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Computer Aided Theoretical Courses in Architectural Education: Building Material Information System

Leyla Tanacan, Elcin Tas, Hakan Yaman

***Abstract* — Building material information systems have an important role to play as information providers. It is assumed that the building material information system will be a supportive object in architectural education. Thus, the students will be able to access all kinds of real and up-to-date information about the building materials available in the construction market. It will also be possible for the students to link the subjects given in theoretical and practical courses and projects studied in design studios by using the building material information system.**

***Index Terms* — Information Technology, Building Materials Information Systems, Education, Architectural Education.**

I. Introduction

The concept of Information Technology, which has recently become one of the most common subject matters discussed, is built upon the features, relations and interactions of two essential components, namely the information and the technology. Herein, the information in concern refers to the real, sufficient and accessible one obtained by means of scientific methods. Moreover, such information has a systematic structure of its own. The speed of access to the information is as important as the quality of the pertinent information. In the information society we live in, computers are indispensable technological tools in terms of both the access to information and information processing.

Developing at an inconceivable speed, the technology not only helps the designers to assess their architectural projects in aesthetic terms by means of the design, drawing and presentation facilities, but also presents new possibilities for studying the projects in structural and economical terms. CAD software and the information highway, the Internet is used as a tool to declare and deliver such kind of possibilities.

In Turkish Construction sector, which has limited sources, it is very important to choose among the compatible building material alternatives that are the most appropriate to the objectives of the project and the planned budget set accordingly to the construction method. The building material used in the construction process is very significant in providing and maintaining the performance expected from the building.

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Moreover, the cost of building materials is an important factor in total building cost.

Like most of the faculties of architecture, the education at Istanbul Technical University (ITU), Faculty of Architecture depends heavily on the project studies carried out within the studios. The information given in the theoretical courses support the design studios. However, for the students who cannot efficiently use the time remaining from the theoretical class hours, it is probable that the studio courses will result in failure. In addition, the more is the speed of societal developments the more is the variety of information that must be given to the student. It is a well-known fact that the thing necessary for the student to reach up-to-date and accurate information within the short time of theoretical courses is the development of effective course materials.

It seems that the building materials information systems can help in solving the problem.

At present, in order to set up and employ a building material information system, it is possible to make use of the means provided by the Information Technology (IT). A research project has been started by the writers of this paper at ITU Faculty of Architecture in order to develop a building material information system that can be used in the preliminary design and design phases of building construction process. A further aim of this research project is to make the information system available to the use of students within the framework of new “Education and Training Development Program” (ETDP) being carried out at ITU Faculty of Architecture.

II. Information Systems

The concept of information has become one of the fundamental sources of today’s society necessary for the success and the survival of organizations and people.

In simple terms information is the knowledge produced by means of data obtained through recorded cases and numbers. Information covers the processes of transferring and receiving knowledge. It informs the users, reduces uncertainties, shows the existing alternatives or helps the elimination of inappropriate ones [1].

The value of the information depends on its analyzability, interpretability, and understandability and ability to be expressed clearly.

On the other hand the information system is a team consisting of people, procedures and sources that gather, process, save and distribute the information in order to

support the decision making and control functions of the decision makers within the organization. From this point of view the information system may be seen as a system that processes the data sources and transforms them into information.

Verbal or informal Information systems are being replaced by formal computer aided information systems, which make use of hardware, software and human resources while transforming the data into information. On the basis of these facts, it is possible to state that computer aided information systems are structural, i.e. they are stable and can not be changed easily and they work in accordance with the previously-defined rules [2].

Information systems assume three main roles in the organizations and these are to support the operations in progress, to help the decision-makers to solve their problems and to gain a strategic competitive advantage against the competitors.

III. Building Materials Information

Recently, setting up and employing an information system have become easier by means of dramatically developing information and communication technology. These means, originate from the developments of various relational database management systems and progresses in the Internet. Online databases and the Internet have an important role to play as information providers.

The participants of the building construction process need accurate, timely, accessible and understandable building material information all the time. Because, they all know that proper use of building materials can only occur as a result of smart design process. Currently, hundreds of online databases and web sites serve to AEC community in order to present building materials information on the World Wide Web. Some of them are just individual web sites belonging to manufacturing and supplier companies and institutions, providing detailed or broad definitions and scanned brochures of building materials and their applications on buildings. Some of them are product selectors, providing all of the information about building materials via a search engine. Structure of the web site depends on the factors such as the facilities and financial support of the company or institutions that maintain it, user requirements, user profiles, capacity, scale and characteristic of the construction industry they serve, etc.

In Turkey, there are numerous manufacturing companies serving to the decision-makers to introduce their building materials both in printed and electronic format. Taking the advantage of storage capacity and versatility, CD-ROMs are the most preferred ones. In addition, directories and catalogue files, which organize and index the collection of manufacturers' catalogues prepared by public and private sector companies are the other decision-making sources for design and construction professionals.

However, not all of these sources are enough to compare, evaluate and select the building materials as a whole. Almost all of the sources mentioned above whether on paper or in electronic media consist of scanned data sheets and brochures of manufacturers, classified in terms of the companies' experiences. So, it is not practical and is out of date for dynamic and rapidly changing Turkish Construction Industry. On the other hand, web site contents and links are very poor; most of them are under construction. Although, it is very important, current market prices of building materials are not included [3].

Finally, it is clear that Turkey has not got a comprehensive and up-to-date source in the field of building material information yet, as it is seen in Europe and USA etc.

In order to cover this gap in Turkey, a research project has been started at ITU Faculty of Architecture on January 1 1999. The Research Fund of ITU supports the project namely "Design of a Building Materials Information System on a Relational Database Structure in Context of Turkey" (BMIS). The objective of the BMIS can be summarized as forming the required infrastructure that helps the decision-makers in solving the problems likely to occur during the building material selection process.

Regarding this objective, it is aimed to gather all the data about building materials currently used in Turkish construction market, process such data and transform them into information, and to present the information to the decision-makers. Thus, in the preliminary design and design phases of the building construction process it will be possible to find the building material alternatives and the cost of them. All the data gathered about the building materials will be indexed according to a classification system, which is developed in compliance with the conditions of Turkey. In order to make the information system internationally available, the classification system is being interrelated with CI/SfB classification system.

IV. The Current Situation Of Architectural Education In Itu

As the rate of the information production increases, the existing information becomes out of date quickly and the previous information becomes inadequate. Architectural education seems to change in accordance with the needs of changing societies, their social, cultural and political features and value systems.

Seemingly the societies and their basic properties have been in the processes of change and transformation considerably for many years and a craft-based culture has been replaced by industrial modern and/or post-modern culture. Thus for the time being, architectural education seems to be developing and modifying to some extend or even radically to meet the changing societies' new requirements, in terms of not only aesthetics but also technology, ecology, culture etc.

The introduction of the prefabrication of mass produced, precast building components led to a process of assembly, rather than of working on materials on site. Now, understanding of materials becomes more elusive. The role of the assembler of parts becomes more important than that of the craftsman who works on a material: complexity displaces art.

As buildings have come into being, more complex specialization has grown up. It is possible to see these as branching off from the mainstream of architecture or design: structural engineering, surveying, quantity surveying, project management, low energy design, facility management and most recently value management. Admittedly, specialization of this kind needs to be in architecture [4].

In architectural education, the information given to the students during the theoretical courses is transformed into skills in practical class hours and in architectural design studios. If such information cannot create a synthesis, it is said to be valueless.

In order to reflect changing conditions of life to education, ITU has experienced a process of re-analysis to survey the existing architectural education. In 1997, studies started to renew the education and training programs. Within the framework of "Education and Training Development Program" (ETDP), the national and international architectural education curricula have been compared by means of different questionnaires and the concerning studies have been assessed in various meetings. Finally, it has been agreed that the students of architecture should take courses less in number but more intense in content and that the education of architecture should be more research-oriented. The decision-makers have tried hard to conform to the course rates mentioned within accreditation conditions of NAAB. As a result, the number of courses taken in a term has been decreased. On the other hand it has been decided that most courses should be carried out practically in order to sustain and strengthen the specific aim of the Faculty of Architecture. This aim is mastering skills to the students in studio courses where the lecturer and the student are able to form one-to-one interaction. It is essential to note that the above-mentioned one-to-one interaction in design studios is a specific feature of the Faculty of Architecture.

Thus, the proportion of practical course hours, which used to be 39% in the old course schedule, has been increased to 43% by the changes introduced with the new course schedule.

While distributing the course hours to the academic terms, the follow-up sequence of the courses was taken into account and considering the fact that the information to be used in practical courses should be given beforehand, some changes were made accordingly. For this reason, the theoretical and studio courses varying greatly in number in the former terms are replaced by elective courses in the following terms so that the student can be guided in a more conscious way. On the basis of this objective the proportion of elective courses, which used to be 5% in the old course schedule, has been increased to 15% in the new course schedule.

V. Computer Aided Architectural Education

The architectural education is being affected by the rapidly developing information and communication technology. However, as the structure, expectancies and training strategies of the architectural education are different than those of the other education types, the applications of information and communication strategies also differ in specific terms.

At present, while a subject is being lectured in an architectural course, methods other than oral presentation are necessary. Due to the necessity that the increasing and varying information should be transferred to the student correctly and easily in a short period of time, the importance of such kind of tools has been increasing. Moreover, the possibilities of analyzing the visual information in its original location are limited because of the lively but heavy traffic of life. What have been emphasized recently are the methods to make the information ready-to-use for the students, rather than the methods of finding the information in its original location.

The current level of computer technology is far ahead of the point of "blackboard and chalk". Today with the advantages of information technology new methods appear on the horizon. The advantages of the new technology are as follows:

- Just with a personal computer, everyone can make use of multimedia techniques.
- Self-learning becomes more practical.
- It is possible for the trainers to include their course materials in computer medium and thus lecture with the help of audio-visual techniques.
- Although comparing more than one material on one medium is difficult or impossible by traditional methods, it is possible to achieve this on computer screens.
- To update the prepared course materials is not a problem any more [5].

Developing technology not only aids the designers to make aesthetic assessments by means of the design, drawing and presentation facilities it provides, but also presents new advantages for analyzing the projects in structural and economic terms. The high-capacity computers provided by hardware producers and CAD software whose versions are announced frequently is two examples about the aforesaid advantages. CAD software is effective methods to present the architectural expressions in the best way. Relational database management software, structural elements calculations and drawing software, cost estimation and calculation software which can all be internalized with CAD software are just a few of the technological facilities. Furthermore, the new information highway, the Internet is used as a tool to inform people about such possibilities and to distribute such information.

VI. The Building Materials Information System As An Educational Tool

In the context of new course schedule the use of the building material information system to be developed at the end of the project will be very helpful for the student. It is considered that the student will be able to reach the information directly in the same room where the student is in one-to-one interaction with the instructor, which is a distinguishing feature of the architectural education. The

building material information system will be helpful especially in the class hours in which the theoretical courses are put into practice. Moreover, it is possible to use it in architectural design studios during the building material selection and cost estimation of the projects in design phase.

In each phase of the design the student will be able to select the accurate building materials to be used in her/his project, reach the up-to-date information about building materials and be informed about the performance and conditions of their proper use. She/he will be able to learn the estimated cost of her/his project approximately. Furthermore, in the design process the student will get feedbacks and monitor the changes in the performance and the cost of the building according to the selected building materials.

In order to reach the building materials information by means of BMIS the student can:

- Search on the classification system, keywords, manufacturer or supplier firm, trade name, product name or geographical region of the company, etc.
- Access the building material properties form. The student who wants to select a building material can access the forms that present the properties of the building materials used in the market. Thus, the student will be able to see the differences among the alternatives in the same medium. A building material properties form for thermal and acoustical insulation materials is shown in Table I. As shown in table, the properties of the available building materials in market are given. The form will enable the student to evaluate all the information about the material to be selected.
- Get the entire information about the pertinent manufacturer or the supplier. If the student wants to get more information about the material, it will be possible by the links to the web site of the manufacturer or supplier, if available.
- Reach all kinds of data produced both in magnetic media and on paper - e.g. CAD drawings, pictures, videos that show the application methods and details. The experiences of the people who have used the material previously can be reported in written form or in oral form, if available.
- Learn the estimated building cost she/he designs in studios. In design process the student will be able to access current market prices of the materials selected. She/he will also be able to learn not only how total cost is affected by the probable changes made in the project she/he designs, but also how the total cost will change in compliance with the selected material [6].

VII. CONCLUSION

According to the ETDT applied at ITU Faculty of Architecture, the principle of orienting the student take courses less in number but more intense in content and encouraging research can be successful, if the BMIS to be developed is used.

The facilities introduced by the BMIS will be used especially in the practical class hours of the theoretical courses about building materials and building cost and on the projects of architectural design studios.

The student of architecture therefore, will be able to make a connection between not only theoretical courses and architectural design studios, but also architectural education and architectural profession. She/he will be able to evaluate the existing building materials in the market, compare their properties and access all the information about details, methods and cost that concern professional practices in architecture.

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TABLE I

BUILDING MATERIAL PROPERTIES FORM SAMPLE

THERMAL AND ACOUSTICAL INSULATING MATERIALS		COMPANY NAME 1	COMPANY NAME 2	COMPANY NAME 3	COMPANY NAME 4	COMPANY NAME 5
PRODUCT NAME						
The Structure of the Material	Organic (plant or animal based, polymer)					
	Inorganic (mineral)					
	Cellular or Fibrous					
Installation Method	Batts, Rigid board, Block, Loose-fill,					
	Cast-in foam, Mortar aggregate, Airtightness					
Institution of Turkish Standards Code Number (TSE)						
Physical Properties	Dimensions (mm) (Width, Length, Thickness)					
	Unit Weight (kg/m^3)					
	Thermal conductance (W/m^OC)					
	Thermal expansion coefficient (mm/m^OC)					
	Shrinkage (%)					
	Flame spread classification					
	Water absorption (%)					
	Water vapor resistivity factor ( )					
	Sound absorption coefficient					
	Sound insulation (dB)					
	Effects of parasite					
	Dimensional stability					
Chemical Properties	Acid resistance					
	Decay resistance					
	Ph value					
Mechanical Properties	Compressive strength (N/mm^2)					
	Tensile strength (N/mm^2)					
	Flexural strength (N/mm^2)					
	Modulus of elasticity (N/mm^2)					
Environmental Characteristics	Raw material acquisition					
	Pollution from manufacture and use					
	IAQ (indoor air quality) impacts					
	Embodied energy required to produce and transport (MJ/kg)					
	Reusability and being able to recycle					
Production Availability	Domestic product (produced in Turkey)					
	Imported					
Installation Place	Floor					
	Wall					
	Roof (Pitched roof, Built-up roof)					
Workmanship	To be cut					
	To be drilled					
	To be driven					
Installation Temperature Range (°C)						
Installation Type	Adhere to the building element					
	Fixing by an adhesive					
	Fixing by a special fastener					
	Fixing by a grid system					
	Fixing by mortar					
	Spread-over					
	Loose-fill in place					
Product Unit Price (TL)	Workmanship unit price					
	Auxiliary material unit price					
	Primer					
	Sub-material					
	Accessory					