Sustainability issues in architectural education: the integrated approach

Euphrosyne Triantis

Architect M. Arch, PhD
National Technical University of Athens, Athens, Greece

ABSTRACT: In the last few years there has been an abundance of bioclimatic and environmental design courses introduced in Schools of Architecture in Greece both on the undergraduate and graduate level. Although the emphasis in these courses differs, as they may deal either with the natural and technical aspects of environmental design or with the inclusion of sustainability issues in the practice of architectural design as such, there is usually a search for the integration of comfort considerations in the design process.
The necessity to understand the conditions of thermal and visual comfort has resulted in the development of new methodologies to deal with architectural design projects, in order to bring students closer to the basic concepts of environmental design not only in terms of technology, but also in terms of comfort for the user. This often results in a complete change in outlook to involve psychological as well as physical issues in design. Such considerations form the basis of a new environmental design course developed for the Architecture School at the University of Patras, Greece, which is discussed in this paper.

Keywords: architectural education, sustainability, comfort

1. INTRODUCTION

If architecture is considered not as a static "work of art", but as a dynamic environment intended to respond to changing conditions of climate, place and use patterns, the design process should be based less on geometric and physical aspects and more on the experience of architectural space both from the point of view of the architect and the user. Therefore a building should not be judged as a complete work in itself, without consideration for the occupants' points of view in terms of its commodity for their life patterns, including their feelings on the quality of thermal and visual comfort provided [1].

The study and comprehension of comfort patterns is quite complex and rather difficult to include in the usual architecture curriculum. Moreover, as proven by recent research, environmental comfort is closely related to environmental awareness and the active participation of the user in shaping his own environment [2].

Space perception is related to the occupant's adaptation to a place, his sense of environmental comfort and the possibility of searching a compromise between user and environment. In studies by Hawkes [3] there is a clearly expressed need by the users of a building to participate actively in the manipulation of environmental controls in order to respond to climate changes, while as discussed in a study on users' comfort in University buildings in Greece, automatic control of centralized heating and cooling systems has caused much higher levels of dissatisfaction.

2. A NEW DESIGN METHODOLOGY

The comprehension of users' attitudes on comfort is certainly not a simple matter and as soon as it is included in the program it often becomes the basis of a complete change in outlook to involve not only physical but also psychological issues in design.

A new methodology has thus been developed for environmental design courses at the Architecture School, University of Patras, Greece, where the analysis of environmental parameters is based not only on performance assessment, but also on the evaluation of thermal, visual and acoustic comfort for users of existing buildings. The latter are used by the students as case-studies for the comprehension of environmental factors involved in their design and operation. They also become a basis for proposed interventions to improve their performance in terms of sustainability criteria, including energy consumption and environmental impact as well as thermal and visual comfort.

The course methodology includes:

1. Lectures on significant sustainability issues including a thorough discussion of human comfort and analysis of examples of selected building types where such issues have been taken into consideration.
2. Selection of existing buildings to be used as case-studies. Each project team is composed of 1-3 students.
3. Collection of existing information on each building (plans, sections, construction drawings, energy consumption data, studies, details etc) as well as photographs and environmental

performance observations on the part of the students.
4. Analysis of use patterns in the building.
5. Auditing conducted by the students in representative spaces of the building (including temperature, humidity and daylighting measurements).
6. Interviews of users on thermal, visual and acoustic comfort conditions in the building, as well as comments on their work environment.
7. Scenaria of environmental retrofitting interventions.
8. Evaluation of integrated retrofitting scenaria, according to a pre-determined set of sustainability principles.
9. Development of the best integrated design solution for each building.
10. Final design and construction details of basic retrofitting components for each solution.

3. BASIC COMFORT CONSIDERATIONS

Although the buildings selected for the case-studies varied, there were two main tendencies:

1) To study university buildings on campus, starting from those used by the architecture school, or other public buildings in the city of Patras, or its vicinity.
2) To study buildings associated to the students' residence, mostly apartment buildings or hotels, or to their home environment, such as factories, offices or restaurants.

As this was the first contact of most students with a "real" building situation, new problems had to be surmounted that surpassed their usual student exercises –such as the procurement of architectural and construction drawings for the building studied and an official permit to visit them, install measuring equipment and interview their users. This first phase of contact with reality was crucial for some projects and entailed considerable loss of time and even subsequent change of project.

Once access to the case-studies selected was ensured, each study team started the analysis of its building considered as a "living organism". The purpose of this phase was not only to collect information on the building concerning its design, construction and use, but also to consider it as a point of interaction of different factors pertaining to its operation as a living environment, each with a potential influence on its present dynamic state of equilibrium.

Following a series of lectures where the importance and complexity of human comfort was discussed, the difference in philosophy between bioclimatic design and current engineering practice was pointed out. In fact, the former considers comfort parameters not just as strict, quantitative figures but as part of a complex, holistic experience pertaining to the subjectivity of the users. The students were thus encouraged to use a combination of objective and subjective approaches in order to comprehend the workings of each building and the role of its users and judge its overall relation to its environment with respect to sustainability criteria selected.

One of the points emphasized was that low energy architecture should offer possibilities for the user to adapt both his own behavior and some aspects of his immediate environment to changing comfort requirements, so that he feels he can actively influence comfort levels. This direct involvement of the user in the shaping of his own environment has considerable repercussions on his level of satisfaction. In fact, as follows from research on comfort, active participation reduces complaints and assures improved operation of low energy systems.

The building was thus considered by the students not as a static material entity, but as a dynamic environment offering different levels of possibilities for users to control depending on their own preferred level of involvement. This basic consideration greatly influenced not only the students' own approach to the analysis of each case-study, but also the phases of diagnosis and synthesis of their own interventions in the projects as well as their architectural design philosophy in general.

4. DISCUSSION OF SELECTED PROJECTS

4.1 One of the projects where the use of the building resulted in a negation of the environmental features in its original architectural design was the Public library building of Patras (Fig 1). This is a building designed in the 30's and constructed in the 50's, with important bioclimatic elements in its design, including a highly transparent South façade, opaque Northern façade and a central double height reading space covered by a partly glazed shed-type roof with operable parts, and surrounded by a mezzanine.

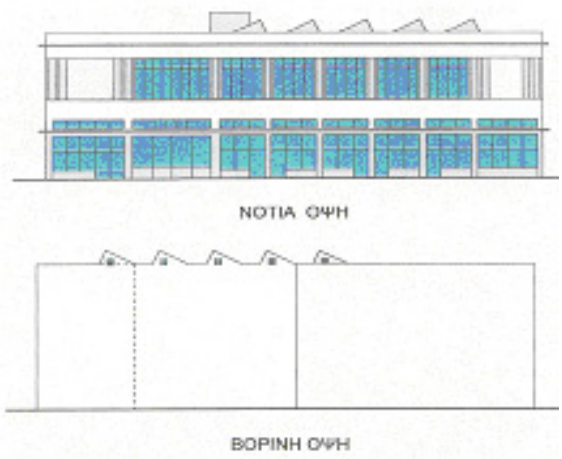

Figure 1: The Patras Public library building – South and North facades

Because of lack of personnel, low maintenance levels of the building envelope and lack of awareness on the environmental operation of the building, its present use conflicts with its design. In fact internal shades permanently keep away daylighting, also blocked by bookstacks, no natural ventilation is

possible as windows are never opened and artificial lighting as well as a/c systems are permanently on –resulting in very low comfort and internal air quality as well as elevated noise levels (Fig. 2).

Figure 2: The Patras Public library building – Daylight obstructed by permanent shades and furniture

The students suggested several simple interventions on the building and a radical change in its mode of operation, more in accordance with initial design philosophy (Fig. 3), which would create a different level of involvement on the part of the employees, and assure improved environmental performance on all counts. There was a strong interest on possibilities of its realisation on the part of the Municipality of Patras.

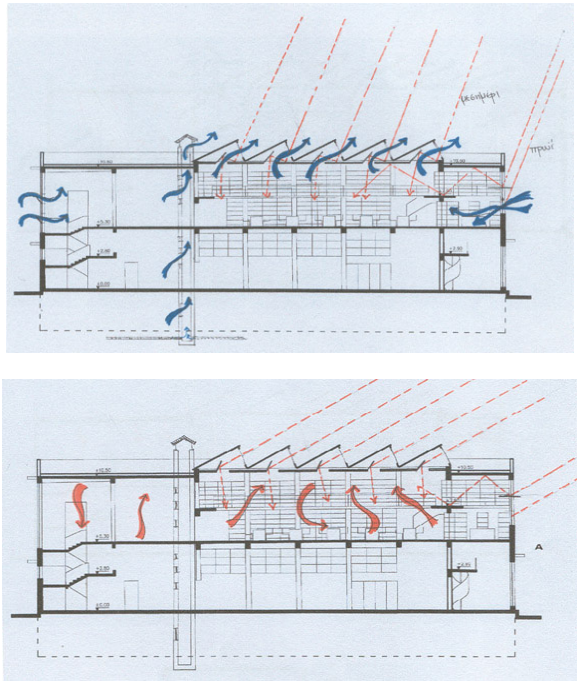

Figure 3: The Patras Public library building: Proposed scenarios summer and winter operation

4.2. A similar relation between the actual use of a building and its original design was reported in the National Art and History Museum building for the city of Nafplion. This is a neoclassical building, built in 1905 as a private mansion and recently converted to a museum. Although the original design showed little differentiation of façades according to orientation internal space layout exhibited a zoning creating buffer spaces to the North and protected main and transition spaces to the South (Fig. 4).

Figure 4: The Nafplion museum building - view from the South

This has been negated by the building's new function, however, as the decision to adopt a central air-conditioning system for exhibition spaces resulted in totally blocking windows, either by shutters or by internal screens. As a result no daylight or natural ventilation can penetrate the building interior, with serious impact on internal comfort conditions as reported by the users. What is more, the most enjoyable spaces of the building in terms of orientation and view cannot be used in the actual space distribution. (Fig. 5)

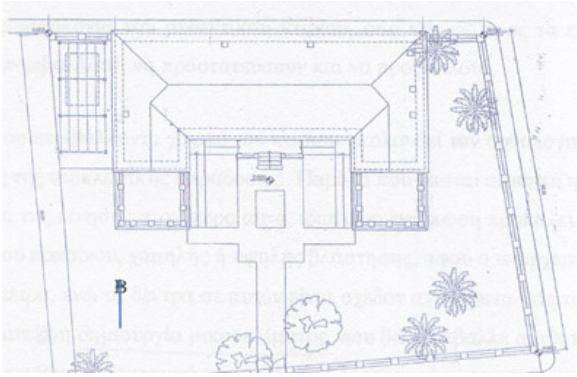

Figure 5: The Nafplion museum building – site plan

Proposed interventions have to be discrete, as this is a listed building and they include the combination of external shades and light shelves for South-facing windows, operable awnings for natural ventilation and the use of night ventilation strategies for summer cooling. The improvement of microclimate by planting, shadowing elements and the use of water will also improve comfort both indoors and outdoors

where gardens and verandas can become accessible for visitors and staff (Fig. 6).

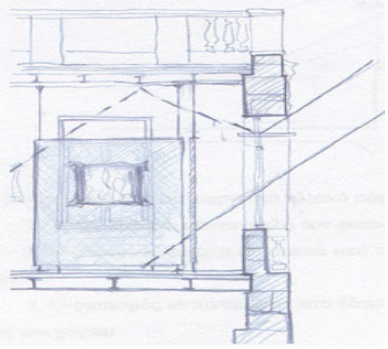

Figure 6: The Nafplion museum building - proposed daylighting interventions

4.3 Another project involved retrofitting of the main public bus-station in Patras, sheltered in a badly designed and constructed building right at the city center. An unusually heavy and extended concrete shelter cannot provide outdoor shade, due to its orientation, but gravely reduces daylight for indoor public spaces, as measured by students and reported in interviews (Fig. 7,8).

Figure 7: Patras Bus Station – S.E. view of the building

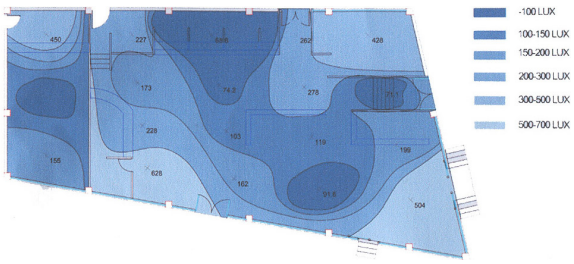

Figure 8: Patras Bus Station – Daylighting measurements

In order to improve thermal and visual comfort and reduce glare, the students proposed shades, light-shelves adjustable to increase interior daylight levels extensions of overhangs to include planting, vertical shades made of climbing plants and PV elements integrated to the roof of the building (Fig. 9). The solution proposed improved environmental performance and user comfort with little or no change to the use of spaces in and around the building.

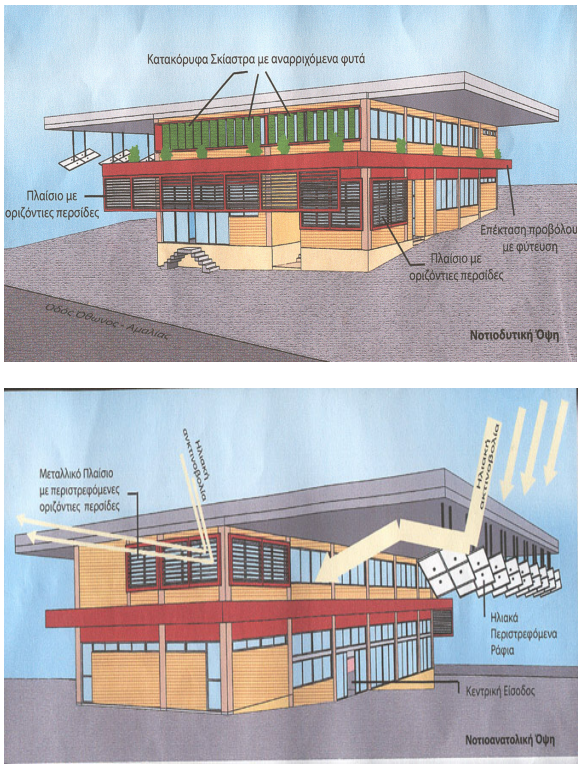

Figure 9: Patras Bus Station retrofitting interventions-Views from S.E. and S.W.

4.4. Improvement of thermal and visual comfort according to users' comments involved the extension of common spaces as well as the use of external shadowing, light shelves, PV integration and microclimate improvement through roof and outdoor planting, for yet another case-study, concerning a typical University building (Fig. 10).

Figure 10: The Physics building-view from the South

In this project the use of transition spaces, both new and existing, as a means of regulating environmental performance and comfort levels in the building, suggested new possibilities for environmental interventions not only in terms of use but also in terms of meaning. In fact new esthetic and symbolic dimensions emerged through the students' design for sustainability features as complex

elements involving a multiplicity of uses and meanings (Fig. 11).

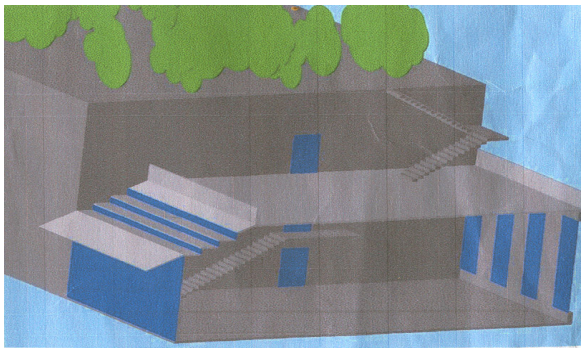

Figure 11: The Physics building, retrofitting interventions: new transition space and roof planting

This was also obvious in two more case-studies, also dealing with University buildings, where not only comfort improved, but also new use patterns as well as esthetic possibilities were suggested by the solutions proposed (Fig. 12-14).

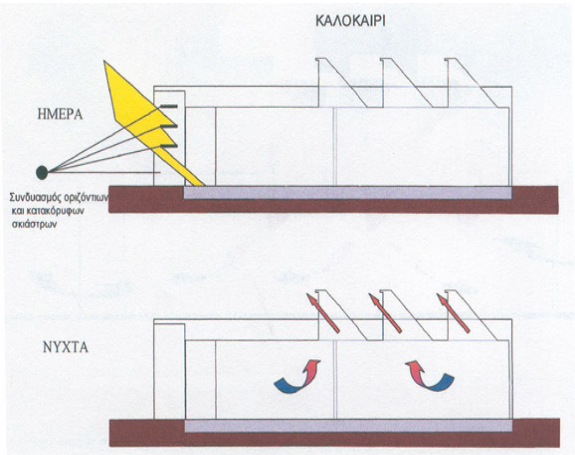

Figure 12: Student restaurant-retrofitting scenarios summer operation

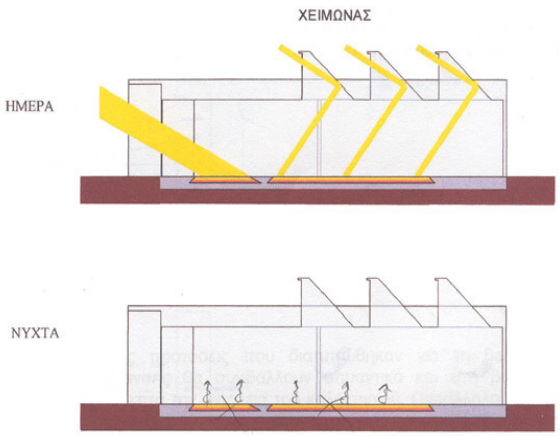

Figure 13: Student restaurant-retrofitting scenarios winter operation

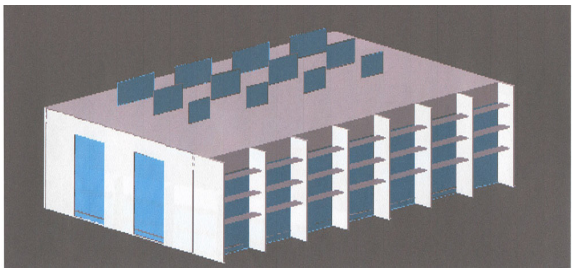

Figure 14: Student restaurant- view of the S.W. after retrofitting

5. CONCLUSIONS

This has been a very interesting course for the students according to their comments. In fact the analysis and comprehension of environmental performance in existing buildings helped them understand their behavior as complex organisms, involving the interaction of many factors pertaining both to the building and to its environment. In case a positive interaction of all these factors is reached through the integration of sustainability features in the design of a building, the user should be included as a potential actor to assure its environmental performance, as follows from the case studies discussed. The different degrees of involvement of the user as well as the comfort levels achieved, are related to points of intervention available in an environmental set-up, where building or space elements can be designed so as to facilitate or even induce his participation in the shaping of his own environment, depending on the degree of involvement he may prefer. These considerations turned out to have a strong influence on the students' philosophy concerning not only environmental retrofitting but also architectural design in general.

6. REFERENCES

[1] K. Steemers and M.A. Steane: "Environmental Diversity in Architecture", London (2004).
[2] N. Bernardi et al: "Participation of users in school buildings to attain environmental comfort", PLEA (2002).
[3] D. Hawkes: "The users' role in environmental control: some reflections on theory and practice", London (1997).
[4] S. Yannas: "Adaptive skins and microclimates", PLEA (2004).
[5] M. Kamaterou and Z. Karayanni: "Environmental retrofitting of the Public Library in Patras" (2005).
[6] P. Tassaina: "The Nafplion Art and History Museum-Environmental Performance", Patras (2005).
[7] A. Camberi and A. Valavani: "The Patras Bus Station – Environmental Interventions", Patras (2004).
[8] M. Tripanagnostopoulou: "The Physics building in the University of Patras - Environmental performance, Analysis and Propositions for Improvement" (2005).
[9] M. Kyriakou and C. Vassilakopoulou: "Retrofitting of the student restaurant in Patras" (2004).