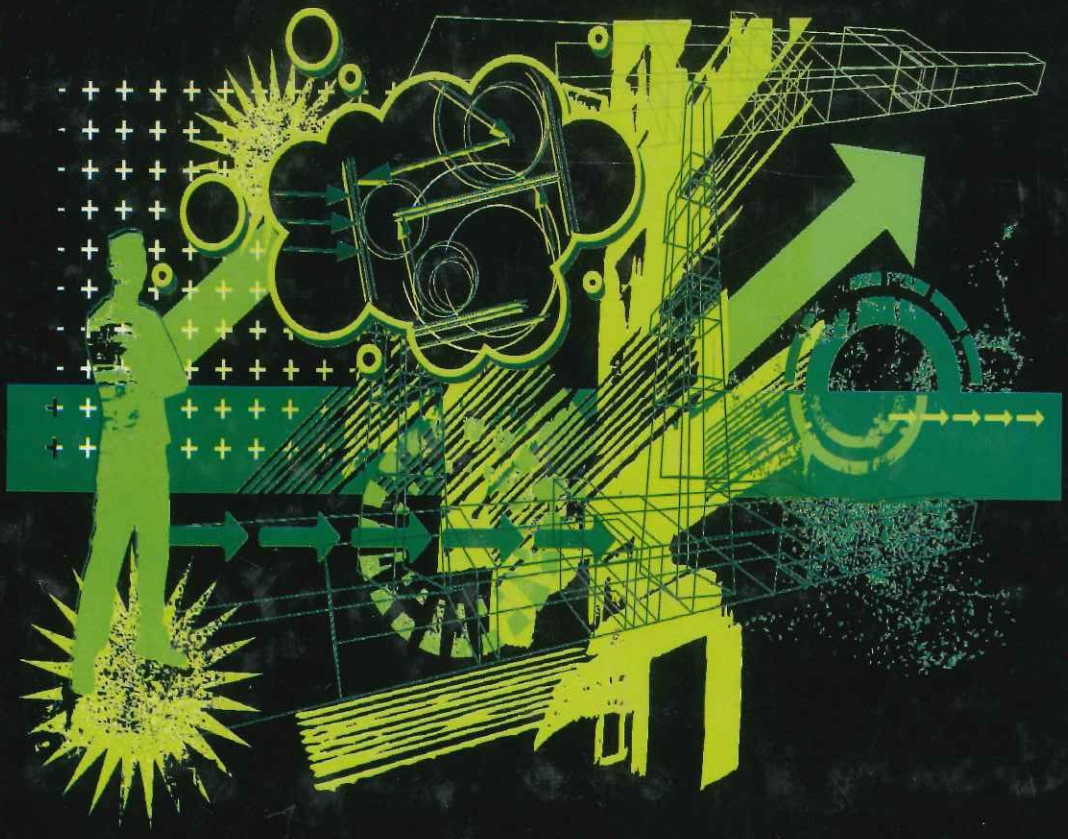
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ENERGY CONSCIOUS ECOLOGICAL ARCHITECTURE EDUCATION IN ARCHITECTURE DEPARTMENTS OF TURKEY

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Abstract

Energy conscious ecological architecture concept is one of the main subjects of architectural education. Through this concept, it is aimed to prevent damages in ecological context with environmentally conscious and responsible approach.

Regarding these issues, sufficient education - training has not been given yet in most of Architecture Departments of Turkey therefore this situation is slowing down the development of architecture in this field. Energy conscious ecological architecture education was analyzed at Architecture Departments of Turkey and similar examples from abroad were given to increase sensibility of architecture education regarding this issue and contribute to improvement of theoretical and practical course contents. Comparative analyses were conducted by qualitative and quantitative research methods; different education systems were analyzed in terms of support and contribution of theoretical courses to studio courses.

Finally, importance of ecology concept in architectural education was reminded once more and situation of undertaking this issue at education programs of architecture schools in Turkey, and position of education in Turkey in this awakening period. With this study the aim is, directly a contribution to architectural education, and indirectly raising awareness of students that can contribute to sustainable architecture in Turkey, with the ability of evaluating and executing ecological concepts.

Keywords: Architectural education, energy efficient and ecological architectural design, Architecture Departments of Turkey, energy conscious ecological architecture

1. Introduction

1.1 Energy Conscious Ecological Design Literature in Architecture

Energy is generally consumed within 3 sectors; industry, intercommunication and buildings[1] and buildings take a great part of energy consumption with 40-60%. In this manner today, "optimized use of energy" problem becomes the most important isuue at building design and administration fields [1,'2, 3]. Architects [4] are the most important actors of building design and have an important role comparative [5] to all other disciplines. Building, city and spatial combination of these items are necessary key points to build a future on "sustainable development" [5]. Basic issue is, the inequality of dynamic fields around sustainability and know-how of the constructed environment [6].

For practical design, decisions taken at first stages of design process, mainly affect the performance of the result. Since the construction will be within a long-term interaction with environment, architects are responsible of designing and manufacturing with "ecological architecture".

Ecological design approach whose first emergence was on 1970s, is a design method aiming of structure production [8, 9] that are compatible with their environment [7] and using passive design principles. Olson claimed in his thesis that best design is the design that follows nature [10], similarly Yeang highlights design with nature [3]. At building scale, Vitruvius describes sustainable development as relation between "function" and "construction" [11]. Ecological design provides conformity when forming a sensitive approach to human and environment simultaneously and also the principle of sufficient and economic usage of world resources at the same time. Under this general approach and explanation, it is possible to summarize general principles of ecological design under six important titles [12] and describe briefly the major characteristic differences between conventional and ecological design (Table 1.)

- Energy Source
- Material Use
- Pollution-Toxic Substances
- Ecology and Economy
- Design Criterias
- Conciousness to cultural and ecological diversity
- Cumulative Information
- Spatial Scales
- The role of the nature
- Analogical Concepts

Table 1. Characteristics of Conventional vs. Ecological Design [13]

Subject	Conventional Design	Ecological Design
Energy Source	Renewable fossil-based energy sources	Renewable energy sources such as solar, wind, hydrotermic, biomass
Material Use	High-quality materials that contain toxic substances that disrupts the natural structure of soil, air and water	Healthy materials that can be converted into reusable, flexible forms with nature-friendly substances
Pollution	Air and nature pollution	Waste will be recycled to nature for reuse, pollution will be minimized
Toxic substances	Many materials widely contains	In very special cases, contains a small amount
Ecology and economy	Short-time cost analysis	Forward-looking cost analysis
Design criterias	Economics, traditions, and satisfaction	Human health and ecosystem continuity
Consciousness to ecological context	Standard types of buildings is same all over the world, regardless of location, climate and culture	Bioregional sensitivity of the design is in harmony with local values
Consciousness to cultural context	Homogeneous global culture ignores the local tissue	Importance is given to the traditional knowledge, technology and materials
Biological, cultural and ecological diversity	The same type of designs that destroy diversity, and use high energy and expensive equipment	The adoption of local culture and economy on behalf of biodiversity
Cumulative information	Interdisciplinary studies in the narrowed areas	Getting feedback from different disciplines by integrating many scientific fields
Spatial scales	Each time design in a single scale	Work in different scales, upper-scale integration between the sub-scale
The role of the nature	Not caring much for nature, can not make contact with user needs	Taking nature as a design element where possible, by taking advantage of the potential of nature as a source of material and energy uses.
Analogical concepts	Machine, product	Cell, organism, ecosystem

1.2 Energy Efficient - Ecological Design Literature in Architecture Education

Regarding increasing environmental problems, it is necessary that these issues should be taken into consideration at architecture education. Design education should cover sustainable environmental design concepts efficiently in order to educate future architects dealing with built environment [14].

Yeang points out in his book 'Designing with Nature' that architecture education should be handled again as covering 'ecology' and "environmental biology", and 'traditional' perspective should be revised again according to ecological design approach [3]. At the present day, "conventional" design based education system does not overrate environmental design problems, and environmentally unconscious architects are raised with inappropriate attitude to technology.

Koester, as a result of his works on design process within the whole architecture education, claims that sustainability concept should be accepted as method to form the best studio design education [15].

Architectural studios are environments that combine various specializations and abilities in architecture education. Also it is beneficial for students since various and different issues are processed that an architect faces. Studio environment is one of the key stone of architectural design field and it should be compatible with architecture disciplines. The aim should not be only designing, but also be respondent to contemporary requirements. In architectural agenda "energy efficient - ecological design" concepts should have an important spot within parts of this studio pratice.

"Energy efficient - ecological design" concept should be given to architecture students within the aim of producing real architecture solutions. Energy concept should be emphasized as the real of the world issue and taken into consideration carefully instead of focusing on ordinary critiques and samples. Accurate decisions taken in design process, eventuate with forming energy efficient building design consciousness in architectural design education. At the present day, most important problem is the students' inability to interpret environmental sustainability decisions at studio design courses.

Other important point that should be taken into consideration is that technological advances in computer environment in design education. Developments at computer technologies make computer use as a tool frequently at building designs and performance analysis [1].

It should be questioned that as if current architecture education programs keep or do not keep pace within the era of ecological architecture and age of technology. Related disciplines should be sensitive and accurate for meeting technology and "energy efficient ecological design" concept within the studio environment for establishing the best appropriate interrelation.

Energy efficient - ecological building design education will be given to architecture students, within concepts of sustainability and energy conservation as design principles. All the facts should be thought together and all decisions should be taken during early processes and between early design to finalization the project, the design should be evaluated within this perspective.

Focusing at architecture education in Turkey, ecology based environmental issues similar to western implementations does not exist. Therefore, most of the architects educated in our country are not fully equipped with the environmental subjects. Getting behind from world literature and education are emasculating new age architects. Only way to change this situation is realizing ecology based education according to school and out-of-school education together [16].

2. Ecological Education Situation at Architecture Departments of Turkey

In this framework a research has been conducted among 45 Architecture Departments of Turkish Universities. The aim was to draw attention and find answers to following questions:

- What is the situation of 'physical environmental control' education in studios?
- What is the ratio of specialists (teaching staff) in environmental architecture to the whole?
- What is the ratio of environmental courses to the whole in undergraduate degree?
- What is the ratio of environmental courses to the whole in graduate degree?
- What is the content of the courses in graduate and undergraduate courses?

A research has been going on through the educational content and web sites of Architecture Departments. Since some of these departments are newly founded, it was hard to reach the necessary data.

A table of the results is drawn to show the teaching staff, undergraduate and graduate courses all through the departments (Table 2.)

Table 2. Educational Status of Architecture Departments of Turkey in the Context of Ecology

	Turkish Architecture Departments	Rate of Teaching staff experienced in Physical Environmental Control	Rate of Undergraduate courses in Physical Environmental Control	Rate of Graduate courses in Physical Environmental Control
1	Abant Izzet Baysal University	0 out of 11(%0)	%2,9	No graduate program
2	Akdeniz University	0 out of 3 (%0)	Cannot reach the data	No graduate program
3	Anadolu University	2 out of 36 (%5,5)	%2,6	Cannot reach the data
4	Bahcesehir University	1 out of 31 (%3,2)	%2,9	%0
5	Balikesir University	1 out of 11 (%9)	%6,5	%14,3
6	Beykent University	5 out of 15 (%33,3)	%11,9	%13,5
7	Bozok University	Cannot reach the data	Cannot reach the data	No graduate program
8	Cukurova University	3 out of 10 (%30)	Cannot reach the data	%17,2
9	Dicle University	2 out of 26 (%7,7)	%9,6	%10
10	Dokuz Eylul University	3 out of 45 (%6,6)	%2,7	%10
11	Dogu Akdeniz University	1 out of 28 (%3,6)	%2,3	%4,4
12	Dogus University	0 out of 15 (%0)	%8,1	No graduate program
13	Erciyes University	2 out of 28 (%7,1)	%6,3	Cannot reach the data
14	Eskisehir Osmangazi University	Cannot reach the data	%3,6	Cannot reach the data
15	Gazi University	6 out of 45 (%13,3)	%6,2	%8,9
16	Gebze Institute of High Technology	2 out of 16 (%12,5)	%5	%14,8
17	Girne American University	Cannot reach the data	Cannot reach the data	%0
18	Halic University	5 out of 25 (%18,5)	%3,4	%16,7
19	Istanbul Aydin University	1 out of 12 (%8,3)	%3	No graduate program
20	Istanbul Bilgi University	1 out of 12 (%0)	No undergraduate program	%2
21	Istanbul Kultur University	4 out of 42 (%9,5)	%7	%13,3
22	Istanbul Technical University	9 out of 90 (%10)	%9,2	%15,7
23	Izmir Economy University	3 out of 26 (%11,5)	%2,9	%3,2
24	Izmir University of High Technology	10 out of 42 (%23,8)	%6,5	%1,7
25	Karabuk University	3 out of 16 (%18,7)	%5,6	%19
26	Karadeniz Technical University	7 out of 45 (%15,5)	%6,7	%7
27	Kocaeli University	5 out of 15 (%33,3)	%2,6	%8,1
28	Lefke European University	3 out of 17 (%17,6)	%2,3	%8,3
29	Maltepe University	4 out of 29 (%13,8)	%4,6	%14,3
30	Mardin Artuklu University	0 out of 1 (%0)	%0	No graduate program
31	Mersin University	1 out of 10 (%10)	%4	No graduate program
32	Mimar Sinan Fine Arts University	22 out of 114 (%19,3)	%9	%8,4
33	Mustafa Kemal University	Cannot reach the data	Cannot reach the data	Cannot reach the data
34	Nigde University	0 out of 8 (%0)	Cannot reach the data	No graduate program
35	Middle East Technical University	7 out of 75 (%9,3)	%10,9	%4,7
36	Selcuk University	4 out of 38 (%10,5)	%6,9	Cannot reach the data
37	Suleyman Demirel University	4 out of 11 (%36,4)	%3,4	%4,2
38	Trakya University	1 out of 11 (%4,5)	Cannot reach the data	Cannot reach the data
39	Uludag University	Cannot reach the data	%5,3	%8,8
40	International Cyprus University	2 out of 36 (%5,5)	%5,4	%13,6
41	Near Eastern University	3 out of 25 (%12)	%8,5	%5,7
42	Yasar University	2 out of 11 (%18,2)	%5,1	No graduate program
43	Yeditepe University	2 out of 53 (%3,8)	%4,3	%10,5
44	Yildiz Technical University	20 out of 101 (%19,8)	%12,3	%27,3
45	Yüzüncüyıl University	0 out of 11 (%0)	Cannot reach the data	No graduate program

The outputs derived from the research are as follows:

- Regarding teaching staff (with specialists in the field including research assistants) experienced in Physical Environmental Control,
  - 4 out of 45 departments, the rate is over %30,
  - 14 out of 45 departments, the rate is up to %10.

- 13 out of 45 departments, the rate is between %10 to %20.
- 2 out of 45 departments, the rate is between %20 to %30.
- 7 out of 45 departments, there are no specialists in these fields.
- 5 out of 45 departments, data cannot be reached.

The overall rate is of specialist teaching staff in this field is %12,2 among all departments. The number is not bad, there are very valuable educators in the departments, but they should be organized as a 'physical environmental control chair' for specialized graduate programs.

- Regarding undergraduate courses in Physical Environmental Control,

  - 1 out of 45 departments, there is no specific course because it is a newly founded department.
  - 16 out of 45 departments, up to %5.
  - 16 out of 45 departments, %5-%10
  - 3 out of 45 departments, %10-%15
  - 1 out of 45 departments, there is no undergraduate program.
  - 8 out of 45 departments' data cannot be reached.

  As must and elective courses in the programs, the course themes are given as followed;

  - Physical Environmental Control Courses
  - Environmental Design and Ecological Architecture Courses
  - Architectural Acoustics and Lighting
  - Energy Efficient Construction
  - Landscape Ecology
  - Building Physics
  - Heat and Humidity Control
  - Architectural Technology
  - Solar Energy Applications in Buildings
  - Daylight
  - Ecology
  - Moisture Isolation in Buildings

- Regarding graduate courses in Physical Environmental Control,

  - 3 out of 45 departments, there are no specialized courses regarding this field.
  - 14 out of 45 departments, up to %10.
  - 11 out of 45 departments, %10-%20.
  - 1 out of 45 departments, more than %20.
  - 6 out of 45 departments, data cannot be reached.
  - 10 out of 45 departments, does not have a graduate program at all.

As must and elective courses in the programs, the course themes are given as followed;

- Performance requirements for Building Elements
- Acoustical problems regarding building typology
- Sound insulation in buildings
- Sunlight in Architecture
- Computer Aided Energy Efficient Building Design
- Architectural Lighting
- Material Performance in Structures
- Passive and Active systems in benefit of solar energy
- Users' Requirements and Built Environment Standarts
- Low energy cost building design
- Traditional materials in architecture
- Climate and Building Envelope Design
- Acoustical Design of Halls for Speech and Music
- Building Element Alternatives
- Ecological Building Materials

Since some departments offer a very condensed graduate program with design studios specialized in this field, some departments only offer a few related courses. There are only a few departments who offer ecological design studios in undergraduate or graduate level. As the results show us, the number of the given courses are not low, but the content should be developed for specialized graduate programs and ecological design studios.

When examining results, following works are realized as a special struggle;

- Ecologic Building Design Undergraduate Studio "Studio 5" exists at Gazi University
- Specialized graduate program on "physical environmental control" issue exist at İstanbul Technical University
- Limited number of universities as Yıldız Technical University, Gazi University, Istanbul Technical University, Dokuz Eylul University have symposiums organized on these issues
- At Turkish Republic of Northern Cyprus Eastern Mediterranean University, project analysis under this disclosure policy at architecture studios with courses on energy-ecology field has been existed since 1997 [17]. Courses exist at Bachelor's level and master levels are supported with group studies, research trips and seminars but specialized studios where studies can be realized within studio scope has not been formed yet.

3. Energy-Ecology Concepts at Foreign Architecture Departments

Generally, at world architecture departments' course programs and philosophy, energy-ecology issues are located moreover faculties are formed around environment sciences as one of the sub-branch of architecture [17]. This consciousness newly began in our country, although theoretical courses are given in this field in many years, unfortunately implementations at architecture in design educations started lately.

"Sustainable environmental architecture" expression at architectural design, exists always at technical infrastructure contexts and are seen as a specialist field where designers are involved as well as professionals in these fields. In this framework, Prof. Chen has been conducted experimental researches at University of Sheffield, on practicing energy-ecology concepts over students' early design processes [19]. Housing design was demanded from students according to certain environmental critiques with "Ecohouses" project in the professional manner, and efficiency of this design method was evaluated via a survey. By this way, increasing knowledge and consciousness in this issue was aimed.

In 1993, with "environment programs" at Architecture-Building and Planning Faculty of Melbourne University, it is aimed to provide connection of multi-discipliner scientific knowledge to design processes. Basic philosophical and social cases are brought up and *know-how, know-why and know-what* were examined [6] At the end of theoretical training given by Radovic in this field, the main subject examined by him was to show the way how to integrate these issued discussed on "Environmental Design" to "traditional" architecture studios. Similarly, works at Turkish Republic of Northern Cyprus Eastern Mediterranean University, Department of Architecture, it was aimed that to give specialized project analysis method under these information at architecture design studios with energy-ecology field courses since 1997 [17]. These courses exist at Bachelor's Level and Master Level are supported by group works, research trips, and seminars, but design studios where work can be realized within studio scope has not been formed. However there are ecological studio formations in Gazi University at undergraduate level since 2003, and Istanbul Technical University at graduate level.

Courses on environmental design and sustainability subject based on knowledge technology (IT/web) applied at various universities [20, 21, 22, 23, 24] and these courses provided studio inputs to design processes [25]. The basic aim of integration to studio education is developing an education system including integration of ecological contents to architecture design [4], transferring knowledge via education programs to candidate architects in sustainable architecture and plant this consciousness [19]. At courses supporting studios, it is aimed to form an infrastructure of education with issues as climatic design, passive design and source efficiency and to inform architecture students on basic physical rules and basic behaviors of buildings [26]. Energy-ecological issues are disposed to most of the architecture discipline, course programs and philosophy. Studies aiming studio integration are applied via various disciplines.

4. Results

Under these struggles within all architecture departments, we are trying to draw attention on consciousness regarding this subject in our country where 61% of energy consumption is imported, share of fossil sourced fuel is 82% within total energy consumption since the use of solar energy is only 0.05%. Using 80% of energy consumption at buildings for heating, energy used for only building heating is approximately 2509 kWh/m^2 (In Germany it is 70 kWh/m^2, in Austria it is 50 kWh/m^2) in a year [18].

It was understood from scientific researches and experiences that architectural design is the one of the most important step of an energy efficient building. Design methods used most of the time to buildings were not appropriate to analyze energy efficient behavior and these mistakes will be corrected later even in production stages. However this will not be the most accurate/successful one nor the economic one. It is necessary to change the belief that architectural design and energy efficient architecture are very

different concepts and two periods should be integrated to each other beginning from first stages of design.

It is necessary that these issues should be taken into consideration, integration of *sustainable environmental design* concepts into design education effectively at architecture education with the aim of improving future architects' education with built environment issues regarding increasing environmental problems is necessary [14]. At the present day, education system has been still embraced based on "conventional" design that does not heed environmental design problems, unconscious architects have been educated in these issues does not exist.

Although there exist more energy resources in Turkey than European countries, these are less used, and in Turkey, in addition to legal studies on continuous improvement of regulations and accuracy implementation of energy saved building design and production, this approach should be adopted in principle at architecture education in similar sensibility. It should be discussed that what will be done for candidate architects to be equipped regarding education of energy efficient building design issue by examining current education. Energy efficient building design courses should be within required subjects at education programs of architecture schools and these courses should not be taken only in theoretical way, but also ecological studios should be realized. Studio studies emphasizing on these issues should be realized in every architectural department. Therefore;

- Theoretical courses in the related field must be integrated with studio courses in the processes of architectural designs.
- Besides must courses in physical environmental control, more elective courses should be tought in academic cirruculum in specialized fields, including computer aided ecological design and building performance analysis methods
- Thematic programs and courses should be structured especially in graduate level.
- Students should be encouraged to study energy conscious ecological design at graduate level, whom may be advisors to the architectural companies in the future or manage own projects.

Architecture education is a whole that accomplish itself with architecture design studio courses and theoretical courses that requires the area of specialization. When detailed technical information is given at theoretical courses that supports studio, it is expected that implementation/gaining experience of these information during studio period will be achieved.

By taking into consideration that most of the architecture students are susceptible to learn with visual material, education techniques including visual media are better choices. In detail, "Building Energy Simulation Programs", must be used at energy analysis and modeling of buildings. With these simulations, students taking energy efficient building design principles into consideration will gain ability of evaluating their knowledge in addition to their theoretical knowledge.
Scientific studies on issue of increasing efficient energy usage at buildings should be accelerated. National or international symposiums, workshops should be organized in related departments.

Our mission as educators that educate architecture students is giving idea of design understanding that addresses requirements of society, oriented to problems that should be solved regarding implementation and that will contribute to future designs.

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