

The Impact of Integration between the Theoretical and Practical Side of Sustainability Teaching in Architecture Departments

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Abstract

Today the world is facing great environmental problems. The built environment with its sick architectural designs has a major contribution in these problems, and it becomes clear that architects play a key role to overcome these problems or minimize their affect by taking sound sustainable measures in architectural designs. This makes teaching sustainability in higher education one of the most important tools to raise student's environment awareness, especially in architecture departments. Here appears **the general research problem** regarding the need to include sustainability teaching in architecture departments as an essential part of its curriculum starting from the early years of study, besides identifying the best methods to combine this subject with the existing ones, here appears **the specific research problem** considering the existing separation between the theoretical sustainability teaching and it's practical application in architectural design. That caused missing sustainable principles in students design. **The hypothesis** refers that adding sustainability as an important part of the curriculum in architecture departments from the early years of study have a great effect in changing students thoughts to shift towards sustainable designs, besides the integrating the theoretical part of teaching sustainability in classroom with its practical side in design studios. This will promote achieving the aimed goals of teaching this subject, and deeper student's knowledge about it.

Keywords: sustainable teaching, theoretical and practical teaching in architecture departments.

1. Introduction

Teaching sustainability appears as a new topic in different collages around the world to the fact that environment, sustainability and the future of the coming generations became subjects of interest to a growing number of people in many countries. it is expected that higher education plays an important role in granting sustainable future through graduates provided with knowledge, competence and values. This will enable them to help their communities to live in sustainable way. However the biggest challenge is associated with discovering the most effective way to teach sustainability and make it familiar to the students, and how to integrate sustainable principles with varied educational curricula. This includes all the departments of engineering colleges in general and departments of Architecture in particular, to the fact that architects have a responsible role in production the built environment. But the way how to include sustainable education in architectural departments as part of its curriculum vocabulary a dilemma that requires research and develop, and this what will be discussed.

2. Teaching sustainability

The United Nations General Assembly declared 2005-2014 as the decade of education for Sustainable Development (DESD). Aimed to encourage the integration of sustainability issues into curricula in all education sectors around the world as one of its goals; this initiative will reorient education in order to insert sustainability values into the curriculum, regardless of the subject matter. Sustainability education can be identified as (The collecting knowledge and developing skills required to take the necessary steps to build new sustainable local and global communities characterized by justice and equality, to live within the limits of our planet's environment, in the present or in the future).

Teaching sustainability seeks to gather knowledge associated with the following principles:

- The existing correlation between community and the natural life on the planet.
- The limited capacity of the earth resources.
- The importance of the biological diversity and the social, cultural values in preservation life on our planet.
- The important role of justice and equality in a sustainable society.
- The importance of accuracy and caution in making decisions that affect society and environment (Wass, et.al, 2007)

Education within these parameters is seeking to develop the needed skills to understand the relationships between different social, economic and environmental issues and assess the extent of linkage between them, to take the right decisions. This will acquire:

- Confidence that such actions have the power to bring positive changes.
- Understanding that we are part of one big community, and our actions must be balanced to fit with the society in which we live and this responsibility lies on our shoulders.
- Understanding that humans rely on the natural world, that requires respecting its capabilities and limitations (www.eauc.org.uk)

3. The history sustainability education

In (1990) a conference held in France attended by 22 universities. The president of Tufts University convened the attendant with Talloires Declaration for sustainability, created for and by presidents of institutions of higher education. This declaration represents the first formal commitment provided by the heads of universities for teaching sustainability, through lessons, research besides to be part of the university official campus work. By (2010) this declaration signed by (433) University Presidents. This announcement seeks to achieve the following:

- Increasing the awareness of sustainable development.
- Creating culture of institutional sustainability.
- Spreading the education concerning the citizen responsibility towards the environment.
- Environmental literacy.
- Encouraging institutional ecological practices.
- Expanding the work with local government institutions and non-governmental associations (John and Cedric, 2004)

After this declaration many initiatives appeared encouraging to teach sustainability in universities, like:

- The (Haga) announcement, for Baltic States, which seeks to teach sustainability in all academic levels (An Agenda 21 for Education in the Baltic Sea Region, 2002)
- The (Swansa) announcement of the Commonwealth League, which emphasizes on the universities responsibility in shaping society for present and to the future of (Haluk and Orhan, 2006)

4-Teaching Sustainability in Universities

There is a Chinese saying launched in 500 BC says (if you're trying to do something within a year plant a seed, if you are seeking to do something within ten years, plant a tree, but if you are seeking to do something within hundred years teach people), so teaching sustainability in universities play a very important role in making graduates familiar with environment and sustainability. This increased the pressure on universities to change their curriculum and restrict them in a creative way. Many universities around the world worked on that, such as the British Universities of Aberdeen, Southampton and Kiel, and the University of Melbourne in Australia, but in a limited scale. Beside that this matter did not find the adequate attention to be incorporated as an integral part of the universities curriculum, though it's importance as indicated by the United Nations, and it's popularity among high education students. The higher education academy in the United Kingdom lead a survey in (2010) among (5763) first grade students concerning the importance of sustainability teaching, the results showed that (80%) of this segment believed in the importance of this subject and how it greatly affect the future employment opportunities. The survey also pointed that (65%) of the students believed that the skills and knowledge for sustainability must be gained from university teaching not from another channels, and it also pointed that (63%) of the students desired to work in institutions dealing with sustainability issue, even if their wages will be lower than other institutions that do not deal with it. (Hanover research, 2011)

4-1-Teaching Sustainability in Engineering Colleges

There is a need to change the curriculum toward sustainability in engineering colleges. This includes changing curriculum content and rearranging it quickly and specifically, since there is no time to lose. The need to modify graduates knowledge and abilities comes from the future requirements of the contemporary life and this confirmed by the (Worlds Union of Engineers) who pointed the importance of providing the graduated engineers with environmental knowledge and skills to make them able to meet the future challenges in their society in a scientific way. This what had been praised by the President of the Australian Society of Engineers when he asked (What inspiring role can the engineers play in a changing world?), especially in the fields of (energy saving) and (pollution prevention) depending on their knowledge and skills gained in their collage study, and how they can reshape the built environment and change production methods to protect the environment? Beside that engineer can occupy administrative positions in the government so they will have a great chance to legislate the correct laws and decisions concerning the built environment related to sustainability and the environment. Here appears the major contribution of engineers in achieving sustainable development.

The Australian union of Engineers suggests the following (engineers should take the full project responsibility from understand the customer and society requirements till reaching the ideal situation or extreme aspects of social, environmental and economic issues along the project lifetime) this statement put solid standards for engineers efficiency, that should be provided by universities and other educational and training institutions .That requires special skills such as:

First: Understanding the social, cultural and environmental responsibilities and the importance of applying sustainable principles in the projects designs. This requires:

1. Estimating the existing correlation between the project and the social, cultural, environmental and economic factors.
- 2-Estimating the safety level and sustainable measures applied in the projects.

3- Interaction with people in other disciplines to expand knowledge and skills.

Second: the ability to use a structured approach to resolve the complex problems of the design. This includes:

1-Dealing with a broad spectrum of confusing technical or non-technical information.

2-Understanding the need to put special plan concerning the project performance related to environmental, economic and social issues throughout its life.

3. The ability to use a comprehensive approach taking into account all the environmental considerations.

4. The ability to find alternative engineering solutions, then evaluating their advantages and disadvantages according to sustainable factors (Cheryl, 2007)

The researcher (EF Schumacher) says (The scale of education is increasing constantly as well as the amount of environmental crises besides depletion of natural resources. If there is an education that will save us in the future, it will be another kind of education that takes us deep into the stuff) so we are arguing for a new kind of education. The researcher (Stephen Sterling) says (To preserve the environment and apply sustainability, we need a fundamental change in the theory of knowledge and thus education). Due to the fact that education of sustainability has become a key part of many engineering disciplines since the nineties of the past century, so many universities developed their curriculum to help their graduate to be trained well in order to possess the needed knowledge, abilities, values and attitude to shift towards sustainability, but there are number of questions concerning:

- What are the skills that student must gain about sustainability in the university?
- How can acquire these skills effectively?
- What is the pattern of the most effective education method to include sustainability in the curriculum?

These can be answered as follows:

- Teaching sustainability in collages helps students to have the acquired knowledge about sustainability and environmental issues. This will help them to take the appropriate decisions concerning these issues clearly.
- Skills cab be acquired through affordable, accessible education to the student and for everyone have the desire to learn.

The definition of skills related to sustainability is a key theme in general education and in engineering colleges in particular, due to the key role of engineers in changing towards sustainability, it includes range of knowledge, cognition, understanding, culture and scientific capabilities backed with ethics values.

The goal of education programs is to Strength and develops these skills by a number of topics through different stages of studying years.

Therefore we need to reorient the curricular and reconsider the way of teaching to achieve effective sustainability teaching in engineering colleges (J.seagales, et.al, 2005)

4-2- The Difficulties Facing sustainability Teaching in Engineering Colleges

Changing the educational goals of a whole institution raises many question marks due to the scale of this change on one side and it cannot happen randomly, for it needs skilled management with a clear strategy to increase the needed awareness for the broad and substantial change in the institute curriculum on the other side. Beside that it requires an adequate monitoring and evaluation to the changing process to assess the extent of progress made in this field. Therefore, several British educational institutions took a comprehensive trend to integrate sustainability in different student's and teaching activities. The British Academy of Higher Education considered this attempt as the first comprehensive trial that simulate the way of education used in United States. However, distribution sustainability topics among educational institutions equally is not easy because it is difficult to integrate environmental issues in certain topic studies , rather it is easy to integrate them in other certain subjects such as the geography and environmental science (Stephen, et.al, 2014)

However discussion about the importance of integrating sustainability in universities curriculum was limited, while the discussions concerning the best methods to teach it was bigger. In (2002) a survey conducted in the Australian universities showed the lack of specialized environmental curricula which caused an obstacle to integrate sustainability to the curriculum. Although a large proportion of the teaching staff have responded positively to the idea of teaching sustainability, but they felt they are facing many obstacles such as:

- Lack of leadership staff.
- Difficulty of access to the specified information.
- Lack of assistant staff training.
- Lack of information concerning the methods to integrate sustainability in teaching (Sarah, et.al, 2008)

Higher Education Academy (the referendum center) indicated the main obstacle to integrate sustainability in the College of Engineering curriculum due to:

- The curriculum over loaded subjects.
- Lack of time to update the curriculum.
- Lack of teaching staff experience.
- The need to learn new knowledge.

- Lack of teaching staff awareness.
- Blurred vision of what should be obtained from the new knowledge.
- Lack of information concerning similar teaching materials.
- Poor management.
- Lack of institutional motivation to comply with this aspect.

Beside the lack of desire to change is one of the major obstacles working against teaching sustainability due to the educational institutions restrictions and regulations. (Hanover research, 2011)

5-sustainable environmental education experience in India

Environment has taken an important part in many countries policy, including India. Particularly within the orientations of the Indian Ministry of Environment where environmental education took a great momentum to the extent that it has integrated in university teaching, for there has been a general feeling that the sick buildings will lead to a big environmental problems. For that the Indian Supreme Court's decided in (2003) to include these issues as an integral part of the academic vocabulary, but the dilemma was whether these topics will be added as a separate specific material, or they will be added within the existing teaching subjects? But after the Indian curriculum was reviewed by the National Institute of Research, Education and training in India in (2000), showed the lack of mandatory environmental teaching materials in universities curriculum. So we can say that environmental teaching currently lacks the logical principles to deal with the environmental problems. Researcher (Pande) says without defying and solving local environmental problems properly, it will not be possible to define and solve it globally, he indicates the basis of local problems are the human behavior and his way of living which is heavily influenced by the European / American manner, this constitute the biggest obstacle to environmental education, so we must hear the affected voice of the poor to create an efficient environmental education capable to reshape their environment. This leads to the following observations:

1. Environmental education must begin with the well known local environmental elements to the global environmental one.
2. Principle of investigation, experiment and analysis through discussions must be the method of teaching.
3. Encouraging teachers to deepen their understanding about this subject and focusing on providing teachers with all the needed skills. (C.J. Sonowal, 2009)

6- Teaching Sustainability in Architectural Departments

Sustainability and environmental responsive designs are the main topics that should be taught in architecture departments from the early years of study to help students to gain knowledge concerning ecological issues and deepen their awareness about sustainability as a fundamental subject in their future technical career. Since the built environment will be produced by architects and will consume half the world energy and will contribute significantly to the global environmental problems, therefore we need a new kind of sustainable teaching in architecture departments, that can be called the (Environmentally -Oriented Education: EOE) involves the threads of the careful use of materials, rational energy building consumption, passive cooling ...etc. This kind of teaching requires changing shareholders traditional teaching thoughts to develop a new environmental teaching order in these departments, this requires the following:

- Including environmental design practices within architectural study topics.
- Identifying the obstacles preventing theoretical environment and sustainability issues to be turned to applicable sustainable designs. (Serigo, 2009)

6-1-(EDUCATE) program

The (Environmental Design in University Curricula and Architectural Training in Europe: EDUCATE) program began since (2009). It aims to accelerate acquisition of knowledge and skills in the field of sustainable environmental design, to achieve energy efficiency in new and old buildings. This will be done through a dynamic design process takes in consideration the culture, economic and social factors during all phases of architectural teaching. This initiative emerged as a result of corporation between seven different (British, German, Belgian and Spanish and Hungarian) academic institutes and supported by the European Commission. The program seeks to achieve the following:

- Removing the educational barriers standing against integration environmental design principles within the architectural education.
- Selecting a methodical framework to cover the gap between sustainable theoretical information and the applicable design in different levels of architectural education to achieve the expected requirements.
- Developing sustainable design concepts for the graduates to make them qualified to work in high level standards engineering bureaus.
- Dissemination the best ways to incorporate sustainable design between architecture students.(Sergio, 2011)

Architectural curriculum largely covers wide range of technical and non-technical topics, which seeks to provide

students with awareness, knowledge and the necessary understanding to reach high level of thinking for architectural design and gives them the ability to make the right decisions to solve environmental problems they face in the future, but there are many difficulties hinder teaching sustainability such as:

- Multiple methods that can be adopted in teaching.
- How to integrate this material with architecture issues?
- The difficulty of making any changes in the curriculum without responding between the new subjects and the old ones.

However it is still considered that environmental treatments will make a positive addition to architectural design, rather than this should be an essential part of it. Such a situation is no longer accepted within the current environmental crises and under the accelerated pressures to reorient architectural teaching.

Therefore there is a need to develop a new multidisciplinary education programs to bridge the traditional gap between the theoretical teaching and its practical application in architectural departments through broad participation between students and professors in classrooms and environmental laboratories and design studios. (Sergio, 2009)

6-2 Examples of teaching sustainability in architectural departments

Researcher (Eleni Alexandrou) in School of Architecture, National Technical University of Athens - Greece says; (Energy Efficiency in Buildings) subject has been taught for many years, but students did not take it seriously because they failed to correlate it with architectural design, this turned the subject into a boring issue, related only with mathematical equations in a mechanical process. Thus most of the students did not implement bioclimatic measures in their designs.

Another attempt took place in the same architecture school to add a new environmental subject titled (construction techniques) to the third year level under the field of (Climate Responsive Architectural Design) aims to teach students different topics such as types of energy resources, energy efficiency, renewable energy, recycling, pollution, environment responsive construction materials... etc, besides exploring traditional environmental responsive architecture in order to help students to understand the traditional sustainable principles and techniques, and enhance their understanding about these subjects and how to use these concepts in modern and contemporary designs. This annual teaching followed by assessing process to evaluate the subject and develop it as an essential part of the school environmental teaching program that cannot be separated from its architectural curriculum. (Eleni, 2011)

Environmental issues became important subjects in (Jnoa) University/Italy. The teaching did not focus on student's architectural designs only, but it addressed environmental issues to the old buildings. That did not take in account environmental issues neither in design nor in choosing construction materials to provide thermal comfort to the occupants. This produced sick buildings that consume large amounts of energy. The teaching program aims to provide sustainable architectural solutions for these buildings, to produce new generations of architects who are capable to enter the realm of sustainable designs. (Giovanna, 2011)

6-3 Sustainable Environmental Education in Al Nahrain University / Baghdad/ Iraq

Teaching environmental sustainability in architecture department /collage of engineering/ Al Nahrain University began in (2009) as a theoretical topic, till (2015) when a trail was experienced to integrate the theoretical teaching with its practical practices through the graduation projects.

6-3-1 The theoretical material for environmental sustainability

Within the vocabulary of the mandatory methodology subjects for the fourth grade students is environment. Since (2009) teaching environment reoriented to sustainability as the main part of this subject indicating the theoretical phase of teaching sustainability, it focused on:

- The impact of fossil energy production on climate change.
- Types of climate change including global warming, acid rain and pollution.
- The relation between the built environment and energy consumption.
- Renewable energies, types and method of use.
- Traditional climate responsive architecture design and planning.
- Thermal comfort.
- Passive cooling.
- Examples of contemporary passive cooling systems used in modern projects, cities and buildings.

Due to the student's interest in the subject and their desire to apply the theoretical gained information in a practical way in their graduation projects, the second phase of sustainable teaching took place.

6-3-2 Application sustainable principles on the fifth grade graduation projects

In order to apply the theoretical sustainable information obtained by the students in the fourth grade to their fifth year graduation projects. We joined the teaching staff of the fifth grade to supervise number of sustainable projects that included passive techniques as part of the project design.

We cooperated with the students to produce sustainable projects that have taken in consideration Iraqi climate and its environment by implementing sustainable principles to the project planning, design, and details. One of them is a manufacturing and training center for Mechatronics. The project provides thermal comfort for its occupants through"

- Planning and design.
- its passive cooling system that includes:
 - a. Outside induced air moving due to the project two blocks masses.
 - b. Cooling and filtering the outer air by passing it over water bodies and green areas then moving it through narrow, shaded, cooled path, similar to the traditional narrow streets, in order to pre cool and filter the outside warm dusty air .
 - c. Cooling the outer air before it enter the building by using water evaporating units distributed and located on the inner façade of the building and as a main designed parts of it. This will add extra cooling to the pre cooled outside air besides and will double filter the air from dust.
 - d. Inside building induced air circulation will occur due to the solar chimneys located on the outer façade of the project as a main part of the building design and as a main feature on its facades.

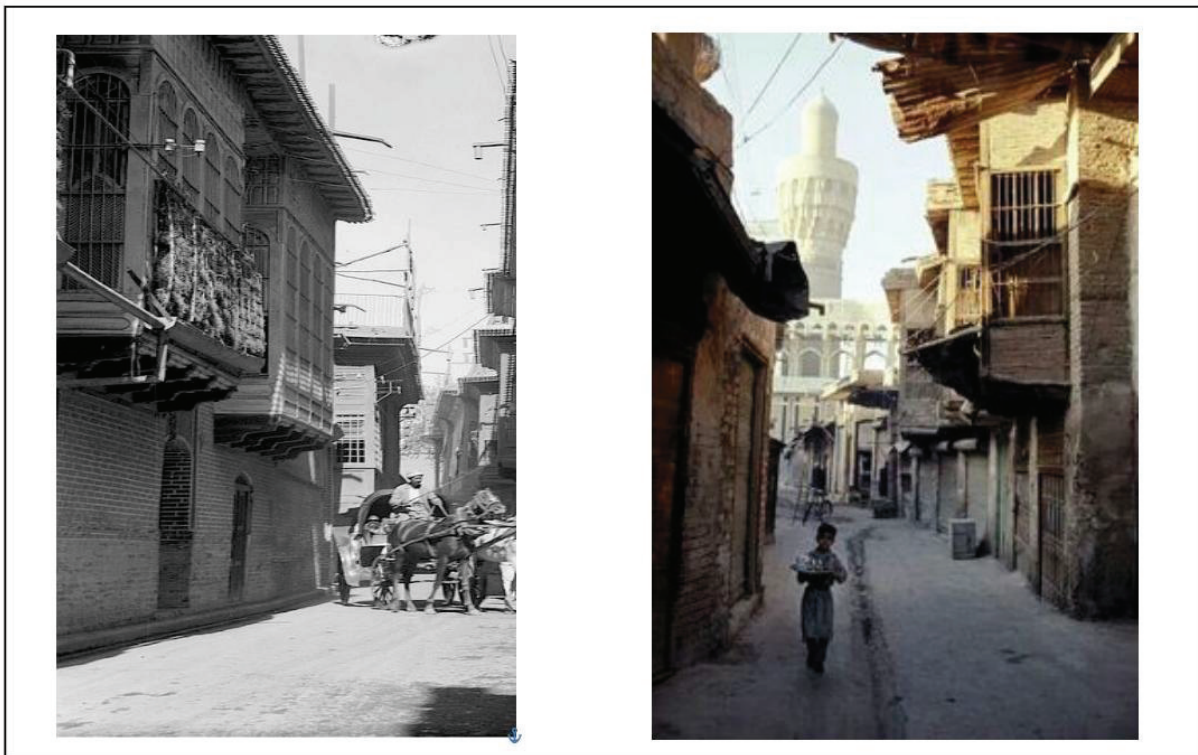


Fig-1 Narrow cool shaded traditional street

<https://www.google.iq/search?q=narrow+streets+of+oriental+traditional+city&biw>



Fig-2 Graduate student project inspire his design from traditional narrow, cool and shaded streets
Researcher from student project

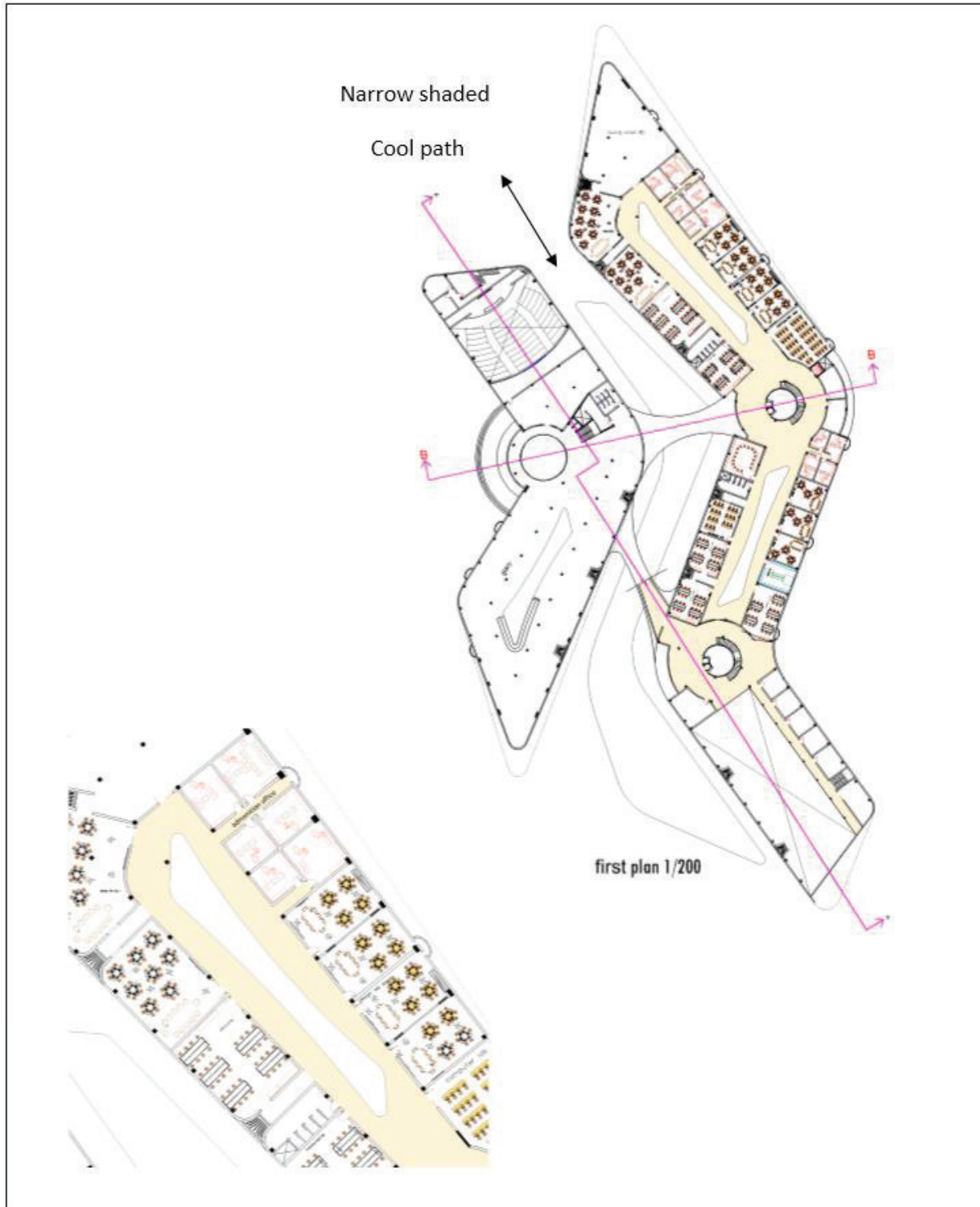


Fig-3 student project first floor plan containing the narrow path and partial enlarged plan
Researcher from student project

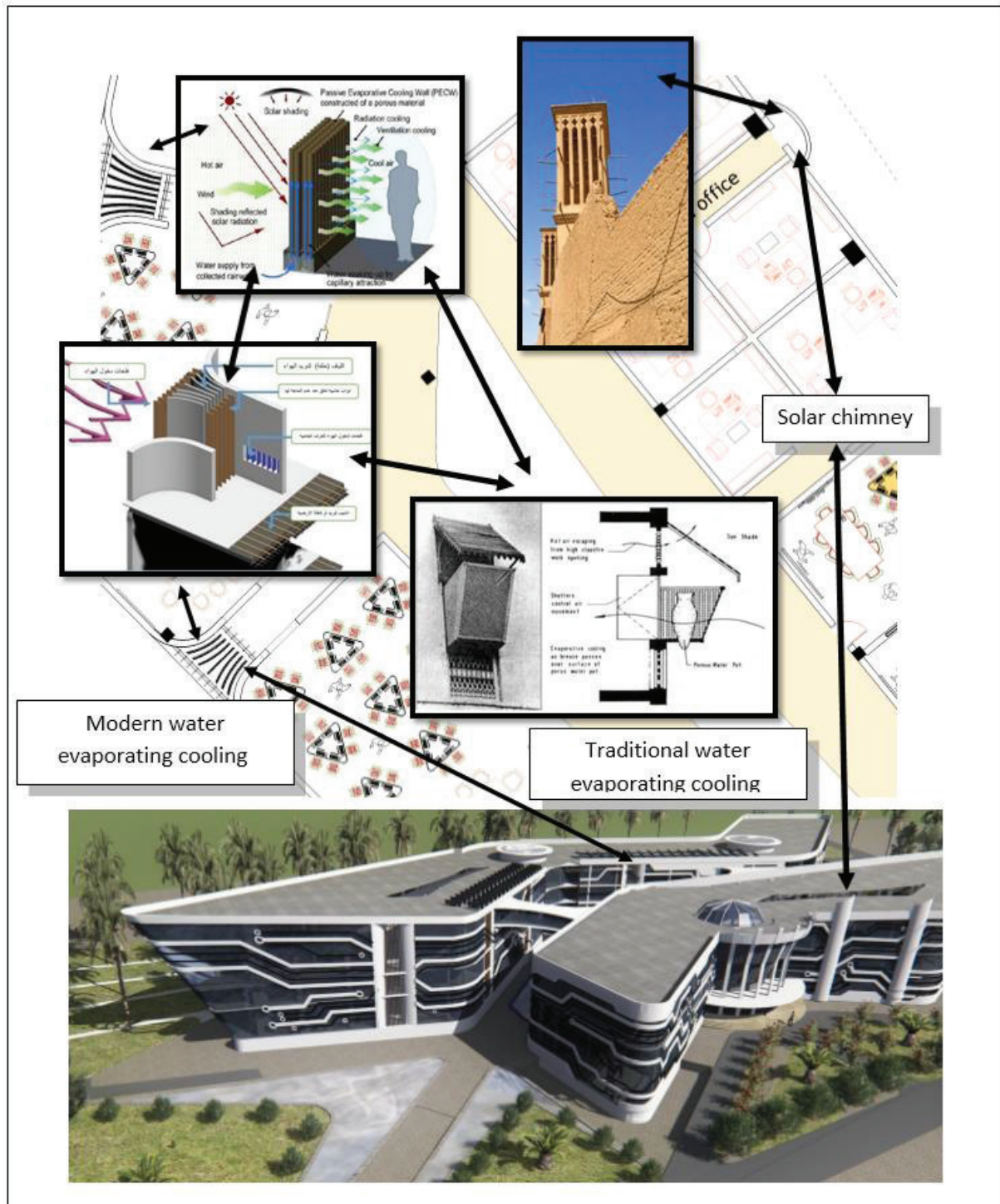


Fig-4 Enlarged partial plan showing passive cooling techniques used to cool the building
 Researcher from student project

Conclusions

1 -Engineers in general and architects in practical play important role in determining the future of life on earth, through designing the healthy buildings that take into account sustainability and environmental issues, therefore, environmental education in architectural departments will help students to take these issues into consideration in their architectural designs.

2- Teaching sustainability and environmental issues to architectural students in theoretical manner will certainly develop student's environmental data base, but this will require practical application of these information in student's architectural designs to achieve the desired goals of teaching sustainability.

3-The practical application of sustainable education will entrench sustainable principles deeply into the students minds under direct supervision of their staff. This will bridge the traditional gap between the theoretical and practical sides of environmental education.

4- Student's projects and research must be directed by teaching staff to deal with sustainability and environmental issues according to Iraqi climatic conditions, this will help to find the most suitable environmental/architecture solutions through student's projects that will fit our environment.

5- Sustainable and environmental treatments applied to students projects must take its weight in projects evaluating, particularly graduation projects.

6- Sustainable education is not limited to architectural students, but it can be part of other engineering department's curriculum, so there will be a new kind of teaching cooperation between different engineering department's staff.

7-There will be a possibility to integrate different engineering department Student's graduation projects into one complete environmental sustainable project in a similar way to the real consultant engineering beureau.

8-Teaching sustainability in this way will help to produce new generation of architects capable to deal with Iraqi climate in a proper way and will help to bring back Iraqi architecture its distinguish native personality away from the international architecture that invaded our countries.

9-This way of teaching will help to combine more than one curricula issue into one integrated subject to insure its importance and deserved weight in student's architectural teaching.

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