Learning Environment

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ABSTRACT: The paper focuses on the pedagogy of sustainable environmental design through the experience of the postgraduate programme at the Architectural Association School of Architecture. The introduction traces the latest developments in the structure of the taught Masters programme highlighting the main issues underlying the projects summarised in the main body of the paper.

Keywords: education, sustainable environmental design, thermal and visual comfort

1. INTRODUCTION

From the 2005-06 academic year a 12-month post-professional Master of Science (MSc) and 16-month Master of Architecture (MArch) in Sustainable Environmental Design have replaced the Master of Art (MA) in Environment & Energy Studies that was introduced at the Architectural Association School of Architecture in 1995 in turn replacing the earlier postgraduate Diploma in Environment & Energy Studies that was started in 1974. The 12-month MSc is addressed to both architects and engineers. The course emphasises conceptual and analytic aspects of sustainable design making extensive use of advanced digital tools and seeking creative collaborations between the disciplines. The 16-month MArch aims to provide a platform for exploring sustainable design as a creative element in architectural research and practice. As with the MA previously, Fig.1, the main research object of both the MSc and MArch is the relationship between architectural form, materiality and environmental performance and the role played by climatic conditions, building programme and other interacting contextual parameters. The dynamics of this relationship provide the starting point for sustainable environmental design and reveal its potential to inform architecture in innovative as well as performative ways. In our teaching programme the development of appropriate conceptual and analytic skills follows a two-stage process. The first stage, corresponding roughly to the first half of the duration of students' studies, is in the form of an intensive training programme that is structured around team projects supported by regular lectures and seminar series. With an annual intake of 15-20 students in their twenties and thirties that come from many different countries, climates and educational and professional backgrounds, this stage is invariably a considerable challenge. The formative period then continues in the second stage which is structured around closely supervised research projects that are individually devised to suit the capabilities and interests of each student. Over the years many of these were presented at PLEA conferences after their completion. The present paper relates to the first stage of our Masters programme and in particular to three of the projects undertaken in the first half of the 2005-06 academic year. In this it follows from earlier papers presented at previous PLEA conferences [1]. As with the earlier papers, the three projects discussed here are presented in a mainly descriptive rather than technical sense, aiming to highlight the pedagogic links and intentions that underline the evolution of our programme.

Figure 1: Conceptual model and detail of heliotropic structure constructed by the last MA cohort in May 2005 [1].

2. PROJECTS

2.1 Improvements to Commercial Building

The extension and environmental improvement of an existing commercial building was the theme of the first project in 2005-06. The main aim of this project was to test new students' previous knowledge and teamwork skills. The project was undertaken as an intensive, three-day design exercise by seven teams each with three students. Situated on a generously sized site in central Athens, Greece, and surrounded by busy roads, the two-storey building was shown to suffer from poor solar control, which led to excessive solar gain, as well as poor daylighting and a number of other environmental problems that led to thermal and visual discomfort despite high levels of nonrenewable energy use. Athens (latitude 38N) has a Mediterranean climate with a relatively mild heating season and a rather more severe summer period that combines high air and mean radiant temperatures and strong sunshine. In this respect the existing building was shown to offer excellent opportunities for the application of passive environmental control techniques, as well as for substantive architectural and landscaping extensions and interventions.

The project brief called for an extension of the building, to add usable space within the limits allowed by current planning regulations. As part of the refurbishment project teams were asked to review formal, programmatic, constructional and landscaping strategies for resolving the environmental issues detailed in the brief. Target indoor environmental conditions to be achieved were given indicatively in the brief. No numerical data, calculations or assessments were required for this project. Proposals were to be purely conceptual. Figure 2 shows some of the proposals from five of the schemes developed illustrating different approaches to site development, landscaping, daylighting, solar control and airflow for fresh air supply and ventilative cooling. The project proved very successful in developing a team spirit as well as starting the years' exploration of sustainable environmental design.

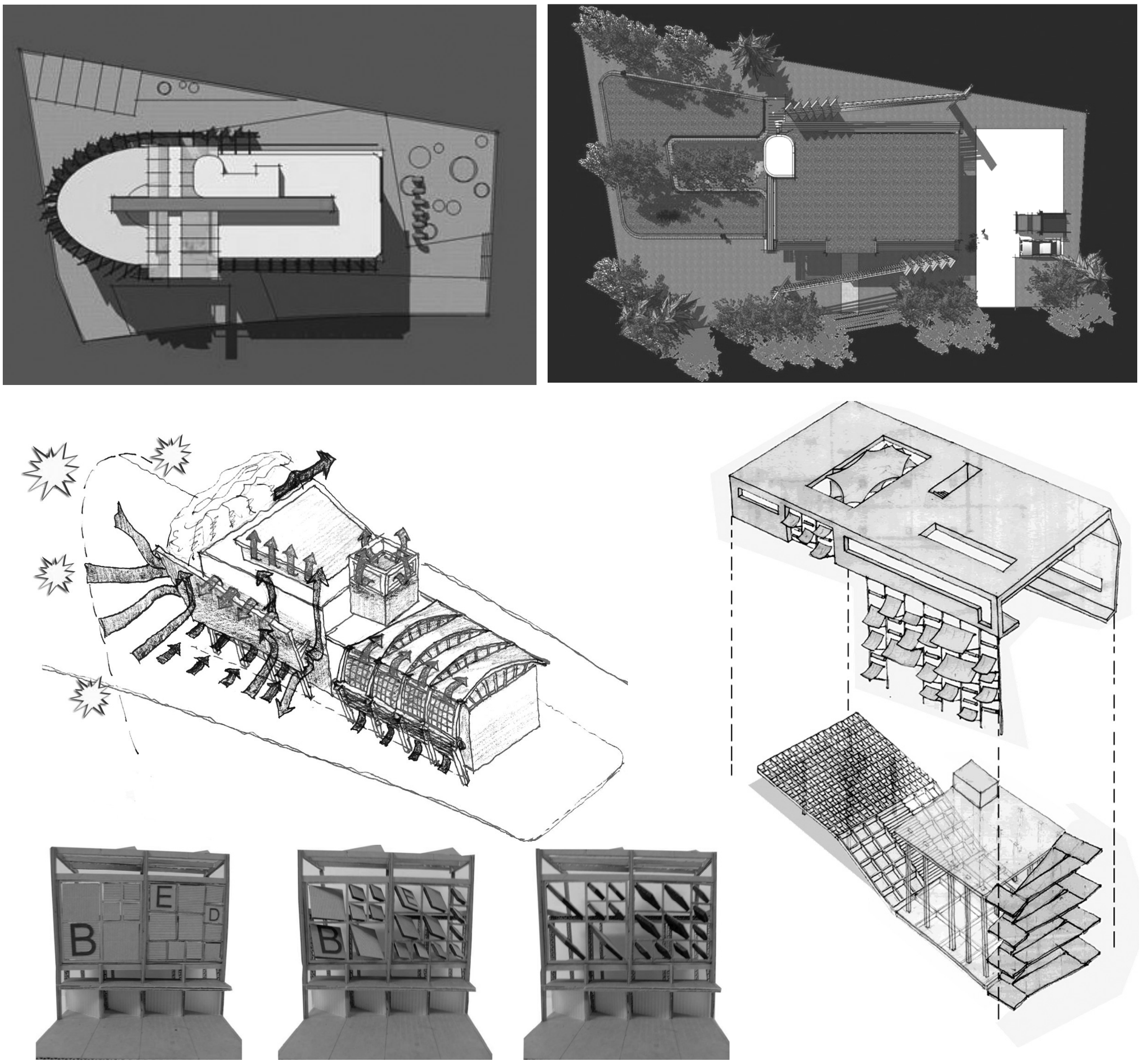

Figure 2: Sketches from five of the seven teams of the first short project of the year

2.1 Daylighting in Art Galleries

This second project was intended to combine the development of observational skills based on selected buildings around London with a focus on a single topic of environmental design, namely daylighting in art galleries. The project was introduced on the second week of the academic year and ran for some six weeks. It involved a building study supported by measurements and interviews in selected London galleries. The project was undertaken in parallel to inputs from lectures and seminars aimed at introducing students to the relevant principles, built examples and computer modelling software. London's museums and art galleries illustrate a variety of different approaches to lighting design for the display of paintings and sculpture. On this project the 21 students taking part divided again in seven teams of three to study a number of these. The Dulwich Picture Gallery, first opened to the public in 1817 on a design by Sir John Soane, was one of the buildings studied in this project, Fig.3. The original rooflights over the display areas have undergone many changes and renovations the latest of which date from five years ago. Other galleries studied for this project included the Clore at Tate Britain, the Sackler Galleries at the Royal Academy, the Great Court and the Kings and Assyrian Rooms at the British Museum, the Serpentine Gallery, the Tate Modern and the Victoria Miro Gallery. Depending on the findings from their observations and measurements in the selected spaces some of the project teams followed their initial diagnostic and analytic investigations with design proposals, Fig.4. Compared to building studies of previous years the strong focus of this project on a single environmental objective helped student teams to work faster and more efficiently. However, in doing so students paid little attention to thermal concepts and issues of fresh air supply and ventilation which were soon to become a major concern in the following project.

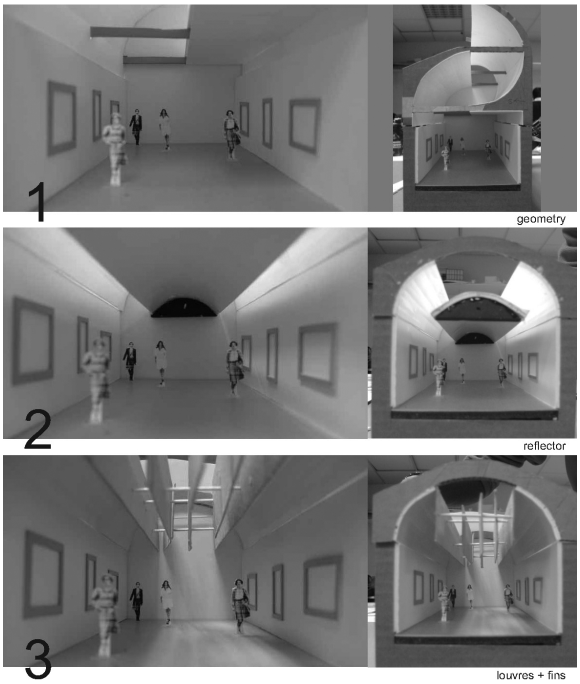

Figure 4: Alternative options for roof openings, solar protection and internal reflectors investigated as constituents of daylighting strategy for the Sackler Galleries at the Royal Academy, which were forced to permanent artificial lighting soon after opening.

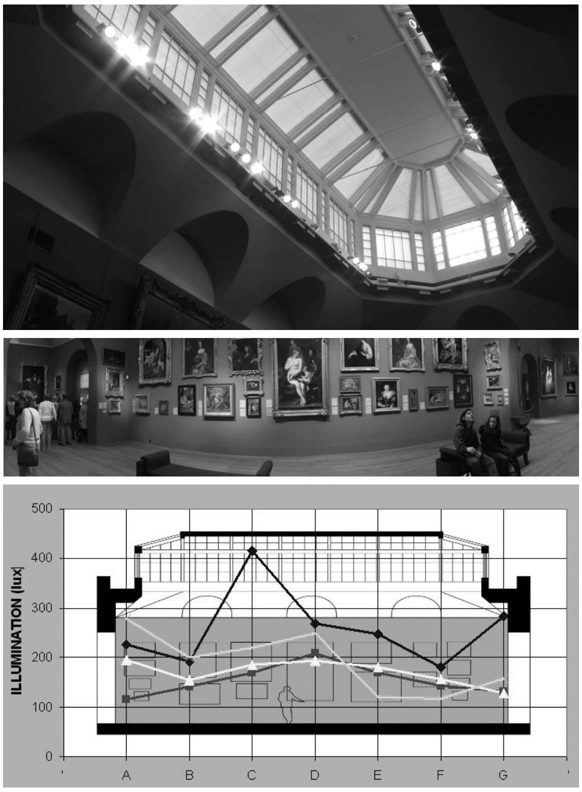

Figure 3: Rooflight, display area and illuminance measurements at 12.00 on 7 November 2005 (External illuminance: 26000 lx) in Dulwich Picture Gallery II, one of the rooms studied in this historical building.

2.2 Learning Environments

In addition to introducing students to further aspects of sustainable environmental design, this second term project, the year's main design project, required that each project team formulate its own brief based on a critical reevaluation of programmatic and environmental requirements of the building type. Challengingly, the project was focused on learning environments. From nursery school to university, learning environments are among the most environmentally challenging and varied of building types. In densely occupied classrooms, daylighting and fresh air supply are critical design requirements, whereas the need for space heating or cooling can vary widely depending on climate, site conditions and building design. Poor lighting, inadequate ventilation and simultaneous underheating and overheating have been common problems in primary and secondary school classrooms across the UK as well as elsewhere. For the many other types of spaces that are used as specialist or multipurpose learning environments, environmental conditions vary yet again depending on location, design and occupancy. In this year's first term lectures the environmental

Figure 5: Proposal for a new classroom module at St Francis of Assisi Primary School, London, featuring a narrow conservatory on the south side and a south-facing clerestory to enhance daylighting on the north side of the room. Thermal simulations suggested fitting of movable vertical shutters and overhangs to protect south-facing glazing in the cool and warm periods respectively.

design requirements and attributes of educational buildings were illustrated with a broad typology of spatial configurations and constructional characteristics derived from built examples across the European Union. This highlighted the close relationship between the architectural programme and the environmental design requirements of different spaces, a relationship that was underlined by this year's project on art galleries. On that building type, the strict requirement in some spaces for preventing direct solar penetration, while admitting daylight within a prescribed illuminance range, could be seen to have dominated the architectural parti as well as justifying its high dependence on engineering services. On the other hand, in being designed for the comfort and activity of human occupants rather than for the preservation of inanimate contents, spaces for learning present altogether different architectural and environmental challenges. Human occupants will normally expect a degree of fluctuation as this contributes to environmental diversity and helps them keep alert. Within acceptable limits, such fluctuation also caters for individual differences and adaptive responses to spatial and temporal variations. Clearly these allow more scope and freedom for environmental design as well as for architectural expression.

Building on the rich body of earlier environmental research and architectural practice, the aim of this project was to develop innovative design proposals arising from a critical investigation of environmental design requirements in different types of learning environments. A key objective was to gain in-depth understanding of the dynamic relationships that shape environmental conditions in buildings. The learning environments forming the object of the project included arts, music, drama, sports, and multipurpose spaces, as well as general purpose classrooms. The development of a well researched design brief was a key requirement of this project. Each project team was expected to research and formulate its own brief demonstrating understanding of environmental design issues affecting the spatial and temporal use of the selected space type, as well as taking account of pedagogic and technological developments and trends. The thermal, visual and fresh air supply targets set by the brief were to be shown to be achievable without any significant recourse to non-renewable energy sources. To that effect each project team was expected to define the range of acceptable adaptive thermal and visual comfort criteria relating to its selected learning environment, and to undertake detailed thermal, airflow and lighting simulations to provide comparative assessments of likely environmental performance. The EDSL TAS and Ambiens software were used for thermal and airflow simulations, and Ecotect and Radiance for daylighting analysis.

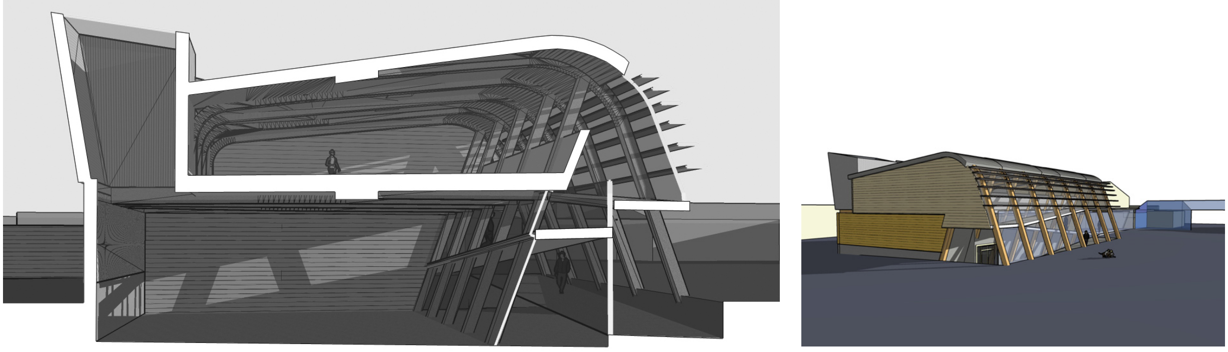

Figure 6: Section of two-storey, south-facing block conceived as symbiotic combination of teaching space above ground and partially earth-sheltered activity space (gym or sports hall) at lower level supported environmentally for daylight and ventilation by transitional areas on north and south sides.

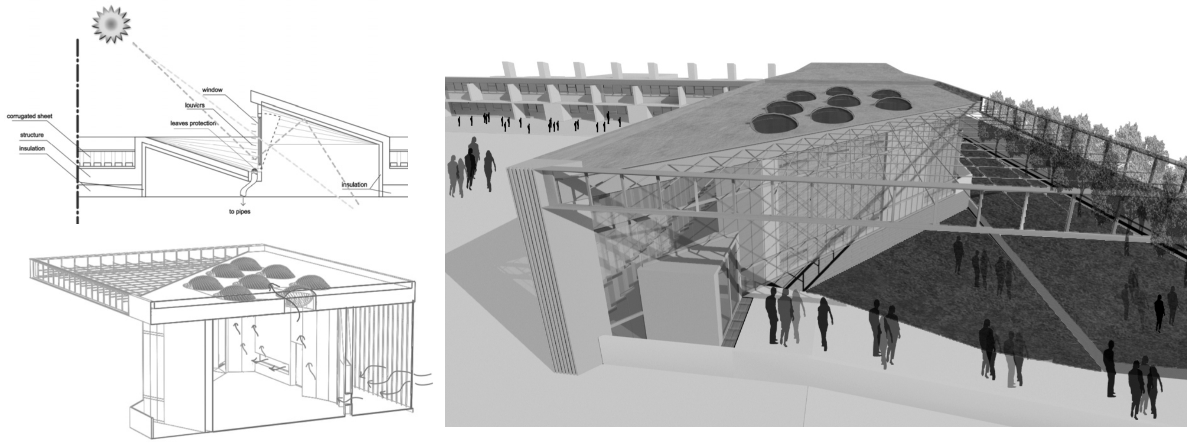

Figure 7: Proposal for new arts, music and performance spaces for a London School and details of daylighting and ventilation strategy.

The project was undertaken over a period of some twelve weeks, still in teams of three. Figures 5-8 illustrate a selection of the schemes produced. Work started with detailed briefing and visits to selected London schools including some recent schemes that were conceived with strong environmental agendas. Most project teams chose to pursue building programmes based in London as extensions to existing schools.

CONCLUSION

There is no ideal formula on how to combine project work with other course inputs or on the precise brief that projects should adopt. Over the years we have tested a number of different combinations, as well as many different project briefs. Clearly, certain choices and combinations can influence the outcome of individual projects and/or the speed at which students may master certain concepts or tools. Equally, one finds that project work must advance in parallel with theoretical input, rather than take place later as application, despite some problems that the former may entail for both students and teachers. However, none of the combinations we have tried so far seemed to be clearly superior to any other in terms of making this first stage of the pedagogic effort faster, easier, or more productive. Time seems to be a more critical factor for learning, assimilation and critical understanding. In that respect our experience in teaching the course has always had downs around the middle of the period followed by ups at the end. Most of our students get it right at the end and this is always rewarding.

ACKNOWLEDGEMENTS

Figure 1 shows the heliotropic structure designed by the entire cohort of 2004-05 Masters students. The MSc and MArch of 2005-06 whose projects are illustrated in Figs. 2-8 of this paper are: Ahmed Aly Abouzeid, Tobi Adamolekun, Giles Bruce, Haven Burkee-Rogers, Joyce Chan, Anastasia Dretta, Clarice Fong, Manuel Alejandro Gallardo, Chanin Kemakawat, Dong Ku Kim, Varun Kohli, Natalia Kokosalaki, Sayed Zabihullah Majidi, Federico Montella, Debra Raymont, Vicki Sagia, Aadil Salim, Sandro Tubertini, Olga Tzioti, Steven Vujeva, Chi-Tsun Wang.

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[1] See: Yannas, S. Living with the City: urban design and environmental sustainability, pp41-48 in Proc. PLEA 98; Toward Environmentally-Responsive Architecture, in Proc. PLEA 2003; Adaptive Skins and Microclimates, pp217-222 in Proc. PLEA 2004; and Education for Sustainable Architecture pp859-862, in Proc. PLEA 2005

Figure 8: Proposal for a Dance School to be situated at a suburb of Athens; roof design for solar control, earth-sheltering for temperature stability and cooling and use of outdoor spaces are key features.