the recruitment of the best performing to act as instructors.

3.7.1. Phase one is the Recruitment of Trainees for The Program

This phase is divided into different stages; stage one is signing the protocol. Stage two is registration. Stage three is exams, and the final Stage is student selection.

3.7.1.1. Stage one - Signing of Protocol

In a magnificent ceremonial signing of protocol "from University to Work" has been with the attendance of number of ministry of investment representatives, deans & vice deans of engineering faculties & ECG representatives.

3.7.1.2. Stage two – Registration

In collaboration with students' bodies, we made info desk in all universities to answer all students' questions and then students filled the application form for project and took the exam schedule.

3.7.1.3. Stage Three – Exams

To ensure transparency students' selection divided into three stages, English test, PST test, and technical test for all students.

3.7.1.4. Final Stage – Selection

Selection of trainees from all divisions was based on their results in a number of technical, English and PST tests. Then, the results of the exams are announced in the initiative website and congratulations' mails are sent to the students.

3.7.2. Phase two is the Technical Side of the Job and Professional Skills Training

After selection stage, a schedule is made fitting the student exams' schedule in different universities.

A training course conducted in collaboration with six universities (Cairo, Ain Shams, Benha, Helwan, AUC, El Sherouk, six October). To ensure transparency, selection of 200 trainees from Structural, Architectural, Mechanical, Interior Design, Infrastructure, and Electrical divisions was based on their results in a number of technical, English, and PST tests.

The Training consists of two programs:
A-General Program:
- Technical Training
- Professional Skills Training

B-Advanced Program:
- Technical Training
- Professional Skills Training

4. Architecture Program (General Program)

Architecture department is committed to provide extensive training experience to architectural students. This has initially started by providing opportunities to the students to join the department during their study and work together with international consultancy staff. The practical experience in that field added another value to the department staff itself and saved big efforts for new employees training. For example, some of ECG new employees are UTW students in the past. Most of students who took such training are easier to be integrated inside work force for any consultancy firm once graduated, because they learned how to transfer the academic knowledge into practical field.

The program's scope is to provide a holistic approach that covers all aspects that recently addressed in the architectural department as well as to tackle skills that are necessary for any architect or engineer. The selected architecture syllabus goal is to "develop the architect abilities and skills to asses, validate, and handle wide spectrum of aspects affecting the project pre-construction phase."
The program goal is shaped through five tracks or modules:
1. Teamwork and Project Work Flow.
2. Sustainability and Environmental Assessment.
3. BIM and CADD.
4. Building Codes and Systems.
5. Special Projects Planning (Healthcare, Airports, etc…).

For each program, a number of expertise volunteers are involved to develop various sessions to address the targeted scope. In addition, a core coordination team is established to support and manage the training program that covers the following lectures.

4.1. Building Information Modeling in UTW Education [8]

The rapid movement from CAD to BIM by professional architects, engineers and construction managers has created several challenges and opportunities for UTW educational programs. Overall, 56% of all programs offer BIM courses. It is known that BIM has not advanced as quickly in civil engineering as it has in architecture [9] (Casey, 2008). The survey supports this argument. Eighty-one percent of the architecture programs, 60% of the construction management programs and only 44% of the engineering programs offer BIM courses. Of the programs that don't yet offer BIM courses, 57% are planning to integrate BIM courses, approximately 25% of all programs. However, 19% of all programs don't have any plans to offer BIM courses in their programs. When the programs were asked about the importance of BIM to the future of the UTW program, there is a consensus between all three program types: around 70% of all programs said BIM is very important.

4.1.1. Architectural Work Flow

This session aims to introduce participants to the organization composition, methodology of work processing, architect's role on the production processes, and the organization system of hiring, monitoring, and developing its human resources.
Learning Objectives:
At the end of this session, participants will be able to:
- Understand the organization composition and the cooperative action between different trades.

[8] The pace of technological innovation in architecture, engineering, and construction education: integrating recent trends into the curricula
[9] "Work in progress: How building informational modeling may unify IT in the civil engineering curriculum."

- Understand the nature of architect's role in a big consulting organization.
- Understand how to join an international organization, and how to fulfill the CV writing and interview basic requirements.

4.2. Sustainability and Green Architecture

This session provides participants to the basics of environmental design focusing on all aspects of sustainability. The session displays a range of active and passive techniques to save natural resources and to achieve the best performance of indoor quality.

Learning Objective:

At the end of this session, participants will be able to:

- Understand the main criteria of sustainable design.
- Recognize the ability of creating a variety of techniques to enhance building performance, which improve the design towards balancing the ecology system.
- Evaluate an entire architectural design and provide solutions that can improve it towards sustainability values.

4.3. Energy Modeling

This session provides participants to the basics of energy modeling's concepts as a tool to measure and check buildings power consumptions.

Learning Objective:

- Energy modeling concept & aim.
- Relation between energy modeling and design process.
- Energy modeling tools.

4.4. Rating Systems such as LEED (Leadership in Energy and Environmental Design)

This session provides participants with the main concept of any rating system, and takes (LEED) as a case study because it is one of the most famous sustainability rating systems in the world. It explains how a project is registered as well as LEED projects.

Learning Objective:

- Understand the main strategies of any rating systems including; Sustainable Sites; Water Efficiency; Energy and Atmosphere; Material and Resources; Indoor Environmental Quality; and Regional Priority.
- Understand LEED scorecard.
- Evaluate a project potential for LEED certification.
- Implement LEED requirements in the design.

4.5. Green Design Workshop

The workshop starts with describing renewable energy concept and presents the phases of green & Sustainable design.

Learning Objective:

- Working among a team and learn the sharing knowledge benefits.
- Learning how to maximize climatic behavior potentials.
- Practical implementation of sustainable techniques.

4.6. Design Concepts and Parametric Design

This session will help participants to have a strong introduction in new design approach and techniques using computational theories & methods.

Learning Objectives:

- Understand how to optimize the designs & get the most appropriate tool according to the design challenges.
- Expand the limits of imagination, and the use of parameters in design.
- How to apply parametric techniques in many architectural applications from design, construction, and fabrication.

4.7. Building Information Modeling (REVIT as Case Study):[10]

In 2006, during the BIM Symposium at University of Minnesota, it was generally agreed that BIM would change the "Architectural, Engineering and Construction" (AEC) professions, and the answer will be clear when the educational programs start to apply BIM in their modules (Khemlani, 2006) [11]. A year later the AIA-TAP discussed the difficulties of teaching the BIM in educational programs (Bronet et al.)[12]. Two years later Kymmell identified the possible obstacles to introduction of BIM in engineering education program[13].

UTW after studying all obstacles and with practical using of BIM decided to apply the BIM as courses and practical based on certain session. This session will provide participants by the practical usage of such a new program in large firms, and describe the solution of some errors for beginners. It is not an educational training for a computer program.

Learning Objective:

- Detailed description for the user interface.
- Creating sheets and schedules using the program.
- Work set concepts (Sync. Relinquish,.. etc).

4.8. Life Safety and Evacuation Strategies

This session will provide awareness to passive life safety design and its objectives.
It leads the audience to the way of using life safety code and applies its requirements onto the architectural design to enhance the building performance.

Learning Objectives:

- Describe the main principles of passive life safety design.
- Allocate emergency exits appropriately, achieving requirements set by life safety code
- Describe how clear effective width is measured for each component for means of egress.

4.9. Building Systems

This session covers the following:

- Defining the engineering disciplines as the design teamwork.
- Define the importance of coordination.
- The impact of passive design on building performance.
- The meaning of value engineering.
- The role of HVAC engineer to save energy and atmosphere.
- The role of electrical and light current engineers to push the building performance forward.
- The relationship between sustainability and HVAC and MEP engineers.
- Understanding the role of the architect to enhance building performance and to select the best equipments for the entire function of the building.

4.10. Healthcare Planning

The session covers the main topics as following:

- Data collection and client requirement.
- Space program.
- Application of national and international hospitals codes.
- Medical departments' distribution and circulation.
- Input from project parties (operators, medical equipment consultant, interior designer...)
- Recognizing the main environmental features surrounding the patient , as well as the main hospital's design mood matching
- Choosing the best finishing materials and architectural details considering standardization and hygiene aspects.

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[10] Maria Barison and Eduardo Santos, "BIM teaching stratigies: an overview of the current approaches" ICCCBE - 2010
[11] Khemlani, L, Building the Future: BIM Symposium at the University of Minnoseta. 2006
[12] Bronet, F., Cheng, R. Eastman, J. Hagen., Hemsath, S. Khan, S. Regan, t., Ryan, R. and Scheer D. Draft "The future of Architectural Education AIA TAP" 2007
[13] Kymmell, W. "Building Information Modeling: Planning and Managing Construction projects with 4D CAD and Simulation. New York: McGraw Hill, 2008

4.11. Airports Planning and Design Challenges

The session covers the following:

- Master plan and layout selection.
- Master plan components of Airside and Landside.
- Airport design parameters.
- Airport design considerations.
- Presenting a master plan case study.
- Presenting a terminal building case study.

4.12. Internal Architecture Coordination Workshop

The session starts by describing the basics of construction documents preparation and its importance in different phases, then create an interactive simulation marking up with other departments and dealing with their request.

Learning objective:

- Types of construction contracts; lump sum, Remeasured, Cost +, etc.
- Basic information needed in construction documents preparation.
- How to manage the requirements of other departments.

4.13. Projects Presentation

A final project is requested to conclude the program objectives. It helps the student to understand the issues covered in the sessions, and to search for complementary information to address self-learning strategies.

5. Sustainability and Environmental Assessment Module

This paper is focused on Sustainability and environmental assessment because of its impact on architectural and engineering design. It is divided into five divisions as described in the next part of the research.

5.1. The Critical Role of Higher Education in Creating a Sustainable Future [(14)]

The sustainable design in architectural education and practice is the main issue of all architectural educational programs, which gives the large impact of the built environment on humans and the natural world and estimates that the built environment will double in size in the coming decades. The recommendations call for several changes in architectural education and practice including:

- An expanded role for architects as design team leaders involving a wide range of design professionals, property owners, and building inhabitants and residents from the surrounding community in the earliest stages of planning and design as well as through the design and construction process
- Practicing sustainable design for community, landscape, and building design (including understanding the local and regional environmental contexts; the complex network and impact of materials and construction; and the cultural, social, and economic contexts)
- A broad-based effort to make sustainable design a core part of all architectural education in the next decade (Glyphis 2001) [(15)]

5.2. Sustainability and Green Architecture

The session covers the following:

- Problems that lead to the emergence of green movement
- Concept of sustainable development as a solution

[(14)] Anthony D. Cortese - The Critical Role of Higher Education in Creating a Sustainable Future - Higher education can serve as a model of sustainability by fully integrating all aspects of campus life"

[(15)] Glyphis, J., ed. 2001. How Can the Architect Contribute to a Sustainable World? Proceedings of the Wingspread Conference

- Sustainable urban design and environmental aspects.
- Passive and active techniques to save natural resources and human well-being.
- Rating systems concepts and examples
- Concept of integrated design.

5.3. Leadership in Energy and Environmental Design LEED

The session covers the following:

- USGBC and LEED founding
- LEED Main objectives & chapters.
- LEED Score card & Building certification
- LEED Certification for persons.
- LEED Certified buildings examples.

5.4. Energy Modeling

The session covers the following:

- Definition of energy modeling.
- Importance of energy modeling
- History of simulation concept.
- Energy modeling simulation tools & software.
- Steps of energy modeling process.
- Case studies & examples.

5.5. Renewable Energy in Architecture

The session covers the following:

- The concept of using alternative renewable energy.
- Solar power & solar panels systems (examples, advantages & Disadvantages)
- Photovoltaic (examples, advantages, & disadvantages).
- Wind power & wind turbines (examples, advantages & disadvantages).
- Geothermal energy (examples, advantages, & disadvantages).
- Open discussion about different renewable energy sources & how to use it.

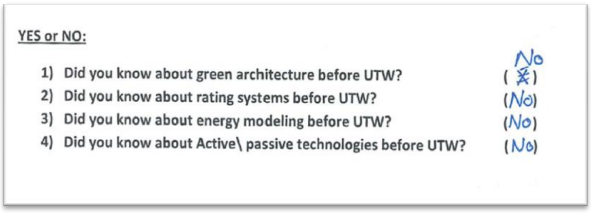
5.6. Green Villa Workshop

The session covers the following:

- Practical implementation on the previous sessions applied on a small house.
- Students are divided into several groups.
- Building a study Model to visualize the effect of modifications applied.
- Presenting the project and concepts of the modification to other groups.

Before the beginning of the module, we had a quick survey about the students' background knowledge (Fig. 1), it was "Yes or No" questions, which was as follows:

Fig-1. Sample of the survey answered by students.

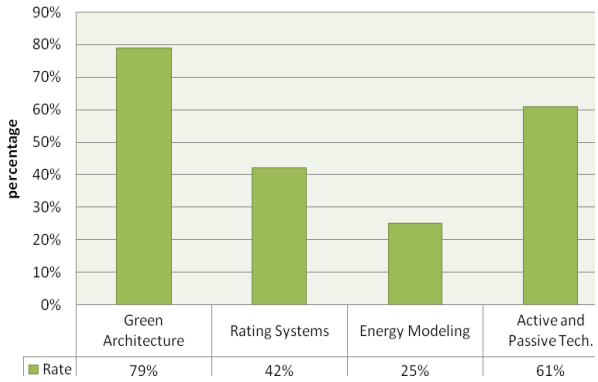


The results were as follows (Fig. 2):

- 79% of the students knew the basics of Green architecture.
- 42% of students knew the basics of rating systems.
- 25% of students knew about Energy modeling basics.

- 61% of students knew about Active / Passive techniques.

Fig-2. Background knowledge survey results.



5.7. The Criteria of the Evaluation Results are as Follows

- 0-30% Lack of basic knowledge.
- 31-60% Weak knowledge.
- 61-100% Good knowledge

5.8. Analysis

The analysis of this survey is as the following:

- 79% of the students mentioned that they know about the basics of green architecture. Therefore, the lectures contain practical knowledge and detailed examples to clarify some important issues.
- 42% of students mentioned that they know about rating systems. This weak percentage shall be considered by adding researches to mix between theoretical and practical knowledge.
- 25% of the students mentioned that they know about the basics of energy modeling. This poor knowledge shall be considered with more time for energy modeling principals.
- 61% of the students mentioned that they know about passive and active techniques. Therefore, the lectures shall contain practical knowledge and focus on some details.

Generally, after the end of the green module, an evaluation test is answered by the students to measure the impact of the module on their acknowledgment. This test is done on March every year, for 15 minutes. The evaluation test was answered by around 40 students from third & fourth year in architecture department from different universities (Ain-Shams University, Cairo University, HTI, Sherouk Academy, Al-Azhar University, MST, Helwan Univrsity).

The Evaluation test contained seven questions covering the five parts of the green module, between general, wide range, sub category & survey questions which is as the following (Fig 3):

Analysis

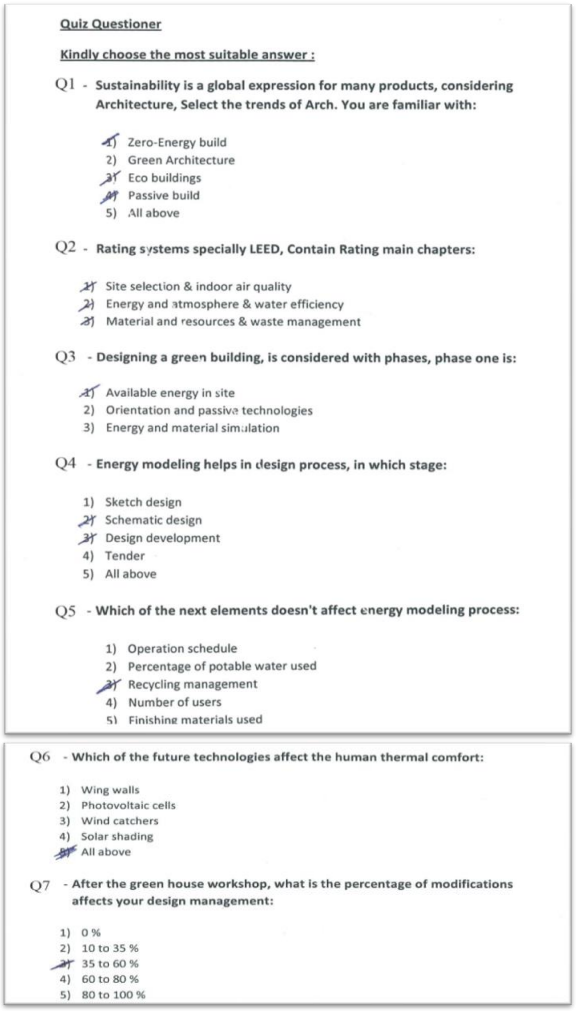
Sustainability and Green Architecture (Q1 & Q3):

- Q1: 67 % of students answered " All the above ", this indicates that the students are now at least introduced to basic knowledge of different approaches of sustainable architectural design.
- Q3: The answers varied between choice 1 (29%) and choice 2 (66%). In the UTW workshop, students were introduced to different schools of design; thus, there are varying results.
- Group 1 (66% of students) preferred the school which approaches the design phase with the site being main constrain studying its potential, challenges, advantages and disadvantages.
- Group 2 (29% of students) approached the design by choosing the latest technologies that are to be implemented or integrated in the project then adapting all the other project's constrains.

Leadership in Energy and Environmental Design LEED (Q2):

- Q2: 16% of the students picked the third answer, which is wrong, yet only 32% picked answer 1&2 only. The range in the middle are confused if “Waste Management" is one of LEED main chapters or not.

Fig-3. Sample of the quiz by student answers



Quiz Questioner

Kindly choose the most suitable answer :

Q1 - **Sustainability is a global expression for many products, considering Architecture, Select the trends of Arch. You are familiar with:**

1) Zero-Energy build
2) Green Architecture
3) Eco buildings
4) Passive build
5) All above

Q2 - **Rating systems specially LEED, Contain Rating main chapters:**

1) Site selection & indoor air quality
2) Energy and atmosphere & water efficiency
3) Material and resources & waste management

Q3 - **Designing a green building, is considered with phases, phase one is:**

1) Available energy in site
2) Orientation and passive technologies
3) Energy and material simulation

Q4 - **Energy modeling helps in design process, in which stage:**

1) Sketch design
2) Schematic design
3) Design development
4) Tender
5) All above

Q5 - **Which of the next elements doesn't affect energy modeling process:**

1) Operation schedule
2) Percentage of potable water used
3) Recycling management
4) Number of users
5) Finishing materials used

Q6 - **Which of the future technologies affect the human thermal comfort:**

1) Wing walls
2) Photovoltaic cells
3) Wind catchers
4) Solar shading
5) All above

Q7 - **After the green house workshop, what is the percentage of modifications affects your design management:**

1) 0 %
2) 10 to 35 %
3) 35 to 60 %
4) 60 to 80 %
5) 80 to 100 %

The criteria of the evaluation results are as follows:

- 0-50% ---->Education criteria need to change
- 51-65% --->Need Some improvements
- 66-80% --->Ready for adding more activity
- 81-100% -->Well done

Energy Modeling (Q4 & Q5):

- Q4: 32% of the students answered all the above, 52% of the student's neglected “Tender " phase from these choices.
- Q5: 53% of the students answered “Recycling management,” yet 47% answered wrong.

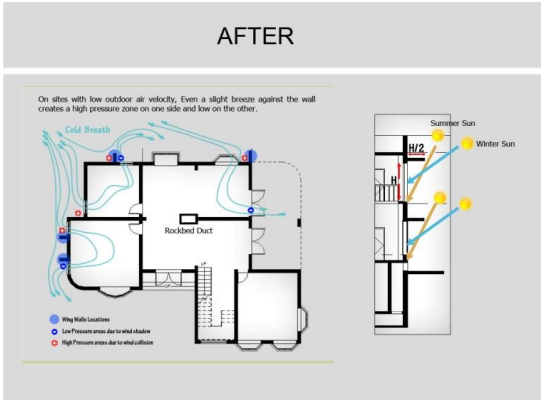
Renewable energy in Architecture (Q6):

- Q6: 79% of the students answered "all the above", considering the direct passive techniques and the indirect ways of creating energy through solar power to use it in thermal comfort.

Green Villa Workshop (Q7):

- Q7: 47% of the students rated the changes they made to the base case villa in the range of (35-60%), 42% of the students rated the changes in the range (60-80%). Most of the modifications were passive techniques, like using wind catchers, wing walls, etc. and material modifications to suite the climate Fig 4.

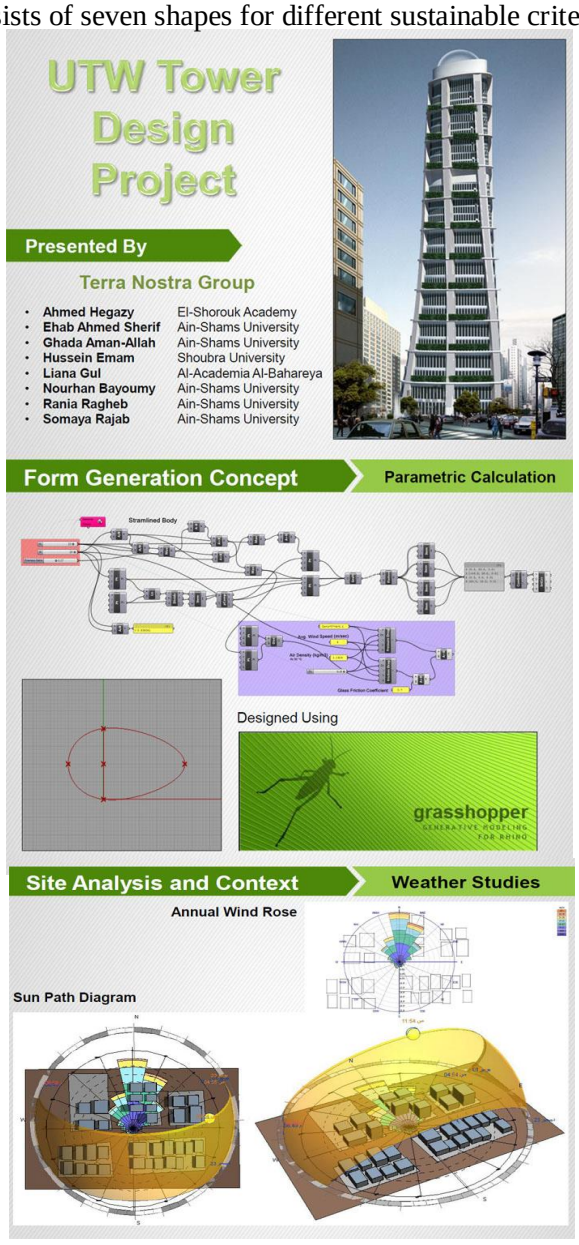
Fig- 4. Sample of students' modification in design, focusing on passive tech



6. Graduation project

The UTW sessions are ended by graduation project Fig (5) & (6), for each group of students. The project is an architectural design applying sustainability, and all knowledge of life safety, BIM modeling, LEED scorecard, etc. The following is a tower design in Madinet Nasr in Cairo.

Fig-5. Consists of seven shapes for different sustainable criteria of building masses.



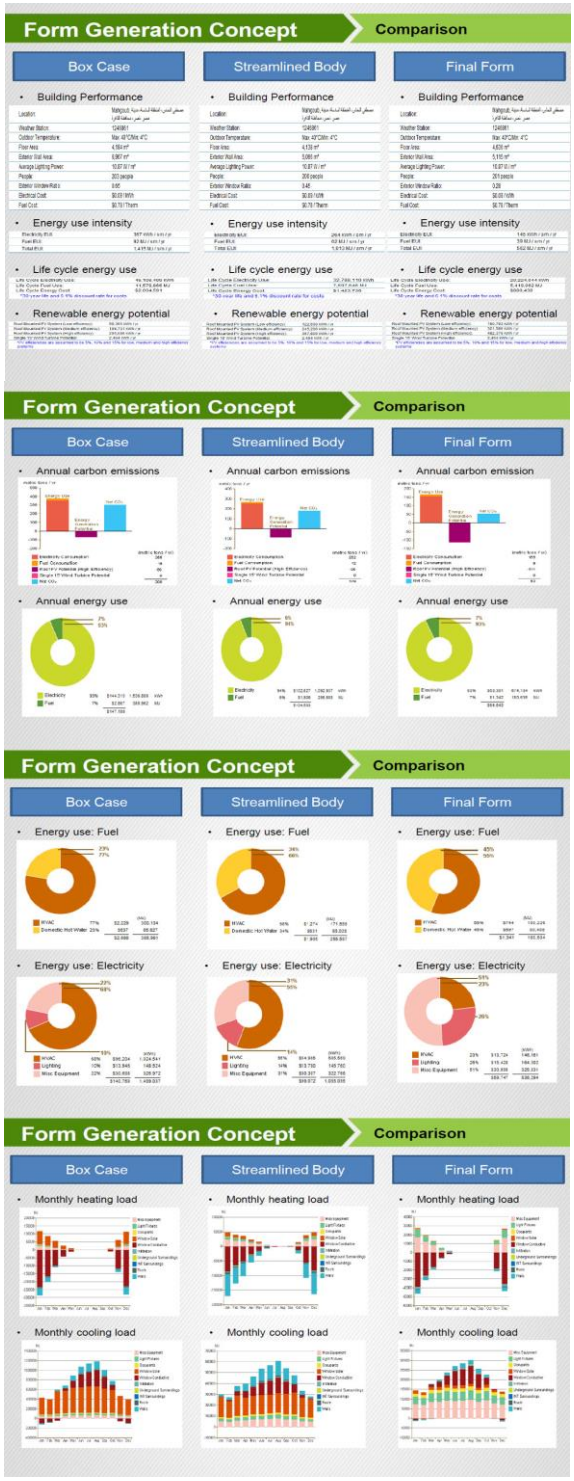


Fig-6. Consists of eight shapes illustrate the ability of the student to discuss the HVAC, water efficiency tools, fire fighting and evacuation strategies, energy performance and form generation concepts.

In the following another project by different group:

- Fire Escape Stairs
- Elevators

Automatic Fire Vents

Fire-suppression system

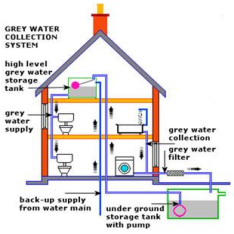
- FM-200 fire fighting system

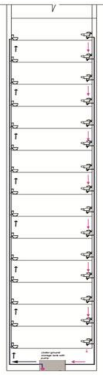
Typical elements and components include:

The Egyptian Code of Fire Fighting states that any building higher than 25m must include dry standpipe.

System:

How gray water systems work:

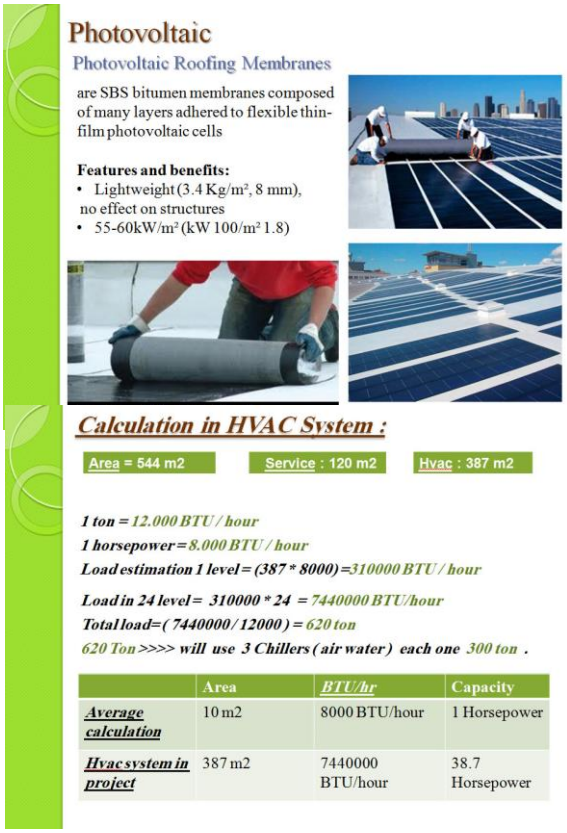




Natural & artiftial lighting

Smart LED system

An automated commercial lighting solution that cuts energy use



7. Conclusion

- The participants of UTW are now familiar with sustainability concepts and related techniques, referring to the survey done before the start of "Sustainability and Environmental Assessment module "
- Referring to the part of "Green and Sustainable Architecture, "67% of the students are clearly familiar with different green approaches. That means sessions are ready to get content that is more detailed to increase the knowledge of the students.
- Students are now able to decide the suitable start for a green and sustainable design, considering the site potentials, challenges and making the best use of renewable energy & techniques available.
- Referring to the part of "LEED," 84% of the students are familiar with LEED chapters. Thus, there is confusion between main chapters and the points of the scorecard.
- Referring to the part of "Energy Modeling," the students got the main aim of energy modeling concept. Thus, 54% of the students only could differentiate between the affecting parameters, and 52% neglected the importance of energy modeling at "Tender" phase. This may request some improvements on the session's content to focus on parameters considered at energy modeling process and the importance of energy modeling for each phase.
- Referring to the part of "Renewable energy in architecture," 79% of the students are able to recognize the direct and the indirect impact of renewable energy on human comfortable zone. Yet, the session still in need to add content that is more detailed or a specific workshop dealing with calculations.
- Referring to the "Green Villa Workshop," 47% of the students changed the design of the base case by (35-60%). This indicates how they became able to analyze the building environmentally and identify the problems and formulate solutions. Thus, 72% of the students focused on passive techniques neglecting the application of renewable energy.

8. Recommendations

- Consultancy firms have a great role to improve architectural and engineering education.

- To create a teaching and training program like UTW program may need financial support, which is refundable on the new engineering staff.
- Sustainable design is not a fashion, but it is a mandatory issue which should be covered into any training program.
- The green and sustainable architecture part needs to get into further details to increase the students' knowledge. Also, adding a site visit considering the same issue to visualize the selected materials, construction way, etc.
- LEED session needs further discussion for the scorecard with the students.
- Energy modeling session needs more practical training than it has in UTW, as the students seem to have many points unclear and confusing.
- The renewable energy part is on track, yet some modifications of case studied and calculations workshop is needed.
- The workshop shall expand its time so as the students become able to study the implementation of renewable energy techniques, yet the results are promising.

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