TEACHING A NEW ENVIRONMENTAL CULTURE
THE ENVIRONMENT AS A QUESTION OF ARCHITECTURAL EDUCATION

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Teaching a new Environmental Culture
The Environment as a Question of Architectural Education

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Teaching a new Environmental Culture:
The Environment as a Question of Architectural Education
What environment?

In our fast changing world, one of the most significant shifts of contemporary thinking is the reconsideration of our conception of the relationship between human beings and nature. For centuries, architectural production has been based upon a conception of the dwelling and the city as shelters for the human being from nature, as powerful weapons and efficient representations of their dominance over the natural forces, laws and phenomena as well as havens where the protected civilization would be able to flourish. Even if nature, as generator of the alive, has always been the architects’ source of inspiration, it has, also, always been the competitive ‘other’ to be conquered, mastered and dominated. This architectural production of our civilization is usually defined as the built environment, which is distinctly and implicitly contrary to the natural environment, where the former undergoes a process of naturalization whereas the latter domestication. Thus the man-made becomes natural and the natural artificial.

Nowadays, however, the line of demarcation between the natural and the man-made becomes increasingly blurred, and the differentiation between the real and the artificial appears unclear. The question, ‘which environment for the human being?’, demands an outstanding, strategic decision making for the future. Environmental sensitivity, sustainability, ecology, pollution, global warming, climatic change, the greenhouse effect, are simply terms emerging from the uncontrolled and aggressive intervention of the built with the natural environment or of human activity against nature. They also encompass and represent the imperative need of a new conception of the relation between nature and human beings, between the natural and the built environment, and the need for a new environmental culture.

Our growing sensitivity to environmental issues has sensitized us to the fact that buildings are the major causes of harming nature. Pollution from heating and cooling buildings exceeds that of cars. The building industry, which is the second largest industry in the world, manufactures building materials that consume enormous energy, and exhaustible resources. Buildings and their construction account for more than half of the entire greenhouse gas emissions and energy consumption globally each year. The building sector is the key source of demand for energy and materials that produce by-product greenhouse gases. On the other hand, our homes, which are the largest lifetime purchase and investment, are built more or less in the same way they were built, at least, fifty years ago. The home that will virtually define our lives for twenty, thirty or forty years in the future is designed only for today, based upon an implicit (and obsolete) conception that the future is just a repetition of the present.

It is high time for our society to update the conception, theorization and implementation of architectural practices which will generate architectural designs responsive to the new conception of the relations between nature and the human
being, where the latter is part of the former depending upon and determining it in a dynamic and parametric relationship.

Is architectural education sensitive to this global demand for a new environmental culture? Do schools of architecture, nowadays, educate students who are capable of taking immediate action towards new solutions and new conceptions of forms, materials and spatial arrangements that are responsive to this emerging environmental culture? How do they incorporate in their educational and pedagogical strategies environmental issues? Which teaching approaches do they implement in order to educate future architects?

**What education for the environment?**

The present volume wishes to address the aforementioned questions by mapping the ways schools of architecture in Europe integrate environmental issues in their curricula. For this reason the Erasmus Thematic Network, 'European Network of Heads of Schools of Architecture' (ENHSA) and the European Association for Architectural Education (EAAE), in their effort to support and enhance the academic physiognomy of European schools of architecture, invited all their partner schools to contribute to the creation of a concise record of the teaching strategies and pedagogic methods of their modules and studios, which promote a new environmental culture and sustainability consciousness.

Schools were invited to present the structure, the content, the expected outcomes of the architectural education they offer in relation to the environmental issues and the teaching approaches they implement to assure these outcomes.

The original aim was for this record to constitute a valuable corpus into which all educators can delve in order to get to know the state-of-the-art of the education of this subject area around Europe. It attempts to present the current approaches in the conception, theorization and implementation of architectural practices, which generate architectural designs responsive to the new conception of the relations between nature and human beings.

The invitation was open to all those who felt that their contribution would allow the reader the comprehension of the pedagogy of the courses / studios related to the environmental issues, the educational objectives and the techniques and methods which ensure the fulfillment of these objectives. Two contributors, maximum, from each school were invited to describe a maximum of two key courses which would better explain the overall philosophy of their teaching of environmental and sustainability issues and which they considered innovative and/or experimental. It was hoped that gathering information about the different cases around Europe would facilitate the exchange of ideas and research in architectural education, useful to all eager educators. It was also expected that this record would enhance the dialogue among the contributors and would enrich their experience in the teaching of environmental issues in schools of architecture.
What, how, why?

In this publication contributors teaching either theoretical modules and/or architectural design studios where environmental issues are central, submitted a text in which they describe the course or studio they teach. In order to achieve a basic comparability and homogeneity, the descriptions sought were structured around a number of key issues, which would form the common ground of the presentations. There were four key issues with which contributors were asked to deal.

The first one comprised the philosophy of the course with emphasis on the perception of environmental issues in architecture in general, the educational objectives, the expected knowledge to be acquired, the skills and competences to be developed and the priorities and values on which their teaching focuses. These issues were better mirrored in the following questions:

What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?

The second issue included a description of the proposed course as well as the adopted pedagogy and educational method. It was thought useful to discuss the pedagogic techniques and strategies for the development of the course(s) (stages and phases, vehicles, activities, lectures, debates, presentations, visits, bibliography, precedent study etc.) the issues with which every stage of the course deals and the reason behind this choice as well as the general organization and structure of the course. All points mentioned aim to allow for an explicit and effective description of the philosophy and the educational objectives of the course. These issues were better mirrored in the following questions:

How do I teach environmental issues and sustainability in the course or studio for which I am responsible? Why do I choose to teach in this way the course or studio I am describing?

The third issue concerned the exercise(s) the students work on. It was considered useful to describe the general and special characteristics of the (design) theme(s) and the exercise(s) of the course, the criteria upon which this (design) theme is chosen, the way it is introduced to the students, the questions the exercise poses, the method whereby the teacher monitors the development of the exercise, the focal points of the exercise, the submission requirements as well as the evaluation of the exercise. The above descriptions would have to be supported by references to the way and the extent to which the choice of the exercise(s) guarantees the fulfillment of the educational objectives of the course and allows for the best grasp of its overall philosophy by the students. These issues were better mirrored in the following questions:

What exercise(s) and design themes do I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?
The fourth section covered questions related to the difficulties encountered by the teacher in running the presented course. More specifically, it was suggested that the teacher would offer an overview and a critical appreciation of the course with regard to its effectiveness and contribution to the overall school curriculum, with suggestions for the improvement of its quality. These issues were better mirrored in the following questions:

*How satisfied am I with the course on environment and sustainability I teach? How could I improve my course?*

The call was addressed to all EAAE (European Association for Architectural Education 114 partner schools) and ENHSA (European Network of Heads of Schools of Architecture, 77 partner schools). Even though there is overlapping in the members of the two networks, as the call was disseminated by the school delegates to all school-member teachers the number of responses is fairly limited. More specifically, the volume consists of 40 contributions, 70 contributors (most of the contributions are co-authored) from 16 countries and from 26 Schools of Architecture across Europe. The first speculation could be that there is either limited teaching dedicated to the environment, or little interest in presenting one’s environmental education in a systematic effort to map the tendencies. Last but not least, one could make the assumption that across Europe there could be a relatively small number of schools and teachers that would be keen on externalizing their environmental education. Alternatively one could assume that the environment is inherent in some schools’ pedagogy and is taught implicitly anyway. Therefore it is not perceived as independent for it to be described in isolation.

**Contributions and Contents**

*Answer to the question:*

*What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?*

Two were the most outstanding approaches:

The first one, more studio-based and subject-focused, a dominant tendency that appeared in the texts, was to teach the environment in the design studio supported by presentations within the studio or by theoretical courses that help the studio work investigate issues of thermal comfort, solar gains, sun proof and natural ventilation at architectural scale. The complexity of the studio brief is increased when environmental issues are regarded and students are asked to consider environmental issues as a significant part of their design brief.

The second tendency was teaching the environment globally across the studies, across the spectrum of scales, from urban to small scale, and across the related subjects, from water recycling to traffic control, and eco-friendly cultural
cultivation of conscience. This thread involves more teaching time across the curriculum, but theory courses are valued and promoted. Students are asked to read, write, archive good practice examples, have open debates and presentations of case studies, attend conferences, workshops and finally design sustainable projects at various scales.

A third approach, which is not that frequent in curricula, was to teach the environment to architecture students through the conservation and rehabilitation of old buildings and settlements. There are few cases where the emphasis is placed on the importance of preserving what there is in the built environment rather than creating something new, costly but with certified environmental qualities according to European or International Standards.

A fourth approach, again appearing rarely, is to take studio work from other studios and re-examine it environmentally; a kind of post-design examination of the environmental feasibility of existing design work.

Last but not least, there was argument over the fact that issues between the natural and the built environment involve a new body of knowledge that deserves and demands a special place and study time beyond the undergraduate courses of whatever nature; therefore suggesting that the undergraduate modules should act as preparatory for post-graduate courses where in-depth analysis would take place and specific knowledge would be acquired.

Methods

How do I teach environmental issues and sustainability in the course or studio for which I am responsible? Why do I choose to teach in this way the course or studio I am describing?

A great number of cases that teach environmental issues, mostly in the studio, stressed the importance of teaching them though precedent study which includes both the examination of vernacular as well as the examination of contemporary examples of good practice. Quite a few teachers praised the validity and the vast contribution computer software on environmental modeling has made, but insisted that there is a need for returning and reconsidering the operational value of empirical drawings and diagrams as well as calculations, especially of the cross-section which for quite a few is considered to be a key drawing much more useful than energy modeling in the lower part of the curriculum.

Those that teach in a larger spectrum of scales and place, equal importance on both the studio work as well as the impact of the contemporary debate on sustainability pointed out the need to involve politicians, the local community and relevant parties and teach the architect how to collaborate with other stakeholders as well as other engineers in the design team itself, such as mechanical engineers, computer engineers etc.
Qualities

How satisfied am I with the course on environment and sustainability I teach? How could I improve my course?

Most authors explained that they are satisfied with what happens in their course but expressed the need for more integration in school curricula and across the board. In fact, quite a few argued that all design projects must consider the environment as a by-default demand of any contemporary design brief and not as the one-off, isolated and disconnected studio demand. There was also a demand expressed for specialists to assist to specific knowledge and more involvement of the end users of real situation briefs to be consulted; a kind of neo-participatory architecture but placing equal emphasis on the community empirical contribution and that of the specialists’ expertise. Last but not least, teachers believe that a way for any school of architecture policy maker to prove their appreciation of teaching the environment to architecture students is to improve the student staff ratio.

In the quest of the fourth ‘P’

The diversity of approaches regarding the time in a school curriculum, appropriate for environmental issues to be taught is quite telling. It is clear that most schools argue that teaching issues of building physics gradually as these can be applied in design is the way forward. However, the case of the environment has been argued quite polemically by a number of educators who suggest that teaching items that concern the limited emission or natural resources consumption is irrelevant or de-contextualizing from the real, political, social and the economic dimension that the environment plays in the education not only of architects but of the entire society. The design studio seems to be a marginalized and isolated milieu; only if supported by public events such as conferences and open workshops where local communities are involved and informed and specialists of other disciplines will regain its key role. What would be the point in learning to create for example an energetically certified building, when in fact its employees would need to drive for over an hour to get to work? Especially if that building is made up entirely out of glass facades and has gained its credits from other environmental manipulations such as water recycling etc. More to the point, what if such a building is misused by its occupants, who refuse to learn how to live with the building’s designed idiosyncrasies to consume less energy. How can the holistic and global nature of environmental issues be part of an architect’s thinking processes and part of each individual’s everyday life? What is the responsibility of schools from pre-school to higher education, professional organizations and politicians?

Some authors have argued that the compartmentalization of teaching subjects in modularized curricula could be the reason why environmental issues
cannot be integrated in the education of the architect. In most schools they are perceived as yet another new subject that has to be added to the education of the architect, or an old subject that has to be revisited/revised. Seen that way it can only add to some false and disjoint competencies and skills that will never contribute to the cultivation of a holistic environmental consciousness. The problem has been pinpointed in what Ken Robinson has suggested for the needs for ‘reforms’ or ‘transformations’ education as a whole. He believes that the problem with the failure to make changes in contemporary education lies in the fact that it is perpetually trying to improve the existing paradigm when in fact it should start from a fundamentally new perception of education in the contemporary context where it has to be redesigned with the premise that it is a new paradigm altogether that takes into account the contemporary context of life, society, the sciences, politics, economy and above all the contemporary world view of human beings. More specifically, in this lecture he argues that despite the good paradigms in education, educational systems can be no more ‘cloned’ but ‘customized’ to contemporary needs.

More specifically, in the case of the teaching of the environment to architects there are some inherent issues at stake:

1. A problem of terminology:
   Environmental issues are not new in architecture. However, in time there have been several terms adopted each one implying something new or adding to the confusion and miscommunication among specialists. There has been no agreement as to a correct use of terms among which lie terms such as environmental control, energy-conscious design, green architecture, zero emission, zero energy, passive systems, bioclimatic design, ecology, sustainability, energetic design, building intelligence, smart-intelligent architecture and many others. Professional bodies and organization have attempted to resolve this ‘linguistic’ chaos by suggesting an abstract Esperanto, but it does not resolve the problem.

2. A problem of conflicting and extreme views
   as a political act the environment has two extreme schools of thought; That which supports the idea that human needs can be fulfilled only by rehabilitating existing architecture and old buildings as opposed to the other view that holds that only contemporary, highly intelligent technologies can cover the broad spectrum of issues raised for the environmental control of buildings

3. A problem of conflicting interests; different priorities between societal needs and where contemporary architecture is heading
   a. Architectural education, for a number of years, has suggested that the design studio is the platform in which creativity is exploited and innovation is produced. Innovation by default is non-standard in a world that demands buildings with energy certificates and building components and materials
with performance indicators. How will the production of new materials be synchronized with their need to be energetically certified? More to the point, how can a non-standard form be certified altogether?

b. A problem of priorities and confusing messages to young people

In a recent survey, it appears that 3 out of 12 architects that have been awarded the Pritzker Prize (the most honorable prize in Architecture) appear to have designed and built buildings that have been awarded by the eight official awards for environmentally conscious buildings (Civic Trust Awards Special Award for Sustainability, RIBA Sustainability Award, BREEAM Awards, The American Institute of Architects (AIA) and its Committee on the Environment (COTE) Top Ten Green Projects, The Global Award for Sustainable Architecture, The Emirates Glass LEAF Awards, AFLA Architectural Foundation of Los Angeles design green awards and the DETAIL Prize 2011: Special Prize for Green Architecture. Interestingly, it is worth noting that the Pritzker Prize is awarded to architects by a committee of architects and all the other awards are attributed to buildings by committees that consists of architects, other experts as well as clients and representatives of the local authorities.

4. A problem of authorship and the interdisciplinary

The increasing complexity of dealing with environmental issues requires the involvement of various members in a design team with very different backgrounds such as policy makers, traffic engineers, environmentalists, material scientists, mechanical engineers, computer engineers, urban designers and landscape architects, beyond the expected architects and structural engineers. Shouldn’t part of the education of the architect be about the roles and lines of demarcation among the various disciplines involved? What are the competencies and skills each of the members of such team should acquire from their formal education at university to enable them to be useful and constructive?

5. A problem of epistemological territory: sciences versus humanities

That brings us to the discussion of the very nature of the two elements involved. By tradition environmental issues concerning buildings have been associated with the sciences such as physics, maths etc. as opposed to architecture which, has been associated with the humanities. There seems to be an epistemological conflict which perpetuates the schism.

Architecture, while being classified under the label of the humanities, very often asserts a position in engineering or the so-called positive sciences. This formal classification has caused significant problems in architectural practice and thinking. When architects felt that what they were doing belonged more to the one pole, they tended to exclude from their interests subject areas and issues belonging to the other pole, losing this way part of the richness of architecture.
as a spatial manifestation of our life. It is time to reconsider this sterile classification as architecture does not belong either to the sciences or to the humanities. It needs both of them, not because they are domains of its investigation, but simply because they are both necessary for the creation of better space. This approach can help the discussion on the environment to find its place in the architectural debate, practice and theorization, and will definitely facilitate the creative adaptation of the environmental discourses and practices in an efficient, purposeful architectural practice and education.

Joan Farrer\(^{13}\) has explained the three pillars that can be associated with the environment described as the 3Ps: people, planet and profit that have to maintain equal importance. The economic pillar has unfortunately taken over the other two pillars, by decaying the planet and by neglecting, therefore, the social and ethical pillar; that of people. The key idea for the reconciliation of the association of the 3Ps is a fourth P; namely Pedagogy. This word has not been chosen as an exclusive play on words but as a choice to differentiate formal education from what is defined by the Greek language as the act of guiding one in a lifelong learning experience from one’s early age\(^{14}\). This entire effort and initiative (the call and the present volume) is an attempt to make a contribution to the construction of the fourth P.

Endnotes
1. [http://www.ted.com/talks/sir_ken_robinsonBring_on_the_revolution.html](http://www.ted.com/talks/sir_ken_robinsonBring_on_the_revolution.html)
2. Sustainable architecture is not a recent invention; It is a rediscovery of an old set of design principles that places the emphasis on quality rather than Quantity (ACE 2002).
3. In 1993, UIA made such a Declaration of Interdependence for a sustainable future states that the architects ‘must rediscover what it means to create buildings that have less of an impact on the environment’ and should commit to ‘placing environmental and social sustainability at the core of their practices and professional responsibilities’. The Declaration is absolutely valuable while posing as many questions as the propositions it puts forward.
4. Purpose of Pritzker Prize
   To honor a living architect whose built work demonstrates a combination of those qualities of talent, vision, and commitment, which has produced consistent and significant contributions to humanity and the built environment through the art of architecture. [http://www.pritzkerprize.com/about/purpose.html](http://www.pritzkerprize.com/about/purpose.html)
   The international prize, which is awarded each year to a living architect for significant achievement, was established by the Pritzker family of Chicago through their Hyatt Foundation in 1979. Often referred to as “architecture’s Nobel” and “the profession’s highest honor,” it is granted annually. The award consists of $100,000 (US) and a bronze medallion. The award is conferred on the laureate at a ceremony held at an architecturally significant site throughout the world.
   http://www.aiatopten.org/
   http://www.livegreenblog.com/sustainable-architecture/the-global-award-for-sustainable-architecture-6228/
12. The architectural magazine DETAIL, in collaboration with ideal partners - the BAU 2011 tradeshow, the Bavarian Chamber of Architects, and the Architectural Society of China - will present the DETAIL Prize 2011.
13. Joan Farrer, University of Brighton, UK: Textile expert Dr Joan Farrer RCA works across the Design & Materials Practice and Fashion & Textile programmes. Her expertise includes interdisciplinary design, consultancy for industrial retailers, NGO’s and Government departments in policy, supply chain analysis, and fashion textile design and sustainable innovation.
14. Pedagogy: ORIGIN late Middle English: via Latin from Greek paidagōgos, denoting a slave who accompanied a child to school (from pais, paid- ‘boy’ + agōgos ‘guide’). Later on used to describe the teacher that showed young people the way forward, metaphorically speaking.
Inspirations
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Handle with Care.
The Challenges of Sustainability and the Agenda of Architectural Education
Abstract

The current climate crisis brings to the fore new responsibilities for architectural educators, students and professionals. The role of higher education to initiate new breeds of architects to the principles of sustainable design is of overriding priority, although several barriers hinder their effective implementation in both curricula and practice. A global review of the embracement of sustainability in academic programmes and in the profession of architecture reveals that the achievement of fully integrated ‘sustainable’ literacy still proves elusive. Teaching of sustainability in pre- and post-professional education is indeed often disjointed to creative studio work so that students are not able to consistently engage with an integrated design process and achieve a mature and in-depth competence in sustainable mandates. New priorities have to inform the agenda of architectural education to overcome existing barriers and facilitate knowledge transfer between the acquisition of sustainability-related notions and their application in design. To contribute to address this challenge, the paper builds on some of the results of EDUCATE (Environmental Design in University Curricula and Architectural Training in Europe), a project funded by the European Commission to promote the embracement of sustainability in architectural curricula and professional practice.

Introduction

Education in architecture faces continuously evolving demands. Buildings contribute at a steadily increasing rate to the burning up of non-renewables energy and material sources, triggering environmental deterioration and playing a significant role in the very causes of climate change (IPCC 2007). Education for sustainability, in all its complex socio-cultural, economic and environmental dimensions, in the disciplines of the built environment is therefore a fundamental priority for addressing the dramatic challenges that mankind has to face. Graduates of architectural disciplines are required nowadays multi-disciplinary skills, knowledge, and competence that range from inspired design through to detailed theoretical and technical expertise. Professional requirements – as well as recent regulations such as the Code for Sustainable Homes in United Kingdom or the European Directive on the Energy Performance of Buildings (EC 2003) – arising from the challenges of sustainability are placing new responsibilities on architectural pedagogies. There is a need to identify and tackle the potential educational and legislative barriers that may obstruct the effective implementation and exploration of sustainability within a creative architectural discourse. New teaching and learning methodologies must hence be enforced so as to provide a communication platform between advanced research in the various dimensions of sustainability and coherent and imaginative design application, to prepare students for responsible professional practice (Altomonte 2009).
An analysis of practice of architecture at a global level indeed reveals that the profession as a whole has been relatively erratic in responding to the demands of enhanced sustainability in buildings within imaginative architectural solutions (EDUCATE 2010a). Concurrently, the criteria and conditions for accreditation and qualification set up by professional bodies to grant access to the practice of architecture seem to be generally inconsistent in fully supporting the comprehensive promotion and diffusion of socio-cultural and economic sustainability and energy efficiency in the construction industry. Ultimately, higher education programmes in the disciplines of the built environmental have been sparsely effective in integrating sustainable design in the education of students and graduates of architecture (EDUCATE 2010b).

By exploring, implementing and disseminating new pedagogical methods and qualification criteria which bridge the existing divide between the ‘sciences’ of sustainability and architectural design, the agenda of architectural education has to be reset to respond to contemporary challenges. This will not only substantially contribute to reduce reliance on fossil fuels and other non-renewable sources in buildings, but will also secure people’s comfort and quality of life in relation to a local and global environment and contribute to meet the planetary objectives established internationally by action plans and agreements.

**Setting the Agenda of Architectural Education**

Despite the awareness that buildings are responsible nowadays for more than 50% of global energy consumption, relatively few architectural practices worldwide have consistently embraced the challenges presented by sustainability as a real driver of their inspiration and as a ‘measuring stick’ throughout the design and construction process. Yet, in publications and magazines almost all recent constructions claim sustainable design (although this term is rarely ascribed a precise meaning beyond the use of technical ‘features’) as a key element of their conception and operation (Altomonte 2009). However, only the minority of such buildings effectively meets its design predictions and expectations, especially in relation to energy efficiency. On the contrary, very few buildings celebrated for their environmental performance have managed to impress for their architectural and spatial qualities.

The idea that a sustainable approach to design is more expensive, or can be a limitation to good design, is still diffused among clients (private and public) and actors of the building market (e.g., developers and contractors other than designers and consultants), whilst the associated costs (or perception of them), lack of confidence in innovative solutions, loose building regulations, insufficient training and conflicting information on effective performance (e.g., greenwash) are areas of major concern to the effective implementation of sustainable design in the practice of architecture (EDUCATE 2011).
Such pedagogical and professional barriers are exacerbated by the lack of consistency in the criteria for accreditation of higher education programmes and in the conditions for registration that are established by professional bodies to regulate the access to the practice of architecture. At a global level, numerous prescription criteria are enforced nationally to ensure that the learning outcomes acquired by graduates of disciplines of the built environment are adequate in response to the design, technical, communication, management and cultural abilities required for professional practice (ARB 2002). However, these criteria are often inconsistent and characterised by inhomogeneous demands particularly in ascertaining an actual balance between technical competence and imaginative design inspiration of applicants.

In Europe, national criteria for accreditation and qualification allow for flexibility of approaches and may slightly differ across Member States according to their cultural and climatic context, legislative structure, academic and professional organisation, etc. Nevertheless, all prescription policies across Europe should ensure that comparable achievements are attained by graduates of built environment disciplines in light of the European Directive EC 2005/36 on the mutual recognition of professional qualifications within European Member States (Altomonte 2009). In Section 8 - Architect, Article 46 - Training of Architect of this EC Directive, the following qualification conditions for graduates of architecture are given:

"Training as an architect shall comprise a total of at least four years of full-time study or six years of study, at least three years of which on a full-time basis, at a university or comparable teaching institution. The training must lead to successful completion of a university-level examination.

The training, which must be of university level, and of which architecture is the principal component, must maintain a balance between theoretical and practical aspects of architectural training and guarantee the acquisition of the following knowledge and skills:

1. Ability to create architectural designs that satisfy both aesthetic and technical requirements;
2. Adequate knowledge of the history and theories of architecture and the related arts, technologies and human sciences;
3. Knowledge of the fine arts as an influence on the quality of architectural design;
4. Adequate knowledge of urban design, planning and the skills involved in the planning process;
5. Understanding of the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale;
6. Understanding of the profession of architecture and the role of the architect in society, in particular in preparing briefs that take account of social factors;
7. Understanding of the methods of investigation and preparation of the brief for a design project;
8. Understanding of the structural design, constructional and engineering problems associated with building design;
9. Adequate knowledge of physical problems and technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate;
10. The necessary design skills to meet building user’s requirements within the constraints imposed by cost factors and building regulations;
11. Adequate knowledge of the industries, organisations, regulations and procedures involved in translating design concepts into buildings and integrating plants into overall planning (Art. 46, 2005/36/EC).

The 11 principles described in Article 46 of EC 2005/36 effectively constitute nowadays the core of the accreditation and qualification policies in all European countries. In the recent revision of the criteria for architectural registration in the United Kingdom, as an example, the conditions for qualification at undergraduate and graduate level (corresponding to ARB/RIBA Part 1 and Part 2) are now being regulated by General Attributes and General Criteria at Part 1 and Part 2, which are “explicitly linked to the 11 points that form part of Article 46 of the Directive” (ARB 2010).

It must be pointed out, however, that the underlying framework behind the Directive EC 2005/36 is actually represented by Articles 3 and 4 of the European Union Council Directive 384/85, the ‘Architect’s Directive’, which set the “minimum requirements for the length and core areas of study for architectural qualifications across the European Union. This is to facilitate mutual recognition of those qualifications and the right of establishment and freedom to provide services across the European Union” (ARB 2002). In substance, the European Directive 2005/36 has simply reiterated the prescriptive principles for qualification that were previously enunciated in the Architects’ Directive 85/384 of 10 June 1985, the original European Directive that for nearly three decades has regulated the domain of mutual recognition of qualifications in the field of architecture within the Member States of the European Union.

Yet, even if the 11 principles refer, more or less implicitly, to both qualitative and quantitative factors that are needed to ascertain the competence acquired by graduates for building practice, and a “balance between theoretical and practical aspects” (EC 2005/36) of the training is considered to be essential for qualification, no unequivocal direction or measurable indicator is given in the Directive concerning the integration of principles and practices of socio-cultural, economic...
and environmental sustainability in building design. Rather, when environmental concerns are mentioned, this is just to provide buildings with “internal conditions of comfort and protection against the climate” (EC 2005/36). Unquestionably, the priorities that should inform the agenda of architectural education have changed substantially throughout the last 26 years, therefore these outdated and deregulated criteria need to be tackled.

Nonetheless, a global analysis highlights that the strive for embedding sustainability in the education of architects and in the criteria that grant access to the practice of design is the focus of activity and concern of numerous academic and professional bodies (Stevenson et al. 2009). Indeed, worldwide there seems to be growing appreciation of the need to embrace environmental sustainability as a compulsory requirement of higher education curricula and professional qualification frameworks, so that graduates entering architectural practice possess the necessary skills to respond to market expectations. Such commitment to education should also continue with Continuing Professional Development of practitioners and also contribute to the dissemination of knowledge of sustainability issues to the general public (EDUCATE 2011).

To enhance the uptake of a sustainable approach in the design of the built environment, it is essential therefore that the principles of resource management, carrying capacity of our planet, cultural and biological diversity and inter-generational equity (WCED 1987) - other than the technical aspects concerned with energy consumption and carbon emissions - are embraced within a culturally, socially, economically and ethically viable design process. Such values should permeate every aspect of the architectural profession, from the pedagogical aims and objectives that inform curricula in higher education up to the conception, construction and operation of buildings beyond the mere meeting of environmental targets.

**The EDUCATE Project**

In order to contribute to address contemporary challenges in the education and practice of architecture, EDUCATE (Environmental Design in University Curricula and Architectural Training in Europe) has been set up as a 3-year project funded by the European Commission to promote the integration of sustainable design in curricula of higher education and in the professional practice of building design. Under the coordination of the author, the EDUCATE project brings together a pan-European consortium of seven academic partners: the University of Nottingham (UK); the Architectural Association School of Architecture (UK); the Catholic University of Louvain (Belgium); the Technical University of Munich (Germany); the Department DATA, University of Rome La Sapienza (Italy); the Seminar of Architecture and Environment, University of Seville (Spain); and the Budapest University of Technology and Economics (Hungary).
The project is also supported by professional institutions in six European countries, by architects widely celebrated for their contribution to the field of sustainable design, by specialists of associated disciplines (e.g., computer science, education, engineering) and by academic and professional associations to “foster knowledge and skills in sustainable environmental design aiming to achieve comfort, delight, well-being and energy efficiency in new and existing buildings. This will be promoted and demonstrated within a culturally, economically and socially viable design process, at all stages of architectural education” (EDUCATE 2009).

Basing on a thorough analysis and consolidation of the international state-of-the-art of educational methods and on the exploration of inter-, intra- and extra-disciplinary contributions to curricular development, EDUCATE aims primarily to: tackle the pedagogical and professional barriers that encumber the effective embrace of sustainability in university curricula and architectural practice; define and test a pedagogical framework and supporting tools which facilitate knowledge transfer between advanced research in sustainability and creative exploration in design; and, in concert with professional bodies, benchmark the level of knowledge and understanding of principles and practices of sustainability expected of graduates and professionals of the built environment (Altomonte 2009).

Skills, Knowledge and Competence in Sustainable Design

Following a critical evaluation of the current state of the art of environmental sustainability in architectural curricula, in conditions for accreditation and in professional practice (EDUCATE 2010a; EDUCATE 2010b), to meet the challenges of sustainability in the agenda of architectural education it is first of all necessary to clearly define the pedagogical aims that should inform each stage of curricular progression towards the professional practice of the design of the built environment. Obviously, such aims should be described at a rather flexible level, so as to accommodate - as previously mentioned - national differences that inform cultural, ethical and environmental priorities and also allow autonomy, responsibility, independence and innovation in programme design to individual institutions of higher and professional education.

Pedagogical aims of any curriculum can be generally defined in terms of knowledge, skills and competence that graduates of an academic program are expected to acquire at every level of their educational career. These descriptors are illustrated, amongst others, in the European Qualifications Framework for Lifelong Learning (EQF), which in 2008 was adopted by the European Commission as a general framework to relate different qualifications systems across Europe (EC 2008). The EQF structures teaching & learning programs in 8 levels, whereas the last three correspond to the cycles of higher education derived from
the Bologna Declaration (EHEA 1999). The aims to be achieved by students at each level of their academic curriculum are expressed in the EQF as learning outcomes, i.e. “a statement of what a learner knows, understands and is able to do on completion of a learning process” (EC 2008). These outcomes are described in terms of:

- **“Knowledge: the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual;**

- **Skills: the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and use of methods, materials, tools and instruments);**

- **Competence: the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the EQF, competence is described in terms of responsibility and autonomy” (EC 2008).**

The taxonomy of learning outcomes is to some extent different in terms of nomenclature of the descriptors between the EQF, other qualification frameworks in Europe (e.g., the Framework for Qualifications of the European Higher Education Area, FQ-EHEA 2005) and specific national legislations in architecture. As an example, in fact, in the United Kingdom the conditions for qualification of architectural graduates at Part 1, 2 and 3 established by the Architects Registration Board and the Royal Institute of British Architects were expressed until recently in terms of awareness, knowledge, understanding and ability to “indicate the level of achievement required in each theme and student progression through the course of study” (ARB 2002). From the 2011/2012 prescription cycle however, in UK learning outcomes for graduates of architectural disciplines will be articulated in terms of knowledge, understanding and skills (ARB 2010). On the other hand, in the United States of America, the criteria establishing the level of attainment of graduates of architectural disciplines are described as understanding - “capacity to classify, compare, summarise, explain and/or interpret information” - and ability - “proficiency in using specific information to accomplish a task, correctly selecting the appropriate information, and accurately applying it to the solution of a specific problem, while also distinguishing the effects of its implementation” (NAAB 2009).

Although the descriptors differ marginally amongst qualification policies, it is clear that the learning outcomes in terms of competence in sustainability requested of students at each of the three levels of their academic education (as
per the Bologna Declaration) should encompass, beyond the unique acquisition of cognitive notions, also practical skills formed on field analysis, testing and simulations, and critical and synthetic capacities that build on the study and critical understanding of architectural precedents (AA, 2010). As a matter of fact, a firm theoretical background is fundamental to offer to students and practitioners the ability of converting physical theories in inspired design forms. Yet, the translation of abstract sciences into design applications has to be enhanced by adequate empirical understanding, evidence-based learning, and by appropriate diagnostic tools, so as to creative explore how scientific laws can be practically utilised and to compare different hypotheses starting from the initial phases of the design process. These three cognitive domains – theoretical, empirical and analytic – have to be concurrently provided in academic curricula, without being relegated to the areas of specialisms (EDUCATE 2011).

The enforcement of appropriate learning outcomes in terms of knowledge, skills and competence in sustainability, in all its complex socio-cultural, environmental and economic dimensions, would empower the students with a passionate commitment to rigorously and creatively address contemporary challenges, organising and structuring distinct types of knowledge into a "coherent architectural design whole" (ARB 2002) and encouraging critical awareness and reflection of the various issues at stake.

This will, however, likely require a substantial restructuring of most current educational practices. To respond to the demands imposed by contemporary challenges, sustainability has in fact to be seen as a priority in the education of architects from the beginning of their studies. This necessitates that academic institutions and professional bodies are all fully committed to this priority, enthuising and inspiring students to the mandates of sustainable development through appropriate pedagogical methods, tools and techniques and the allocation of adequate research, human, financial and temporal resources. Education for sustainable development must encourage critical awareness and reflection on the numerous multidisciplinary dependencies within cognitive domains and support an investigative discourse between the various parties and professions involved, engaging in life-long learning and continuously contributing to the evolution of knowledge through cutting-edge research and responsible practice (EDUCATE 2011).

Curriculum Development in Response to the Sustainability Challenge

The pedagogical principles that inspire the mission, programme structure and delivery methods of architectural curricula have witnessed relatively limited changes in the recent past and are often still based on an intrinsic separation between theoretical and applied modules. Technical and specialist information is yet generally delivered in satellite lectures that are seldom
integrated (physically and temporally) to applied investigation in coursework, therefore undermining the role of the studio as the natural forum for the creative synthesis of ideas, concepts and skills into coherent design (Rutherford and Wilson 2006). The unique outcome of this naive and deceptive pedagogical practice is that it reinforces the detachment between the acquisition of knowledge and technical principles and their exploration in applied design. This conception of how knowledge is attained and utilised indeed limits the development of critical thinking and personal development and the engagement of students with a comprehensive and multi-faceted design process, whilst only promoting the meagre (and often transitory) cognitive process of notion accumulation.

Obviously, in consideration of the challenges mankind is now facing, this pedagogical approach is no longer tolerable and there are significant demands to recalibrate the priorities driving the agenda of architectural education and practice, as requested, for example, by the evolving requirements placed on practitioners through demanding building codes and regulatory frameworks. It seems obvious therefore that new priorities that fully embrace an effective knowledge transfer are required to reconcile the seemingly conflicting realms of the technical lecture theatre and the creative design studio (Gelernter 1984).

A collaborative approach to the delivery and assessment of specialist information in studio has to be enforced, defining pedagogical methods that facilitate knowledge transfer between theoretical and applied domains. Students should not be provided with a half-brained education, but rather curricula in academic programmes should integrate left brain (analytic, linear sequential, e.g. from lectures) with right brain (imaginative, visual, creative, e.g. from studio) spatial processes (Salama 2005). Such change should support the formation of schema (solutions) from schemata (solution types) and avoid over-emphasis on one or the other of the brain hemispheres. If knowledge is offered in advance, in fact, learning happens by ‘rote’ (i.e., memorisation) and cannot be retrieved from the ‘mental filing cabinet’ when needed (Gelernter 1984).

On the contrary, to promote ‘deep’ learning, knowledge should be constructed “by active engagement, participation, and collaboration between learners and educators” (Datta 2007). As opposed to ‘surface’ acquisition of notions, the creation of new schema from schemata and ‘deep’ learning are particularly important to support education for sustainability, due to its intrinsically multi-disciplinary nature (Warburton 2003). In this case, in fact, the capacity to holistically structure diverse kinds of knowledge into a reasoned and articulated whole is fundamental to achieve knowledge, skills and competence in sustainable design, where the three cognitive domains of theoretical, empirical and analytic abilities are equally balanced towards their application and exploration in the practice of design.
The achievement of such aims, however, necessitates that the pedagogical programme encourages students to engage in comparative and synthetic thinking at disparate levels. This may demand a potential intrinsic reorganisation of most of the existing educational practices in architecture, embodying for example the notion of Problem/Project-based learning in curriculum development, where, to foster technical rigour and creativity in exploration, the learning can be acquired in the context of its application (Kilroy 2004). As a matter of fact, Problem/Project-based learning encourages the process of “reflection in action” (Shon 1984), whereas concepts are acquired within their practical design investigation.

This can be reinforced, for example, by several individual or small-group student projects where staff uniquely act as moderators of the learning process, providing students with timely and appropriate feedback (Kock 2002). By anchoring ideas based on experience (Gelernter 1984) and encompassing communication between disciplinary domains, this educational method can foster interactive dialogue towards an integrated pedagogy, promoting problem solving, critical and creative thinking, efficient conflict resolution and decision making, and fostering life-long learning. Obviously, activating the learning environment by joining knowledge acquisition with its application, and explicitly making connections between concepts and their exploration, represents a significant shift in teaching and learning practices that requires full buy-in by the school and needs the investment of appropriate resources.

To effectively educate for sustainable development, curricular programmes in architecture have therefore to be informed by an overarching ethos that combines the acquirement of cognitive notions with experiential, comparative and synthetic abilities. Clearly, a plurality of approaches in terms of programme structure could be adopted to accommodate such aims, making it impossible to formulate the ‘ideal’ model of a curriculum (Guy and Moore 2007). This, in fact, has to respond to the specific teaching culture, aims, methodologies and organisation (e.g., staff-to-student ratio) of the higher education institution concerned.

According to the correlation between pedagogical areas, the EDUCATE project has recently published a ‘Framework for Curriculum Development’ with the objective of offering an underlying conceptual support to programme design and development that endorse the comprehensive implementation of a sustainable approach to design in higher and professional education. The pedagogical principles and strategies suggested in the ‘Framework for Curriculum Development’ are not intended to define a ‘prototypical’ curriculum, but rather have been formulated to provide guidelines in curricular advancement, yet maintaining enough flexibility for them to be adjusted to a wide range of contexts, pedagogical systems and approaches, environmental targets, and therefore to be
applied to different educational structures and organisations (EDUCATE 2011).

The ‘Framework’ organises curricular models in five main categories:

- **Parallel**, where each disciplinary domain runs autonomously;
- **Partially integrated**, where different cognitive areas are linked in delivery or, more frequently, in the assessment of students’ coursework;
- **Fully integrated**, where various disciplines converge around the central core of the studio (Levy 1980);
- **Iterative**, where knowledge is progressively deepened through a series of cognitive ‘loops’; and,
- **Elective**, where curricular contents are enriched by optional courses, potentially structured as a sequence of domain-specific modules (e.g., Minors).

Each curricular model brings its own advantages and constraints, therefore it is necessary that the education is supported by adequate pedagogical methods and tools. Indeed, process is important for learning, and the way learning occurs is as important as the content of the learning itself (Orr 1991).

In this context, new didactic techniques derived from Information and Communication Technologies (e.g., e-learning) have been proven, amongst other methods, to offer significant opportunities to encourage self-reflection, deep learning and critical understanding, and promote multidisciplinary cooperation between diverse specialisms, fundamental abilities to the realization of an integrated pedagogy (Warburton 2003).

To this aim, in order to support a collaborative approach between students, educators and professionals, and provide teaching & learning tools that facilitate the convergence of technical and creative domains, EDUCATE has explored, evaluated and assessed existing and developing e-learning technologies that can contribute to pursue an integrated pedagogy in the education of architecture. Further to this, the project has developed an intelligent Portal on sustainability that can foster online interaction between diverse groups of users and provide students with feedback on design and other coursework, whilst also disseminating principles of sustainable design to building professionals and the public (EDUCATE 2011).

The Portal is configured as an interactive system structured in six main components: **Knowledge Base, Student Space, Expert Space, Instructor Space, Professional Space**, and **Public Space**. Amongst its primary functions, the Portal hosts a broad Knowledge Base of sustainable design, which – coherently with the learning outcomes previously illustrated - is built on a tripartite cognitive framework composed of Issues & Principles, Applications & Case Studies, and Tools (**theoretical**, **empirical** and **analytic** domains). The Knowledge Base is not limited to a conventional ‘tree structure’ organised in sections and subsections, but rather it is built on an **ontology** of Directories, Categories, Clusters and Topics that can support an intelligent ‘match-making’ process to promote a concerted
approach to the integration of sustainability in studio work. Enrolled students in fact can access the Portal to get hold of technical principles of sustainability and relate them to applications and tools for design and performance studies. Also, they can post questions to experts, browse through customised Frequently Asked Questions, engage in discussion with other groups of users, upload development of their design work and receive feedback from their tutors and from their peers. A further area of the Portal is dedicated to professional bodies where announcements, regulations, news, etc., relevant to the practice of architecture can be published. This area also contains information and e-learning tools expressly designed for practitioners to enhance their expertise in sustainable design towards the achievement of Continuing Professional Development credits (Altomonte 2010).

Conclusions

The ‘Framework for Curriculum Development’ and the operating structure of the EDUCATE Portal are currently in their testing stage and it is hoped that the results obtained will sustain the call for a substantial revision of the principles that inform the architectural agenda in academic and professional institutions.

Undeniably, new teaching & learning approaches and the support offered by advances in Information and Communication Technologies can provide higher education with innovative pedagogical methods and tools that can foster deep and critical thinking and allow flexible learning via the use of more responsive delivery techniques. These novel principles, strategies and instruments of education are likely to offer revolutionary prospects for the technical knowledge related with sustainable design to cross the boundary of the environmental calculation or the energy certification and assume a more relevant position at the core of the pedagogical and practical activities of professionals of the built environment.

However, in the priorities that architectural curricula have to consider to fully embrace the challenge of education for sustainability, by no means advances in technologies and communication techniques should be considered as a substitute for traditional delivery methodologies, the lecture theatre, the environmental lab, the seminar room, the design studio. As a matter of fact, although students from the ‘iPhone generation’ largely demonstrate fluency and familiarity with innovation in technology, there is a substantial risk that they could solely rely on the most basic visualization, searching and learning tools, thus not developing the necessary critical and analytical insights necessary to relate technical knowledge with evidence-based and applied design work (Altomonte 2010). Yet, by enabling some teaching & learning activities to take place outside the physical boundaries of the academic ‘walls’, recent studies support the idea that the effectiveness of the pedagogy can benefit in increasing engagement of students in education, encouraging reflection and critical self-evaluation, improving the
richness and diversity of coursework, supporting students’ awareness of design-related issues, promoting methods of communication, and, ultimately, enhancing the quality of the teaching and the overall learning experience (JISC 2009).

In conclusion, several programs, experiences and research activities conducted by academic and professional organizations worldwide represent a testament to the increasing demand to move beyond the line of conventional disciplinary separations, and reconcile seemingly disparate cognitive domains, technical sciences and imaginative arts, theoretical abstractions and practical applications, teaching & learning in conventional (academic) and virtual (online) environments. Such awareness can pave the way towards the achievement of integrated and deep learning that, by exploiting new educational approaches, methodologies and tools, can reinforce the requirement for a holistic attitude in pedagogical development facilitated by enhanced communication, exploration and exchange of ideas, the acquisition of transferable skills, and increased opportunities for critical and independent thinking.

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Teaching a new Environmental Culture


Contributions
The course

Climate responsive design as well as issues of sustainability are an imperative to architectural teaching and should be introduced from the early years of study. Students should develop ecological and environmental awareness and perception and realize that sustainability with all its constraints should be a leading parameter from the early steps of conceptual design.

For years, in our University the course of energy efficiency in buildings has been a topic that students did not take seriously under consideration because they failed to correlate it with architectural design. The courses seemed more mechanical engineering oriented with calculations and numbers. Therefore, most of the students did not implement bioclimatic elements in the design process.

Our experience has shown that working mainly with calculations and numbers alienates the student from the main goal which is produce architecture of high quality that responses to all the aspects of the profession. The computational approach is much more familiar and representative of the building performance.

Two years ago we introduced a new course in the 5th semester (3rd year) in the field of building technology with the title "Climate responsive design". We have been monitoring the process and the students’ response to the course in order to improve the formula every year and implement it as it evolves.

The challenge is to induce students which are in the middle of their studies to the climate responsive design –an uncompromising parameter- without losing their goal which is proceeding in designing buildings of profound quality.

Climate responsive design is a part of a holistic design approach with sustainability in mind and can not be separated from so many aspects that refer to architectural design and planning. The endeavor is relating built to natural environment.

With that in mind, students should get familiar with topics such as: energy and resource efficiency; alternative renewable energy applications to buildings and communities; self sufficiency and standalone systems vs central systems; water conservation and recycling; land preservation and restoration; building pollution and healthy buildings; environmentally responsive building materials and systems, etc.

All these matters must be introduced with underlying themes that relate to topics such as: structure and construction technology matters; the lessons of vernacular architecture; form that should fit to climate, context, culture and place; ecologically sound and planning principals and systems and their applications through examples.

The objective is to bring all the above together focusing on innovative, architectural design that will combine the lessons and experience of significant examples of the past with new technological advances.
Efficiency should reflect in many aspects such as the site, the size, the function in relation to the form, and the materials used.

Focus is directed in the following points:

1. The design process of a new structure. (research, design—with all the parameters and constraints—, construction)
2. Developing the fundamental criteria in order to evaluate the built environment in all scales, targeting in energy efficiency upgrades
3. Developing the necessary criteria for evaluating and interpreting the ecological attributes of protected natural and built environments, for implementing conservation acts and low impact interventions.

In all three directions the main goal is the optimization of thermal living and lighting comfort for the user of a building along with minimizing the adverse consequences in the natural environment.

**Teaching methodology**

Even though the course is oriented in technology and focuses mainly on the tools of bioclimatic design and energy efficient strategies we try to encompass vital issues of sustainability. Our goal is to provide the students with the basic tools in order to approach the design process with sustainability in mind.

The course takes 6 hours weekly from which 2.5 hours theory and 3.5 hours for the exercise. The theory is given to all the class whereas for the exercise the students are divided between 3 or 4 professors and work on the exercise in groups of 3.

In the three years that the course has been running the final project is a little house either existing where they have to enhance bioclimatic elements and improve its energy performance, or a new building from scratch given only the shape and some guidelines. The final project and its context will be discussed extensively later on (Figure. 1).

During the semester they are introduced to the basic concepts of climatol-
ogy, design criteria and strategies against which their final building design can be evaluated. We are focusing on the step by step endeavor that will help them control the incoming knowledge and assemble the pieces to the final project.

We approach our teaching methodology with the following modules on which the students have to respond accordingly, with research, sketches, diagrams and so on:

1. The Basics (thermal comfort, climate analysis, passive heating and cooling, sun motion, ventilation, lessons of vernacular precedents)
2. The Tools. The building envelope 1. materials, 2. form and orientation (dictate solar gain, and natural air movement), 3. sun controls, 4. environmental controls (passive and mechanical) 5. conflicting variables
3. Examples of contemporary buildings
4. Implementation of all the above to the project.

The Basics

a. Thermal comfort, understanding the climate, sun motion and ventilation, passive heating and cooling

At first we introduce important issues of human thermal comfort and climate. It is very important for architects to comprehend the climatic elements and how the natural environment works as well as how these parameters are perceived by the human body. We introduce the aspect of climate and micro-climate and the nature of the factors that affect the climatic conditions of the earth such as solar radiation, long wave radiation to the sky, air temperature, humidity, wind and precipitation as well as the sun motion air movement and natural lighting. We teach all these parameters and urge students to try and experience the phenomena in order to understand what thermal comfort and heat exchange are and how a building should work towards that direction. All this is necessary in order to go to the next step and make a climate analysis with data specific to the location under study. We use mainly the digital program ECOTECT and/or a program created at UCLA called CLIMATE CONSULTANT to produce the graphs that present the climatic characteristics and the psychrometric chart, in order to conclude to the strategies that should be implemented to the design along with the form and function as well as the construction (Figures 2-6).

Figures 2-6. Climate analysis
b. Vernacular precedents

We believe that the study of the indigenous and traditional architecture is an important aspect as vernacular settlements present a wide range of lessons regarding sustainability. They demonstrate the concrete manifestation of the human–environment interaction that constitutes culture and has led to the development of a multitude of cultures by different people in different environments. The solutions provided by generations of traditional societies, which used only natural resources of energy, may be of great help in opening new fields for research and application.

The indigenous people succeeded in balancing culture, available materials and climate. They built in accordance with nature and not against it. They considered nature sacred since it provided vital resources and realized their dependence upon it. Energy conscious principles and examples of passive heating and cooling systems are evident in many forms of vernacular architecture. Furthermore the assessment of vernacular precedents is very helpful in understanding what kind of building envelope is suitable for every climate. According to the harshness of the climate the climatic parameter may have a decisive impact on the form of the structure.

Apparently, a lot has changed in the economy, the building techniques and even more in the standards of comfort we have and therefore, re-adopting the old construction practices is not practical. However we can learn a lot in our effort to adapt the new buildings in the climate if we perceive the principles upon which traditional settlements and building techniques were established.

The study of vernacular architecture demonstrates in the best way how cultural, technical and economic forces were integrated with those of thermal comfort to influence building form and reveals many sustainable attributes:

- Limited size and consistent human-comprehensible scale
- Easy contact with natural world
- Good use and preservation of natural resources
- Exploitation and adaptation to the contextual forces of the site
- Climatic characteristics such as orientation and arrangement are clear in community scale as well as in individual buildings for maximum indoor and outdoor comfort.
- The use of natural local building materials and local energy sources in very strict conformity with other natural factors such as weather and location.

Additionally, students of that semester attend another course called "Analysis of a traditional settlement". Every year they visit a settlement that preserves in a significant proportion its initial form and structure, and work on the field for about a week. They analyze all the parameters such as the configuration and arrangement of the buildings in community scale, as well as their form and structure, the climatic characteristics and finally the use of building materials.
Additionally studying the vernacular architecture of our country helps future architects to respond in the most suitable way in matters of restoration, and refurbishment in respect to the place, climate, culture, and the built environment.

**The tools**

Following the basics is the design and evaluation of the building envelope and all its parameters that have to be defined early in the design process in accordance to the climate, in order to respond to the internal environment both passively and actively. These parameters are:

1. The materials of the envelope. We discuss extensively the materials used, regarding not only their thermal performance and effect but also their life cycle and their energy input to the environment. Additionally we discuss extensively their effect in the overall building performance (weathering, emissions leading to the “sick building syndrome”, etc).

2. Form and orientation of the building for the best performance, in order to profit of the favorable and protect from the unfavorable characteristics of the local climate. Consequently, we present the strategies for solar gain and the physical mechanisms of ventilation (Figures 7.1, 7.2).

3. Sun motion and control, ventilation functions and requirements for passive heating and cooling. Also the input of environmental controls both passive and mechanical (Figure 8).

4. Conflicting variables. Bioclimatic design faces most of the times the task to work with many variables most of which appear to be conflicting, since the building is a live organism that has to respond to climatic conditions that differ day and night, winter and summer (Figures 9.1, 9.2).
The above issues are presented extensively technically and always with examples that demonstrate their performance and architectural forms in particular buildings (Figures 10.1, 10.2).

Additionally there is an extensive bibliography suggested to the students along with the course reader book and student notes on which the students are examined in the end of the semester on a written test.

**Examples of contemporary buildings**

After the study of the vernacular architecture, we present an overview of the recent contemporary buildings that combine both simple and sophisticated technology systems and demonstrate efficiency and moderation in the use of materials, energy and spatial resources, in our country and abroad. We discuss at length the building in its entity and especially the quality of its form and function.

At this point the students present an existing building of their choice and try to assess the bioclimatic elements the sustainable attributes, the impact to the environment according to all the parameters discussed previously and finally the architectural quality in its entity.

Students get informed of the increasing awareness of the environmental challenges presented by climate change and resource depletion. We also try to arrange as many field trips as possible to some of those buildings.

**Design guidelines and the final project**

At last the students wind up with the design guidelines of their project and conclude in the strategies that should be implemented to the design along with the form, the function, the materials, the architectural elements as well as the construction accordingly to the climatic conditions. They determine the strategies for passive heating and cooling along should work well with all of the above and also surpass successfully the conflicting variables. At this point the produce along with all the architectural drawings and construction documents
all the bioclimatic diagrams, charts and calculations that demonstrate the performance of the buildings in all seasons of the year, both day and night (Figures 11-20).

**Evaluation of the course**

The course runs under the third year, and the students in all three years have shown great interest in it. There is a great feedback that shows that young people are getting more and more aware and responding in environmental issues and ecology. We monitor the course year by year. As far as theory is concerned we try to implement it every year with everything current without forgetting the unchanging great values of the past.

In the first two years we asked the students to do most of the calculations by hand in order to evaluate the performance of the building they designed. The teaching staff of the course includes a mechanical engineer that works with the students throughout the semester and provides all the necessary information. In the current year we introduced more dynamically the program ECOTECT to which the students have access through the computer lab of the school. With this program they have the ability to test all the parameters, conclude to the envelope and its final form and evaluate its performance to the different design strategies by creating models and running all the necessary diagrams and calculations. The main point to that is that they have instantly the answers graphically.

Another important element which we believe is very essential for the success of the course is the continuous feedback from the students throughout the semester. The information from the theory –new to most of them- can be overwhelming if it is not put immediately into practice. Therefore we focus on Figures 11-15. Students’ final projects

Eleni Alexandrou
the week by week work from the students that is reflecting the comprehension of the theory. Most of them respond with interest and seek additional information from the internet and bibliography.

We consider very important the teacher to student ratio for the course. Unfortunately this is not always possible and that may cause some malfunction in the progress of the studio. However midterm pinups alleviate the problem.

**Conclusion**

Nowadays we have been depended totally on the mechanical means and alienated ourselves from implementing nature in the process. It is very difficult to make the new generation that has grown totally accustomed, familiarized and depended on the machine and technology to re-approach nature and its endeavours. A whole mechanism is needed in order to make them think and acquire an ecological consciousness that will be implemented in their education and profession. Therefore, great effort is needed to help students realize the profoundness of sustainability and the interrelation with the environment. Energy conscious design is a leading parameter in the design process. Building in a sustainable manner requires paying attention to the predictable and comprehensive outcomes of decisions and events throughout the life cycle of a building, as well as the renovation process of existing buildings and the reshaping of communities and cities.

The goal of the course is to provide scientific, technical, and philosophical foundations for a mature civilization that will nurture the disintegrating world. Architects should be able to communicate all these ideas and in a way teach their clients or other people in participation, the principles of sustainability that will help our natural and built environment sustain future changes, stop the degradation of the natural resources and improve our living conditions.

Last but not least we should not forget that architecture has moved to a new era where in the name of sustainability both hopeful but also inexplicable
things may come. There is a profound danger of promoting a new architectural style that uses the great technological advances in the field to create extra and sometimes huge buildings that cost a fortune in the name of sustainability. Architectural magazines and all the big firms in the world are building energy efficient buildings. Some not to say most of them are accounting great constructions costs that are not always alleviated by the building performance, use of extremely expensive materials and most of them have to fulfill huge programs. There is a new style with great approval should we say of environment sensitive architecture that can be very successful if we avoid some apparent contradiction.

Figure 19. Structural detail

Figure 20. Calculations
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Eco-Friendly Design for Environmental Spaces of Residential Building
Environmental open spaces quality of residential building

Recently architecture, considered as a phenomenon ruling all the morphological changes of the natural and human-made environment, has been estimated as an interaction between the project and its results on natural environment and human society to be afforded with renewed conceptual and suitable operative systems. Such instruments come from a complexity of aspects, including transformation technologies of the human environment, belonging to different scientific communities called sustainable communities, eco-oriented technologies, or more generally environmental technologies. Following this renewed environment reckoning, new spaces for design have been opened, favouring the development of sustainable architecture technologies, characterized by the essential environment for example:

- the attainment of the actions and techniques to the material culture of the place that comes through and interprets in the project view the genius loci concept fully developed from contemporary culture;
- the bio-morphology and climate of the place, where we work, that introduce and push to study and interpret a series of factors such as the climatic, geomorphological, energetic parameters, etc.

Further criteria to be adopted for a sustainable architecture consider non-polluting materials and techniques to be integrated and coordinated to the other modifying reversible and flexible operations, that determine the so-called “sustainable use” of the territory, opened to possible time and space variations. These definitions help to reflect about the need to find a project process attaining to technological information, meant as acknowledgment of the action range forecasting, pre-setting and controlling instruments of the action technologies.

From this point of view the project process is enriched with other values such as:

- the minimal reduction of environmental impact, developing the actions such as the transformation of the “material” able to reduce ex-ante both dangerous use of resources and waste;
- the compatibility between the pre-existence and final construction;
- the innovation and restoration of traditional opposition overcoming between the natural and artificial cycle.

These new acknowledgments have determined, since the beginning of the '90s, the need to experiment with new ways of teaching technological advances in the Architecture Faculty. The definition of strategic objectives for the sustainability of residential buildings, both public and private, is necessary to incentive the acknowledgment, in the students attending the last years of the Architecture Faculty. An eco-compatible design must compare new aware and compatible with the innovation forms, method and product system expressed by the evolving national and international panorama, and studied and re-interpreted in the project.
In the project development, teachers have introduced, through lessons and seminars with different sector operators, issues such as the renewable energy sources (the production of domestic hot water and electric energy), the active and passive solar systems, water saving technologies, innovative eco-compatible and recyclable materials, with a low environment impact. The students have focused, at first, on the general urban organization and the relationship between the residential building and its surrounding environment.

As a result, the open space, plan-volumetric dispositions, urban texture, green and sports and free time areas have been designed with different connotations, sun control strategies, both in winter and summer, adopting typologies and different materials such as pergolas, lodges, fixed or mobile breis-soleil and other items. In relationship with the wind sources regime, the summer ones have been canalized to increase the natural ventilation of open spaces. In order to defend the cold winter winds, some screens have been used evergreen vegetal barriers, combined with the dispositions of the city buildings and urban settlements.

In the executive phase of a single building module, the students realized the exact control of the construction, using only the eco-friendly materials.

**The sustainable technologies for the rehabilitation of open spaces**

In today’s society the demographic, economic and cultural changes have often oriented the politics of the territory towards the rehabilitation of open spaces, inducing the institutions to collect resources for the rehabilitation of the existing urban environment. In order to intervene in the urban development with the aim to find an alternative to the model imposed in the twentieth century, the rehabilitation of open spaces must be necessarily seen from the sustainability point of view. According to that viewpoint, the perception of the open space changes must be conceived as an organization endowed with a dynamic balance achieved through the technological control of complex functions. The sustainable open space must be shaped, therefore, as an environment to be enjoyed in safety and with high standards of quality, without making the consequences of the transformations, which assure such conditions, a burden for the future generations. In urban scale the rehabilitation for sustainability must, therefore, consider the territory as a complex issue where the border between artificial and natural environment cannot be seen and where each process is checked, so that its impact and, as a consequence, the irreversible degradation induced is the minimum possible in relationship with the ties of the process itself. The urban space, making up a real “urban ecosystem”, with its complex interrelation of structures and relationships, determines its own trace in the surrounding environment defined as an ecological imprint. Such an imprint is a sign of degradation left as a burden to the future generations. Operating in the view of a sustainable development, it
is necessary to limit such an imprint to a minimum that is determined, above all, by massive and energetic information fluxes characterizing the urban system.

Therefore, it is very important to orientate the processes of rehabilitation as interventions of control of such fluxes, so that the imprint, which cannot be eliminated, is limited as much as possible. The qualitative and quantitative description of the fluxes, that is how people move, how they exchange information, how they interact, how the energetic uses are sustained, how supplies and services are arranged, is needed to characterize the urban environment and hypothesize interventions of rehabilitation having the aim to make the fluxes compatible with the sustainable transformations from the environment where they are placed. The restraint of the ecological imprint increases its loading capability of open spaces that can be defined as the capability to absorb and control the phenomenon of urbanization with a sustainable impact for the ecosystem. The aims of rehabilitation for sustainability consist of qualifying life, protecting health, increasing safety and favouring the interrelationship among the inhabitants.

With reference to sustainability, therefore, the aspects necessary to be checked in the interventions of rehabilitation of the urban open spaces are particularly those ones of mobility and viability, green space and fittings, energetic systems, common spaces and integrated cycle of waters use.

**Mobility and viability**

In the urban areas the motorized traffic, being invasive, determines a remarkable noise and air pollution, influences the quality of life limiting the social activities and, besides, it is often a threat for the weak end users of the road like pedestrians, particularly children, old and handicapped people. Therefore, a conflict is generated, for which a suitable solution between the desire of accessibility from the motorized traffic and the inhabitants’ quality of life must be found. It is necessary to organize the road system and control the traffic, in the local viability, in order to discourage it, let it go slow and be careful with the problems of the pedestrian viability. Traffic slowdown and limitation gives the result to reduce the emissions of polluting gases in the air and it carries out also a higher standard of safety, linked with the vehicular traffic. The mobility and traffic control also involves that one of the noise pollution. The level of urban noise, in fact, is almost exclusively due to the vehicular traffic. Traffic, let go slow and limited, has as consequences, besides a greater liveability and reduction of the air and noise pollution, also a greater fruition of the urban spaces, not invaded by cars and given back to the inhabitants’ activities of relationship.

**Green spaces and urban fittings**

A synergic action for the pollution control, on a hand, and the increase of relationship fruition, on the other, are represented by the interventions of green space
arrangement and urban fittings. The green space, in fact, besides characterising the landscape so that citizens are induced to cross its spaces, develop a very important function in checking the environmental comfort of open spaces. The intervention on the green space, therefore, must consider the capabilities that vegetation has to impact on the local micro-climate and regenerate the air quality. Moreover, the choice of the essences results to be very important to optimise the control functions of the micro-climate. Some essences, besides, succeed also in withholding dusts and particulate on leaves, so contributing to the control of the air pollution.

Besides the traditional interventions on urban parks, public gardens, private green spaces, rows of trees along the roads, they can be also considered the typologies of the green façades and pergolas that contribute to the local shadowing that can be a factor of qualification of the external environment in the climates, where summer condition is more serious than the winter one.

In synergy with the intervention on the green space, it is necessary to endow the open spaces with fittings that make it possible a temporary rest, amusement, a sporting engagement, a pause of reflection, a friendly conversation. The design of the urban fittings is an important element to qualify and make the open spaces lively. The particular signs of the urban fittings must be able to make connections easily individualize among different roads, pedestrian paths, services, transport systems, access areas.

Fittings and green spaces go together because the former must be completed by the latter, and the fittings cannot be installed correctly, but in spaces where there is an opportune green space arrangement.

**Energetic systems**

The environmental rehabilitation of the urban open spaces cannot leave out the control of the relationship with the natural exchanges of energy, that, as far as possible, must limit the relationships of supply of the energetic systems supporting the housing quality to heat, cool, ventilate, illuminate when natural exchanges are not enough.

You necessarily need to rehabilitate, on the one hand, using at most the natural contribution of heat, light, air, using also active systems of conversion such as the photovoltaic ones, and, when it is not enough, you need to use either electric or gas systems able to give heating, illumination and ventilation of integration and, on the other hand, to rehabilitate using as little energy as possible in the uses that can be satisfied only with conventional energy consumption, as those ones of the transport system.

The interventions of rehabilitation, moreover, must foresee modernization and improvement of the existing electric and gas systems, so that they can develop their function with environmental compatibility and safety. We can’t renounce to it for our necessities anyway.
**Common spaces**

The quality of the urban open spaces also depends on a complex interlace-ment of functional and cultural aspects that characterize the common spaces, places where you can walk, meet, do business, supply something. The quality of common spaces is closely linked with other factors (mobility, pollution, services), that must assume an optimise conformation in relationship with the aforesaid aspects. Walking is in the European cultural tradition, which has favoured spaces, used for such purposes to create social relationships. The urban design in Europe has been careful to guarantee the users’ need of interior as well as exterior spaces. This has characterized the architecture of the buildings having porticos, shelters and particular relationships between the curtains of the buildings and the overlooking public spaces. There is also the possibility to protect the common spaces from the bad weather, through structures in light and eventually transparent, both horizontal and vertical materials, these last ones for the protection from the wind and the windy rain. At a level of buildings, in order to make a good relationship between residence and open spaces, the access of the inhabitants to the common spaces must be stimulated, making them safe and desirable with a supply of comfort and better environmental perception.

**Waste treatment**

Correct management of the solid urban waste is essential for controlling soil pollution and keeping the balance of the environment ecosystem. In the politics of safeguard and environmental hygiene and health protection, the problem of the waste treatment is faced as a more general problem of management of waste itself. From the management point of view, the involved systems must, first of all, provide to decrease the waste produced and its higher environmental compatibility, reuse in material or energy and finally the treatment for the residues not reusable anyway. Within the interventions of rehabilitation, it is very important planning again the system of treatment, leaving away the custom of disposing unsorted waste in landfills and privileging the phases of recovering and recycling.

**Integrated cycle of water use**

Water is a very precious resource and, therefore, the whole cycle of the waters must be seen in the view of saving and possible recycling, where it is possible. In the interventions of rehabilitation it is very important to correctly design the systems that must be previously dimensioned for the satisfaction of the increasing water requirements. The interventions of rehabilitation of the urban open spaces, besides the drawing of the wastewater from all the possible uses, must also assure the distinction between the clean water and the so-called sewage, so that those clean ones can be reused after an opportune treatment, for watering the green areas and
washing roads and squares, while the sewage is delivered to the purification system that completes their treatment. It is also necessary for the waters of first rain, bringing in solution dusts and polluting substances of various types, to be separated from the clean water to be circled again through some spillways and conveyed into the sewage pipe for the following purification. The final purification happens in systems that must allow the dejection of the main polluting substances contained in the wastewater, so that they can be delivered in a final water body.

The traditional systems of purification, in the case of small potentialities, can be supported or replaced also by natural treatments that reduce to the minimum the artificial elements and the energetic consumptions: for example, instead of carrying out concrete ponds, the environments, where the processes happen, can be some natural damp areas, the outflow of the waters can be made as far as possible for gravity. Chemical substances are not introduced in the system to favour the processes and the energetic inputs are reduced to the minimum. Such natural treatments, in some cases, can also be an element of interposition between the system of purification and the final receptor body to demolish the residual organic load and protect the environment in case of malfunction of such a system. In order to carry out the purification of the waters without using mechanical systems with a high impact, systems of purification based on natural processes, such as the phytodepuration can be used in some cases (small uses).

Figure 1. Environmental network characters of open spaces
Didactic results of eco-friendly design for environmental spaces

The contribution illustrates the didactic experience carried out within the Laboratory of Technological Design in the second year of the Skilfull Bachelor in “Buildings and Environment Innovative Quality” (2009/10 a. y.; teachers: M. Isabella Amirante and Antonella Violano) and the Construction of Architecture Laboratory in the second year of the Architectural Science Course (2009/10 a.y., teachers: M. Isabella Amirante, Antonella Violano and Rossella Franchino) at Faculty of Architecture of the Second University of Naples.

The case study is the eco-friendly design for environmental spaces and rebuilding social housing in the Pianura district (nearby Naples).

The Memorandum of Understanding between the Campania Region and the City of Naples aims at solving problems concerning Social Housing, built thirty years ago in the Pianura, Soccavo and Chiaiano-Piscinola-Marianella districts with heavy prefabrication technology.

In order to achieve the aim of “zero-mobility for residents”, who are the assigned social housing families, the Municipality has identified the so-called “trigger area”, that is a free area near the prefabricated building to be replaced, where the demolition-construction program can be started. The Pianura social housing program covers a total of 605 flats and a systemic set of works aimed mainly at upgrading the environment quality by:

- polycentric buildings articulation and their aggregation around courtyards, squares and green spaces for a shared use also to emphasize the local social identity;
- two different levels of traffic networks: a residential internal road network and a district external perimeter one, the latter is mainly used as a connection with surrounding areas of the same district and Naples metropolitan area;
- many tertiary services, carrying out pedestrians and commercial areas;
- a complex network of urban route paying great attention to urban design and architectural barrier removal;
- a large pedestrian square in front of the existing church, to welcome the pilgrim during the numerous celebrations for Don Giustino.

The urban design proposal redefines the new urban settlement and valorises its landscape, aiming at enhancing the relationship with the Camaldoli hill.

So, the proposed solution is structured along two main urban axes: the longitudinal and the transversal one, ideal extension of existing roads; they become the main generator circuit for the arrangement and combination of commercial and residential buildings.

The choice of directions is directly connected to the surrounding agricultural areas that, infiltrating between the buildings, become garden, urban farm, green areas and recreational trails that improve the quality of living.
Shops, laboratories, sports facilities and community services become places of social relationship and meeting. In this context, there are many community facilities in public spaces in order to produce a social regeneration and overcome the problem of exclusion and separation from active life.

In the green areas, the project provides to plant deciduous and evergreen trees helping to reduce the solar energy absorbed by the soil and thus the temperature.

The open collective spaces rehabilitation has been explored in different eco-friendly approaches, with a particular attention to the following principles:

- use of recycled materials;
- application of naturalistic engineering techniques;
- water-use in integrated cycle networks;
- project solutions of sustainable mobility;
- design of open spaces illumination with renewable energies;
- management of urban waste cycle.

The analysed environmental open spaces are near residential buildings; therefore, rehabilitation projects have to consider their particular needs. Different solutions of spaces rehabilitation are proposed. The approach is multidisciplinary with the contribution of expertises’ seminaries aimed at a complex and diversified construction design.

Particular attention is paid to redesign environmental spaces, redefining the relationship between public and private areas.
Reasoning about the types of relationship between the built / not built, how to use open spaces, their dimensions and limits involves the search for solutions reflecting the change of the meaning that these areas have taken over the resident’s new requirements.

Some design results achieved by the students during the activities of the Laboratories are shown as follows. Particularly, in the Project called “Sustainable Canon Settlement”, the designers are Salvatore Matarazzo, Carmine Montella, Matteo Nigro, Giovanni Vita, students of the Technological Design Laboratory (second year of a two-year Master in “New construction and contexts quality”).

Endnotes
1. Edited by M. Isabella Amirante
2. Edited by Rossella Franchino
3. Edited by Antonella Violano

Figure 6. Green areas: construction details
Figure 7. Community Center’s open spaces
Figure 8. Library design
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A Pedagogic Approach towards Environmental Education: Cultivating Environmental Conscioussness to Undergraduate Architecture Students
Introduction

Our growing sensitivity for environmental issues has indicated that buildings are the major cause for damaging nature. Pollution from heating and cooling buildings exceeds that from cars. The building industry, the second largest industry in the world, manufactures building materials consuming enormous energy, and exhaustible resources. Buildings and their construction account for more than half of the entire greenhouse gas emissions and energy consumption globally each year. The Building Sector is the key source of demand for energy and materials that produce by-product greenhouse gases. On the other hand, our houses, which are the largest lifetime purchase, are built more or less in the same way as they were built at least fifty years ago. The home that will define our lives is designed by and large only for the present, based upon an implicit (and obsolete) conception that the future is just a repetition of the present.

Our society needs urgently new approaches in the conception theorization and implementation of architectural practices, which will generate architectural designs responsive to the new conception of the relations between nature and the humans where the latter are part of the former depending upon and determining it in a dynamic and parametric relationship. Architecture education has a role to play in the above debate. The fragmentation of architecture education constitutes the environment as yet another ‘must’ subject but with no connection to the design process in general and to the design studio in particular, while the design studio has always been the platform on which either implicitly or explicitly all fragments come together towards quality architecture.

At our School of Architecture, after a number of pedagogic trials and errors, has recently designed a series of interlinked and innovative courses based on the model: initiation- theoretical background, grounding: precedent study through matrixes, conceptualization-delving into theory-implementing through design. The present paper will focus on the second course of this series. In this course: grounding: precedent study through matrixes, two lectures an introductory and a simulation of what is expected of the students are delivered by the staff. Each week students present a case study of a distinguished, for its environmental sensitivity, building on matrix of criteria set by the staff and students regarding performance, natural ventilation, cooling, heating, solar shading etc strategies. The students compile a digital archive of good practice examples.

Generic Course objectives

The investigation lies in the teaching approach in the framework of the new course "Energy conscious Architectural design and technology" at the Department of Architecture of the Aristotle University of Thessaloniki A.U.Th.

This course was taught, for the first time in two parts, in the winter semester of academic years 2009-2010 the first part and 2010-2011 the second part as
a compulsory module offered to third and fourth year architecture students accredited 6 and 6 ECTS respectively.

The main objectives of the course aim at:

- developing an understanding of the basic concepts, theories and issues of building skins towards sustainable design
- developing an understanding of the role of building skins in the environmental control of buildings towards sustainable design
- developing an understanding of good practice examples worldwide
- developing an understanding of the particularities of climatic zones, geography, culture and their role in design decisions
- becoming familiar with simulations tools and software that investigate the energy issues of building skins
- exploring the materiality and constructability of contemporary building skins
- appreciating issues of building skin adaptivity to climate and inhabitants needs through quality design, technology and the exploitation of conventional and/or the genesis of new materials.

Analysis of a case study building
In 2009-2010 academic year, the students worked in pairs and chose, after the approval of the teaching team, the building or project to be researched.

The analysis of the examples was made on the basis of an indicative model that was given by the teaching team, so that the conclusions that are drawn from every project should have a common base of comparison and reference.

The analysis included 4 parts: Descriptive brief, Environmental analysis, Building skin design and Conclusions. This structure served a gradual approach from the general rules of design to the construction detail of the shells.

I. Descriptive brief
In the introductory part some general elements were presented from the standpoint of the Owner, the client, the public, the Architects, the Engineers, the Consultants, the Budget, the Use and the building programme.

There was also reference to the main idea of the design and how much it included decisions concerning the energy efficiency of the building. When the existing bibliography through journals and Internet sources was not analytical enough students were asked to produce sketches and diagrams through which the environmental control of the building could be better understood.

II. Environmental analysis
The environmental analysis includes the following points:

1. Site analysis
   Location, Latitude-Longitude, Altitude
Climatic data (temperature, sunshine, humidity, wind, rainfall, meteorological elements)

Vegetation, Urban design and site improvement

The relevancy of every building with the environmental space is particularly significant, both in the wider region and the urban fabric. A significant number of buildings with environmental conscience are related to a wider range of construction regeneration of entire regions, either for new buildings, or for reuse of existing buildings.

2. Environmental loads - Consumption of energy and resources
   Emissions
   Solid waste
   Water management
   Consumption of energy, water, material

3. Interior Environmental Quality
   Ventilation (natural and artificial)
   Thermal comfort
   Acoustic comfort and sound insulation

4. Control of constructive systems
   Functionality and efficiency
   Control of the construction systems
   Which technologies have been applied during the design and the construction and for which purpose?
   How do they function and what role do they play within the energy balance of the building?
   Are there innovative elements in the plan and construction of the building in relation to other modern buildings?

5. Long-term performance
   The sustainable character of the building is also dependant on the flexibility and adaptability
   Is there flexibility in the change of use or is it made for a specific use?
   Do the changes in the building affect the energy efficiency?
   Maintenance and Operative Performance
   How easy is the maintenance of the building and its systems?
   Do the systems of the building change during use as much as they did at the research stage?

6. Economical and social aspects
   Financial profits
   Depreciation of construction by energy saving
   Contribution to local society
   Connection with local tradition
   Economic parameters
What is the cost of the design and the technologies that were applied?  
Has the period of depreciation of these technologies been estimated?  
Has the building got financial benefits for the owner, the local community or the country itself?  
Financial parameters  
The contribution of the building in the local community  
Is the building relevant to the needs of the society?  
Is the building relevant to the local technologies and traditions?

III. Architectural and technological design of building skins

The limit between the exterior and interior space regulates the desirable conditions in the interior. The architectural and technological design of the building shell is a key issue with multiple parameters.

In this part the analysis of the building shell is required, in order to understand its function on a constructional level.

Construction designs are included, charts and sketches which comprise the essential documentation of the shell’s function.

1. Functions of the skin  
Natural lighting management, Transparency, Thermal behaviour, Sound insulation interactivity

2. Architectural Design  
Materiality  
Aesthetics  
Facades design

3. Technological design and features  
Construction detail  
Intelligent management systems  
Energy performance  
Sunlight management systems  
Integration of RES (renewable energy sources)  
Green roofs.

IV. Conclusions

Critique (personal and peer reviewing), views and opinions (of architect, engineers, occupant) Efficiency assessment, Benchmarking and evaluation.

After the three stages of the analysis, the students were invited to write a report/critique on the building in relation to the questions posed. The posters produced and the report were presented to their peers and debate followed.

In this final stage, the students had to conclude whether the final result has the expected function and performance, according to the initial expectations of the design or does not function as it was envisaged. It was also useful...
for the critics to voice their criticisms of other architects, engineers, researchers and users.

**Case studies of 2009-2010**

During the academic period 2009-2010, 33 buildings were chosen and studied as shown on the table below.

Observations of the buildings that were analysed:

Most of the buildings that were chosen were office buildings. That is not to say that the sample is enough to provide reliable results, we could say that it confirms the tendency that has existed over the last few years in the field of office buildings for a complete viable design.

Kleio Avarli, Anastasios Gkouzkounis, Nikolaos Panagiotopoulos, Emmanuil Tzekakis and Maria Voyatzaki
Examples of student work

Project A:

Teaching a new Environmental Culture
Project B:

Guzzini Headquarters/ Κτίριο γραφείων
Mariou Guicelli Architects, 1997

"The light canopy"

- Φωτιστική φωτεινότητα
- Θερμική αφαλάμβανο
- Φυσική καθαρότητα
- Κυκλική ρύθμιση εσωτερικού φωτισμού
- Εξωτερική κλιματισμός από παράθυρα
- Εισωτερικά αμμόλυτα φυτά
Teaching a new Environmental Culture
Overview

In the first academic year of teaching there were significant benefits for the students:

• The development of the research skills, bibliography analysis, comparative study of buildings, setting up a matrix of criteria upon which the buildings should be judged.
• The development of an understanding of the difference between design and environmental design.
• The acquisition of essential knowledge for the design of modern buildings.
• The cultivation of the critical thinking on the current issues of the environmental design.
• The integration of the requirements of the environmental design to architectural design.
• The development of writing a report on the environmental performance of a building.

The material that was compiled is a new base of information that will be accessible through the web to other undergraduate or postgraduate students.

It will support students of this course, as well as students who are following a theoretical or design course of studies.

The aim of the course is to evolve into a design laboratory on viable design in a real context and climatic zone.

References


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Architecture, Experimentations,
Building Cultures and Eco-Responsibility
The program of Lyon City Campus application to imagine the campuses of tomorrow as exemplary, registered sites in an approach of sustainable development through eco-responsible management. Objectives mobility alternative to the development of soft transport modes car control and better to consume energy in achieving best buildings by their sobriety, finally integrate academic sites in the city, in terms of their physical, social, economic and cultural relations. This new foundation took a body at a time where the campus administration wondered about 3.300 housing installed on this University site, and where the commune of Villerbanne, which already hosts 15,000 students considering rebalance public investments to those private building 1.000 students additional accommodation, either within the habitat areas, either by taking advantage of available on-campus land.

We are entering our pedagogy research by the atmosphere of the territories of the student to understand how to live rather homogeneous space on this campus, and propose its evolution. La Doua campus was established in 1958 to allow scientific teachings, North of Villerbanne. Breakdown of scale and morphology with the outskirts of this city of Metropolis Lyons and disconnected from the River, it is at the heart of a program of rehabilitation, registered in a wider national operation of revitalization of the campus.
To another practice trade

Why shall we hire a renewal of pedagogy in the field of architecture and urbanism? Because the world is changing. This is its way. Linear loop or two, but never like depending on the time, expand, fold or emulsion. Today, something livest up and leads humanity to leave millennial positions. The collective consciousness of belonging to a common world on land which has issued its limits produced another relationship to the rest of nature and humanity, another report to the power and energy change relations between societies from North to the South, between individuals within societies and between individuals and objects. How these fundamental changes would alter not practice, teaching and research in architecture? Expression of culture, architecture cannot prevent revolutions philosophical, scientific and political world that it hosts; only practitioners, teachers and researchers in architecture can, but at what price! The reluctance of professionals proves in any way the relevance of their practices. Architectural Act, our architects and teachers’ work, anchor helps accommodate these changes. On the one hand, at a time and in one place, it crystallizes the nebula of the data to develop a project of society and not just a building project. On the other hand, multidisciplinary manners are expanding and we can try new methods and crosses between space, the sensitive and social. We pleaded so the neighbourhood near and distant future occupant is anticipated, which involves all sensitive representations of space.

A team of student (Joanne Boachon, Aurélie Denis, Emilie Lorand and Coline Rambaud) surveyed the slab of Tonkin located south of campus in Lyon (France), a «funny place,» inhabited many students and urbanites. «Live in Tonkin today on the slab is isolated from the city,» they say, from its soil. For them, neighbourhood conditions will be improved with the development of a passage or the development of activities in DRC, such as the proposal presents Marielle Page.
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Olivier Balaÿ

Restore considerations between a territory, its inhabitants and its planners

Why hire such a pedagogy research? Because the architectural Act contributes to the great current work: rehabilitation of the world, or even its new enchantment³ and all paths are leading to it. Rather than its factory from scratch, it aims to reform the world being already there⁴, its rearrangement, rehabilitation heard within the meaning of sustainable development and fair as well as literature: «I would like to living well enough to see Dreyfus rehabilitated», noted Marcel Proust⁵. Regain prior - before shreds - State of the world including ephemeral load us foresaw, is a chimera that may prohibit any viable spoke with history. The functionalist approach fails, especially in our field where the hegemony of economic and technical function contributes to the defeat of the public space. Change of paradigm operates if we do not look to users from dogmatic thinking and if we open our mind for comments amount territories, and the lifetime for a real eco-responsible investment by all actors. Rehabilitation as reconciliation comes alive under a cultural day in preference to its acceptance «technical building». It introduces ecological commitment and effectivity in the method of teaching; She built, next to what is defined by a knowledge on the subject and techniques built worldwide, political knowledge and affective⁶ also report to the object, a commitment and effectivity leading to believe otherwise it towards a new anti-violence worldwide.

Coline Rambaud, in a draft manifesto that attempts to answer the difficult question of the balance between proximity, promiscuity and urban in compact city intimacy shaped wondered how to provide everyone a real quality of life in an ever-increasing of «living with each other issue?» What are urban uses meet dwellers tomorrow? What will be the places where the city accommodates these new urban activities? The project proposes a mesh of new public spaces. This network across the campus and the city is a deep culture of the street. The abandoned urban, real «empty reserves» in a saturated city, is the support of a mesh of «spaces of freedom». Smaller sizes, close people, flexible and free, these spaces are perhaps ideal media to generate a dynamic Exchange and shares humans.

Thinking the affected use

Any inhabitant likes a place, is assigned by it. These echoes are realized in experiences (every man that lives is in one place) which bind sensory perceptions and opportunities of social, physical, and sensitive actions in relation to a particular society⁷. The precept of the architect Sullivan «form follows function,» so often taught in
schools of architecture, is no longer. Experience puts forward functionalists aspects or formalistic aspects of places\(^8\); non-stop, it crosses social and sensitive spatial perceptions. The user does not live in places in terms of adaptation to a form and a function, but in terms of appropriation and accreditation. It focuses not on the causes, prefers the mechanisms of certain effects. So it reacts to sound, light, thermal differences rather than measurable noise passed in space, intensity of light reflected on a wall or refreshed in the vicinity of a front air. If it wasn’t somehow stabilized to a report of ongoing neighbourhood with sensitive elements of his life, he would lose in a chaotic spin of impressions would never identically identified.

Architectural study draft entitled A time space donor (this project was presented exhibition “Operation Campus” in the Park of the cité Internationale Universitaire de Paris, November 6, 2009) proposes to install some sort of stability environmental at the entrance of the campus of La Doua and boulevard on 11 November. The proposal starts from an observation: the campus was born modernist space. He single object-oriented and abstract posed a territory where there is an undifferentiated space. Together they form a “nespace”, says the philosopher Benoît Goetz\(^9\), which has lost its public dimension because of too much functionalism. Elise Duriez (08/09) it invents a place tire a newline which passes the current campus boundaries, slows the movement of traffic, is based space for pedestrians and reorders flows (people, air, Sun and water) in a benevolent Hall of shadows on the one hand the morning, another in the afternoon, and sounds donor time to market.

**The hypothesis of a new space : the atmosphere of the multitude**

In the process, we share with Peter Sloterdijk that the relationship to space is principal, that the given territory is not only a sum of constraints to resolve, but also an sum of emotional reports to consider; that man is gifted for the neighbourhood, that “life is constant, formulated questions afterwards, the knowledge a space where everything flows”\(^10\). But we do not have his sentence to admit that citizens are able to collaborate on rehabilitation of the world\(^11\). With him, Gilles Deleuze and Félix Guattari, Mille plateaux \(^12\), we see that space is an area in which intensities make sense for those who live, that this manufacture form a rhizome, a reservoir of potential uses, of plausible fiction we say, a theme of our teaching. But
much more, architectural act can configure opposites, makes space with taking account of subjective and objective perception aspects. He knows invite science, art, urban scales and the individual live it. He ever wonder: what man am I building for? Out of modern and post modern designs, we belong to a continuous interiority space, «plateaus» tangled incorporated common terrestrial connect both close and close and remote. Too attached to buildings and artifacts, the current environmental crisis resolution does not reflect this revolution. It is not the aim of creating healthy Interior, nor of this continuous increase in air-conditioned interiors. We live in an area whose continuity is final, despite the heterogeneous expressions of communities. For human, more life into the outside is expected. Both sides of our world, biosphere and world Cybernetics, produces the same space, an immense interiority finite but whose scope would be such that the mind perceives infinite.

A new scope, not only soil, atmosphere. The atmosphere of a multitude, both: air, climate, atmosphere, environment, décor and Biosphere of a humanity which closes again some unknown. In a shared environment, architecture condensed energy exchanges: give, receive, and bartering with the world already factory a celebration even more daily that the neighbourhood is tight. Facing necessary invention of another city anti-violence, ambiance for urban betterment and fight against the pollution, collective and individual forces are convened together with the material. Another spatiality develops, this atmosphere of the multitude.

Béatriz Lopez proposes to transform the University buildings in welcoming residences throughout the green campus casting, working and teaching spaces, resting spaces, spaces of meetings with the villeurbannais. Time on a daily basis is a timesharing and extensions outside the interior spaces allow meeting, resting and day: a volume of air shared as we often say in our teaching.

**A teaching tool: common air**

To invest this hypothesis of a volume of air shared, common urban culture and its always localized expressions here marked by student demonstrations, we start from the principle for each company, ways of access to natural light, the Sun, a soundscape desirable, beneficial shade, a congenial, natural ventilation, as well as the presence of plant form a knowledge useful for processing of com-
mon ground for regeneration of the public in an urban ecosystem space given. We add that if the feeling of comfort and ambiance in a room given convene as many action users than experts\textsuperscript{16}, and contributes to the definition of the physical conditions of a spatiality (there is sense, perception, recollection of perception, familiar memory, habit, etc.), it is illusory to think achieved by only whether technical reality hidden and ultimate architectural and urban space which would depend on the future happiness of the dweller. On the other hand, it is essential to devise a way of project discusses the architecture and the city in a less alienating manner which takes into account human art, the inhabitant with his art to make and their aesthetic shares mutual\textsuperscript{17}, as mentioned at the beginning of the words inventive posture support. A rebalancing is required between the living and the scholar, the perceived and the built, the felt and the reasoned, between which do premium said and words were as important as drawing. Architects students meet the inhabitants and trying to seize their affectivities and feed them.

This approach has led Julie Gomez and Frédéric Roux to transform avenue Gaston Berger, a major axis North South on campus, in village connected to Villeurbanne avenue. Residents had identified the sounds of nature in great surroundings of the campus, students had identified the sound of water which could accompany routes. Hence “City-Age” project expands existing buildings floor transforming straightness of road, a programming mixed to accommodate an atmosphere or sonic human presence and a unit of dwellings with shops, mixed quarters and spaces of teaching. The route water drip and its uncertain “plac plic” accompanies the passage for travellers.

**About ambient engineering**

We know genius civil engineering, genius urban engineering, *Genius loci*\textsuperscript{18}. Ambient engineering is art capture and projecting the sensitive vicinity of a society and its environment, such as «technical device composite and bound forms built», on the one hand, and on the other hand as «perceptual whole gathering
objective and subjective and represented as atmosphere, climate, physical and human elements»19. Ambient engineer pleads for the abandonment of the idea that the only thing is to calculate environmental data of architecture or urban form20. Better teaching is motivating atmosphere”21, produced by human and taking the sensitive neighbourhood in a real space. Explanation of an upcoming space is beyond the scope of the statement of sunshine, diagnosis sound, olfactory or ventilation analysis; It is also taking account of the skills people do to establish emotional rapport with the world according to their cultures and daily environmental conditions. In the pedagogical framework, it leads to develop principles, and not recipes, that make perceptible and close of experience a situation likely neighbourhood situation unscripted into a local culture. We «look» space such as a field of movements, experiences and potential uses in local conditions.

Emilie Vignon gives an existing residence on campus a wide terrace in front of which it constructed a building which will house with other students. Experience the opposite has been carefully studied and the likely atmosphere will reign between two buildings has been anticipated. Here, common ground is only a transmitter of moods (as in Marielle Page draft) or an insulator of ambiances (as in spatio-temporal bracket Elise Duriez proposed in November 11 boulevard). The soil is an ambiances exchanger, buildings share moods among themselves and with the ground.
The political and social ground

Concerned reader of Phenomenology, we know the impasses\textsuperscript{22}; If we are looking for the commitment of the individual body, affect, and use, as well as by spatio-temporal measurement, we do the perceive not beyond any historical context and project. Also our sympathy of pedagogical designers for parsing Sloterdijk, particularly with regard to globalization and the weakening of powerful but located, identities increases our agreement with «local project» of the University and Italian politics Alberto Magnaghi\textsuperscript{23}. In the proximity described by the German philosopher, local project, its alter functionalities and social and environmental values unfurl in situ. Even if some human archaisms we motivate (sit, walk, meet), we refuse any approach that would not tend to socialised and historicised the behaviours. Here is our interest in soil as not caring for the soil for the city of tomorrow, is exposed to an abstraction. The soil is the joint by excellence, one side local Earth page where the social can be seized seems Bruno Latour «by traces it leaves (for testing) when a new combination creates between elements that are not «social» by themselves»\textsuperscript{24}. Soil invites, invents a continuing atmosphere inside, able to reassemble the social and its heterogeneous communities. Between students and the population of Villeurbanne we are therefore looking for possible associations («fluid circulating» wrote Tarde \textsuperscript{25}) on soil and its plant, associations capable of to future development are «moods are a collective».

Horizon: atmospheric area

Global warming is already an event in Lyon, the temperature has increased by 1.6 ° C between 1995 and 2005\textsuperscript{26}. This obvious truth alters the relationship between the closed and open; habitable surface will be more only inside. Architecture built with economic and durable materials will offer outdoor places great ability to use, ownership and sensitive exchanges; inertia and natural ventilation is to compete with unusual cultural organizations. Can the presence of the plant required for the wet city where you will work more, be considered only from the...
environmental point of view? Stands on the plant beauty and beneficial shade? It integrates its contribution climate and to what extent? New aesthetics assumed third-landscape and a welcome weed belong to our urban culture? Can be approached from audio, Visual, olfactory and thermal phenomena? Soil and plant experience is the same under different ethnic and social cultures? This cultural and sensitive approach contributes to believe otherwise construction, rehabilitation, habitat urban territory management? And beyond of the presence of the plant and «still life» what public space would be born? What is the community around this presence? What new uses are shared collaborated, integrated, etc.?

Mathieu Pedergnana (08/09) adopted the Third landscape landscaper Gilles Clément, and then his reinterpretation by the Belgian architect Lucien Kroll. By year-end entitled «before/after» that we by in our teaching, he finds that literally becomes poor and the abandoned rich volunteer. The project, everything is rehabilitation, that old industrialized classes of containers and a panel from material sorting industrialized building waste near Lyon. Another aesthetic happens.

Naïs Imbernon and Olivier paste using the sociability of water offering of new “bath” in the interiors dedicated to students, a well being found, and wet spaces shared with villeurban-nais around of basins located on campus. This project was presented at exhibition “Operation Campus” in the Park of the cité Internationale Universitaire de Paris, November 6, 2009.

Project Jennifer Lemot, to which the current highly circulated today, November 11, boulevard becomes students boulevard, a boulevard that loses its linearity for successive pockets and including this generous places where people should be able to live moments together with students, especially at meal time. This idea will be taken in the teaching of the master AA & CC field shared with the Ecole Nationale of Architecture of Grenoble for 2011.

Olivier Balaÿ
The invention of neighbourhood situations

If for some, there is no innovation without a creation of “socializing technological inventions”\textsuperscript{33}, for us, innovation in architecture and urban planning must retrieve technical hegemony. It is to imagine the experience, commitment individually and collectively to the invention of a new anti-violence worldwide in an eco-responsible appropriation of neighbourhood situations. Shareable air space between students and urban dwellers in composer..

Endnotes


2. Led by the University of Lyon, supported by the Région Rhône-Alpes and Grand Lyon, Lyon City Campus is the project of university restructuring through the clustering of existing sites and interdisciplinarity in favor of broad research questions: “Science and health engineering”; “Knowledge, trade and regulation”; “Issues and modeling of complexity”.


4. Michel Lussault, President of the University of Lyon, proposed for two lyonnais sites universitariser urban Mérieux and urbanization on Campus at la Doua (Conference, March 26, 2009 at the ENS - LSH).


6. One lira regarding Ferdinand ALQUIÉ, book of the newspaper Le Monde, 12 lessons in philosophy, nov 1982, who wrote again: “Should therefore not be confused knowledge and knowledge.” Distinguishing between “know” and “think” Kant stated that can affirm the “thing in itself”, and therefore whether it exists, without this come about. Outside of scientific knowledge, can discover other knowledge, it should be said emotional. No, however, that he must rely without examination to all contents of this knowledge. Neither dream nor madness tell the truth. “The poetic revelation itself cannot say clearly
that it delivers the world of this “real life” referred to by Rimbaud (*real life is absent*, Arthur Rimbaud, *A season in hell*, delusions I). Ferdinand Alquié has, among other works published *experience*, PUF 1957.


8. See *The UMR 1563 architectural and urban ambient environment* work together two research laboratories in schools of architecture of Nantes and Grenoble, Cerma and Watercress.


12. Gilles Deleuze, Félix Guattari, *Mille Plateaux*, éditions de Minuit, Paris, 1980: «my territories are out of decision-making, and not because they are imaginary, on the contrary: because I am in the process of the plot.»

13. ibid.


16. The atmosphere produces. This is not a given. Territory produced by flows that propagate in the air, it happens the expert skills in the Act of building and the “art of” user.

17. Balay Olivier *The ounds, the architect and the townsman*, enabling to conduct research, planning, Social Sciences and management, Université Pierre Mendès-France de Grenoble, Grenoble, Urban Institute 2002.


20. Applying for example in the methodology of impact studies.

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Sustainable Architectural Design;
Attitude Versus Technology
Background
The level of environmental awareness and environmental culture in academic education reflects to a considerable degree the state of consciousness of the entire society. The case of of Poland clearly proves existence of such relationship: twenty years after the fall of communism the country underwent political, economic and social transformation on unprecedented scale, yet post-communist mentality is still slowing down socio-cultural changes. Departure from socialist collectivism to ego-driven individualism favours development of consumerism, increases reluctance to participation in public life and to taking responsibility for the environment. Although the concept of sustainable development gained formal approval in the country’s legislation, it remains still quite often declared but less often practiced. The explanation is always the same: living with the syndrome of ‘imitative society’ leans towards putting temporarily aside the environmental issues in pursuit of economical success.

So far the presence of the notion of environment and of sustainability is still a kind of novelty or fashion; it is not a key theme of contemporary architectural curricula in Polish schools of architecture. The conception of environment and of sustainability is rather ambiguous, much misunderstood. Traditionally environment was perceived as the nature, which in some cases may deserve protection.

Environment in broad sense consists of two basic parts: natural and socio-cultural elements. This concept of environment as a whole integrating nature and culture is quite new idea, similarly to discovering the inclusive nature of sustainable design and the relational character of the space.

Gdansk school of architecture
Only few students understand the notion of environment and sustainability, some find it important, for vast majority both terms have marginal significance. It is partly because imagination and creativity is widely considered not only as the essence of the profession but also as an excuse for unlimited use of resources for the sake of creation – a value of itself.

Despite attempts to build coherent curriculum with interrelated and interacting subjects producing synergetic feedback to the teaching process, the school at present continues long established tradition of numerous separate, autonomous subjects. Consequently, there is little space for transferring and propagating the knowledge on environment and sustainability to the core of the teaching process: architectural and urban design studios. As the result the knowledge and understanding of the notion of sustainability is limited and fragmentary. And what is worse, in terms of scientific reasoning this ‘sui generis’ deconstruction appears to be counterproductive for understanding the relational, holistic character of the conception of environment and sustainability. Making architectural & urban design more environment-friendly is mostly associated with implementing
randomly chosen “eco-technologies”, usually added to the earlier independently designed structure.

Environment in broad sense consists of two basic parts: natural and socio-cultural elements. It is important to understand not only the complexity of each of them but – even more – their mutual interrelationship. In terms of teaching environmental culture it is therefore important to develop holistic approach and integrated design. Teaching (or shaping) environmental culture requires holistic approach.

Current curriculum

The current curriculum includes a number of subjects concerning various aspects of environment and/or sustainable design. However, it is important to notice that this set of subjects does not constitute any coherent, in-depth description of theory and practice of sustainability in architecture, nor it is addressed to all the students.

Second year – sem. III.

Environmental Aspects of Architectural Design and Urban Planning

Lecture 15 hours (150 students)
Seminars (exercise) 15 hours (150 students)

Content of course:

physical, geographical and environmental conditions, which should be taken into consideration and determine architect’s and urban planner’s design approach to shaping and/or modifying human environment.

intended effects:

• awareness: importance of proper management of natural resources in the land use policy, and of the function-space conflicts occurring in geographical space;
• knowledge: the main features of the geographical space, which have to be considered in the development processes of urban and rural areas;
• understanding: basic terminology concerning landscape ecology and protection of natural environment & landscape;
• ability: implementing this knowledge in conscious, environment -friendly design & planning process of the built environment.

Second year - sem.III.

Architectural design

Studio 5 x 15 weeks = 75 h (20-30 students)
Lecture 10 hours (150 students)

Content of the course:

Lecture:
1. *Dwelling and Home*. Place and dwelling;
2. *Place and context*. Genius loci – history, structure, interpretation and notion of place; surrounding as natural and socio-cultural context of place;
3. *Environment, structure and shell*. Designer’s and users’ environmental awareness. Building structure – heat accumulation, thermal zoning, winter garden; building shell – external barriers;
4. *Four elements and cyclical nature*. Energy – daylight and artificial lighting, heat;
   Matter (criteria for selection of building materials, recycling, biologically active areas); water (water and sewage systems, rain water); air (air exchange, emissions, heat recuperation);
5. *Environment-friendly technology*. Characteristics of ecological technologies: low-tech, appropriate technology, BAT, high-tech. Selection criteria for ecological technology;

**Studio:**

The subject of the project is a detached ‘ecological house’. The detached house is seen as an example of interaction between man and surrounding environment. The project is intended to develop understanding and implementing basic principles of environment-friendly architectural design. The studio work is preceded with the site-visit aimed at identifying the environmental and cultural context of the place. The project is focused on learning the resource-saving design, based on proper selection of building materials and structure, as well as environment-friendly technical systems (simple passive solar and saving water technologies.

**Intended effects:**
- awareness of the necessity of contextual approach in architectural design;
- knowledge of mutual relations between man, building and surrounding environment;
- understanding general principles of the resource-saving design;
- ability of gathering information necessary for meeting man’s needs in the process of shaping human environment, designing detached house fulfilling aesthetical, functional, technical and ecological requirements, implementing adequate environment-friendly technological and material solutions.

**Third year - sem. V**

**Architectural design**

Studio 5 x 15 weeks = 75 h (20-30 students)

Content of the course:

The subject of the project is a ‘centre for environmental education’. The project is aimed at developing students’ ability to understand basic problems of shaping public spatial structure for small group of users and to design a non-profit socio-educational facility.
Intended effects:
- awareness of social aspects of the design process, addressed in particular to handicapped and/or socially underprivileged individuals and groups,
- knowledge of mutual relations occurring between people, buildings and surrounding spaces,
- understanding contextual and socio-spatial aspects of the design process
- ability of collecting information on shaping human environment according to individual and social needs, programming and designing the socio-educational facility fulfilling aesthetical, functional, technical, socio-cultural and environmental requirements.

Third year – sem. VI.

**sustainable architectural design;** methods & technologies

Theory + studio 30 hours (30-60 students), elective

Content of the course:
To be decided jointly with the subscribed students

Fourth year – sem. VII.

**Professional ethics**

Lecture 15 hours (150 students)

Content:
Environmental ethics (3 hours)

Fifth year – sem. IX.

**Architectural design**

Studio 4 x 15 weeks = 60 hours (15 students)

Content of the course:

Architecture of transformation. Project of temporary transformable architectural structure located at different locations and adaptable for a variety of functions (exhibition, open air performance, workshops with housing units); taking into consideration system of transporting elements to be built-in, assembly, transformation and disassembly. Project should include: [a] analysis of structure’s life cycle, [b] implementation and utilization of recyclables, [c] application of the environment friendly technologies.

Intended effects:
- awareness of resource-saving principle,
- knowledge of building life cycle and environment friendly technology in space design,
- understanding social and cultural determinants and processes of participatory design
- ability of applying environment friendly criteria for selection of materials, construction technologies in the process of design of transformable architectural structures.
Teaching strategy

• Within the society low environmental awareness/culture requires giving priority to shaping basic hierarchy of values over technological knowledge.

• As the curriculum of the school is scattered into a large number of separate, autonomous subjects, it is meanwhile better to temporarily adjust environmental culture issues to the present curriculum structure before its general reform - regardless how unpopular it may be - becomes likely to happen.

• As the curriculum guarantees limited number of elective (optional) subjects (provided the number of subscribed students reaches 30), this opportunity has been used to propose new subject (Sustainable Architectural & Urban Design), intended to tie already existing environment-related subjects together and to merge them in a comprehensive, holistic vision of sustainability in architectural & urban design and research.

• The status of elective subject allows for teacher’s greater autonomy in attracting the students and in choosing the most appropriate pedagogic method; the hitherto positive experience encourages inviting students to actively participate in shaping the content and its accomplishment (field work and seminars).

• Teaching effectively environmental culture and sustainable design should not be confined to a separate subject within the curriculum; it creates conviction that the concept of sustainability is a narrow auxiliary branch of mainly technological knowledge, which can be utilized randomly at one’s own discretion. In long term it is therefore of the utmost importance to persistently work on creating the concept of sustainability not as one subject amidst others, but as a profound attitude based on socio-cultural paradigm.
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Environment on Architecture
and Construction Engineering Teaching
Our Experience in Ural, Barcelona
Philosophy of the course

Introducing environment concepts as a part of future engineers and architect’s training is not just because it is a new business model for them or a new field for the profession; it is mainly a lesson with ethic compromises, with the intentions of increasing the understanding and respect towards the environment and the reality of our planet.

Construction is one of the industries with more connotations in the global contamination. The construction process puts together many fields and some of them are much more contaminating than others. Architects and construction engineers are involved in the design and construction process; neither of them can make big energy savings in terms of quantity but clearly in terms of concept. To encourage the awareness right from the beginning of those who will be involved in this field helps to increase their consciousness and the necessity to act towards and for the environment.

For us, the contribution in the education of architects and construction engineers is about buildings that adapt to the environment in order to achieve maximum comfort from passive systems and not by thinking that they will need also energy systems to be completed.

At the same time, students will understand that each building is an integration of systems that must coexist with each other. Energetic systems are born in mind with the spatial, the constructive and the structural systems.

In this way the students link all the subjects and what is being taught in relation to the environment and energy has a direct repercussion in their projection method from the first years of their learning.

Methodology

At early courses is where theories and practices of passive design are introduced in the way to give to the young students the basic tools to understand how energy works from the beginning.

In order to do that the building is analysed as an ecosystem that is exposed to external energies, and releases elements into the environment. From this point of view, we can study the incoming energies, the consequences of it and also the produced energies. Those analyses are done in different ways at our School: with specific trainings of particular subjects (such as simulation tools...) and with a general course where environmental and energy design concepts are taught and applied to examples.

That general course is done in two main knowledge themes: natural and artificial energies implicated to achieve the comfort. That comfort could be hydrothermal, acoustic etc.

The first theme, “natural energies” is based on introduce conceptions of forms, materials and spatial arrangements to have a correct control of buildings.
That is explained from passive energy systems for hydrothermal comfort and a correct design for acoustic comfort.

The second theme, “artificial energies” is about the systems that have direct energy consumption and that give more comfort to the building. There are basically HVAC, lighting design and building services.

The main relation with environment and sustainability is in the first theme. It is supported by weekly lectures, seminars and workshops.

**Lectures**

The environment analysis requires the knowledge of some physical concepts that are a little bit complicated for a twenty-year old student.

**Hydrothermal comfort**

In order to understand the energetic behaviour and to be able to apply in the right way the passive design solutions these concepts are grouped into the following topics about hydrothermal behaviour:

1. Comfort settings
   - Climates
   - Environmental control and comfort
2. Energy flows. Heat transfer fundamentals:
   - Conduction
   - Convection
   - Radiation
   - Isolation values
   - Thermal inertia
   - “Greenhouse” effect
3. Heating load application, gains and energy interchanges
   - Occupation
   - Artificial lighting
   - Other gains from used machines
   - External movement of air.

The course also looks at the relationship between climate and architectural evolution. Traditional and contemporary approaches are used as built examples. Maybe the best example of the adaptation into the environment in order to have comfort is the traditional architecture but is very important to show how it is used nowadays. The theoretical concepts can be seen in a range of techniques that the man created in different ways in order to adapt and take advantage of the environment.

To understand these techniques where the man applies the physical concepts explained, the students see it in two ranges of application:
1. Structural or passive methods (systems that don’t consume energy they are produced by the design and construction)
   - Environment: obstructions, settlement or adjoins
   - Orientation: implication for each climate and use
   - Shape: compactness, porosity and slenderness
   - External surfaces: percentage of opaque and transparent surfaces
   - Natural air movement. Passive systems that can move the air as solar shafts or wind towers
   - Direct or indirect solar systems. Designs to obtain energy gains from the sun as solar walls, Trombe walls, sunroom...
   - Direct or indirect systems to control solar gains as solar protections, patios...

2. Artificial or energetic methods (that have an energy consumption)

Those the concepts are of the second theme of the course, so there is a very important link between the two main themes. This link is done teaching some concepts like:
   - Air renovation
   - HVAC (heating, cooling, air conditioning)
   - Artificial lighting.

**Acoustic comfort**

The acoustic comfort is a new big deal for the profession. It is a very complex theme and we only introduce it in the way that they can be able to understand the concepts that are usually applied and some important design premises like:
   - Comfort concepts
   - Physical-physiological concepts
   - Equipping premises
   - Absorbent materials
   - Criteria of designing rooms
   - Air traffic and impact noise insulation
   - Analysis of different frequencies.

**Seminars**

Some of the concepts that are introduced theoretically are developed in short exercises that students do in class time individually. The more relevant ones are:
   - Heat loss calculation. They learn to calculate it manually in order to know which are the concepts that can change as designers in order to control the gains. At the same time they understand the design consequences and can evaluate which is the positive or negative loss in each climate conditions.
   - Calculation and radiators distribution. They practice designing a bitubular heating system for a simple dwelling as an example of energetic systems in relation with passive methods and energy loads.
Workshop

This is a hands-on workshop that provides training on the application of those concepts in a personal project. All the students are divided in group of twenty-five or thirty persons with a teacher for each group that check weekly their work progress. They work mainly in class (three hours per week) and some at home. The exercise is done in small teams of two or three students that can be future architects or engineers, learning from this early years how to work together like in real practice.

There are four exercises: two of natural energy and two of artificial. The natural ones are about energy and acoustics and the artificial are about lighting design and services.

All the objectives of the course are evaluated in three different ways: exams, individual work and group exercises.

Main course exercises

In order to analyse the relation with the environment the workshop about natural energy is done with the two exercises that involve design coordination: the one about passive design and the other about acoustic design.

The passive design exercise is based on a very simple program of a seventy square meter house with a workshop for a young architect. All students have the same program, but to pluralize the proposals two sites in an urban context and with similar dimensions but different orientation are given as project site.

In order to assign a climate to work in it, we are working around our city. Barcelona is in a region that globally is temperate, the Mediterranean, but in our next territorial context we have some different climates because of the topography, sea distance, high mountains existing...that allows us to speak about three basic climates: cold, warm-dry and warm-humid. This classification gives to the students nearly examples like the typical Pyrenees or arabian dwelling. But also, in a world-wide vision, they can extrapolate it to a global level as an igloo or a typical tropical house.

Students design the small house replying with passive systems to the typical characteristics of each climate. The project must include:

A context analysis noticing the meteorological and physical environment characteristics. Best orientation, existing shadows, usual winds...

A fixed list of the main aims to achieve and the main problems to be considered.

A complete design of spatial issues and best relation between spaces and functionality.

Definition of the construction type and details, showing all the façade components and explaining why it is chosen as the best solution for each project.

Evaluation of the project in relation with the environment, how it works in each time of the day and the night and in each season of the year (Figure1).
Heating loss calculation of one façade or roof which is basic for the project, depending on it.

Figure 1. Illustration of students group work, energy output

According to us, that is the clearest way to see the range of possibilities to be energy efficient taking into account the other systems that is part of the project.

The acoustic design is raised with an exercise that consists of correct design acoustic conditions for a conference hall.

The students have an existing hall that is located in the university in order to be able to visit it. They must adapt to the new use changing interior geometry, space and materials. They also need to calculate the reverberation time and obtain a correct one for the new use adapting geometry and materials to it.

The project must include:

- A single studio of the existing hall conditions.
- A complete design of the conference hall. Spatial conditions, materials and functionalities.
- The construction description with materials remain on the acoustic characteristics of each one.
- Reverberation time calculation.

There other two exercises are about artificial energies so they are not really involved in environment issues. The lighting is studied by the design of an exposition hall where they must define which lamps are been considerate and why they have been chosen. They also do a manual calculation of the illumination. The services are introduced with the identification of the services that each one has in their own house.
Conclusions

In each way of the evaluation the student shows what they have learnt:
- Exams. They show that they have learned how to design and use the systems, components, processes or experiments to reach the established requirements and to analyse and interpret the results obtained. It also shows their ability to calculate in a manual way.
- Individual work. They have understood the environmental impact of building industry and the importance of working in a professional environment and being ethically correct.
- Group work. The student learns to have the technical and planning knowledge for the practice of the profession. They also identify, formulate and solve related problems in a multi-disciplinary environment, as members of a team that is composed of future architects and construction engineers working together as in real practice. They are improving their capacity to criticize, also to be self-critical and to appreciate the diversity of the many disciplines which form part of the process.

They also achieve different personal skills as capacity for analysis and synthesis and ability to plan and organize the necessary knowledge to develop the area of study and to put into practice.

The main goal to introduce such a relevant and difficult problem as is the relationship with the environment as the first objective of a project is that it means a great effort for the students. That is why after this exercise they usually integrate all the passive design concepts into their natural way to project.

We are satisfied with the general results but sometimes the student have too many inputs and complexity for their age and is in the following years when they really understand and applied it into their own designs.

Figure 2. Picture of the model of a students group
Acknowledgements
This paper is a short resume of the work that has been carried out in the university since its foundation ten years ago. Many people, teachers and also alumni, collaborate directly or indirectly to develop it and consolidate the course and the importance of teaching environment in our school.

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Endnotes
1. In our School both undergraduates share most of the courses.
2. In a building process we can identify four systems: spatial, structural, construction and energetic (that includes natural and artificial energy, it means energy performance and building services).
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Fragile - As a Framework of a “General Human Ecology”

fragile
**Philosophy and objectives**

"Fragile wants to highlight social, ecological and humane architecture and to stimulate designers."

Terms as ecology and sustainability, although important issues in today's world, are becoming more and more common buzzwords. Labeling a term a buzzword pejoratively implies that it is now used pretentiously and inappropriately by individuals with little understanding of its actual meaning. Buzzwords differ from jargon. Jargon seems esoteric, but is a precisely defined terminology used for ease of communication between specialists in a given field. A buzzword (which often develops from the appropriation of technical jargon) on the other hand is often used imprecisely among non-specialists. As a consequence it is essential, -if we do not want to lose focus- to reflect in a continuous way on the precise content and meaning of those words.

It is evident that sustainability contains important technical issues on waste management, heating, zero-energy building, ecology, mobility, design for all, urban planning, sustainable landscape... and that it is important for any architect or urban planner to master those technicalities and competences. But at the same time it is more and more common knowledge that the concept of sustainability is layered and that, beside the fact that it can be positioned as a scientific topic within modules of a curriculum, it is also an attitude related to human values. In this last sense sustainability, as a broad human value, is an ethical issue. Assuming that architectural education is mainly situated in the social sphere, it is hardly to pinpoint it in one specific block of the curriculum. It is a general competence.

As an ultimate alternative for the buzzword 'sustainability', and in reference of the term as a 'general human ecology' the notion of Fragile was launched at the beginning of the academic year 2010-2011. 'Human ecology', states professor Alain Findeli, 'is but an extension of animal ethology. For the purpose of design, the field of human ecology should be extended to the cultural and spiritual dimensions of human experience, consequently of the human-environment interactions, without for that matter neglecting the other dimensions. This is why I prefer to speak of a general human ecology.' Fragile was presented it as a major theme and concept 'above' all the design and theoretical courses in the different educations (Urbanism, Architecture, Interior Architecture and Interior Design) within St-Lucas School of Architecture at our campus Ghent and our campus Brussels. The presentation of Fragile, with its intriguing logo with an intentional vagueness, resulted in a welcome of 'Fragile' by the audience as an Aha-erlebnis. Through the creation of a renewed climate of reflection, 'Fragile' manifests itself intuitively by and for the different stakeholders (the students, the teaching staff and the school) with different actions and happenings.
‘Fragile’ tackles design attitudes and approaches beyond classic designerly capacities and shaping. It deals with all kinds of interactions with society and is in search for civil or social engagement. It incorporates evolving topics, issues and concerns as: ‘general human ecology’; about ‘the way we look at the human-environment interactions'; ideas about the complex social reality; Alive Architecture; ‘le don d’écouter; how to design architecture and urbanism for ‘good living’; understanding the real needs; high human quality; deliberately fragile theories; the concept of ‘Care’; complexity; consensuality; soft spaces in the city.... Fragile becomes a central concern that underpins and drives all (theoretical and design) production. It is a lens through which to look at all the different issues presented and elaborated upon in the school. As a general overarching quality/question it has the possibility to check studio and theoretical answers in the way how we look at the human-environment interactions. With fragile we want to place social, ecological, human and socially engaged architecture on the forefront.

**Description of the content, adopted pedagogy and educational method, student work**

In a non-curriculum tied way, Fragile organizes stimuli for students and designers to induce and provoke ground-breaking reflections on the discipline of design. Results can only be achieved by taking a multiplicity of different actions: workshops, student conference, international lectures, fragile-magazine, fragile-website (http://www.sintlucas-fragile.be/), discussions, fragile student competition, ... Defining the used approaches for development and communication were very important. How can you operationalise the theme and keep the momentum?

Before the start of the academic year a guest curator, Alain Findeli, was appointed to inspire. At the same time the participation of a team of 5 close working students was essential for the success. The whole was organized with an in-between bottom-up and top-down (student vice-dean) approach. The impact of a student-team on the content and the organization of the activities is seen as essential. The official launch happened at the academic opening. The Fragile student team presented the first issue of a new opposition magazine, announced the website, and moved into their new cool designed workplace. The guest curator had a dream. A miracle movie and a staged photoshoot confronted the public.
One student team per campus is responsible for taking, steering and coordinating the initiatives as well as for budget control. The student teams operate from their own workplace, which they develop when starting. Key to success is teamwork. They work together with our communication office. The student teams meet on a regular basis with strong involved teachers and one administrative staff responsible for agenda setting and process coaching. The international conference is steered by academic staff. The inspirational leader is Alain Findeli.

The actions:

A careful selection of international guest lecturers sharing in a way similar concerns, broaden the scope while guiding or confusing the audience, stimulating interest, challenging their own thinking, achieving different outcomes. On our confirmation list is Patrick Bouchain, Otto Von Busch, Veronica Valk, Ismael Farouk, Olivier Bastin, Bow-Wow, Edouard François,…

01.12.2010
20u BRUSSEL (eng)

Otto Von Busch
/Fashion Hacktivist/

Adressing social issues through fashion design

www.sintlucasfragile.be

Figure 3. Poster for the lecture by Otto Von Busch ‘Fashion Hacktivism’

23.11.2010
18u BRUSSEL (nl)

Debat

De keer geen mannen, enkel vrouwen, Vrouwen staan al een beeld vanwege hun andere blik op architectuur, hebben zij ook een andere lijk op eenjaarhoma, fragilité?

Sylvie Bruyninckx
An Fonteyne
Barbara Van Der Wee
Hilde Daem (moderator)

www.conixarchitects.com
www.nua-architecten.net
Brussels restauratie-expert
www.nubrisarchitecten.com

Figure 2. Screenshot of the website

Figure 4. Poster for a discussion ‘a feminine view on Fragile’
More intimate are the in-house evening debates, providing a forum for unanswered questions to be turned into knowledge and firmer opinions and bringing potential new members to the Fragile way of thinking. Architecture exists at reprieve of discussion! (?). Notable professionals who are former students, defending different sides of the topic, lead the discussion.

Participating debaters: bOb Van Reeth, Geert Beullens, Bart Hollanders, Sylvie Bruyninckx, Barbara Van Der Wee, An Fonteyn, Charlotte Geldof, Johan Vandessel, Johny Eyers, Peter Swinnen, Luc Binst, Paul Lievevrouw, Michel De Bièvre. Searching for more ways to involve people, the small scale local initiative baptized “the Evenings” (De Avonden) was born. These projects (2 each week) are sometimes relaxing, sometimes exciting, sometimes daring – always connecting to the bigger picture. It is a relationship way that enables the student team to get a better grasp of what people want and to support students’ passions.

The internal Fragile student competition provides an opportunity to challenge Fragile approaches to design. All current students are free to participate. Winning entries will be awarded monetary prizes and will be recognized during the conference. The contest rules, registration process, submission and jury are organized by the Fragile student team. The competition keeps the debate going.

The aim of the Fragile international student conference in April is to bring together students and young academics who will be our future influential thinkers and who will reflect on how space and architecture are putting the people back in the centre of their disciplines. The conference is about how the urban reality can be not only about the built up environment but about how it can be a space that is able to absorb the differences between people, how it can transform
the hard built environment in a “people-centered” soft space. It is about how architecture is no longer about city branding or nation branding but about putting people first, it is about creating Alive Architecture. We encourage a broad range of formats from project presentations or papers to videos, installations or performances. Philippe Corcuff is our guest for the opening lecture and Dag Boutsen closes the conference the second day. Members of the review committee are Lianne Verstrate, Orna Rosenfeld, Wouter Bervoets, Burak Pak, Nel Janssens, Aurélie De Smet en Caroline Newton. On day 3 we plan study visits.

The conference takes place during the Fragile week promoting a Fragile environment, with lots of possibilities for exchange of information and ideas on the Fragile subject through workshops, lectures, exhibitions. Equally important is the opportunity to create friendships and social networks, inspiring future cooperation between different people from different countries. Some examples of workshops are about warm and artisanal architecture (e.g. Mette Ramsgard www.cita.karch.dk), a workshop with children, a workshop on recycled material. Master students are free to participate the “Pressroom” elective, think-tanking on Fragile and preparing critical articles and professional publications.

As weeks pass by, the quality of the opposition magazine improves and Fragile is picked up by our research groups, by our libraries’ purchasing policy, by our quality control division, by our long-term investment service deciding on buildings and infrastructure. Academic staff organizes more lectures and more workshops struck by the Fragile virus. In the meantime the international character of the activities and different types of online communication help us to leave traces across borders.

The website, facebook, twitter... are seen as strategic elements for communication and discussion. They are designed as informative and social platforms for a growing database of input, reviews, reactions, discussions and designs that fascinates and intrigues us all and enforces the discussion on human ecology and engaging architecture.

Some numbers and difficulties encountered

D. Boutsen, R. Dhont, S. Dieltjes, P. Guillaume, Y. Schoonjans, F. Tombeur and H. Van Den Biesen
Some numbers:

The official launch happened at the academic opening which was attended by more than 70% of the students and 40% of the staff-members. A student team of 5 students (3 students at the campus Ghent and 2 students at the campus Brussels) is responsible for taking, steering and coordinating the initiatives as well as for budget control. Teams change every semester. They are coached by an academic staff of professors of different disciplines and the communication office. At the end they have to hand in a 5-credit paper with a theoretical reflection on the theme, under supervision by a professor of theory. Between 50 en 250 students attended the evening lectures. In the intimate debate-evenings ca. 60 students went into a discussion with 3 to 5 respectable (alumni) architects. In a search to create a maximal interaction very small scale, but more daring and provocative, initiatives were organized for 30 to 70 participants. 1500 copies of the monthly magazine Fragile were distributed. The official Fragile activities were complemented with ad-hoc activities (exhibitions, lectures, workshops...). 15 students enlisted the elective press-room, a Fragile think-thank for critical articles and professional publications. Later on the semester we have a student-contest and international student-conference. The call for the student-conference was distributed towards 500 institutions. The scientific board is formed by young researchers. The library achieved Fragile-related books. The Fragile
website counted in the beginning of January 2011, 5211 hits. 10% of those visitors were outside of Belgium, mostly Western Europe. 38% were direct hits. This means that the URL is well known. 28% is google related (with search on the word 'Sint-Lucas'), and 12% is facebook related.

The Fragile-student team and the academic management have high expectations for Fragile. The impact of the activities of the first semester are enormous. The whole school buzzes on the fever of Fragile.

But still, different difficulties were encountered. Because the fact that Fragile is a not compulsory framework it is impossible to control of quantify the achieved competences by the students. It is more seen as an energy-flow to initiate debate and reflection.

The energy- and time-load of the Fragile student-team that is responsible for the content and organization of Fragile for the whole school is rising to an almost unbearable level. The fact that St-Lucas School of Architecture has two campi (Brussels and Ghent), 1 bachelor programme and 4 master programs and holds 1600 student does not make it more easy to manage. Due to the work for the practical organization the members of the student)-team had to loosen on several moments focus on the deepening of the content. It is essential that the academic management gives more support in the next semester on the organization level.

At all times both communication to the target groups as mutual communicating between the team-members is of vital importance. The degree of success of each initiative depends on the intensive back and forth signalization of ideas, state of the art, adaptations, complications and changes. The need of being constant in touch resulted in a permanent stand-by modus with the intensive use of e-mail, telephone, SMS and meetings at the most varying moments. The network of communication with a larger group slowed down the finalization of some stipulated activities.

Communication for the different activities by means of posters or mailings was often drowned in the abundance of other simultaneous communication within the campus.

Another problem is the fact that is not simple to hold the interest, participation and commitment of all stakeholders at all times. There seems to be an abundance of different activities with a cultural or architectural content in the cities. Certain activities had less response than others. The question that the student team posted was: ‘How can the Fragile activities be positioned in the whole offering?’ ‘Do we have to increase the activities or, is it better to frame them more?’

At the end of the first semester the student-team states that Fragile begins more and more to live in and outside the school. It starts to leave tracks. It stimulates new initiatives and acts like a binder on different aspect of the school. Fragile is not only followed by students and staff from St-Lucas School of Architecture but finds its way to other schools and organizations. We are convinced
that the Fragile-initiative can obtain a big significance in and for the school and the educational programs. It is able to generate a strong, dynamic, interactive and creative drive by which St. Lucas could flourish, and were student feel themselves continuously supported and challenged to develop themselves and their environment in an engaging way based on human ecology.

Figure 10. Fragile magazine
Vivienne Brophy

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Linking and Integrating Environment, Technology and Design
Introduction

“The architectural project is at the core of the culture of Architecture here in University College Dublin (UCD). The architectural studio provides a special kind of learning environment, a space for reciprocal thinking. It combines the benefits of learning-by-doing with opportunities for direct guidance, hand-in-hand with an open invitation for individual reflective exploration. A thriving studio culture is one in which students are equipped with the competencies necessary to analyse, evaluate and propose appropriate responses to changing social and environmental condition; equipped with the skills to become fluent in plan, section and three-dimensional design; encouraged to be curious about construction, material and the functions and structures of buildings; inspired to think creatively and to arrive at independently informed conclusions with their own firmly held and flexible convictions”. These are the words of John Tuomey, Professor of Architectural Design, in his address to students and staff at the commencement of the 2010 architectural programme. With such a value given to the learning environment of the design studio it is critical that environmental issues are explored within the architectural design project and integrated into the design process.

The architectural programme is of five years duration and the Middle School (incorporating second and third year) addresses the idea of collective space and the role that architecture can play in defining the places and spaces that provide the setting for our collective lives. There is therefore an implication of communality; a certain suppression of the individual in favour of a collective, of shared experiences, of social interaction and a heightened responsibility for the shaping of space to facilitate this.

Second and Third year students are combined in a vertical first semester, with groups working separately on a common theme within alternate years of urban and landscape environments. The second year programme requires that students develop an understanding of the role and responsibilities of architecture in the world, landscape, city, neighbourhood and social responsibility. The first semester focuses on creating public place and space. The second semester focuses on social housing reinforcing a sense of place, a connection to the community and a relationship with a wider context.

Environmental issues are core to the social agenda of the second year programme and a core objective of the programme is to develop in the student an understanding that the consideration of environmental issues is an integral part of the design process and that there should be no conflict with, rather it should enhance, the achievement of the delight of architectural place and space.

The design studio programme modules, Architectural Design III and IV, integrate and apply the principles presented in the lecture series; Architecture and the Environment I; Indoor Environment II; Architectural Technology II and III, into the design projects. The Architectural Technology Design Studio, which
is the vehicle for their integration, is allocated 10% of the Architectural Design module mark and it is mandatory to achieve a pass mark in the AT Studio to complete the Architectural Technologies module.

The integrated nature of this programme is the focus of this paper. I have selected Year 2, Semester 2 to illustrate how the courses Indoor Environment II and Architectural Technologies III are integrated into Architectural Design IV. My role is to coordinate the integration of environmental and architectural technology courses within the design studio programme. I act as studio tutor and lecturer.

**Programme Philosophy**

Sustainable architecture is not a recent invention; it is a rediscovery of an old set of design principles that places the emphasis on quality rather than quantity (ACE, 2002). Traditionally, the design of buildings responded to and modified microclimate, realised internal and external spaces appropriate to their function, were constructed from indigenous materials by local crafts people, and provided somewhat comfortable buildings with minimal impact on their surrounding environment during their life cycle. With the evolution of a changed social and commercial context, expanding regulations and legislation, increasing scale of work and specialisation, and the development of new materials and methods of construction, modes of practice and building procedures changed (O’Cofaigh, 2001). While many of the changes had the potential to be beneficial, the focus on quantity and intensity has reduced the emphasis on life long environmental quality (ACE, 2002).

The Union Internationale des Architectes (UIA) Declaration of Interdependence for a Sustainable Future (UIA/AIA, 1993) states that architects “must rediscover what it means to create buildings that have less of an impact on the environment” and should commit to “placing environmental and social sustainability at the core of their practices and professional responsibilities”.

Notwithstanding the EU and national legislative requirements for building designers to reduce carbon emissions and design energy efficient buildings, we as educators should be providing our students of architecture with skills to meet the policy outlined in the Architects’ Council of Europe (ACE) Architecture and Quality of Life - “to deliver high quality, sustainable architecture” and prepare them better for professional life. “Sustainability issues cannot be considered only in their technical dimensions, as of their nature, these approaches and systems can have profound architectural implications” (ACE, 2004).

Many professional bodies have incorporated UIA and ACE principles in ethical codes and there is agreement that the concept should be integrated into professional practice, undergraduate education and CPD programmes (UIA, 1999, ACE, 2002, RIBA, 2002, RIAI, 2005, WFEO, 1997, ICE, 2002). Several of these bodies together with university teachers have developed networks to progress the integration of sustainable principles in design education.
In its most recent Charter for Architectural Education (UIA, 2005) created on the initiative of UNESCO and the UIA to be applied internationally to architectural education, it concluded that:

“Beyond all aesthetic, technical and financial aspects of the professional responsibilities, the major concerns, expressed by the Charter, are the social commitment of the profession, i.e. the awareness of the role and responsibility of the architect in his or her respective society, as well as the improvement of the quality of life through sustainable human settlements”. The UIA recommends that architectural education and professional training “undergo continuous change and review if it is to keep pace with the changing nature of practice and expectations of the public”.

Amendment to the RIBA Criteria for Validation, (RIBA, 2003) states “greater emphasis is placed on knowledge and understanding of Technology and Environment and the ability to integrate this within design projects” and stipulate that in Part 1 Technology and Environment students “will demonstrate, within coherent architectural designs and academic portfolio, the ability to integrate knowledge of the principles of building technologies, environmental design and construction methods, in relation to human well-being, the welfare of future generations, the natural world, consideration of a sustainable environment, use of materials, process of assembly and structural principles”. A recent amendment to the RIAI Statement of Policy on Architectural Education has reinforced the requirement for students to apply their academic knowledge of sustainability in design studio projects (RIAI, 2005).

However, the method of integrating these issues within design projects in undergraduate architectural design studios has been the subject of much discussion by educational bodies, such as the Society of Building Science Educators (SBSE) and European Association for Architectural Education (EAAE). At the Oxford Conference 2008 – Resetting the Agenda for Architectural Education, Tom Woolley, recently retired Professor of Architecture Queens University Belfast, stated that the environmental imperative is in danger of falling into the same Cinderella relationship with design as building technology.

The Sustainability Special Interest Group (Architectural Education) on behalf of the Centre for Education in the Built Environment (CABE) (Fowles et al, 2003) conducted research into the learning and teaching of sustainability across the curriculum within Schools of Architecture across the UK. They found that sustainability has been relegated to technology subjects with very few links to studio work. The study concluded “a major change is required in attitudes, and curriculum content, to help future architects contribute to a sustainable future”.

Sustainability and technology are, of course, inextricably linked. Optimised performance and environmental quality of a building is based on passive design principles but achieved through the development of form, envelope and systems
of the building. With the advance of modern architectural science; availability of innovative technologies and materials and computer software to simulate performance, the envelope has become an interactive environmental mediator rather than a separator as in the past. Research and demonstration projects have shown that the successful delivery of holistic sustainable building demands an inclusive design decision making process, through which the interconnections between building form, envelope components and its systems are considered and pursued in integrated design strategies, to achieve cost effective optimal solutions and quality architecture. No longer can the traditional linear process where architects design and hand over to the technologist and engineer to deliver be applied (Brophy, 2005).

Mies van der Rohe said ‘Less is more’: Today, Alexandros Tombazis, international architect, says ‘Less is beautiful’. At the recent Passive Low Energy Architecture (PLEA) conference in Dublin, he stated in his keynote address that “classic design elegance is found in the complete simple solution and sustainability is the key” (Tombazis, 2008). He exampled the design principles and strategies implemented in his recently completed Church of the Most Holy Trinity, the fourth largest Christian Church in the world accommodating 9,000 worshippers, in Fatima, Portugal. Based on traditional vernacular and modern movement principles, it is intimately tied to place. Orientation, siting, form and building envelope are optimised to provide natural daylight and ventilation and components and materials chosen to provide a sense of calm and beauty in the place of worship. There is no conflict between the materialization of this sustainable enclosure and the delight of architecture. Nor is there evidence of tacked-on, eco-bling in this highly energy-efficient building. The success of the delightful spaces lies in thoughtful design. Tombazis would say that architectural delight and quality cannot be realised without consideration of these issues in the early stage of the design process.

In order that the students develop competence in the process of developing such enclosures they must have an understanding of the impact which siting, climate and form has on architectural design intentions and the external and internal environment of the building. To develop the appropriate envelope they must have knowledge of the characteristics, properties, design detailing and performance of the materials in use and an awareness of innovative components and technologies appropriate to scale.

Programme Pedagogy

Comparing the potential of student-centered learning (studio) and teaching-centered delivery (lectures) pedagogy is a basis for evaluating the appropriate learning space for optimised teaching and learning of environmental issues.
Students are aware that the design studio is the core activity of the architectural programme due to its high value status, credit load, time allocation, and the central ideological position it holds in the perception of what the architect does – and rightly so. Consequently in studio, student initiative and self learning is more pronounced and students become competent in their problem solving and design thinking.

There is an assumption that lecture based knowledge is transferred from lectures to studio design work, however, this has not been evident in design studio projects in the past. Although students may be competent in design thinking, they have been poor in applying knowledge from other courses unless encouraged to do so in the design studio brief and by design studio tutors. To omit these issues from the design studio project suggest to the student that they are not relevant issues to the design decision making process and are addressed at a later stage (and perhaps by another person) than the design stage achieved in studio.

However agreement within the architectural teaching staff that they have a responsibility to embed sustainability within the architecture curriculum and support the pedagogical approach outlined above is essential. A framework must be developed that allows a common language to be developed that is familiar to all tutors (and students) – one that includes increased responsibility for social and environmental considerations at all stages, is evident in lecture content, expands the palette of design criteria and provides increased opportunities for application in design.

**Programme Characteristics**

**Design Studio**

The Design Studio second year course is delivered in two modules entitled the ‘The Space of Appearance’ and ‘Housing Design’.

The studio programme requires the student to develop their understanding of the role and responsibilities of architecture in the world. The modules explore issues where architecture has a significant social role. The second semester module focuses on collective social housing.

The existing city in its fabric and its detail can be seen as the residue of the collective intentions of its occupants and the accidents of history. No part of it exists in isolation, it forms a complex weave of interdependencies that is continually shifting and changing. With each new tide of development new forms take root and the fragile is flushed away.

In this scenario the public space we inhabit, which is the lifeblood of our cities and the context for our cultural life, is the subject of change and is under continual threat from economic and social forces. In order to find a way of proposing the future spaces of the city we would be wise first to probe beneath the skin of the existing spaces to arrive at an understanding of their current form.

Vivienne Brophy
The students address the idea of collective space and the role that architecture can play in defining the places and spaces that provide the setting for our collective lives. There is therefore an implication of communality; a certain suppression of the individual in favour of a collective, of shared experiences, of social interaction and a heightened responsibility for the shaping of space to facilitate this.

The location for this year’s study is the neighbourhood, understood as the traditional social unit of the city. In re-asserting the claims of the neighbourhood there is seen to be a need for the city to decentralize, meaning that the centre should not be exclusively show-cased at the expense of the periphery. This is a means to begin moving away from zoning to the making of a more complex interwoven city, where a multiplicity of functions co-exists (Pike, M. 2010).

Optimised performance and environmental quality of a building is based on passive design principles (as outlined in the Environmental Science course) but achieved through the development of form, envelope and systems of a building (as outlined in the Architectural technologies course). With the advance of modern architectural science; availability of innovative technologies and materials and computer software to simulate performance, the envelope has become an interactive environmental mediator rather than a separator as in the past.

The Architectural Technologies Design Studio module facilitates the integration of the principles outlined in the lecture courses described to be fully realised into the design studio project. While it has its specific title on the timetable, it is, in essence, a period within the design studio weekly programme where special emphasis is placed on the realization and materiality of buildings. All assignments and outcomes are directly related to the design studio project, with project briefs and review processes in unison. Studio tutors are required to support students in all aspects of the design studio project, including the integration of environmental strategies.

It is this integrated design process in Year 2, Semester 2 that is described below and is illustrated in Table 1. The design studio design project and supporting lecture courses are outlined below.

**Housing Design Project**

"Tree is leaf and leaf is tree - house is city and city is house – a tree is a tree but it is also a huge leaf – a leaf is a leaf, but it is also a tiny tree - a city is not a city unless it is also a huge house – a house is a house only if it is also a tiny city."

Aldo van Eyck (Strauven, 1998)

Housing is a highly complex issue, described by Le Corbusier as “the problem of the epoch”. The word itself presents difficulties, implying as it does a
certain suppression of the individual in favour of a collective. Housing implies communality, it suggests shared experiences, social interaction and a heightened responsibility for the shaping of space to facilitate this. Housing proposes a qualitative impact on the physical and social environment which is bigger than the sum of individual units. Existing on the edges of marketability, it strays into the realm of the visionary, utopian and the critical.

In this module the students are encouraged to explore their own concerns in housing design, to investigate new ideas and to find their own voice. By the end of the semester, it is expected that they will have developed the capacity to respond critically to a housing brief, to propose a strategy for a given site and to develop detailed design solutions for a housing unit within your project. Diverse responses, experimental approaches and critical enquiry are actively fostered. Great importance is also attached to the need for design development and to their capacity to make ideas manifest through the use of drawing, modelling and a range of media (Pike, M. 2010).

**Project Outline**

The module is carefully structured to enable the students to develop this required capacity in their design work. The semester begins with an analysis of housing typologies. This is intended to equip the student with a series of references and with a vocabulary of strategies that they can then begin to apply to their design work. This work is in groups and will involve detailed study of a series of projects followed by the making of analytical drawings.

In parallel with this project students are asked to look at a room in their own dwelling in detail. They are to make detailed survey drawings of the inhabited room and then propose one modification. This study aims to reinforce the critical importance of dimensions and measure in the design of housing, as well as emphasising the essential role that drawings play in the design process. Students are also required to observe and survey the indoor environment under a number of headings eg. daylight, ventilation, etc. which is recorded in text and illustrated by sketches. Where negative aspects are recorded the student puts forward solutions to address the issue and suggest how a more positive environment could be achieved.

The housing design project is then introduced. The project is divided into two parts, with the first part dealing with the elaboration of a site strategy. An environmental survey is undertaken of the site. An environmental site analysis checklist is provided for the student to assist in recording environmental information in order to assess the potential to create a microclimate which enhances the comfort of external and internal spaces and reduces the environmental impact of the building. The information collected is used as to assess the site potential within discussion groups.

The first week involves making survey drawings, analysis drawings and a site model. The second week start the exploration of site strategies, using sketches,
block models and scale drawings. Following on from the environmental site analysis and investigation of indoor space environmental requirements the student presents design strategies to include:

- Site analysis – showing sunpath (summer and winter), prevailing wind, availability / obstructions to daylight, trees, buildings, river / sea and other data which impact on your site
- Building form analysis - initial site concept for the placement of your proposed building/s on site, illustrating its form on plan and section in relation to its surroundings
- Initial layout of spaces in plan and section to illustrate graphically (in simple solid / void) your proposed strategies for indoor comfort addressing daylight / sunlight / ventilation issues
- Indoor and outdoor space analysis - initial conclusions regarding the comfort requirement of the main spaces ie. the living room and others that you consider to have specific environmental issues to be addressed
- Structural analysis – three dimensional diagrammatical structural proposal for building, defining large and small spans and appropriate structural materials.

This will lead, in the third and fourth weeks, to the development of a coherent strategy at the scales of 1:500 and 1:50, working at the scale of the landscape and the scale of the unit concurrently. An Interim Review will be held to conclude this phase at this stage.

A week of preparation for the study trip abroad is then included. Each student is asked to make a model of one of the projects that they will visit. This model is brought on the trip and photographed in the building. A series of workshops is also held this week, providing the student with an opportunity to learn and develop new skills. The study trip allows students to experience and study buildings of architectural significance and to explore the relationship between a particular place, its culture and its architecture. It is considered a vital part of the work of this semester, providing ideas and inspirations for the design project. Following the return after the trip, a one week project is run based on a significant issue recorded on the study trip.

The final four weeks of the semester focuses on the detailed design of the student’s individual housing project. As part of the project the students undertake a precedent study where they are asked to make drawings of important housing projects from the 20th and 21st centuries. The drawings are made at a large scale, exploring a housing unit in detail, including environmental issues. This scale will then be used in their own design work, where they are asked to look in more detail at the internal workings of a typical unit; the structure and construction, the materials of the elevations and the use of light and colour. They are asked to work primarily through hard-line drawings in order to develop a work method,
aided by models at the scales of 1:200 and 1:50, working from both the city to
the unit and from the unit to the city in order to develop the kinship between
the parts and the whole. The building envelope is also developed at this stage
while developing their individual design for the Housing project, informed by the
environmental and structural analysis already undertaken, as it is essential to
develop the construction of the building envelope alongside design development
as it will impact significantly on the achievement of architectural intention.

The student is requested to undertake a thorough investigation of the physi-
cal envelope of their building project through the medium of sketching. As a
follow on from sketch details the student complete either one A1 sheet of hard-
line or sketch drawing of living room or other significant façade and/or make a
construction model to 1:20 scale, to illustrates how the building envelope acts
as a mediator of climate, optimises internal comfort and provides a healthy
indoor climate, and illustrates the construction and sense of materials of your
envelope including structure, external skin and internal lining and fixings of all
components.

It is expected that the chosen structure, façade construction and material
selection will be evident in all of the design studio design drawings - plans,
sections and elevations. This ensures that environmental issues are integrated
into the design studio final presentation drawings and models for review. All of
the integrated design studio work is displayed, in an open forum, for the Final
Review. This ensures that environmental issues are integral to the discussion
of the architectural intent and delight of the completed design project and that
both internal and external reviewers include it in the discussion and review. This
is critical to enhance the value of these issues and to encourage the student to
integrate them fully into their design.

Environmental Science

The subject area of Environmental Science is delivered to students of Archi-
tecture in two modules entitled ‘Architecture and its Environment’ in first year
and ‘The Indoor Environment’ in second year.

The Indoor Environment

The Indoor Environment module in second year explores the relationship be-
tween the external microclimate, the indoor environment and occupant comfort
through theory and application. It considers the physical role of the building and
its components in modifying the internal environment. Subject areas covered
include the visual, thermal and auditory environments, ventilation and indoor
air quality and the energy and environmental consequences of related building
design strategies. The module is delivered through lectures and supported by
research in the form of a project.

Vivienne Brophy
On completion of this module students should be able to:

- demonstrate comprehension and understanding of key concepts of sustainable and healthy design and of generic environmental attributes of contemporary buildings and their indoor spaces
- demonstrate familiarity with building energy modelling and performance assessment tools and techniques, understand their applicability to inform design decisions and use them to assess comfort, environmental impact and performance of buildings and urban spaces
- formulate and test proposals for new or existing environmental designs taking account of climate, site and building occupancy.

Course Outline
Daylight and Architecture
Light and Design
Natural Ventilation
Thermal Performance of Buildings
Renewable Energy and Architecture
Building Integrated Design

Both modules are assessed through an exam and a project. The project is an important element of both and provides a valuable link with Design Studio.

Architectural Technologies
The subject area of Architectural Technologies is delivered to second year students in two lecture modules entitled ‘Making Frames’ and ‘The Sustainable Building Envelope’, design studio module and building laboratory workshops.

The Sustainable Building Envelope
The semester two module introduces to the student the concept that an inclusive design decision making process, through which the interconnections between building form, structure, envelope components and systems are considered and pursued, achieves cost optimal solutions, providing healthy indoor environments and quality architecture.

The emphasis is on developing building envelope solutions through an understanding of the principles of framed construction and the application of appropriate environmental strategies to create spaces with environmental quality externally and internally while achieving architectural design intent. This understanding is developed through the use of observation and investigation, while developing drawing techniques and processes and research thesis skills.

The objective of this course is to develop in the student:

- an understanding of the impact which the construction of the building envelope has on architectural design intentions and environmental quality of space
• an understanding of the impact which the building’s siting, form and envelope have on the comfort of external and internal environment
• a competence in the process of developing the building structure and envelope of medium scale framed buildings
• a knowledge of the characteristics, properties, design detailing and performance of the materials in use
• an awareness of innovative technologies and materials.

The second semester focuses on the creation of good quality indoor space and the impact which the design and construction of the building envelope as a climate mediator has on the thermal, visual and acoustical environment of internal space in the design studio project. The integration of innovative components and technologies are investigated to improve building performance, internal environment and reduce environmental impact. This builds on ‘The Indoor Environment’ and applies the principles of environmental science to the design and construction of the building.

Course Outline
Introduction to sustainable design
Design Process and delivery
Designing for passive solar
Designing for natural and efficient ventilation
Energy and EU/National legislation
Housing design and Building Energy Regulation
Designing to Passivhaus Standard
Zero–carbon Housing
Traditional v. innovative materials
Building envelope insulation
Alternative materials
Innovative components and technologies.

Overview – Effectiveness and contribution
Little difficulty has been encountered in the integration process. Environmental issues are very appealing to the student and result in very good participation in the subject. Long term studio tutors value the added dimension in the development of the studio design project. However, the success of the programme can be attributed to the following:
• Responsible teaching staff: the willingness of all studio tutors and lecturers to value environmental issues and facilitate their integration into the design studio course is critical to success
• Programme timetabling: the manipulation of the programme timetable to facilitate environmental issues to be integrated from the commencement of
the design studio project and the scheduling of lectures to support its application are essential to provide a holistic integrated approach

- Integrated brief, review and assessment: the development of one brief, shared tasks and one review are essential to illustrate to the student that environmental issues and their application are central to the design of buildings. Alloting a percentage to the design studio marks to the specific environmental and technology activities has a direct impact on the students overall grade for their design studio project provides and instils greater incentive to integrate.

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Teaching Creativity with Sensibility towards a Sustainable Architecture
Courses content

At University Lusofona the architecture department has recently included a sustainability course on the curricula. It is a fourth year class but it is optional.

The 1st semester course is called Architecture and Sustainability. It is articulated with the project design course and has been taught since 2009. Although the course is quite recent, it is popular among students since most Master theses address the subject of sustainability.

The 2nd semester course is called Urban Ecology and is articulated with the studio course as well. This one will address case studies in Europe and will promote mostly workshops.

The main goal of both courses is to develop a creative but sensitive approach towards sustainable architecture emphasizing refurbishment as the major Portuguese priority and market.

Refurbishment as the goal

The course is divided into a daytime course and nighttime course. The method is slightly different between courses since students ages and experience differ between night and day classes.

The daytime students are taught fundamentals and show interest in a creative approach to sustainable design. The teacher main challenge is to develop their interest for refurbishment.

The nighttime students have an informed view of sustainability and their main concern is on practical use of concepts. Refurbishment is already a sensible option for them.

The reason why refurbishment is presented as good sustainable practice is because Portugal is a country with a very high number of houses per capita and our built environment is decaying very fast. Our country is already 900 years and until recently suburbs were sprawling due to the land high cost in urban centres. These are now abandoned while the urban population is still growing.

Nevertheless in our architectural schools, Architecture is still taught as a tool for building and not for rebuilding. It is now important to teach that sustainability is better achieved through reusing rather than building. Furthermore 80% of architects are involved in new projects, 88% of which are residential, and only 22% concern rehabilitation.

The exercises involved

The courses are both theoretical and practical. The theory will be followed by the application of main concepts to the studio project through a critical report which involves a new construction. The other exercise is about refurbishment on campus. A critical view will be developed day after day through an environmental assessment of a building and the campus as well. This allows students to think of their campus
as a former military facility adapted to a university campus. The lack of a sustainable approach in the original plan turns the campus into a privileged case study for an environmental upgrade which will be presented at the end of the semester.

Furthermore and since 2010, both courses have become responsible for 2 conferences: a national and international one. The main theme of the national conference is urban regeneration. The second semester conference is about vernacular architecture, bioclimatic architecture and regenerative architecture. Critical reports on these conferences are another opportunity to promote a critical approach to the subject preparing the students for later research.

**Sustainable Re-architecture**

My own experience as a master students teacher is that students are not critical enough about what surrounds them lacking a perspective on their future professional play role in the market. They should be more aware and informed about the country’s present needs and their important role fighting the urban environmental decaying and unsustainable development. The high number of architects in the market is one problem they will have to face and that should lead recent graduated architects to specialize themselves on topics related to sustainability and refurbishment such as pathologies, construction waste recycling, waste reusing, for example.

In short teaching future architects in Europe requires teaching them a new paradigm of doing architecture which is Sustainable Re-architecture. This paradigm can be considered a challenge since creative process has to deal with a great amount of constraints and sensibility.

**The different scales of sustainability**

Designing a sustainable building requires a global perspective, as urban impact, regional impact and world impact can be assessed in a project, thus different scale impacts should be addressed early on, at the design stage. Therefore students are required to write an on-going report for the studio project, so that they can apply sustainable criteria at urban scale, building scale and detailing scale. This was considered a valid approach for a project in Lisbon that consisted of a residential empty lot in downtown Lisbon.
On the other hand addressing topics like social, environmental and economic aspects of a project in Lisbon has seemed to be a challenge for students whose understanding of sustainability is limited to an environmental approach. Nevertheless students show an increasing awareness for social issues during the semester, but their view of economic impacts of sustainability is limited to cost and payback time. Among nighttime students this topic is more relevant than during day time course.

Nevertheless students are receptive to solar strategies and water efficiency as well as sustainable materials but south orientation is not a priority they are concerned about. This is also due to other professors not encouraging this kind of approach.

**Thinking refurbishment on campus**

The second exercise addresses refurbishment on the University campus which contains 20 buildings. The exercise consists of a building environmental upgrade report based on a post-occupancy diagnose which includes interviews, measurements etc. This exercise intends to prepare students for a growing market on building rehabilitation for energy and water efficiency. In this market there is also a demand for experts on environmental certification, therefore exercises address environmental criteria proposed by a national certification system.

![Map of campus](image)
New paradigm: a biocentric world

The course tries to discuss the need for a new concept of mankind’s interaction with nature: one that doesn’t envision a man’s centred world but a nature’s centred world. This is a new paradigm that needs to be conveyed in architectural schools. Often students are sensitive to the concept of biocentrism but show no ideas on how to apply it.

In Europe and looking at the past, we can find architectural examples where balance with nature was achieved; namely vernacular architecture. New bio-climatic architecture is a recent step towards that same balance but the future requires a new approach and that is of a regenerative design architecture that allows mankind to create assets for nature in order to return the ones that were lost. This will be the main topic of a conference to be organized in the University entitled: sustainable architecture: past, present and future. The topic which needs to be discussed in this conference is the need for a new style for sustainable architecture nowadays.

Green urbanism

Teaching sustainability to architects is to create a sense of their responsibility in transforming the world into a more nature oriented one, which can be done in the cities, through urban design and urban ecology. Transforming cities into more balance ecosystems requires a real understanding of what ecology is about and requires a real understanding of what nature can do and how it works in order to achieve balance.

This is one goal of second semester course called Urban Ecology. This course proposes students to create more resilient urban design that is articulated with ecology principles and ecosystem balance.

This will be a course based on workshops since the subject is very recent in Portugal. There are various entities organizing meetings on this subject and this is an opportunity to create a bridge between architects and landscapers.

Conclusions

Teaching sustainable architecture in Portugal is not part of a traditional academia curriculum therefore there aren’t much constraints on how to teach it. Nevertheless it is still needed to address the main problems at a global scale but also at national scale, thus defining priorities for Portugal.

The other conclusion is that the curricula should include courses on sustainability at an early stage, starting on the first year.

The last conclusion is the importance of demonstrating to students they can have a future career on either sustainable design or refurbishment design with is as creative as any other form of architecture.

Sensibility is also something that should be very present since architects deal with clients directly and need at some stage to become sustainability teachers.
References


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The need for a Critical approach towards Environmental issues in Architectural Education
Introduction

Environmental consequences of human-made artifacts are and will continue to be the main concern of this century as societies are facing the facts that energy and natural resources are running out; air, water and land are becoming more and more contaminated; and excessive usage of fossil fuels has resulted in too much emission of CO₂ in conjunction with the climate change that the planet is experiencing related to these. One of the sectors that directly influences the above-mentioned causes is the building sector. Buildings use up large quantities of materials, natural resources and energy throughout their life from design and construction to their subsequent upgrade and redevelopment. Products selected for construction not only consume resources and energy, but also produce air and water pollution.

However it is a fact that the building sector forms an important part of a nation’s economy. This makes it uneasy for governments to develop environmental precautions, which may be more related with preservation rather than building activity, on the grounds that these may slow down the process of economic development. That is why even though there is general agreement that architecture as a practice makes an enormous environmental impact, in the recent past interrogating the profession’s relationship with the environment has been realized related to human beings, and this scope has limited the subject to visual, physiological and psychological effects for many years.

Fortunately today we are entering a new era where research and implementation of environmental approaches in physical surroundings are enormously speeding up day by day. However both the chaotic structure of the literature and the interdisciplinary dimension of the subject require a critical evaluation for the architectural perspective.

In this article, the course “Sustainable Architecture, Critical Approach” conducted by the writer of this paper at graduate level (1) in Yıldız Technical University Faculty of Architecture, will be presented in order to help constitute a pedagogical basis for environmental approaches in architectural education.

The Necessity of Criticism and Unlearning in Sustainable Architecture

I saw that one inquiry only gave occasion to another, that book referred to book, that to search was not always to find, and that to find was not always to be informed; and thus to pursue perfection, was, like the first inhabitants of Arcadia, to chase the sun, which, when they had reached the hill there he seemed to rest, was still beheld at the same distance from them (Adler, 1975; p. 8).

In his book, *Ecological Fantasies*, Adler (1975), while talking about the limits of his research on environmental pollution, quotes the lines above from Samuel Johnson’s preface to his dictionary. Adler thinks that covering all aspects of en-
vontational pollution would be like chasing the sun, an endless task. The author states that there are more than 600 books written on this subject and if reports, articles, speeches, meetings, debates and programs are added to this, the research might easily come to a dead end. For this reason, like Johnson, Adler sets limits to his work so that it would be finished before the world comes to an end and trusts that it contains sufficient matter to rouse and please discriminating readers. Therefore he limits his readings to articles in Science, The New York Times and approximately eight specialized environmental journals. However, as the publications are diversified, the author adds that he could easily rewrite whole chapters of the book on a monthly basis with new material, none of which would alter his basic assumptions.

From the year 1975 when Adler published this book until the present, the literature that the author was talking about has immensely diversified and expanded. A quick search in the archives of the Library of Congress in Washington, D.C. will reveal nearly 10,000 books on sustainable development. We have strong arguments to believe that it is no longer possible for Adler to hold on to his assumptions with entirely different textual material. Therefore it is obvious that today anyone attempting to deal with the concept of sustainability, at first, has to be able to research, choose, categorize and reproduce this vast amount of information. Obviously to achieve this goal, critical thinking has to be developed. The issues outlined above become the first motivation of the course “Sustainable Architecture, Critical Approach” conducted by the author in YTU.

The reason for “sustainability” to be selected as the main axis for the course is that the current stage that environmental debate has come to necessitates our undertaking environmental, economic and social dimensions of the subject and therefore obliges us to use the terminology of sustainability. Besides, political reflections that sustainability generates are worth exploring. The idea of sustainability is criticized as a short-term, passing fashion, lacking real substance and reflecting political opportunism. The definitions of sustainable development are found to be vague, technocratic and inoperative. Still, for the future of the environment, activities surrounding the sustainability concept may define a meeting point instead of a platform of compromise. It is obvious that the ambiguity of the concept (which is defined in that way on purpose), makes it an umbrella for all groups and sectors representing totally opposite interests. This feature might facilitate cohesion as a positive social value in society. Sustainability involves the adoption of a holistic and transactional perspective that links all the dimensions of the milieu as an ecosystem with individual and social behaviours, and at the same time with values, lifestyles, forms of production, technologies, policies, and social structures. In this context sustainability is found to be not only related to environmental concerns but also to solidarity and equality (Pol, 2002). These different interpretations of the concept make a productive medium for discussions executed in the classroom.
Overall, the course aims to create environmental sensibility, to transform this sensibility into professional knowledge and make students competent to conduct and criticize research and practices on their own. However in order to achieve an awareness, understanding and ability in sustainable architecture, at first, it is important to start an “unlearning” process since in the formal undergraduate curriculum, issues mentioned above may not appear as controversial. The student, after four years of architectural education often graduates with a portfolio full of unsustainable design practices and an environmental agenda filled with buzzwords. That is why, in my point of view, the biggest accomplishment of the course, “Sustainable Architecture, Critical Approach”, if it manages to succeed, is to unbuild certain ways, perceptions and patterns of behaviour encountered worldwide in many schools of architecture rather than build up these conventions. Consequently, to assist students in the process of finding their own interpretation related to environmentalism in architecture.

**From Environmental Problems to Urban Social Movements: A Journey from Theory to Action**

In order to meet the aims of a learning/unlearning environment, including critical evaluations and alternative positions, the course structure is divided in three different modules. It starts with theoretical discussions on the environmental movement, continues with criticism in architectural and urban sustainability and concludes with seeking different modes of resistance and alternatives.

Following the path outlined above, the first module consists of socio-political history and context of environmentalism. It is intended to unlearn and debate on certain “facts” about environmental problems. Theories on the role of population, the Industrial Revolution and consumption patterns of different societies in the creation and birth of environmental problems are explored and the sincerity of international agreements on the “prevention” of these problems are investigated. Then a history of environmental approaches in the built environment is evaluated. Here certain attention is paid to different terminologies used. It is obvious that from radical green to energy preservation and healthy working environments, changes in the concepts and different modes of environmentalism point out different attitudes within the movement. For instance from the 1970s to the present, green, ecological, sustainable definitions within the field of design and architecture at first started as approaches that suggest buildings should offer healthy mediums for human comfort. Later this was oriented towards an effort to establish a harmonious relationship with the environment. Lastly these paved the way to current perceptions where the environmental debate has enlarged, covering social and economic dimensions as well. As changes in the terminology disguise shifts in social and political understanding on the environment, in this framework, it is seen as vital to re-read the environmental history of our profession.
For instance, according to Bookchin (1988), environmentalism is nothing other than environmental engineering and it does not question the main concepts of the current society, especially human control over nature. Similarly Beaufoy (1993) thinks that environmentalism is a managerial approach to the problems, secure in the belief that they can be solved without fundamental changes in present values or patterns of production and consumption. According to the writer this concept was applied by those who wanted to face up to the ecological crisis, but who did not want to adopt radically different ways of life. This has led to concepts of sustainable development and green capitalism. The true greens have tried to fight by highlighting the contradictions within green capitalism. They warned of what they saw as the ineffectiveness of capitalism in solving environmental problems and of the dangers of green consumerism. Looking from this framework corporate enthusiasm for sustainable development can be defined as a “virtuoso conversion”, a “masterpiece of business pragmatism” (Beaufoy, 1993). This module finalizes with a critical evaluation of sustainable development and the idea(l) of sustainability in general by evaluating sustainability’s relationship with science and politics.

The second module examines the built environment’s role in the debates of sustainability. In this context it focuses on architects’ achievements and failures in terms of environmental and social sustainability. This section can be evaluated on two levels. In the first part projects and buildings with different attitudes on energy, natural resources and material conservation are discussed; life cycle assessment of buildings are stressed; environmental friendly design and planning of cities are explored. And lastly social projects involving environmentalism in architectural and urban space are dealt with. This section concludes with a discussion of different attitudes and dilemmas such as man versus nature, nature versus technology and urban versus rural within the environmental movement.

The second part of this module consists of criticism of architectural and urban projects and applications of sustainable architecture. Unfortunately, sustainability today has become the formula of presenting the environmental look without changing current practices. Undoubtedly the discipline of architecture is also affected by this approach. Professional organizations, architects and academicians, who want to benefit from the social responsibility tag that the concept of sustainability offers, have shown great interest in the environmental debate in recent years. However here the deficiency of the critical evaluation of the concept is felt because whatever precaution the architect takes, architecture, due to its very definition, is an act against ecology and the environment. Despite this, design parameters within the environmental movement have not departed significantly from the approaches of the last century and the climatic responses of vernacular architecture. Still, the general interest shown in the
concept of sustainability in the name of professional legitimacy and social responsibility, ignoring the things that have been stated above, results in one of the most important merits of the spending society: rapid consumption. That is why at the end of this module, applications selected from different periods, geographies and cultures form the basis of comparison and examination. Special attention is given to award systems, the media’s role, regulations and building certifications.

The last module of the course is based on a search for alternative sustainable positions in built environments. Looking from the discipline of architecture, we can determine that neo-liberal politics are significantly re-shaping the built environment. That is why it is important to undertake the subject in terms of the social realities of this century. For this reason in this module the environmental and social dimensions of the subject, which is also under the influence of architecture, are taken into consideration together. In order to present some guidelines, different modes of resistance, particularly stemming from the neglected geographies of the world and presenting different levels of environmental concern, are evaluated. In particular, urban transformation projects led by governments and the voices against them claiming “place” are studied. In this regard, concepts such as anarchy and architecture, autonomous architecture, eco-feminism, eco-socialism are investigated.

Means of Criticism: Evaluation/Suggestion on (un)Sustainable Architectural/Urban Implementations

Architectural education in my perspective is constant research and discussions of the student and the lecturer initiating a learning process for both parties. This course, therefore, is based on research/discussion. Along with lectures given by the course instructor, invited lecturers from a wide variety of disciplines and field trips to the cases, interrogated in the classroom, become the vital parts of the course. This treatment also allows outcomes from the course to be inputs of the following semester.

Student contributions to the course “Sustainable Architecture, Critical Approach” are of great importance and are expected to be delivered on two different levels in which one of three formats can be used. In order to explain this further, it can be stated that, on the first level, students are encouraged to criticize a text, a project, a built environment (either on building or on urban scale) or a political action that involves an urban decision on sustainability. The cases have to be selected in connection with the discussion points of a certain week in which the student volunteers make a presentation. Discussions occurring in the classroom over the presentations help the subjects evolve. This part of the work enriched with the class input, is evaluated as a semester study.
Here, *in situ* experiences are encouraged as they are thought to help students in structuring their critical thinking. For instance in the 2009-2010 winter term, the focus of the analytic examination was concentrated on LEED certificated buildings in Istanbul. The discussion points were as follows: How buildings were certificated; on which levels buildings were found to be “successful”; were these “so called” successful entities corresponding to local conditions; if it was possible to create another set of criteria, how would these buildings respond to them.

In the second level the students are asked to draw their own perspective of architecture’s relationship with sustainability in an alternative way by developing a text, a project or a political decision. This approach is preferred as it might have the possibility to be a vehicle to develop a student’s ability to explore, assess and pursue various alternatives for sustainable design. This work, which is to be presented by the final exam date becomes a part of the student’s final grade. Two studies that the student is required to do are expected to be delivered in written or drawn format on the final exam day.

Evaluation criteria of the studies are the students’ competence in using and building upon the concepts and discussion points that were dealt within the class hours. Originality of the research and its proposition is of great importance. The final grade is given as the sum of 30% participation in classroom discussions, 30% first presentation, 20% second presentation and 20% the paper.

**Conclusive Remarks: The Need for More Criticism, Ethics and Social Responsibility**

Undoubtedly there are too many limitations for constituting a medium of critical thinking on sustainability. Determining the grounds on which discussions on sustainability will be based is one problem. Drawing the framework of criticism is another. Within this context, the backgrounds of the participants of the course become an important entity. If they are not open to unlearning or critical thinking and are not familiar with the topics of ethics or social responsibility (as is the case that the lecturer faces from time to time over the years), the course structure has to be re-written according to the diversified abilities. The lack of infrastructure in that sense constitutes an important constraint. Still if we consider the learning process as a reflexive one, it can be stated that the course evolves every year into a new structure with the input and criticism of the contributors of the course.

It is obvious that trying to compensate for all the issues that the formal curriculum excludes about environmentalism and architecture, like chasing the sun, would be an endless task. However the course experience shows that insisting on the need for more criticism, ethics and applications of “real” social responsibility in sustainable environments in theory and action is nevertheless worth seeking.
References

Endnotes
1. Architectural education in Turkey consists of a 4-year study resulting in an undergraduate degree. The students may continue with a 2 and/or 4-year study finalizing with a graduate degree. The course presented in this article is taught in Yıldız Technical University, Faculty of Architecture, Building Planning and Research Graduate Programme.
Torben Dahl and Brian Edwards

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Multiple Ways of Teaching Sustainability
Introduction

Sustainable design and construction is taught to architecture students at the RDAFA via a course known as TEK4. This mandatory two week course at the start of third year builds upon TEK1, TEK2 and TEK3 and presents material specifically on ecology, resources, climatic design and low carbon technologies in architecture. There are also exercises on energy modelling and calculation aimed at strengthening the students’ understanding of sustainability.

By the time students take TEK4, earlier technology courses have introduced them to the properties of materials, the physics of structures, the principles of construction and assembly, and the nature of heat, light and acoustics. Hence TEK4 develops learning in the area of sustainability which grows out of a solid base of prior learning in construction and technology. One feature of the technology courses at RDAFA is their hands-on nature with students building walls and fabricating structures in metal, timber or concrete. This ensures that by the time they address sustainability, students have had direct workshop experience of construction materials and laboratory processes.

Philosophy of Course

The course teaches sustainability with a broad focus. It is not just about energy but presents material on many aspects of environment and ecology. This includes water conservation and its use in architecture, assessment tools available to measure impacts at the design stage, emerging concepts such as cradle to cradle and biomimicry. The course explores actions related to mitigating the adverse impacts of climate change through better design and planning, and actions needed to adapt to a world with reduced resources and an altered climate.

Since the course is taught to potential architects, planners, landscape architects and interior designers, the pedagogic approach is one of presenting core knowledge and skills as well as transferable ones. Also the taught material, learning outcomes and assessments are designed to be of interest to students across scales and at different timeframes.

Structure of the course

TEK4 is structured into a taught week with formal lectures and a workshop week conducted as design tutorials with groups of students arranged in their teaching department configurations. The aim is to give new knowledge and to test its application in design exercises. As the number of students is high (normally around 160) the design exercises are not new but are based upon the redesign of an earlier project where students are asked to apply the theories, principles and knowledge gained in the lectures.

TEK4 provides a basis whereby research in the Institute of Technology (the institute responsible for delivering all of the technology courses) finds expression

Torben Dahl and Brian Edwards
in up to date knowledge and critical practice. As the institute has a number of PhD students and is engaged in externally funded research projects in sustainability, the course provides one of the channels (along with the more research based TEK5) for ensuring that new knowledge reaches undergraduate students. The key areas of research here are in climate-related design, in the Nordic tradition of sustainable architecture, in materials, prefabrication and tectonics, and in new methods of forming brick structures and concrete walls. This area includes research into rammed earth construction and fabric formed concrete.

Although not all research areas are appropriate for an undergraduate course on sustainability, the benefits for the students are in the cutting edge character of the course and its intellectual rigor. In addition, Brian Edwards who coordinates the course, has written the ‘Rough Guide to Sustainability’ which has been authored specifically under guidance from the Royal Institute of British Architects (RIBA) to provide an overview of the subject for use by students at this level in Europe’s many architecture schools. Another key book ‘Climate and Architecture’ written by Torben Dalh, leader of the Institute of Technology, finds its way into course material. So scholarship and teaching are closely related, ensuring that students are presented with contemporary material and have subject experts available for guidance.

One tradition of the course is that an international speaker is invited to share their views on the subject. This last year Professor Dean Hawkes, Emeritus Professor from the Welsh School of Architecture and Fellow of Darwin College, Cambridge travelled from the UK to give three lectures. Professor Hawkes has written widely on the subject, led research projects on low-energy design, and has practiced in the area of sustainability, winning architecture prizes in the process. His lectures based upon the books ‘Environmental Tradition in Architecture (1996) and the Environmental Imagination: technics and poetics of the architectural environment (2007) augmented those by institute academics. The lecture examining the work of Peter Zumthor from an ecological perspective proved particularly popular.

**The importance of practice links**

There is another key theme to TEK4 and that concerns practice. The course is structured so that practitioners can share their experience of trying to bring ecological approaches to reality. Normally three practices present examples of green projects and the sustainability tools employed in an attempt to demonstrate that green principles can lead to attractive and innovative architecture. Although speakers vary from year to year, the list normally includes the large Copenhagen practices of CF Møller and Henning Larsen Architects and the engineers Arup. One benefit of this is that students understand the necessity of sound science in helping to develop the new clean technologies of the future. Another is that good
green design is often the result of partnership between architects and engineers, and frequently involves an enlightened client and innovative contractor.

Practice is widely interpreted and includes material manufacturers such as Rockwool and the component and glazing company Velux. These two Danish companies provide speakers who describe the way sustainability is influencing the choice of construction products, the development of new technologies, and how these impact upon design approaches. Students are also taken through prototype projects via site visits or video such as the Home for Life initiative of VKR Holding (parent company of Velux).

These various links provide a triangulation between teaching, research and practice which underpins the philosophy of TEK4 whilst allowing it to become a platform for TEK5 which is the mandatory postgraduate technology course. To summarize, the learning outcomes for TEK4 are:

- Understanding the interaction between energy, climate and architecture
- An appreciation of the different concepts of sustainable development, sustainable design and sustainable construction
- An appreciation of the ecological stresses on resources and construction products
- An understanding of environmental assessment methods and key principles which drive architectural form from an environmental perspective.

Since students attending the course come from different teaching departments where they work at various scales of design application (from urban planning and landscape to furniture design) the material seeks to be generic in application. Hence the scope of lectures spans from principle to cases of application across a wide field. As an undergraduate course, the material presented in lectures and tutorials is aimed at developing core skills in architecture and also transferable skills beyond the normal boundaries of the discipline.

**Assessment and the assignment**

The chance to apply the new knowledge imparted in these lectures is via the assignment which carries 3 ECTS points. Here students are asked to redesign an earlier project applying the ideas and technologies introduced in the course. Specifically students are required to provide a short text explaining their design approach from a sustainability perspective, to show before and after drawings side by side, and to provide at least one calculation (for example a U value calculation of construction as previously designed and as modified, and preferably set against current Danish building standards). A critical drawing here is often the cross section which shows the environmental thinking and the nature of architectural spaces which flow. In fact, one benefit of the course to students is to highlight the importance of the section as a generative drawing from a green perspective.
Students are given guidance on their assignment in the second week. Specifically, their design reports presented in A3 landscape format should contain four assessed elements:

- A summary of their sustainable design approach.
- The modified and original design with key annotation highlighting the design changes made.
- An explanatory text of about 1,000 words explaining and justifying the green principles, concepts, technologies and materials employed.
- A calculation of one element of green construction (U value, PV electricity generation, Ground Source energy, water conservation etc).

In their presentations students are encouraged to cite appropriate precedent, to use tools such as LEED and BREEAM to guide them, to test the theories of ‘Cradle to Cradle’ and other emerging concepts. The aim is to encourage exploration within the terms of reference determined by the students themselves within the context of their own projects and the approach of their study (teaching) department.

**Conclusions and reflections**

The approach to teaching sustainability at RDAFA builds upon three earlier technology modules which lay the foundation for the green understanding. Hence students are already familiar with key concepts and have a good grounding in the science and technology of construction. The triangulation between teaching, scholarship and practice is a construct aimed at ensuring that sustainability is grounded in material reality. However, there can be a conflict between the science approach and that of art which is the traditional strength of the Copenhagen school. The name Royal Danish Academy of Fine Arts signals a particular approach to architecture. Sustainability is taught so that it does not challenge the centrality of the art axis in design. What is provided in the lectures and via the invited speakers is the means to make architecture more poetic by using the tectonic potential of sustainability to create even more beauty in the students’ projects. That is why existing designs are taken as the starting point for the assessed assignment.

However, one problem with the approach to assessment is that some students argue that it is difficult to retrofit a project with green thinking if it was not a factor in the original brief. This is a fair point and highlights the importance of the integration of sustainability at the outset of studio projects. So the concern is turned into teaching benefit- green thinking is fundamental to architectural quality and cannot be added late in design evolution. Another problem is that many web-based tools are available to measure environmental impacts. These lead to drawings with the air of competency but are not always fully understood by students at a conceptual level. So one answer is to require more hand draw-
ing which shows genuine understanding of the interaction between sustainability and architectural design rather than CAD images.

A key drawing in teaching sustainability is the cross section. The course emphasizes the importance of this drawing type. However, some students are more familiar with plans, models and elevations than sections. Without a good grasp of the section as a means of cutting through construction and relaying the pattern of heat, light, ventilation there is limited opportunity to test and develop knowledge of the physics and thermal dynamics of architecture. The loss of the cross section as a key pedagogic tool in favour of the abstraction of plans is a worrying tendency from a teaching sustainability point of view. This is true too of the ‘climate screen’ - the critical edge conditions which are needed to moderate internal and external environments. Sections through facades can save a thousand words of description and are more useful than the blue and red drawings of CAD energy modelling.

**Figure caption**

This example of a TEK4 project by Rasmus Emborg shows how the student has applied Ecotect and other tools to model the impact of light and energy flows on his project. Notice how the window areas are intelligently distributed and sized. Notice too the attention to the ‘climate screen’ in the use of shading of glazed areas and occupation of the window zone.
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Renewable City, Regenerative Region: Urban Design and Planning in the Age of Climate Change and Fossil Fuel Depletion
General

A focused understanding of global and local sustainable development in an integrated program

The Sustainable Urban Design (SUD) program comprises a teaching curriculum within the Sustainable Spatial Development group's broader activities in the Institute of Architecture and Planning. It aims at the design of cities and towns with near and far futures in mind. It is founded on a firm definition of sustainability: there can be no sustainable development unless it is entirely based on renewable sources and processes only. SUD combines architecture, landscape and civic design with advanced concepts of local energy and water autonomy, to help fight climate change and other challenges to social, economic and environmental health. Founded on broad traditions of responsible design, it helps participants conceptualize and manage places as authentic settings with a strong genius loci - nurturing global connectedness while building local prosperity at a shrinking ecological footprint. The program consists of four connected core courses: the Sustainable Urban Design Studio; and three lecture subjects: The Renewable City; Responsible Property Development; and Urban Quality - Assessment and Design. The program is fully embedded on the chair's Sustainable Spatial Development group framework that also integrates related research, network and outreach efforts.
Sustainable Urban Design lecture courses
The Renewable City

Cities, buildings and their evolution cannot be fully understood without looking at the resources and technology used to drive change in civilization. The 20th century was marked by a global fossil fuel combustion frenzy, bringing human and urban civilization to the brink of calamity, as much of this fuel grows dangerously scarce, and has emerged as the major source of human caused greenhouse gas emissions. This subject covers the role of energy in modern urban history, climate change threats and responses, the logic of the renewable energy revolution and a set of tools and techniques of lowering global and local dependence on unsustainable resource use through approaches to urban and architectural design that permit the exclusive reliance on sun, wind, water and other forms of renewable power.

Learning Objectives
The subject is designed to help gain a critical grasp of urban form and performance, link the institutional, technological and design dimensions of climate change action and empower future architects and others in engaging both basic and complex design tasks at building and city scale. This is to respond to current needs in transcending traditional boundaries of building design, embracing design program, client interaction and community change from a renewable energy integration and sustainable resource management perspective.

Approach and Format
This hands-on course consists of lectures and presentations, in-class discussions and challenges, assignments, discussions and presentations. Investigative, analytic and interactive projects will supplement these. The class will be supported by several key textbooks to assist in skills development and comprehension. Evaluation will be based equally on individual class participation, weekly exercises and team efforts.

Responsible Property Development
This subject has a twin objective: to bestow an understanding of real estate development, and to do so in a sustainable development framework. The
subject introduces the worlds of real estate and property development, investment, finance, marketing and management: these drive most architectural design commissions and outcomes. Students will begin to understand the real property interests and dynamics that determine design briefs and, together with public policy directions and planning objectives, set the stage for the design and planning profession to unfold and excel within. Familiarity with the conceptual frameworks, practical tools and language of the world of real estate is an important asset, since, when inadequately applied, development frameworks can constrain creativity and design quality - and lead to practices that can be regarded as socially, environmentally and economically unsustainable. Students will encounter the growing domain of responsible real estate that seeks to innovate in a socially and culturally responsive manner while drastically lowering the ecological footprint of development, reduce energy risks and help stabilize the global climate.

**Learning Objectives**

The subject is to assist in developing both a sense of ethical responsibility and practical vision in achieving financially feasible and resilient projects that respond to environmental, social, cultural and economic demands. It is to help develop a working knowledge of sustainability action in real estate development, such as principles of corporate social responsibility and community investment; concepts of “design dividends”; tools of gauging sustainability; incentives and other mechanisms for quality guidance and market innovation; energy efficiency and renewable energy finance; as well as partnerships and other means of effective implementation. The course is to motivate and inspire by providing models for practice, in projects, practice and people committed to building a survivable world of prosperity.

**Approach and format**

The introductory course consists of lectures, discussions and workshops. International case study presentations may accompany the curriculum. Students will be engaged in directed real and virtual field visits, and individual and/or team study assignments. The subject is structured into distinct elements: a) general definitions; b) fundamentals of property development; c) sustainable real estate development dynamics. It may feature workshops and case studies as supplementary teaching tools. Resources will include literature, guest lectures and other support. Evaluation will be in equal parts on participation, group efforts and individual progress. Architecture students may be involved with candidates of the International Financial Management Master degree program to allow both groups deepen their understanding of the subject matter in both methodological depth and conceptual breadth.
Urban Quality Assessment and Design

This subject focuses on urban observation and representation; methods of urban design control and concept development; and approaches to research inquiry by design and into the processes and products of urban design. Assuming elementary design skills, it seeks to provide a conceptual and personal framework for enhancing these abilities, and make them more sensitive and relevant to urban settings and public environments. The course provides a good foundation in perception and critical analysis, design investigative skills, verbal and visual communication skills. It helps combine personal experience and methodical expertise in nine dimensions of urban quality management through assessment and design, while providing participants with a good understanding of the key literature.

Learning objectives

The course provides a good foundation in quality assessment and design skills, an appreciation of the importance of these skills and on approaches to foster, develop and advance them over time. Specifically it will seek to convey personal experience and expertise in these nine dimensions of quality management in the first semester sequence of lectures and exercises:

- **Telling**: how to express knowledge, beliefs and memory
- **Sensing**: how to feel, anticipate and intuitively understand
- **Noting**: how to observe, notice, map and remember
- **Inquiring**: how to postulate, test, discover and reflect
- **Researching**: how to conduct design investigations
- **Imagining**: how to exercise your imaginary powers
- **de/briefing**: how to communicate in the urban design process
- **conceiving**: how to conceptualise and invent creative solutions
- **guiding**: how to positively influence complex processes and their outcomes

In the second semester the focus is on application of advanced and professional forms of quality analysis, management and control.

Approach and format

This hands-on course consists of instruction, in-class projects and challenges, assignments, discussions and presentations. Graphic tools will be applied, from manual to photographic and computer-based. Besides the weekly tasks, there will be reading assigned to assist in skills development and comprehension.

Sustainable Urban Design Studio - sample of recent project

The Sustainable Urban Design Studio studio is focused on the design of sustainable settlements via the development of an urban systems prototype. An advanced low-waste, low-energy building system with ancient roots forms its ma-
terial basis. To start, contemporary and historical settlements will be observed to derive and test urban design principles.

These will be examined in their

- material sustainability (resource life-cycle and energy autonomy)
- socio-economic aspects (history, culture, markets)
- contribution to the environment (ecology, biodiversity, food, climate, water)
- urban design quality (built form, connectivity, access, sense, meaning).

Together with the study of other projects and places, this evaluation will help students derive their own regenerative urban systems prototype. In the second half of the semester each student select a location from her or his home country to test the adaptability and flexibility of the prototype. This will require analysis of the existing site conditions, deriving design options, and conceiving sustainability criteria to evaluate options. To demonstrate the universality of the prototype, a large and underused industrial precinct in Switzerland will be used as reference design case. The final product will be a well programmed and designed urban system adapted to multiple locations.

The studio addresses these questions:

- What constitutes the making of good urban form?
- What is good urban design, what is great urban design, and what is sustainable urban design?
- What methods help us design and build in socially and culturally sustainable ways?
- How can local energy, material and water autonomy help good urban design?
- Are there universal principles to the design and function of cities? Are historical models relevant?
- What will future cities look like, cities that regenerate healthy and resilient regions?

**Research Projects and Initiatives - samples**

**Sustainable Process Management**
January 2011-August 2012

- Study of a comprehensive sustainability framework for organisations, using the University of Liechtenstein as research focus.

**Biocity Prototype**
January 2011-August 2012

- Study of a comprehensive sustainability framework for organisations, using the University of Liechtenstein as research focus.

**BAER - Bodensee/Lake Constance-Alpine Rhine Valley Energy- and Climate Region**
October 2009 to October 2012

- Applied research to develop renewable energy to address regional climate change and energy risks: an initiative of the Hochschule Liechtenstein, with four other regional university partners. www.baernet.org
Renewable Liechtenstein
September 2009-February 2011

The project explores the resource autonomy potential of the country, based on a spatial and climatic modelling of efficiency improvement, local energy supply and carbon biosequestration potential.

E-REGIO - Eco-energy Export Great Walser Valley (Region Grosses Walsertal), energy autonomy and surplus export in alpine regions
Recently completed

This project entails the exploration of means to supply the UNESCO Biosphere Park designated Region of the Great Walser Valley in the Austrian state of Vorarlberg as an ecologically sound produced renewable energy source.

Teaching by outreach; research discourse: conferences and seminars
Vision 2020
Quarterly public fora on sustainable urban design and spatial development issues

Dokonara

The annual PhD Colloquium in Sustainable Spatial Development is organised by the University of Liechtenstein’s SSD Program, with counterparts in the Universities of Kassel and Innsbruck, as well as Hafen City University Hamburg.

Liechtenstein Congress on Sustainable Development and Responsible Investing

Awaken by financial, ecological and political threats the global economy is transforming fast, from short-term thinking and a systemic reliance on non-renewable resources, to an innovative, just, sustainable and prosperous future. The bi-annual Liechtenstein Congress provides an international platform for practical research and informed practice in Sustainable Development and Responsible Investing, guided by effective policy and enlightened by a deep sense of responsibility.
Michael Edén

Chalmers University of Technology
Gothenburg, Sweden

Integrated Design for Sustainable Architecture
Introduction

This text consists of four parts. First, a story behind the establishment of the course and its context in the curriculum. This history will tell a little about “what” is being taught. It will serve as a background for a discussion about the implementation. The second part describes the studio “Sustainable building - competition”. This description will mainly deal with the questions “how”, “what exercises” and “improvements”. The third part is a discussion about the history and the studio, with reflections on its future development. In the fourth part some student projects are presented.

The history of the environmental curriculum

The birth of the environmental education at Chalmers Architecture

In the late 1980s the University of Gothenburg and Chalmers University of Technology established a joint school of Environmental Sciences. The initiative came from researchers at both universities and the intention was to form a strong body for cooperation in research and education. The School was “immaterial”, meaning that all members had a position at a department, and that the school should function as a forum for networking and development. From the very beginning, researchers from Chalmers Architecture were members of the school. Today the school has developed into the “Centre for Environment and Sustainability” - GMV.¹

At the same time the Royal Swedish Academy of Engineering Sciences, IVA, found that environmental matters were important for engineers. The academy formulated a policy that all technical universities should establish environmental issues in their education. The academy is independent, but it is in an important institution with large impact on the activities in the universities. The message from IVA functioned as a strong argument for GMV in order to convince Chalmers about the necessity of environmental education. Chalmers adopted the policy from IVA into a recommendation that the education should contain a certain – but not very big – amount of voluntary, environmental courses.

Chalmers Architecture gave a quick response and established two compulsory courses “Architecture and Environment” and “Transport and Environment” for students on the advanced level in the fourth year.

The slow growth

The two courses lived a vulnerable life their first years, as the education was reorganized from time to time. During one period they were voluntary. Then the transport course was omitted when the professor in charge retired. However, due to a successful and strong establishment of environmental research, GMV grew in strength and importance and could keep the pressure concerning the need for education. For example, one of Sweden’s successful exports “The Natural Step” had
Teaching a new Environmental Culture

The broad implementation

In the new millennium a new era took its form. The Bologna model was introduced and the existing advanced level at Chalmers Architecture was transformed into two master's programmes. One of these, "Design for Sustainable Development", was entirely dedicated towards the environment and sustainable development. Furthermore, in both programmes a common, compulsory course, “Sustainable Development and the design professions”, was established.

The curriculum in 2010

Today the examination regulations at Chalmers stipulate that a student must have passed at least 7.5 credits in Environment and Sustainable Development in order to receive a degree in Architecture or Civil engineering. The “environmental curriculum” at Chalmers Architecture is shown in table 1.

Table 1: The “environment and SD track” in the curriculum.

Bachelor level 180 credits

<table>
<thead>
<tr>
<th>Year</th>
<th>Env &amp; SD courses</th>
<th>Other courses and projects, integrated aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Architecture, Environment and sustainable development, 7.5 credits</td>
<td>The intention is that the students shall be able to find integrations of their own.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>In the third year there is a course in essay writing. Many students select “Architecture and Sustainable Development” as their theme.</td>
</tr>
</tbody>
</table>

Master's level 120 credits

<table>
<thead>
<tr>
<th>Year</th>
<th>Programme Design for Sustainable Development - DSD</th>
<th>Programme Architecture and Urban Design - ARC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sustainable Development and the Design profession, 7.5 credits</td>
<td>Planning track Studios</td>
</tr>
<tr>
<td></td>
<td>Building track Three courses, each 7.5 credits, in “Sustainable building”, preparing for the competition studio</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sustainable Building – competition, 15 credits</td>
<td>Master’s thesis, 30 credits</td>
</tr>
<tr>
<td></td>
<td>Master’s thesis, 30 credits</td>
<td></td>
</tr>
</tbody>
</table>

180 Teaching a new Environmental Culture
The profiles of the different courses and studios

The introduction course in year 1 at the bachelor level aims at introducing the problem area and the obvious connections to architectural practice. To exemplify such connections built projects are used that the students shall analyse and reflect on. The projects represent the frontier in environmental building. The course is focused on “learning”, in which the search for information and reflections play an important role. The reasons are in short: 1) Every architectural task is more or less unique, and the architect must have methods to match relevant environmental information with the given context. 2) The field is dynamic, solutions or knowledge that is at hand during the student’s first year might very well be outdated when they graduate. Hence, the main aim can be said to implement a sense of responsibility together with will and skill to conduct research about environmental matters in each project.

Currently, one challenge is to continuously integrate self-evident matters of environmental technologies into the “ordinary” education. The integration has, so far, been slow, mainly because the teachers are not familiar with the connections, and, thus, can’t give relevant support. However, “soft” issues concerning social and functional aspects have always been elementary aspects in architectural education long before they were denominated as “sustainable”. The point is to make those connections clear for both teachers and students.

The introduction course on the master’s level also emphasises the research approach. On this level the students come from different countries and cultures. They are familiar with the architectural profession and have lots of references. For some, the references form a base for making conclusions on how the issues of environment and sustainable development affect architecture and architects. For others the references have become fixed perceptions about what “ecological” architecture “is”. The scope of the course is, therefore, wide, complex and global. In the end of the course each student is asked to formulate a personal strategy on how to cope with the matters.

The “planning track” in the DSD studio deals with global problems in local contexts, both in Sweden and in developing countries such as East Africa. The students get to know a defined community, in which they shall propose relevant design interventions.

The “building track” consists of a series of studios dealing with solutions to minimize the environmental impact. The contents are: Materials and details, water treatment and green infrastructure, energy efficiency and solar energy. The methods are investigations and implementation in small architectural projects. The studios are meant to be a preparation for the competition studio, in which all the findings in the different investigations should be integrated.
The competition studio
The initiation

You can say that the origin of the “building track” is the generous donation from a devoted architect. In 2003 architect Hans Eek, Sweden, and Diploma Engineer Wolfgang Feist, Germany, received the Gothenburg International Environmental Prize for their persistent work over decades in order to develop sustainable building. Mr Eek immediately used his share of the award as a donation to Chalmers in order to establish a competition for students from both Architecture and Civil Engineering.

Hans Eek is one of the most important Swedish pioneers in the field of energy efficient building. He has since 1975 systematically investigated the performance of “passive” design in a series of projects. Gradually the buildings have grown less complicated and more optimised. The lessons to be learnt from Eek’s series of development are not only the design solutions. Eek stresses the “integrated design”, between all consultants and also including the client and even every worker on the site. The design process should be based on common goals embraced by all participators. The intention of the donation was to prepare the students for such cooperation.

In Eek’s wide international network, Norwegian experts have been very important. When the Norwegian State Housing Bank learnt about his donation to Chalmers, they immediately made the same donation with similar aims to the Norwegian University of Science and Technology, Faculty of Architecture and Fine Art, NTNU, in Trondheim.

So, in short, with these prerequisites the two universities decided to cooperate in the courses initiated by the two donations.

Merging four faculties at two universities

The strategy was to establish parallel studios, with a common assignment and a common jury. The start of the competition and the jury assessment became the meeting points. The inter-Nordic cooperation has, so far, been accomplished in exercises in site analyses with mixed groups from both universities. The site has been altering between Trondheim and Gothenburg (see below table 2).

The following report about the studio deals with the accomplishment at Chalmers.

Goals and objectives

The main aim has been from the beginning to train the students in handling problems tied to sustainable building that call for cooperation. The aim is that both categories should leave the studio with enhanced skills in design for sustainable building, with a deeper understanding of how their competencies can be used in a joint project and especially competitions. The architects should come out of the studio as more skilled architects, and with a better understanding about technical systems. The engineers should likewise be more skilled in their
profession, and with a better understanding about conceptual design in early phases. The main method is that both categories shall exchange ideas and learning independently during the design process.

The competition form means the students must work independently, with limited support from teachers. The measures on how to arrange the arena for the mutual learning among the students has been an important issue.

Setting the learning environment

The foundation consists of a team of teachers, architects and engineers, who design the course and the exercises, who conduct the consultations together and who make a common assessment of the outcome. It has been important to sort out the relation between competing and learning. The competition is assessed by a professional jury. This result is only a part of the studio; the teachers assess the entire process.

A competition is a familiar enterprise for architects, but not for the engineers. The challenge has been to initiate the cooperation between student groups who have not met in collaboration beforehand, and now have to work together and communicate their outcomes in a competition entry. The crucial moment each year is to make the students aware that the project is theirs, not the teachers', and to awake their enthusiasm for the responsibility.

The studio is divided into three phases:

- Preparation phase - laboratory exercises. These “labs” are designed in order to start the exchange of competencies and to train students to visualise the results in a form that resembles the communication in a competition. Each lab has a new group formation decided by the teachers, so that all students have met and learnt to know each other
- The competition. The students team up by themselves and conduct the competition. The teachers give support in consultations
- De-briefing phase: Those who have been awarded are most often content with the studio. The others are disappointed and have to be assisted in order to see what they have achieved. The de-briefing phase consists of a series of seminars in which the result and the jury assessment is penetrated and analysed. All students shall also produce a report of the studio.

Preparation phase, “labs”

The labs are directed towards four themes. The first focuses on technical and architectural solutions, which provide required indoor and outdoor environment for people who are using a building and to visualise the performance. The images shall tell a story about heat and air flows, tightness and climate barriers, wind loads, water on the roof and indoor climate.

The purpose of the second lab is to identify and explain the structural system of a given building, and to discuss the materials in an environmental perspective.
The third lab is a reflection about how to express sustainability. The stuff is to be found in books or magazines or ongoing exhibitions. The themes for the reflection are the pairs Substance/Symbol and Information/Inspiration.

In the fourth lab some environmental assessment systems are introduced, e.g. LEED, BREEAM and GB. The students shall make a comparison between the scope and contents of the systems, and draw conclusions about their usefulness in a long term perspective.

**Competition phase - Study objects over the years**

A criterion concerning the object is that it should not be an “ecological” settlement; instead it should represent a typical assignment from a typical client. In the first course, the study object was selected in order to contain a “reasonable” complexity concerning the intra professional difficulties; in order to give much time for mutual, inter professional work and learning about the environmental qualities. The object was students’ housing, a task that should be easy to grasp for students.

However, the experience was that “housing” was too uncomplicated concerning the relation between a good indoor climate and energy use. Therefore, the object for the second course was a kindergarten, a kind of building with more complicated demands on indoor climate, comfort and air quality, which calls for early cooperation between the professions in the interplay between spatial design, HVAC systems and detailing. The variation of study objects over the years is shown in table 2.

<table>
<thead>
<tr>
<th>Year</th>
<th>Object</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Student housing</td>
<td>The result was good, but the decision to use two sites was not successful. The outcome from the schools was not comparable</td>
</tr>
<tr>
<td></td>
<td>One site in Gothenburg, one in Trondheim</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Kindergarten Gothenburg</td>
<td>With a common site, the differences between the “cultures” of the schools became obvious, which gave god opportunities for comparisons in different aspects, such as technical systems and building regulations, etc.</td>
</tr>
<tr>
<td>2007</td>
<td>University Centre Trondheim</td>
<td>The leap from a kindergarten of about 500 m2 to a centre of about 10 000 m2 was a risk. To our satisfaction, most of the students managed to fulfil the assignment, however with shortages. Not all groups could master the scale, and in many cases the detailing was insufficient.</td>
</tr>
<tr>
<td></td>
<td>Kindergarten in a Carbon neutral district. Trondheim</td>
<td>We went back to a more limited task in order to give time for detailing, but instead the scope was widened concerning landscape and the urban context, which had to be designed together with the building.</td>
</tr>
<tr>
<td>2008</td>
<td>Central urban site for mixed use Gothenburg</td>
<td>The experience from 2007 and 2008 made us convinced that the students were ready to grasp both urban and building matters. The site was part of an urban re-generation area with a complicated traffic structure. Furthermore, the programme was open; the students had to decide about what kinds of functions that were the most adequate in the urban re-generation strategy.</td>
</tr>
<tr>
<td>2009</td>
<td>Central urban site for a theatre Gothenburg</td>
<td>The client from 2009 – an public urban development company - was so satisfied with the result that we were invited to continue in the same area. The developer wishes to find some kind of “signal” project that can set the agenda for the re-generation, and suggested a theatre by the riverside. The programme is so far the most complex when it comes to “intra professional” difficulties. It is a building with two experimental stages, restaurant, cafe and a foyer for public events plus offices, storages, workshops and rooms for technical equipment. In addition, there might be lots of references to theatres, but not so many to “green” theatres.</td>
</tr>
</tbody>
</table>
Competition programme - Environmental objectives

The environmental objectives have been expressed as performance criteria of systems. “Solutions” have not been exemplified or advocated. The intention is that the students shall investigate and compare solutions in relation to the performance criteria.

You can say that it is the duty of a university to be ahead of the practice. The energy and environmental objectives over the years do in one way reflect the rapid changes taking place in the “real” world. You should, however, divide the “real” world into ambitious developers and a majority of laggards. The objectives in the competition programmes mirror the improvements made by the “spearheads”.

During the period 2005–2007 the energy balance of 70 kWh/m²*a was an ambitious target value, well ahead of practice. In 2008 the trend of passive housing had grown strong, meaning that an ambitious energy balance should land on about 45 kWh/m²*a. The objective was also sharpened from efficient use to also include the energy supply, hence the demand of a “carbon neutral” building. In addition, the first programmes were focused mostly on energy. Gradually objectives concerning material selection have been included as well as openings for new solutions for water supply and treatment, waste flows and biodiversity. In general, there has been a movement from “best practice level” to “innovative level” in the environmental objectives.

Competition programme - architectural objectives

One overarching question is how to express and give character to “sustainable architecture”. The competition differs to some extent to an “ordinary” architectural competition, with its precise environmental target values that shall be verified through estimations or even calculations. Nevertheless, any credible concept should also have some kind of quality that makes sustainable architecture just as aesthetically strong, innovative or desirable as any architectural project.

The theme can be illustrated by some quotations:

Thus, an important goal for the competition is to demonstrate the self-evident integration of environmental issues into architecture of high quality. The competition should lead to proposals that convince the clients, the users, the public and the building sector that what is a necessity, environmental care, also can be desirable (2006).

Can a musician say: “Some days I play correctly, and some days I play beautifully” (Headline 2008)?

The development of innovative concepts on at least a building level has to be emphasised. Innovative in this context means more than just technical systems and measurable performance. The sustainable future should not only be viable, it must also be desirable and give us a vision that in all aspects – practical as well as aesthetical – and give us hope and force to cope with the never ending challenge of contributing to sustainable development (2009).
Jury

The professional jury consists of architects, engineers and representatives from the client. As in all competitions the selection of jury members is of great importance. Our policy is that the jury does not necessarily have to be “green”, we have paid more attention to their professional skills. The hidden agenda is that a skilled professional will learn a little bit about environment and sustainable building in the assessment process.

Since this competition differs a little bit from and “ordinary” architectural competition the jury gets instructions to especially scrutinize.

- Integration: To promote cooperation between architects and engineers. There should be some equal contribution and equal level of qualities from the different professions in the entries
- Credibility: “Sustainable building” is very much a matter of measurable qualities. The entries need to be thought over in functional, technical and environmental matters. For example:
  - Indoor climate and indoor environment
  - The energy idea, concept and system
  - The material idea, concept and system
  - The water idea, concept and system
  - Logistics; persons, equipment, air flows
  - Universal design.

Otherwise, the issues are similar to any competition; e.g. conceptual strength, boldness, clearness, attractiveness and potential.

De-briefing

Directly after the jury assessment the students have follow-up seminars. The first one is a session in which students interview each other and ask the simple question: “What are you proud of regarding the process and result?” The aim is to start a reflection of the learning of the whole process they have gone through, not only the competition and the jury verdict.

The second session is a seminar with each group in which the teachers and student discuss the jury verdict and analyse what could have been carried out in a better way. The first matter that is discussed is the communication, the consistence of the entry and the presentation. After that the teachers give their opinion of the entry following the scheme used by the jury. We also ask how the group work has functioned, and if it is necessary special talks with individuals will be conducted.

The last assignment for the students is to produce a report of their work. These reports are used as literature for the successors.

Finally, the studio is then evaluated in the standard form at Chalmers, a digital survey with about 20 questions, followed up by a discussion with a committee.
of students about the results from the survey. The survey and the protocol form the discussion are published.

**Results from the students’ evaluations**

The most common answer in the first de-briefing session is that the students are proud; proud that they managed to go through the process, to establish cooperation, reach a result and, also from the “losers”, pride of the result.

The evaluations are, in general, positive, and the most common key-phrases are:

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Urgent topic</td>
<td>- More literature seminars and inspiring lectures in the start</td>
</tr>
<tr>
<td>+ Feels like real job, you have to find information on your own</td>
<td>- It is hard for students to form competition groups by themselves.</td>
</tr>
<tr>
<td>+ Exciting meetings between engineers and architects</td>
<td>- Too little international exchange.</td>
</tr>
</tbody>
</table>

**Finally – experts from the juries**

In general, the juries say that they have been impressed, both by the amount of work and the results.

“The members of the jury are astonished by the huge amount of work that has been produced in a short time. The results are impressing and reveal commitment as well as skills, and all entries have a “realistic” approach. The overall qualities in the entries fulfil the general purpose of the competition; integrating technical and architectural needs. This process seems to be an inspiring but difficult way to go” (2006).

Finally, and once again, the programme is complex, ambitious and difficult to fulfil. Perhaps a little bit too difficult for students. The students have made impressive efforts and the jury has been forced to work hard in order to give a fair assessment. This work has been both interesting and stimulating (2007).

The competition has also this year given a result with interesting entries and an impressive amount of work from the students. The jury wants to congratulate all participants for the commitment and ability they have shown...The assessment work for the jury has been both interesting and stimulating (2008).

The jury is impressed over how much work has been achieved, and impressed both by the wide range of ideas covered and the depth that they have gone into as a whole (2009).

**Discussions**

**Some reflections about the history**

The implementation of environmental education shows that research and researchers have played an important role. GMV has been an important pres-
sure agent, as have the researchers at Chalmers Architecture. The research at Chalmers Architecture has produced competent teachers who have been available to take responsibility for the growing need of teaching capacity in the subject area.

The implementation is of course also dependent on external factors. One reason for the more or less sudden and strong implementation of environmental education after the year 2000 is certainly the overall political discourse and climate, not the least the debate about climate change, the “Al Gore Effect”. On a national level, the Swedish parliament ratified “15 environmental quality objectives” that have functioned as visions for the building sector, both in practice, education and research.

The conclusion must be that a school of architecture can benefit from research that can foresee the coming needs of competencies earlier than the political and professional bodies.

**What has cost most labour?**

There are similarities between the planning process for the environmental courses and the implementation of sustainable building. Everyone thinks it is a good idea, but very few are ready to alter their routines or give room for newcomers. The preparations for the competition studio took about a year in which most of the time meant navigation between more or less rigid schedules from different departments at two universities. During the five years the studio has been given in at least three different positions in the schedule, with a variety of credits. The conclusion is that practical matters often are need harder work to solve than pedagogical.

**Threats and opportunities**

Since the studio is voluntary it is dependent on the interest from two student groups. One weakness during all years is that there has been an overweight of architects, and from the engineering side an overweight of students in building services engineering. Not until recently the studio has caught the interest from students in structural engineers. The conclusion is that a study object should offer a wider range of challenges for all kinds of students than just “sustainable building”.

Reorganisation can be both a threat and opportunity. The competition studio was introduced in a reorganisation. From 2011 all master's programmes at Chalmers shall be restructured. Furthermore, Chalmers has expressed that “Built Environment” shall be an area of advance. The departments of Architecture and Civil and Environmental Engineering have the clear intention to enhance the contacts and collaboration. The competition studio will remain, and the context seems to be more supporting.
How do we teach?

The team of teachers have collaborated well over the professional boundaries from the very beginning. We have shared a common responsibility for both categories of students. The course design, the aims and learning outcomes, the labs, the consultations and the de-briefing is conducted by the entire team. The exchange of experience and knowledge between teachers is an important prerequisite for a successful studio; if the teachers can’t collaborate, how can we expect the students to do so?

Then, how to teach in order to encourage students to learn? A common theme for all environmental courses and studios at Chalmers Architecture is the focus on research activities and methods for information handling. Depending on the contents of the course or studio the activities are conducted in different manners. In the competition studio project-based learning is used as a method, since the task is hands on and resembles any architectural project.

Systems or details, performance or solutions?

One problem is that too many books about “ecological” architecture have their starting point in “new” solutions or details. A student will easily get lost in the list of straw bales, earth construction, natural ventilation, “healthy” materials, “local” resources, wood stoves, solar panels, wind turbines etc. without being able to make the details interact in a building. “Hard” environmental science tells us that it is the life cycle impact from the building as a whole that counts and that impact must be measured.

The agenda set by Hans Eek is a useful model, even if only deals with energy. The design starts with a target value for the energy use. During the design phase the team can test a variety of solutions in relation to the target value. The obstacle so far is that there are no similar and simple target values for the impact of e.g. material flows. You can find LCA data from some materials, and you can out define materials with hazardous substances, but the engineer that wants to make LCA calculations on the building as a whole will have a hard time. We have solved it in the way that students shall support their material concept with data from reliable sources, or refer to established systems like LEED; BREEAM etc., systems that they have been introduced to in the labs.

In this field we can see a range of methods and tools with a huge potential use, such as Building Information modelling, BIM, Mass Flow Analyses, MFA, which can be connected to CAD tools.

Tentative thoughts about the improvement

The positive feature that doesn’t need to be changed is the overall course design in three phases. We can see that the first phase needs a continuous attention. The labs should catch up the frontier in research and development in order to foster an innovative attitude towards the competition.
Going one step back (or ahead) the contents of the three introduction studios in the master’s programme (table 1) also need to be reviewed. These studios could be the arena for introducing the IT-tools mentioned in section 3.5. The intention of more collaboration (section 3.3) will also give new opportunities for more meetings between engineering and architectural students already in the preparatory studios; in seminars, short exercises critics etc.

Concerning the international contact with NTNU, the main obstacles for wider and deeper collaboration are trivial; financial resources and schedules. The history tells us, however, that such problems can be handled with a little bit of patience and innovativeness. We share a common vision with collaborative exercises in the first phase and that during the competition the students shall be formed in teams with members from both faculties in both schools and conduct their design via CAD-communication. We even share a vision to enclose a third Nordic university in such collaboration. Some Danish schools have expressed their interest, but so far, the practical matters have not been solved. However – even if the road towards sustainable development may contain many stumbling blocks there are many promising signs occurring. So why give up when it comes to a relatively simple matter of coordinating education? Perseverance does it!

Endnotes
1. See GMV http://www.chalmers.se/gmv/EN/.
Teaching a new Environmental Culture
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Acting upon 20th Century Architectures:
Environmental Issues and Questions
Renewal, Refurbishment and Upgrading qualities of the recent built environment

An “environmentally-oriented” education - involving the careful use of resources, rationalization of consumption, and aware, responsible choices during the entire arch of an artifact’s life - has by now taken its rightful place in every sector of architectural education, although it has, naturally, taken different forms to fit the various disciplines. Within the educational programs of the Faculty of Architecture of Genoa (five years program of Architecture, master program of Landscape Architecture, bachelor program in Industrial Design) environmental questions and issues are treated at different scales (the territorial one, the urban one, the building one, the object, through specific courses or modules).

Looking at the building scale, environmental issues have a preeminent role not only to face the design process of new constructions, but also to imagine how to manage the recent built inheritance, mostly edified in the second part of 20th Century, discarding attention to climatic conditions, to the duration of materials and components, to the comfort of the users, to the right use of sources and energy saving during the life span. This is the main field of research and teaching of the author, regarding problems raised by the possible re-use, refurbishment and upgrading of existing buildings and artifacts. The name of the course that treats such arguments is “Technology of Architecture for Conservation, Renewal and Refurbishment” and is set at the fifth year of the educational program of Architecture.

Since several years, a reflection on the destiny of existing architectures has been seen as a strategic field of action for future architects, both on historical heritage and on recent built environment (the “contemporary” city). The peculiar historical condition we live in, in fact, leads us to enquire into the significance and role of our recent inheritance and of the present times (what we call “the contemporary”) upon the construction of the near and far future and, therefore, into what should be our attitude towards them. A quasi-total absence of maintenance and a state of abandonment, decay, inefficiency and un-trustworthiness in terms of performance, scarce architectonic and environmental quality, lack of safety in living and working spaces, absence of any process of identification and cultural appropriation, often translating into social distress and individual and collective alienation... all these problems are common in the urban sprawl and, generally speaking, in many European cities from the second half of the Twentieth Century.

A focus on the refurbishment of the contemporary urban space, as well as carrying a social - and, in some cases, ethical - urgency, is thus even more justified by the economic interest of stakeholders, at the present time in our Country involved in refurbishment more than in new construction, evident from data available on the national scale. All these considerations lead future architects to timely devote their studies to the conscious appropriation of a field which will be under sure development in the near future.

Giovanna Franco
The philosophy of the course

How best to prepare the new generations to intervene upon “the present” to build “the future”? Is it true that the low quality which characterizes recent constructions can only be improved by working on increasing (quantitatively measurable) energy efficiency? The problem is surely larger, less easy to quantify, involving, as it does, a deep reflection on the role that technical solutions have played, and are still playing, in contemporary times, where technique has often prevailed over actual aims, which have been silenced, and rarely shared.

The crucial issue of sustainability, in fact, cannot be considered only environmental or architectural, neither be reduced to the fulfilment of standard requirements and customer needs (not to mention the role of “icons”, so pervasive in contemporary formal), but involves a social, economic and cultural dimension.

Even in our educational programs a preliminary discussion is missing that leads students to investigate the attitude that we can or should have against the most recent “products” of the last century. How to solve huge environmental problems caused by inefficiency of recent architecture? Is it right and legitimate to forget quickly, remove the traces of a recent history through projects of substantial transformation, if not dismantling, that seems to be the only mean and end to solve a large amount of problems? Is it right and “sustainable” to considered architecture as consumer goods to be quickly replaced or, even worse, as a collection of images to be substituted because they are not “in fashion”? And, at last, which are the best teaching tools to improve students’ awareness?

The issue is serious. It involves the real reasons - no longer merely technical here, but deeply cultural - for conservation, demolition, or modification and transformation of our built heritage (Gregotti 2002, Pedretti 1997).

If the architecture we produce today (even modifying what is already built) will really represent the “heritage” of the future, it is time to wonder if, and how, the inheritance we leave to future generations really expresses our aspirations, our cultural references, our values. It is time, therefore, to reflect on our actual responsibilities, as teachers, in educating for environmental, economic and social sustainability, in a truly holistic, systemic and dynamic dimension.

When students, in the design studio, are invited to comment recent refurbishment projects of existing architectures, selected by the teacher, and to identify the concepts that are behind them, given answers are often very simple, if not poor. The reason does not depend completely on students’ maturity, it probably involves the perception that we have about “contemporary”, and the difficulty we have in its comprehension.

If it is true, as Jacques Le Goff says, that the city has a «material face» and a «mental face», it is on this difference that we should work, as on the sense of identity, citizenship, on the presence or absence of symbolic values hidden in the buildings that the Twentieth Century culture has conspicuously produced.
To prepare students for their future profession\(^2\), education in the fifth year of teaching is dedicated to the “quality” assessment of recent architectures and settlements, (single buildings or building stocks) and to the definition of appropriate strategies for their possible refurbishment and upgrading.

According to the statutes of the discipline taught by the author (Technology of Architecture), quality assessment refers primarily to:

- safety of the built heritage in relation to environmental and accidental hazards (against the seismic risk, the fire risk, the risk of collision, collapse or other accident, due to the conditions of deterioration or failure of components);
- accessibility and “usability” of buildings (compared to the needs of the current and future users);
- eco-efficiency of buildings (environmental quality of the settlements compared to the established geological, climatic and morphological features; energy efficiency of buildings and of the building envelope; integrated technical systems, use of renewable sources);
- durability of materials and components;
- Life Cycle Assessment and low emission of pollutants.

**Methodology and pedagogy**

The course, which covers the whole academic year (29 weeks for 8 credits, 4 hours per week) is organized through theoretical lessons and studio activity and is based on a strong “permeability” between research and teaching, considered very profitable, as it allows a process of continuous updating of the teacher too.

The course is given by the teacher alone, but lectures by external experts are essential to go deeper into specific topics and through design studio, where the student makes his/her own experience on a projectual theme on refurbishment and reuse of recent inheritance.

Theoretical lessons aim to the achievement of knowledge on the reasons and the ways of production of recent architecture, on the assessment of its actual performances, on possible reasons and ways to keep it, modifying, or to completely demolish and abandon it. In particular, main topics of the lessons are:

- constructive and architectural features of 20\(^{th}\) Century Architecture, forms and phenomena of degradation, durability of materials and components, energy efficiency performances, quality assessment;
- energy efficiency techniques for rehabilitation and upgrading, deeply considering the issue of compatibility between technological innovation and with existing architectural values or/and landscape;
- assessment of energy performance (before and after);
- set of examples of recent refurbishment projects considered as paradigmatic examples to develop a reflection on theoretical questions.
Very interesting and effective is the contribution of experts, both coming from the Faculty or outside, in the fields of eco-efficiency (in Building Physics and in traditional and innovative materials, especially translucent ones) to assist students in using software tools for calculation and simulation of thermal behaviour and energy gains, more or less simplified (Ecotect, Epiqr, Design builder, Energy Plus or other national tools). In particular, one of the aspects that is commonly investigated – through the use of simulation methods – is the energy consumption monitoring and the testing of possible benefits deriving from the application of insulating systems on the building envelope and innovative technical disposals (through the use of renewable sources).

But the real experimentation, for students, arise practicing on real cases, affected by a general lack of quality, where other voices have to be listened (experts in Urban planning, in Architectural design, in Restoration, sociologists, economists...).

Quality presents, without any doubt, the desirable aim of any design approach. Anyhow, providing quality for the future cannot simply mean respecting certain technical parameters and needs (which are, by the way, constantly evolving and changing), but must also include the ability to imagine, to operate upon and to manage a complex process.

Responsibly planning means setting out, first of all, the aims to be pursued. It means being familiar with systems (in a multi-scale and multi-focal dimension) and with the relationships that govern them, strenuously pursuing the optimization of such systems (and not merely the maximization of a system to the detriment of all others), knowing how to pinpoint conditions, conflicts and boundaries and, only after all this has been mastered, knowing how to choose the most suited tools to match set objectives. Projects, in this perspective, are essentially marked by a transversal, multidisciplinary and trans-disciplinary approach. The potential for different systems of knowledge to establish fruitful dialogue must be enhanced and encouraged if the process is to be managed at various scales. Different approaches must come together, learn how to compare each discipline’s scale of values, and how to build models which may effectively describe the living interaction of data, even when information comes from very different spheres of learning.

The teacher tries to propose, within studio activity, a multi-perspective approach (Gardner 2006) to the same theme (or problem), underlining different ways in which it can be seen and solved, to help students to move within the "fence" of the discipline but, at the same time, to be able “to gaze” beyond it. This is, in fact, a necessary requisite to give convincing answers to the emergence of growing environmental problems and this requisite has oriented the teacher to search constant improvement of the didactic programs.

Following the given inputs, students are moving the attention from the design experience as a single act, focused to search for a new configuration (and a
sudden act, concluded at the moment of conception), to the design experience as a program and process, that implies a progressive set of operations involving different actors, from time of conception and formulation of choices to the construction and operation over time.

**Exercises of the students**

Exercises of students regard mainly huge complex edified before or after WW2; they can be social housing settlements, fabrics, schools or commercial spaces; they could be abandoned or still in life. In any case, the complexes chosen as case-study represent an injury for the life of the city (social housing, public schools in state of degradation with very poor or absent environmental quality or even an architectural value left to the ruin of time).

Projectual themes are therefore very complex, because they touch different competence and disciplines.

Depending on specific themes, student are requested to assess existing values and to investigate how to achieve their own set of objectives:

- following a process of historicizing of existing architecture, trying to identify what, and why, could still represent a value for our present and future life;
- satisfying the needs of a vast, differentiated user-base;
- designing building spaces that are healthy, safe (also in terms of environmental risks) and accessible to all (both in the sense of urban mobility and accessibility to single buildings);
- putting in place an efficient and effective service network;
- raising the quality of urban space at the ground and the architectural quality of the building;
- reducing the use of resources and set the scene for responsible consumership;
- mitigating environmental impacts, including those linked to a wasteful leakage of heat and energy.

Objectives are reached through means that can vary from volumetric reduction, to partial demolition, to enlargement, to substitution of building envelope and so on. Objective are reached, also, trying to keep all together the different scales involved, although the design studio regards a single object or a single complex: the urban scale (infrastructure system and network services); the landscape scale (presence or absence of green, pollution, climatic conditions...); the economic/financial dimension (whether is better demolition, that often represents a huge problem of dismantling, or maintenance improving lacking qualities); the social sphere (identification of real needs of users); the constructive approach, towards a new architectural quality (according to structural constraints), new performances, even working hardly on the building envelope, the less durable part of recent architecture.

Working on 20th century buildings, very often considered as totally negative examples, and discovering, little by little, that there are someway signs of
positivity, although weak and not immediately obvious, it means, first of all, to undermine some prejudices about the destiny of recent heritage, and to teach students to develop a «relevant knowledge», namely «to promote a knowledge and understanding of the key global issues and to inscribe them in the partial and local knowledge» (Morin 1999). This also means helping them to understand the results of the diverse culture of the Twentieth Century under points of view not only related to architectural thought.

The students’ reactions to the proposed case study in a multi-perspective vision help to make some partial conclusions.

Working on cases that, as huge social housing settlement, represent a “paradox” (perhaps more dramatically and effectively than would be offered by the choice of a more traditional theme), was able to develop in the students what Gardner calls «respectful knowledge»; respectful of the multiplicity of people living in that spaces, with their needs, their background, their expectations, but also respectful of the collective built heritage that represents the cultural product of the contemporary era.

The students are forced to work on different dimensions, the “public” one and the strictly “private” one, addressed to the deep sense of living. The two dimensions, and the real connections between them, lead the students to think very carefully about the possible consequences of the changes they are proposing, fully embracing the concept of responsibility that contemporary philosophical thought has already clarified (“ethics of responsibility”).

Addressing this kind of inquiry, respecting the multiplicity of actors involved and the many arguments (among them contradictory or conflicting), can definitely help students to understand the real difference between putting beside disciplines and integrating their knowledge and analytical methods. But - more than anything else – the exercise of contextualization and the prediction of possible effects help students to get rid of a thin determinism (analysis-project) that, within their curriculum, often force them to sophisticated analytical procedures as paralysing as closed in themselves.

Finally, the choice of such “fragile” and complex issues will oppose some of the myths of contemporary society, including: the rapid consumption, the predilection for teaching themes regarding entertainment or leisure and the proliferation of pre-fabricated images from which the student draws, without reflecting enough, to create, often too superficially, his own architectural references (Calvino 1985).

Furthermore, the choice of such themes entails some important consequenc- es (Musso 2009).

Considering the intervention on Twentieth Century buildings as a “program” (and as a procedural action) means to enhance the value of the strategies for action on building segments rather than the development of fashionable drawing using sophisticated digital tools.
This is particularly significant for the case study of social housing settlement, on which the local administration has spent, during the last years, large sums of money, beside the insertion of new elevators, to rectify any failure, or to solve some existing inefficiencies, especially against infiltration from the covering and the façades. These interventions have been thought out from a program containing a coherent and comprehensive set of measures covering different items (for example, enhancement of social initiatives, diversification of users and surfaces of dwellings, improvement of management of external areas and of public system of transportation). Maintenance operations, further more, have been set without any serious reflection on the real cause of the state of decay (first of all due to the bad connection of prefabricated components) and, in fact, the buildings are, after few years, affected again by the same problems. The construction of a whole program might have succeeded in preventing the squandering of money on ineffective interventions over time, why not aimed at solving the problem by removing the causes to temporarily buffering one or more “emergencies”.

Contextualizing the program of actions, beside the search of new configurations that are in harmony with the landscape and the environment, make the students able to provide for the mutual interactions between the actions identified and, above all, the likely induced consequences. This is particularly important because the student has to imagine to evaluate the feasibility and gained benefits, not only in terms of efficiency (energy saving and reduction of harmful emissions) but also in terms of effectiveness (response to real problems of people and durability of the buildings).

This kind of teaching is, hopefully, helping students to grow up their own real and sustainable “creativity” as an act of synthesis, moving away from a reassuring deterministic approach, whereby a technical action directly corresponds to a problem detected during the diagnosis. Students are stimulated to practice a thought able to connect more than one able to separate, even at the cost of instilling doubts more than certainties, and to help, as Morin writes, them to «learn to sail in an ocean of uncertainty through the archipelagos of certainties» (Morin 1999).

**Encountered difficulties**

The teaching takes place with the full consciousness that the path of learning and knowledge is always a process of *long durée*, whose effectiveness is measured on time, and, therefore, the teacher should promote the use of methods and approaches that can “break through” the student with a certain speed, but can leave signs and messages for future development, for example choosing paradoxical cases.

Anyhow, some doubts still exist: after several years of experimentation and teaching, the author is still wondering on the danger hidden behind ex-
pression “on fashion” as eco-efficiency, renewable sources, ecological or bioclimatic architecture and on the tools to evaluate energy behavior of an architecture, that is not the same as an industrial product.

The analytical approach and the widespread use of testing and simulation methods, setting up a refurbishment design, are certainly necessary but not free of risks. The user-friendly software are, in fact, just “tools” and we have to avoid the risk to transform into “data” themselves. Every tool, in fact, less or more simplified, keeps in count only a limited number of variables involved in the problem. Further on, the large part that teaching activity sometimes devotes to digital tools could possibly give rise to a segmentation of the design process, and the student could fall in an excessive reductionism (against holism!), using all his mental energies in the analytical and scientific assessment, forgetting that the architectural project is mainly a synthesis of a complex process.

On these items many architects (and students, in their final thesis) are working today with refurbishment projects which provide increases in eco-efficient performances with approaches that tend, unfortunately, a shift toward a fascinating “technicism”. To this we must add the “fatal attraction” for innovative technical solutions (devices, materials, components) that substantiate the architectural language of their design experimentations, mainly concentrated only on the building envelope, as the boundary between indoor space and the surrounding environment, as well as a skin bearer of new messages. Sustainable refurbishment is therefore, in the discourse of several magazines and textbooks, equated to projects which employ - in whatever terms - “bioclimatic” and so defined “sustainable” technical solutions. And yet, nowadays, when control over energetic resources has become one of the main collective needs, the bioclimatic approach risks going from useful tool to one of the most evident expressions of architectural reductionism. New specialisms are emerging from the environmental emergency, expressing their preeminence through the construction of sophisticated digital tools, pure technicisms leading to building choices and architectural decisions which have nothing to do with architecture and the context. The language spoken by the new architecture makes all-too-easy recourse to the codes of a sort of new “international, or global, style”, now expressed in the use of technical devices (a new “ecological aesthetic” revolving around the use of brise-soleil on the façade and of various systems to capture the solar rays) (Lauria 2008).

To avoid this risk, students are invited to face complex problems and, where possible, to go deeper into theoretical reflections, also through the help of literature, developing the project in the final thesis.
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The Environment as an Issue for Education: Subject and Matters for more Conscious and Competent Architects
Although the concept of sustainable development was encoded in 1987, it is only since 1993 that world of construction has been awarded about the relevance of environmental consequences from its actions, and soon after the consciousness to act in a proper way focused the attention of designers. In the same year the XVIII World Congress of Architects held in Chicago was titled “Architecture at a crossroad: designing for a sustainable future” and it recorded the first systematic approach to the search for new solutions and new conceptions of forms, materials and spatial arrangements responsive to the imperative demand for new approaches to the environmental issues.

The responsibility of professionals to take actions towards a new environmental culture immediately calls for an appropriate education of them, aimed to develop environmental issues as integral parts of the educational and pedagogical strategies in the school of architecture.

At the Faculty of Architecture, University of Trieste, since its start in 1999 the choice was made to develop subjects in the field of sustainable development and construction and different key-actions were carried out at different levels to arise the consciousness of a new environmental sensitivity and to recognise that pollution, global warming, climate changes, greenhouse effect are, among others, consequences of the uncontrolled and aggressive coexistence of the natural environment and the changes due to its transformation by men; the consciousness that the building industry is fully responsible for consuming resources and energy – mostly not renewable – even if in different rate down the whole process; the consciousness that, overall, sustainable environment however has something to do with a larger vision than merely building and, just for that, it calls us for an holistic approach to the issue.

As responsible for educating the future generation of professionals who will affect the process with their decision, we are in charge to develop a new “conscious” approach to the environmental question, that is to increase competencies for an environmentally sensitive architect who is supposed to outline a strategic vision for sustainable living environment in a holistic way, and to carry our postulates and following proper actions in behaviour, in designing and managing the built environment, to shape and to realize spaces and infrastructures (and services as well) which better fulfil the aim.

Since the beginning the educational career included subjects dealing with environmental issues; moreover, the faculty was involved into the organization of specific courses addressed to professionals to improve knowledge and to retrain in the field of sustainable building and urban planning. The post-graduate courses could also be taken by students as “elective” courses for those of them who would like to better qualify. Last, but not least, pedagogy has been developed in strict relation to research activity: other than in the filed of sustainable construction, researchers were involved programmes aimed to the definition of
strategies and tools for spatial education, according to the UNECE Strategy for Education towards a Sustainable Development. Researches were funded by EU programs, within the Interreg IIIB-CADSES frame.

Although there has been no specific curriculum in “environmental architecture”, the approach to the education of a responsible architect was to stress the importance of the design choices to achieve the goal of an environmentally sensitive architecture, starting from those related to the resources consumption (energy at first) due to the building process and the long life running of the building itself. Thus, it was decided to set up a “technical” path by strengthening the existing subjects of the student’s career (graduate) dealing with the behaviour of materials and building systems and techniques, stressing the environmental consequences of choices related mostly to materials and equipment, or those aspects of the architectural project which nowadays are asked to fulfil requirements according to assessment protocols of environmental behaviour.

Most of the courses dealing with these issues are given within the frame of a “laboratory”, and in particular for graduating students they are asked to attend:

Construction Laboratory 1 – Course of Analysis and Design of Building Components, Course of Building Physique.

Construction Laboratory 2 – Course of Building Technique, Course of Building systems and equipment, Building planning and costs

other than the course of Building materials and elements which is given at the first year within a Architectural Design Laboratory 1.

The aim of the courses is to inform the students about the need to move from the concept of RESOURCES CONSUMPTION to the AVAILABLE RESOURCES EMPLOYMENT, thus the need to move from the concept of the building as an “OPEN SYSTEM” – belonging to the conventional way to intend it – to the concept of “CLOSED SYSTEM” much more proper for the sustainable one.

Attention is focused at least to the following issues: energy and water care, waste care, building material choice care, design of appropriate building components, indoor air quality air, energy performances care, process strategies and control management.
In addition to the compulsory courses, students could follow elective classes dealing with side aspects of sustainable design: at present, Design and management of natural resources and landscape, Methods and tools to assess sustainable design, Inclusive and Universal design are the optional courses which are offered by the Faculty.

In the master course, students are acknowledged on further issues that include more specific technical aspects of the project, as for example high performance buildings and building automation, as well as on question related to urban and spatial planning, and linked to economic and social issues.

The aim is to arise the need and skill to manage responsible spatial planning, which care for the territory use and exploitation, the scale economy, making use of participation tools to reach good governance process.

The next step has been to try to integrate technical and aesthetic issues of the design project, by implementing the studio work and making the students working on more and more complex projects which span from the eco-sustainable dwelling to the eco-sustainable town.

Thus, to make the experience really effective, a further step concerned the possibility for the most interested students to spend a qualifying period of their curriculum in architecture firms or enterprises where they could improve the specific knowledge of environmental issues of a design project, to develop their final work.

According to the above described curriculum, students spend up to 25% of the credits in subjects directly related to environmental issues (considering only the compulsory courses). The rate rises up to 40% if we consider the possibility to develop the stage and/or the final work in the field and the choice of optional courses when dealing with environmental/sustainability issues.

At the end of the studies, architects are supposed to have good knowledge and expertise for the design of comfortable and healthy environments (indoor as outdoor space), performing the environmental standards which need to be achieved to fulfil legislation requirements, by means of appropriate use of the building fabric and of mechanical services, in order to practice in a
Teaching a new Environmental Culture

sustainable way. As they can also practice as urban and spatial planners, they are supposed to have knowledge of environmental and planning governance, expertise in GIS and spatial analysis, planning skills and ethics to create places for community in a multicultural society.

For what concerns the pedagogical method, the aim is to develop critical thinking which starting from the acquisition of information leads them to a personal development of knowledge and enables them to an active engagement, participation, and collaboration with educators and invited guests; that is one way to guarantee a really effective learning. In such a way, we try to act according the theory of the “experiential learning” to develop a critical thinking, which is based on the four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Kolbs, 1984). Through a series of different design exercises developed in the Laboratories, architectural students are guided to learn the critical investigation of the complexity of the problem they face and to identify a methodological approach to them. Students are asked to focus on the solutions but in a critical way, also by focusing the methodological approach followed to reach the detail solution (on which of course they receive criticism).

Generally, courses are organized in a set of class lectures and exercises/personal work/workshop that the students develop in small groups and facing a more or less complex design problem. Class lectures are given by academic staff, but also professionals and expertise are invited to contribute, introducing the students mainly to the most advanced question in the field of materials/components performances. National Associations are invited to specialist seminars, as the NA for thermal and building insulation, Copper Italian Institute, NA for brick production. Some professionals are also invited to discuss the results of personal design works and at the end of workshop, where they also take part as tutor/discussant. Even study visit are organised on site or factories where special components are produced/installed (as i.e. “intelligent façade elements”, equipment components, etc.).

Different types of works are proposed to the students along the education career; mostly personal works at the beginning, and group works moving towards the last two years where the workshop format is widely used to produce complex works at different scale (large building complex, spatial planning, etc.) The format, moreover, is acknowledged also among the students as a “good practice” to bridge the gap between the large domains of the technical lecture and the creative studio, to develop competencies and skills where technical knowledge is synthesised within the natural forum for creative exploration as the studio is considered.

To rise the awareness of the need of good choices from the formal/functional standpoint as well as from the material and technical standpoint, students are guided to develop works dealing with more and more complex issues along their
career. Nevertheless, they always develop a project, at different scale, dealing with conditions in a "real" context.

Referring to the design of building components, which is the aim of the courses given at I and II year, most of the efforts deal with the design of a them as part of a single building as a whole complete system which relates to the context (site condition, climate condition, building culture condition, etc.).

In particular, in the course of Building Construction 1, students are asked to design solutions for the building envelope based on local climate, aimed at providing thermal and visual comfort, making use of passive solar systems which have to be incorporated into the buildings and/or to utilise environmental sources (as i.e. air, wind, vegetation, water, soil,) for heating, cooling and lighting the buildings. They have to design detail solution for roofs and exterior walls, choosing the appropriate materials and by the use of sustainable design analysis software they have to simulate the energy analysis functionality within the context of a given environment and they analyse and visualize the incident solar radiation on windows and surfaces, over a given period.

The work is based on a classroom discussion at the beginning of the course; then students develop their work home and are invited to present the progress in a class discussion (at least two). Then they finalize the work and discuss it during the examination session.

The same outline is followed for the course of Building Construction 2, where the attention is mostly focused on the role of technical systems and equipment to reach a high level of the energy performances of the buildings than on the formal and material choices for their envelop. In the same course, there is a first approach to the use of assessment protocols for environmental and energy performances of buildings and students are required to implement the VEA (Environmental and Energy Assessment) protocol, acknowledged at the regional level as the validation system for building performances.

At the end of the III year and during the following two, students face also the problem of designing a complex building or large buildings as part of an urban context. The concept of sustainability, then, is carried out at different scales and the efforts are focused to find ways of organizing the structure and function of cities, including land use, buildings, and infrastructure in order to bring them into harmony with their surroundings. The project work developed by the students explores both social and economic impacts of the choices in order to plan an energy- and materials-efficient economy with minimal pollution and equitable distribution of benefits.

Proposed project themes always refer to local needs and students often work on real case studies, dealing with part of the Trieste town or regional territory. The format is almost the one of an open workshop, which starts with class discussion and class lectures given by professors and by invited guest; at the end of
the semester, 2 long-lasting week seminars conclude the course, where students work in the classroom in close collaboration with invited professors and researchers; at the end, an open debate during which they present their work is open to the participation even of local administrators.

Example of exercise for the Course of Building Construction 1 – how the design of a wall opening affects the room temperature (diagrammes by Ecotect outputs)
Even if the Faculty has been based on the principle of multidisciplinary design laboratories since its starts, most of the difficulties met in developing education in the field of sustainability come from the collaboration with the Architectural Design courses. At the present, the issue of a sustainable building, and in general the technical one (design of specific details for building components, evaluation of technical performances, integration with innovative equipment, etc.) are seen as complementary aspects of the design process. The approach to the architectural design of the building since the first year is mostly focused on the making-up of living space more than on its performances; only in the last project works students are required to go deeper in the technical aspects and check building efficiency.

At present, educational career is under reviewing. There is the attempt to reshape the content of single courses, as well to define a more structured knowledge in the field of sustainable building also combining in a different way courses within the frame of Design Laboratories, stressing the importance of workshop and the need to open them to international experiences.
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Teaching Sustainable Design Today,
an Ethical Question
The realizing of a wind farm is an action that many people would consider to be a very favourable process for sustainable development. In the same way the establishment of Sites of Community Importance (SCI) or Protected Areas, to safeguard the flora and fauna of a certain area against anthropization processes is an action recognised as sustainable.

However, today it happens quite often that these favourable actions are not compatible. Recently in Liguria, a region in the north of Italy whose capital is Genoa, local rules have been issued whereby some areas have been determined as unsuitable for the installation of wind turbines because of the presence of birds, and more in general of naturalistic and landscaping values (Regional Council Resolution – DCR No. 3 dated 3 February 2009, Annex 2). These rules have been disputed by various council administrations, trade associations and professionals as they are considered to be extremely penalizing for wind power plants. As a consequence a debate has begun between several experts from the power sector and well known environmental associations.

Notwithstanding the specific reasons adopted by one and the other, this debate is a strong sign of an increasing contrast inside the group of people who, even though sharing the objective of a sustainable development, follow incompatible strategies in order to achieve this objective.

It goes without saying that the phenomenon does not only affect Liguria or Italy, even though it has only become a talking point only over the last few years: It is an international problem well described by journalist Fred Pearce in the New Scientist magazine. In an article which appeared in Italy in the weekly magazine “Internazionale” published in 2009 he stated: “a schism has become necessary in the environmentalist movement. On one side the sustainability supporters who consider nature as a resource to be managed. On the other side the preservation supporters, who insist on the sacredness of nature, and who refer to defeat for any damage inflicted on the eco-system by mankind” and again “for the preservation supporters any compromise is impossible”. For the sustainability supporters compromise is the essence of environmentalism”.

However, the debate does not only turn around wind power (a topic which in Italy has opened up many arguments due to the presumed impact on the landscape and the Mafia interference in the southern regions); in fact there are several issues to be dealt with: for example, once again in the Ligurian region the recent attempt to introduce the Strategic Environmental Assessment (SEA) for urban planning (by means of regional Law No. 10 dated 28 April 2008 and government white paper of 25 September 2009, and still to be converted in legislation) has once again created strong contrasts which, in brief, can be identified as the two distinct positions mentioned previously.

Opposing positions can also be seen regarding the way of increasing the diffusion of the application, in the building industry, of systems and technologies,
to use renewable energy resources and to respect the environment: on one side there are those sustaining that the only possible way is to identify forms of incentives (subtracted from urban planning costs, volumetric premiums etc.), while on the other side there are those sustaining that statutory regulations are required: also in this instance the two positions are often incompatible.

For example, the photovoltaic industry has been promoted in Italy by funding from Feed-in Tariffs which, even though applied late in Italy if compared with other countries, has given way to a rather significant development of the specific productive sector and new to sectors of the building industry (roofs and claddings). Maybe the lobby of these same producers has heavily influenced the possibility of success of other micro-generation technologies and electrical generation from renewable sources (micro-wind power, mini-hydro power, thermodynamic solar power, that do not receive comparable funding), but also influenced the possibility to really being oblige to install photovoltaic plants. In Italy the use of photovoltaic power has been made mandatory by the 2008 Financial Legislation which imposed 1 KWp for each new installation (through a review of the building Regulations), but the term for this legislation enforcement, initially set as 1 January 2009, has slipped twice and is now set at 1 January 2011 (by means of a Decree commonly referred to as “Mille-proroghe” – Thousand Extensions – and by means of a subsequent Government White Paper approved by the Senate on 11 February 2010) and there is a good chance that the date will slip once again. This is probably due to the difficulty in applying mandatory measures: many would like to get round these (for example in historical town centres, calling for technical reasons or due to shortage of funds) and therefore it is still preferred that the funding promotion remains (that the obligation, as a rule of thumb, should reduce or eliminate).

Once again in relation to the contrast between the positions of those wanting incentives and those who believe in rigid regulations, another instance can be mentioned. For the administrative approval process of certain strategies (in which I have taken part) that proposed forms of incentives for bio-climatic design and green housing for the Territorial Coordination Plan in the Province of Savona (one of the four provinces in Liguria), although there was a substantial agreement between the various political parties, there were also unexpected criticisms by the environmentalists and landscape experts who considered it inadequate to encourage, with volumetric bonus, the use of bio-climatic technologies in building.

At last, another topic which is the subject of discussion is the energy certification of buildings, which is fundamental for a diffused change in the end user mentality. In Liguria there is a regulation issued the 22th January 2009 which is important and quite interesting but, to some extent, is criticisable: for example because leave a small amount of space, in the parameters of energy classing of
buildings, for the use of power systems from renewable sources by considering, only thermal and photovoltaic systems and only for little accessorial electrical consumption for heating. This is an approach given by the writers of the above mentioned regulation, in accordance with current legislation, which evidently represents a position that not all supporters of bio-climatic architecture agree.

Quite recently, even at a regional level, there is a particular phenomenon which is causing a debate already well acclaimed at an international level: the creation of different positions – at times in strong contrast among them – within the group of promoters of a sustainable approach to territorial and architectural design.

Until recent years the opposition was, if ever, between the supporters of a more conscious approach to the environment and its resources, and those who did not care about these topics, considering them, in good or bad faith, to be of scarce interest. Nowadays things have changed to the extent that another significant form of ideological opposition has been generated: the contrast between different forms of that which could be called “environmentalism”.

This has a very important consequence regarding the teaching of topics on sustainable design.

I have been a charged professor since 2004 for two official teaching courses at the Faculty of Architecture, University of Genoa. One six-month course on Environmental Sustainability for students of landscape design and a 12-month course on Bioclimatic Design for architectural students, both of which are technology courses. During my lessons I face topics ranging from a wide scale (sustainable planning, SEA, territorial and micro-climatic analysis, use of vegetation in an urban context for environmental control etc.) down to a small scale (technological applications on a building scale, eco-compatible materials, up to eco-design). I am strongly convinced that this type of teaching approach (above all in relation to the level of current training on these topics in the specific local reality) which attempts to capture the full set of problems concerning the sustainable design, cannot be renounced; in fact what would be the sense of being able to design a building that does not waste energy from fossil sources, does not generate emissions, is constructed with healthy and fully recyclable materials, if it is to be built in towns that are energy-intensive and polluted and where there is no market for building materials recycling?

Nonetheless, this type of teaching approach has started to raise a few problems over the last few years.

When I started to teach the course six years ago I had no problem whatsoever in explaining the types of analysis to be performed for territorial planning in order to safeguard the local eco-systems and to sustain, at the same time, the need of wind powered development on a large scale. Consequently, in this way I did not have any difficulty in sustaining, with the students, the need at the same
time of incentives and regulations – which were drip fed in Italy – for the evolution of the design in a sustainable sense. Furthermore I could only but wish that energy and environmental certification processes had started even if irrespective of their content.

Nowadays (thank goodness) it is no longer like this. Whoever is involved in teaching these topics is obliged to explain the different emerging positions and more and more often has to take a side. In other words, one can not only limit himself or herself to teaching technological notions of sustainability. It is also necessary to approach the problem from an ethical point of view, with more care and greater difficulty with respect to the past (also due to the fact that in our local reality quite often we are isolated, and the opportunities for a serious confrontation are few and far between). By attempting to maintain the right balance one must also explain which policy is considered as the best for a real diffusion of the concepts explained during the lessons.

In Italy, the relatively recent approach to this type of teaching in the Faculty of Architecture has gone through, in simple terms, at least three different phases (not always in the same time order):

- The “philosophical” definition of the problem (not a casual adjective, given the frequent references to Heidegger rather than to other idealists) which has set the basis for the existence of this type of teaching. The definition of the problem has been useful in order to understand why a sustainable approach to the design of the built environment was important – which is not by chance a coined phrase, together with many more, in this first phase – in a sector, like the building industry, which did not really take care of the waste of resources and the pollution produced;
- The general definition of the methods in order to approach the problem as defined (through reference to the most advanced experience in America and north European countries). In this way possible strategies and technologies have been defined for the design along with systems for environmental and micro-climate analysis;
- the setting up of different “schools”, often at times associated with the Faculties of different cities, but also with other training centres belonging to professional associations (ANAB, INBAR, Legaambiente and others), that have examined different topics on several scales and with a different orientation, according to the occasions linked with public or private commissions or research projects (where it has been possible, since the Italian university structure does not have sufficient funds for such a research program along these lines).

Therefore nowadays, whoever is involved in teaching these topics may certainly take for granted (notwithstanding some arguments with old fashioned-
type professors) the need for a more careful design on environmental topics and can understand all its processes well enough to be able to relate with students. Nonetheless, a professor must not limit himself or herself to only affirm that the sustainable approach is correct but must assume the responsibility of explaining how this approach is able to find a real realization. Consequently it is necessary that the universities are able to communicate a more reasonable adhesion and criticism of the sustainable design with a better judgement in relation to its processes, therefore it shall be necessary (besides the funds as mentioned previously) to start a new phase – in addition to the three phases as above – which brings about a re-thinking of the environmental problem in architecture also from an ethical and political perspective.

The universities must enter into the spirit of the debate which nowadays accompanies the spreading of the sustainable approach in the building and urban planning process, current and real. The teaching of theory is fundamental (and it is important that the same is done with equilibrium and competence) but, now that there is maybe the concrete possibility that theory can be put into practice rather than just be experimented, it is no longer sufficient. It is necessary a confrontation between the various professors of the Faculty of Architecture, between the professors of the various Faculties, and between the different countries not only to discuss the specific content of this type of teaching, but also about the more suitable policies to translate this into diffused reality. If not, a University already having very little money (as the Italian one) in order to significantly affect the productive innovation, will lose the occasion – as it is already doing in part – of becoming a leader or at least one of the leading institutions for a concrete and significant cultural and social change on these topics, and will run the risk of taking a useless and sterile position in diffusing technological approaches, often outdated by time and reality.
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Territories—an Educational Method for Sustainable, Site-specific Research and Design
Territories - An educational method for sustainable, site-specific design
Territories is an interdisciplinary approach, connecting architecture to literary techniques to achieve site-specific, sustainable development strategies. It challenges design students to reach an awareness of the city and the landscape as communicating personalities.1 This approach to architectural design and education aims at developing a sensitive reading of places, from the level of the landscape to the scale of human everyday life, and to propose site-specific interventions accordingly.

Environmental culture: the changing role of the architect
When searching for new approaches to address environmental themes in architectural education, we should first critically rethink the task of architectural design in its contemporary context. Indeed, issues such as climate change and the depletion of resources demand a shifting view on architecture, as well as on urban and landscape planning and construction practice. Through the use of materials and energy, through the production of waste, but also through the social and economical aspects of building, the act of design reaches across different scales and perspectives. Therefore, the traditional role of the architect to translate a given brief into a spatial design within the limits of a plot, is no longer sufficient. The responsibility of the architect in an environmental culture reaches further: the consequences of design for the larger scale of the territory should be taken into account. Also, to address the full scope of sustainability, the spatial, economical and social levels of architecture need to be part of the design. All these different viewpoints make the design process extremely complex. The challenge for architects and urban planners is to incorporate sustainability in such a way that it becomes an integrated part in their designs.

In current architectural education, however, sustainability is in most cases still regarded as a separate course. This leads to the general assumption that sustainability is only an option, comparable to the choice of an architectural style, rather than as a necessity within each design task. Moreover intrinsic environmental design should not only be a set of green washed technological options, but an integrated process in which materials, spaces, scales, users and time are placed in an intelligent framework. Only when the wellbeing of humans and their natural environment, are central to each design task, we will be able to provide future generations with vital cities and diverse landscapes. Therefore, it is necessary to develop a smart educational method, which encourages students to creatively engage in the complexity of environmentally conscious design. Territories is an attempt to approach architectural education from this point of departure. Its premise is that contemporary environmental design should be inclusive, connective and imaginative.
First, the aspect of inclusiveness refers to the idea that the architect’s perspective is no longer limited to building as such, but requires a conscious thinking of the landscape and the territory as well. Designing in an environmental culture implies that the designer is aware of the reciprocity of scales; what happens at a local level, has effects on the larger territory and vice versa. Our acts of design and construction influence the regenerative flows of nature. Water, air and all kinds of materials, each have their own natural loops: some very local, and others on the scale of the region or a mountain range. An example of a design approach that departs from the idea of cycles is “Cradle-to-cradle” design, which “…offers a framework in which the effective, regenerative cycles of nature provide models for wholly positive human designs.”

Too often, however, our way of building dramatically breaks the natural loops, which results in pollution and depletion of resources. A design that fits well to all scales, can instead contribute positively to the natural flows and regeneration of resources. To make future architects aware of the consequences of their designs on all scales in regard to the flows and resources of nature, it is important that educational methods apply an inclusive approach regarding scales. In each project, whether it is an extensive landscape or complex urban design or a small local building or urban intervention, the consequences on other scales should be questioned and assessed.

Second, connectivity implies that the different viewpoints at stake in a design process are taken into account. Looking at environmental issues alone will not be sufficient. For an integrated design approach, environmental aspects have to be connected to the social, economical and the local. In the late nineteen nineties, John Elkington, introduced the Triple Bottom Line, which connects the notions “people planet and prosperity.” This method, that was first intended to help businesses to develop sustainable strategies, is also valuable for design issues. Indeed, sustainable design contributes to the environment (planet), but it can only be successful if it enhances peoples wellbeing (people) and generates economical and social prosperity. At Delft University of Technology, professor of sustainable design Kees Duijvestein elaborated the Triple Bottom Line for architectural and urban design, adding the notion of “project” as the fourth “P”, addressing the role of the designer in regard to sustainable development. Indeed, the architect, responsible of the “project” in all its complexity, should in this view integrate these aspects of people, planet and prosperity. In recent years, also project developers, politicians and other stakeholders in building industry have come to realise that it is not only the environment that profits from sustainable design. In fact, living areas become more vital, and well-built, energy efficient buildings also generate more economical value on the long term. This acknowledgement gives possibilities for a new role of the architect, as a strategic connector of different perspectives. In contemporary design processes, the architect needs to be aware of the perspective of other parties involved in the process of building, as well as those of future
users, inhabitants, etc. Instead of the birds eye view of the master planner, the architect changes his gaze to a more participatory view, the discoverer of existing potential rather than the planner of totally new structures. For design education, this means that students should learn to approach their assignment from different perspectives and be able to connect diverging incentives. In that complex design process the local is the common denominator, to which all perspectives are related.

Finally, the aspect of imagination refers to the creative act of design to imagine future situations. Indeed, by the very nature of their profession, which aims to provide spatial constructions for a near future, architects are obliged to connect their spatial imagination to a view on how a situation (urban reality, site, context) develops in time. It is the power of imagination that can produce innovative solutions for environmentally conscious design. Only through imagination, the architect can approach the assignment at hand from the various perspectives of stakeholders and users, and imagine how design will effect the cycles on various scales. The aspect of time is crucial in this respect. The architect has to deal with an unforeseen future, in which the programmatic use of the building can change in time, as well as its economical and even climatological context. It is part of the responsibility of the architect to foresee such possible futures and include in his design a view on flexibility and durability as well as demolition and waste. Therefore, educational projects should draw on the students’ creative capacity to imagine. Courses should challenge students to creatively approach their project sites from different perspectives, and with a shifting gaze: from the viewpoint of the project developer, of the city deputy, of the inhabitant, of the natural resources and materials. Also the aspect of time should be taken into account- students have to learn to anticipate on the possible alternative scenarios in the future life-span of their project.

The architect’s task is thus to include and connect various scales, various perspectives (people, participants, clients, ideas) and various fields (cultural, social, political, environmental), and to imagine multiple future scenarios. The environmentally conscious architect is therefore an integrated thinker, the person who raises questions in a process before giving answers, who creatively engages in process as a catalyst rather than following pre-set rules, and who is capable of imagining alternative scenarios rather than working towards a fixed final image.

**Engaging students through Terristories**

*Terristories* as an educational method thus departs from the changing role of the architect to include, connect and imagine, and helps to unravel the complexity of sustainable design by looking at local conditions as being part of the greater territory. It is the revealing of local specificities that creates new possibilities for embedded environmental design. It replaces the traditional programmatic-functional-ist thinking to a rooted framework thinking, departing from the capacity of place. *Terristories* connects awareness of the sources of the earth (*territory*) to literary
instruments (stories). This choice for stories as a tool to address design questions derives from the possibilities that literature has to offer in stimulating students to broaden their perspective. A story allows looking from the perspective of another character, to observe and describe local characteristics, and to use narrative as a means to connect activities and events to the spatial setting of the territory.

In this way, the use of literary instruments provides a means for various scales and viewpoints to come together, and offers a playful and productive way to address sustainability.

The basic idea of a Territory, is that the students explore their site and its larger territory from the perspective of different “characters”. Depending on the design task at hand, these characters can be stakeholders in a project, but also environmental elements such as water or wood. The first task is to find a trace of the character on all scales. Such a trace can be represented by an object taken from the site, a sketch or a text. Then, stories are composed, in which the life cycle of the characters, future events and possible needs and demands for the site and the territory can be imagined. This multi-perspectival analysis generates a broader and more inclusive understanding of the reciprocity of scales and environmental characteristics of the project, and provides the stepping-stone for integrated design solutions.

The Territory concept can be used in different educational forms. In the following paragraphs, we will discuss two examples of using Territories in teaching sustainable design. First, we will present an intensive workshop for students of all levels, a full-time program of a week. Then, we will show how Territories can be used as a critical tool for analysis in a longer project for environmentally conscious design for students in the higher levels of master education.

**Territories intensive workshop**

The Territories Summer School that took place in the Republic of Macedonia in July 2009, was an intensive workshop for an international group of 35 students of architecture of different levels. The goal of the summer school was first of all to raise environmental awareness of different scales to architecture students, and to generate enthusiasm for such themes through a creative, interdisciplinary approach. The territory of investigation was Kriva Palanka, a town in the Northeast of Macedonia, located along the river Kriva Reka, in a predominantly agricultural mountainous landscape. The territory suffers from a number of social and ecological problems, such as erosion, pollution of the river, but also unemployment and a lack of well functioning public spaces. The workshop addressed the need for innovative ideas to make better use of the natural resources of Kriva Palanka, and to enhance the quality of life in the town.

The students were divided in five groups, each investigating the town and territory from the perspective of one of the “characters” of water, earth, light, wood...
and man. In the first days, the character was personalized: students identify its specific appearances, habits, rituals and desires, and the relation of the character to the site and landscape of Kriva Palanka. By means of sketching, model making, and writing, each group constructs a story, that moves in between the level of territory (1:100 000), the public scene of everyday life (1:1 000) and the place of man and his family (1:10). These scales form the scene, or setting of the stories. The stories should address the three themes of the Triple bottom line (people, planet and prosperity) as well as the aspect of local identity (place) in regard to sustainability. In the second part of the workshop, designs are made to connect the characters to the three mentioned scales. The 1:100 000 might be a conceptual sketch for a large region, while the 1:1 000 could be a proposal for an urban or a landscape intervention. Finally, the 1:10 entails a model of a site-specific intervention like a pathway, a bus-stop or a shelter. By the end of the week, the five Terristories were exhibited as five chapters of a large book, and presented to the local authorities of the town.

Through this intensive workshop, the students have been acquainted with thinking, moving and designing through different scales and from different perspectives. The storytelling technique taught the students to develop awareness for sensory perception of materials and details of the territory, by means of the descriptive aspect in their analysis. Further, they developed an awareness of the life cycle of materials by means of imagining the material as a living character: where did the material come from, how has it been transformed or produced for human use, how does it age? Finally, they were shifting their gaze by means of working with characters, replacing oneself in the mind of another character, with another background, lifestyle, and other incentives.

As a result, the Terristories workshop for Kriva Palanka offered proposals for spatial interventions for specific sites throughout Kriva Palanka town and region, which indeed address the four aspects of sustainable development: people, planet, prosperity and place. When considering the social aspect “people”, indeed, many interventions served social purposes: they aim to enhance social life in the city of Kriva Palanka. The proposals included for example playgrounds for children, meeting places, and market stalls. In terms of “planet”, the Terristories took into account the life cycle of materials and their influence on the landscape. The group of ‘water’, for example, proposed to make the Kriva Reka banks livelier, by means of a general strategy for cleaning the river, and a number of site-specific designs for the riverbanks. The aspect of prosperity was present in the Terristories in the sense that they refrained from costly designs, but rather proposed smart investments that improve the quality of life in Kriva Palanka with minimum efforts. Finally, the aspect of “place” prevailed in all interventions. All proposals aimed to offer a heightened experience of the extraordinary qualities of the landscape in and around Kriva Palanka.
**Territories as a critical tool in a sustainable design course**

The course about Sustainable design at the Fontys Academy of Architecture and Urbanism in Tilburg, takes 16 weeks (one semester), based on weekly meetings of a full day. With a design task for a site in Tilburg as a central focus point, students conduct an integrated design research in which a wide range of viewpoints on sustainability is discussed: technical, legislative, commercial, economical, climatological and social. The design task entails the refurbishment of a building of choice or the design of a new building at a monotonous industrial area of the nineteen eighties. Such a building, previously used as factory, office or warehouse, has to be converted to a public building as part of a larger urban redevelopment of the area into a mixed-use urban neighbourhood. In the first weeks, the students are asked to make a design while taking into account sustainability regarding technical, and material aspects. Then, the design is critically assessed by means of a number of different methods. One of the exercises is the use of a **Terristory** to test the design from multiple viewpoints and to regard its embedment in the larger territory.

In a one day workshop, students are asked to each imagine three characters, who are involved in the (future) use of their design. These characters are to represent three different scales. For example, an inhabitant represents the scale of everyday life in the new neighbourhood, which takes place at a 1:10 scale, while the head of the school (1:1000) and the city councilor (1:10.000) experience the site in a larger context.

First, students are to define the daily relationship of the characters to the site: how does the character use it, what are his or her trajectories, which buildings or objects play a role in the relation with the site and so forth. This results in short stories about the character in his surroundings. Then, the students gather to present their character and form groups in which various characters sit together for an imaginative charette. In this charette, each character is to come up with a proposal to enhance the level of sustainability of the site, while keeping in mind the personal incentives of the character. The charette reveals contradictory incentives of different stakeholders in the design process, which need to be addressed in order to find shared solutions. The outcome of the discussion is used to formulate an extension of the brief of the project or to propose changes to improve their design.

**Conclusion**

Thus, what Territories aims to achieve with students is to raise an environmental awareness and an enthusiasm for integrated design. Therefore, Territories makes use of the creative method of story telling to challenge students to approach their project from different perspectives. By these means, students learn to work with the complexity of integrated environmental design. As shown
in the above-mentioned examples, the pedagogical method of Territories can be used for students of different levels, in courses of various length and intensity. It educates future architects to work from a broad perspective and capacity to involve all scales and other fields and specialities. Then, sustainable thinking can become evident in each design process.

Figures 1-2. Territories results workshop in Macedonia

Endnotes
2. William McDonough and Michael Braungart, Cradle to Cradle, Remaking the Way We Make Things, North Point Press, New York 2002. In Cradle to Cradle, the authors address product industry, but by extension, its basic principles are also relevant for architectural and urban design and building industry.
3. The Triple Bottom Line for sustainability was proposed by John Elkington in 1998, mainly addressing business strategies. Originally, the three P’s stood for people, planet and profit. In a later stage, the word profit was replaced with prosperity, which has a broader, not merely economical connotation.
4. Cees Duijvestein, 4-P tetraëder, Symposium Faculty of Architecture TU Delft, April 16 2009
5. The Territories Summer school was initiated and directed by Klaske Havik (TU Delft), Sebastiaan Veldhuisen (Builddesk sustainable development, Delft) and Lorin Niculae (Ion Mincu University, Bucarest) by invitation of the Faculty of Architecture in Skopje, and co-tutored by Slobodan Velevski, Marija Mano Velevska, Bojan Karanakov, Filip Cenovski and Mihaljo Zinoski of the Faculty of Architecture in Skopje. A more extensive report of the workshop was published in OASE#80 On Territories, Tom Avermaete, Klaske Havik and Hans Teerds (editors), NAi Publishers, Rotterdam 2009, pp. 70-76
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Exploring Dimensions of Slow Life Filtered through Sustainable Design
The following essay describes the efforts of the Studio titled “Exploring Dimensions of Slow Life Filtered through Sustainable Design,” as it was taught in the academic year of Fall 2009 and Spring 2010.

**Context of Studio within the Department of Architecture Fourth-Year Study Units**

In the year 2009, the Department of Architecture of the University of Nicosia initiated a unique direction for its fourth-year students. Instead of a conventional thesis preparatory year of full academic studies followed by the fifth year where the thesis project is to be generated, the faculty created two Study Units from which the students entering their fourth year would have to choose from. Each Study Unit has a distinct area of concentration expressed within the framework of its related studio.

In addition to the Studio, each Unit is comprised of two supplementary courses where the students are exposed to theoretical and technical issues associated with Study Unit. The faculty undertaking responsibilities within each Study Unit are strictly selected for their expertise, knowledge and experience in the Unit’s area of study. In cases where no faculty member in the particular area of expertise was available, part-time faculty members were hired in a concerted attempt to maintain the highest standard of education within the Study Units.

Regardless of which Studio the students are registered to, they are all expected to follow all supplementary courses offered by both Units. This achieves a much-needed balance and uniformity among fourth-year studies. The Studio is a two-year commitment on behalf of both students and faculty. By their fifth-year, students are expected to have developed, expanded or isolated their fourth-year studio studies and promote them to a successful thesis.

**Sustainable Architecture Unit**

The Studio offered within the Sustainable Architecture Unit is titled “Exploring Dimensions of Slow Life Filtered through Sustainable Design” and it shall be the main focus of this essay. As mentioned above, the Unit is comprised of the Studio course and the two associated supplementary courses. These two courses are History and Theory of Sustainable Architecture and Sustainable Design Practices. The History and Theory course offers a comprehensive understanding of the principles of sustainable architecture within a historical and socio-political context, whereas the Sustainable Design Practices course provides the necessary technical background and mechanics to succeed in creating sustainable architecture.

**Studio Members**

In the Fall semester of 2009, seven students with an interest in sustainable design enrolled in the Sustainable Architecture Unit Studio and three transfer students were placed in the Studio based on their individual academic interests.
The Studio and two supplementary courses were taught by a collaborative unit of an architect and a landscape architect, each approaching the issue of sustainability from different perspectives, including bioclimatic architecture and innovative design, ecological systems and sustainable urbanism, and socio-economic issues pertaining to sustainable living.

**Philosophy and Perception**

**Slow Life and Sustainable Architecture**

_Waking up late... rushing to get dressed... forgetting to comb... no time for breakfast... rushing to the car or to the bus station... getting to work and then, rushing... and then some more..._

*What makes our life rush by so fast, what compels us to always be on the run? What inner need provides us with this momentum? Is it the need to compete, to achieve, to succeed?*

*Is the applied frequency emitted by our built environment subliminally feeding our impulse to rush?*

*We eat fast food, think fast thoughts, talk quickly to our friends and colleagues and inevitably, we create environments to match the fast rhythms of our lives. We live fast lives and most likely design the appropriate architectural elements to accommodate us.*

*Take a moment and stand still.*

*Does food taste different when you chew while standing still? Does the ground under your feet feel softer?*

*Does your breath feel cooler, stronger when taken in slowly and released slower still?*


*Is slow life a virtue that can be identified within western lifestyle? Does it need to be juxtaposed to fast life for it to have a discernible meaning? How does sustainable living compare to slow and to fast living?*

*Does architecture have a measurable speed? How do we feel about our surrounding architecture? Can we identify slow and fast paces in our built environment?*

These thoughts, expressed almost in a style of stream of consciousness, act as springboards for the foundation of the Studio’s philosophy. In turn, these questions become the impetus for an entire set of other issues requiring students to investigate interpretations of slow life and fast life within the context of sustainable architecture. However, in order to progress successfully to this level of investigation, each student is first encouraged to develop his or her own idea of what sustainability means.

Slow life is primarily concerned with the analysis and reading of architectural dimensions as a conceptual framework for the presentation of significantly new, origi-
nal and meaningful architectural ideas. The Studio explores the theoretical, the philosophical, the physical and the aesthetic qualities of slowness from life to architecture, their potential for making space and the emotional capacity of the spaces they make.

**Philosophical Positions**

Twenty years ago, sustainable architecture, since it was not included in conventional academic curricula, it was considered by most non-academics as a fad. Academics themselves looked upon it partly as a novelty, although most certainly a worthy cause. Nowadays, where sustainability appears firmly in a large number of academic institutions, believers consider it a “must” and cynics consider it fashionable. The future generations, however, regardless of their philosophical persuasion, will most definitely consider it a necessity. Slowness, whether of living or of design, is an intriguing concept whose elusive nature encourages creative thought and sets numerous sceptical filters benefitting good design. Identifying, observing and evaluating slow life raises issues of perception on time and accountability to nature in ways that are intrinsic to sustainable design.

Let us try to playfully visualize all-things-architectural to be the product of a specific muscle group in the designer’s subconscious. The muscle group comprises other smaller muscles which we can identify as “creativity,” “practicality,” “technical accuracy” etc. We can visualize the muscle at its earliest appearance in the subconscious mind, while it is still somewhat atrophied. Upon attending architecture school, the muscle is exercised and gradually starts functioning as a unit, all members flexing and contracting in unison producing a well-shaped, efficient muscle. Sustainable design and environmental responsibility customarily appear in the designer’s subconscious as members of this “architectural” muscle group and together they have the potential to make the muscle stronger, more efficient and more resilient.

Since in the case of the Department of Architecture of the University of Nicosia, studies focusing on sustainable design officially enter the curriculum for the first time in the fourth year, regarding the principles of sustainability as part of the muscle group mentioned above may not be a realistic vision. In the course of a five year educational programme, it is probably safe to assume that the synergistic members of this muscle group have already been exercised into a shape by working together with method and system and any attempt for alterations may be met with resistance or with less than adequate results.

Consequently, the purpose of this Studio and the philosophical quest supporting the Sustainable Architecture Unit as a whole, given the circumstances of the Unit’s conception, is not to enforce sustainable design and environmental responsibility as surrogate members of the muscle group. The purpose here is for these two principles to be the primary forces that help shape the muscle to fitness. They are not to be regarded as muscles, part of a larger unit of body,
but as the weights, the dumbbells if you will, the design muscle is trained with in order to become more capable and resourceful. A timelier introduction of sustainable issues into the department’s curriculum may be a more beneficial investment in the future of environmental culture in architecture schools, but such adaptations take time, patience and perseverance on behalf of academics and administrators alike.

**Practical Extension**

On a more tangible level, the mission of the Sustainable Architecture Studio is to elevate architecture and design to a coexistence of a harmonious and productive synergy of man, nature and the spirit of place. At the end of the studio journey, the students should be in a position to face their architectural identity in such a way where sustainable design will not represent an attachment or a supplement to their design principles, but both entities operate as an integrated process.

At the start of the studio journey, a foundation needs to be set where all attempts to define sustainability are put on the table and theories are taken into consideration. The global, multifaceted nature of sustainability is presented in such a way that students become aware of its ever-elusive definition and the range of disciplines it involves. This realization is inevitably faced by the students with some trepidation, so time is set aside for individual consultations helping students identify their own niche within the network of possibilities of sustainable design.

Sustainability is expressed not only as a healthy building technique but as a deep socio-political issue that transcends generations, race and social class. The Studio projects themselves, aim to explore the interdependency of issues of environmental, social and economic sustainability with students being prompted to develop individual, critical positions with regards to the broad concept of sustainability and to extend and explore those positions through their architectural design process.

**Studio Description and Pedagogical Methods**

**Site Analysis**

After the initial influx of new information regarding the philosophy, mechanics and application of sustainable architecture, the students need a means to feel grounded. For this reason, the first order of business is to establish familiarity with the proposed site and with the climatic and geographical circumstances that are specific to it.

The site chosen is a multifaceted one since it is a National Park located in a suburb of Nicosia, flanked by a university campus, the Nicosia General Hospital, a commercial complex and some residential districts. The paradoxical boundaries of this park make it a fascinating area of study with numerous possibilities and
challenges whether the architectural intervention is a single building or a series of smaller, interrelated ones.

The students of the Studio are expected to develop their own brief – a good preparation for their self-directed thesis investigation which will follow in their fifth year of studies. Students in groups and individually, are called to examine the park in its entirety and to uncover its layers of complexity and potential. Shortcomings of the park are scrutinized and discussed in a productive and educational environment, while case studies are used to offer depth and perspective. During a guided class visit to the park, the students are called to investigate the site’s literal characteristics but also to observe and document their own emotional responses.

Site analysis of the park and its surroundings is conducted in groups which produce a series of overlays pertaining to basic analytical issues such as land use, fauna and flora, circulation, geology and topography. Some groups may choose to examine issues of particular interest to them and produce relevant overlay maps. The finished product of base map and overlays are then scanned and made available to all students. Since this is the first contact some students experience with site analysis of this scale, they are encouraged to review the work of Ian McHarg and James LaGro. Once students are comfortable with the park’s particulars, they are called to develop a masterplan for a theme park of their choice. This masterplan will serve them for the entirety of the year, since all their subsequent building interventions will be based on it.

Lectures, Guests and Critiques

Developing an understanding of design, maintenance and operation of the built environment while minimizing energy needs is a strong component of the Studio objectives. These issues are presented to students by a series of in-studio lectures presented by the faculty and student peer presentations on case studies, technological advances and social issues. The basics of sustainable architecture, such as theory, ecology and technology are offered to the students through the two supplementary courses they take as part of their fourth-year curriculum.

The Sustainable Architecture Studio fosters a culture of diversity of opinion and constructive criticism. Throughout the duration of the studio year, a series of guest lecturers and critics offer their time and advice to individual students, evaluating each project’s merits, providing intriguing stimuli, feedback and helping each student elevate his or her work to the next level. All desk critiques with guest lecturers are done in the presence of at least one of the studio instructors to better communicating class objectives and to facilitate communication.

Guest critics have included artists specialising on ecosystems, practicing architects focusing on bioclimatics and digital design and professors of relevant subjects from other local universities. Through their diverse educational background, the guest critics, some of whom studied and worked in countries such
as Germany, Spain, Holland, England, USA and Greece, were also in a position to offer unique pedagogical perspectives.

Most studio days begin with a pinup of each student’s work and it is being discussed earnestly and constructively by fellow students and the instructors. As with all studios at University of Nicosia, there is a mid-semester review for all students where the entire faculty is invited as well as guest critics from other universities and professionals. These reviews prove to be an excellent means of coordinating progress in all same-year studios and they provide an opportunity for students to benefit from the experience of a large scale presentation.

**Assignment Structure, Exercises and Projects**

Students are assessed on the level of concentration they exhibit, their rigour and tenacity. Their subsequent grade is determined by the maturity with which they tackle problem analysis, the depth and commitment of their research work, the clarity of their thinking process, their creativity in generating ideas, application of mixed media skills, the quality of final product, progress and attendance.

**First Semester**

All projects assigned in the first semester have a distinct period of duration ranging from two to three weeks depending on the workload. As a result, students are encouraged to approach these projects as charrettes and work under rigid deadlines.

*Site Analysis Assignment*

Analysing the site is a process that takes up the better part of the first studio month. The first assignment is the production of the site base map and site analysis overlays and it is entirely focused on group work. This proves to be a great opportunity for student socializing, particularly since some students may have recently transferred from other schools. Students also develop a sense for handling group dynamics and conflict resolution.

*Theme Park and Masterplan*

Each student is expected to develop his or her own theme park based on his or her individual evaluation of the site’s shortcomings, community needs and environmental betterment. The students choose a theme that is a challenge to them; one which they hope will lead them somewhere they have not been before. Students’ individual tasks include:

- Exploration of thematic dimensions of the concepts of *slow* and *fast* (keeping notes, drawings, samples, cut-outs and anything else appropriate)
- Research and peer presentation on their chosen theme.

During this time, students explore their theme in any creative way thinkable. This may include travelling, reading, drawing, talking, writing, film-making,
performing, painting, writing stories and anything else which may or may not appear productive to their cause. The students are encouraged to take every opportunity to concentrate their efforts on comparisons and conclusions relating their theme and conceptual dimension of slow life. The projects will be generated from the creative observation and interpretation of the term slow either as a place, an object or an activity. The students’ understanding and developed sensitivities will spawn much of their subsequent architecture. Their architecture must respond to environmental and sustainable demand, functionally as well as poetically.

The theme park is then translated into a masterplan in an appropriate scale. The plan is expected to exhibit mature decision-making with respect to citing functions and buildings as well as proper circulation provisions. No level of detail is expected, although free-hand mood shots or collages are encouraged to provoke students to imagine the attitude and the feel of the park.

**Resting Points**

The first habitable space students are called to design is a series of resting points whose location has already been established in the Masterplan. The resting points, intended as a spot where the park’s visitors can take a break, represent the students’ first attempt at a structure that follows basic principles of sustainable design. The design of the resting point structure must be such that it can be erected or installed at any point in the park, but can be adaptable and responsive to the particular location it is intended for.

The concept driving its design must be related to the park’s proposed theme and must be consistent with the findings of the investigation of slow. The structure’s area must not exceed 10m² and all passive and active solar design principles must be applied. The prototype must be responsive to climate, wind, sun and other particulars of the site and it must offer protection from the rain. Material investigation and selection is crucial.

**Building 50-100m²**

The second building assignment presents the challenge of maintaining all bioclimatic lessons learnt in the previous exercise and applying them to a larger area. The use of this building, intended to be unique within the masterplan, promotes a use relevant to the park’s chosen theme. Choice of materials must be dealt with more perseverance, bringing forth topics such as material longevity, potential toxicity, recycling and reusing. Energy-saving technology is investigated as well as other established technologies demonstrating the principles of sustainable architecture and construction.

**Building 500m²**

The final assignment before the end of the first half of the Studio is a building larger in dimension to the two previous ones. The challenge of designing sustainably is now elevated to include architectural concerns such as access,
entrance, space-use hierarchy, accommodation of auxiliary spaces, circulation and aesthetic acceptance within the natural landscape. Issues of cross-ventilation, orientation and exposure to natural sunlight are now examined more rigorously.

Review

While working on the three building assignments, the students approach the park in a greater level of detail and inevitably identify issues that need to be addressed on the level of the masterplan. At the end of the third building assignment and prior to the final review of the first semester, the students are compelled to revisit their masterplan and make all necessary corrections and adaptations based on lessons learnt during three assignments.

The first semester final review panels are present all major projects tackled during the semester, i.e. the masterplan and the three buildings as well as anything else the students deem necessary to their investigation. The panels are presented in A1 sheets and the students are instructed to make the panels as well-narrated as possible so as to require little or no explanation of the project’s intentions.

Second Semester

Building 1,000m²

The final assignment of the Studio is a semester-long project, intended to exhibit all skills acquired and practiced in the three projects of the first semester. A more complex building is expected to be generated responding to issues of site specifying and sustainable design. Since energy performance is conventionally less efficient for larger-scale buildings, students also have the option to produce a complex of smaller buildings and to tackle the challenge of a mini urban environment surrounded by protected nature.

Before addressing their intervention, whether that is a building or a complex of buildings, the students are assigned an exercise to affectionately known as “site reconnaissance.” This exercise is intended to bring students physically and intellectually close to the site of their proposed intervention. They are required to section their proposed site to a grid where each square has the approximate dimensions of 2mX2m. Then the students are called to investigate and document each grid as a microcosm, isolating particular characteristics present in most of the grids and proposing a possible hierarchy. Through this exercise the students are encouraged to develop their own language of reading the landscape of their site. Their findings are then presented in class in the form of a conceptual model, stationary or interactive, or in two-dimensional images.

Upon considering the final building, the following issues become relevant:

- Design dealing with complex environmental problems emphasizing the planning of large-scale buildings
• Students are compelled to use their knowledge and experience of different constructional and structural models and their aesthetic properties to choose aptly and with sensibility from a range of possibilities
• Students are also encouraged to consider how the luminous and acoustic aspects of design can be manipulated to facilitate the activities to be sheltered and explores how they can control objective mood and convey symbolic values
• Human and social impact of the built environment of the inhabitants of the project’s particular environment
• Contemporary perspectives on the relationship between human behaviour, designed environments and energy efficiency. In effect, the final project explores the implications of those relationships for the purpose and future direction of design education, design research and design practice
• Students become aware of design factors affecting indoor comfort and explore concepts, structures and techniques that lie behind the realization of energy conscious design
• The link between quality of life and energy consumption, the variation in fossil fuel resources and end-use energy in Cyprus
• The role of renewable energies in reducing environmental impact.

Critical Evaluation and Conclusions

Academic Year 2009-2010

If the degree of success of the Sustainable Architecture Studio is measured by students’ enthusiasm, then the Studio was surely a triumph. During the course of the year, the students gradually became committed to the Studio’s culture, as evidenced by the quality of their finished product, the degree of collaboration inspired among the group and the close bond fostered between the students and the two instructors.

A diversity of thematic projects were taken on such as skate board and cycling facilities, a dog park, a performance park, an educational centre, etc. A variety of subjects were tackled, including modularity, appropriate water purification technology, flexible occupancy and space reuse and issues of embodied energy. The Studio’s standards were kept at a constantly challenging level and small number of students who were not able to keep up had to withdraw. Although all help was made available to them, the students decided on their own accord that they had more to gain by repeating the studio year.

The students were not only able to produce mature projects touching on all basic issues proclaimed by the Studio agenda, but most of them were able to greatly improve on their overall ability to solve complex architectural spaces and successfully present them in professional drawings and impressive computer renderings. This was partly the result of the instructors’ perseverance and insist-
ence that students should be handled as adults who are but a heartbeat away from professional employment.

Since this was the first year this Studio was offered, there were a series of valuable lessons to be learnt. It was established that the Studio’s site was revealed to the students too early in the semester. In retrospect, it may have been wiser to allow students time to investigate sustainability and the slow dimension of its influence in architecture without the predisposition of a known site. The objectivity or these early research attempts may have produced a stronger, more focussed result if they were executed on a more universal background.

Another improvement the Studio will be striving towards in future years is to keep the slow life parameter closer and more apparent in the Studio process. Some students’ research on slow life, regardless of how thoroughly it was initially executed, stayed in embryonic stages and was overshadowed by more tangible concerns such as derived from sustainable architecture. Conversely, one student opted to view slow life as a product of comparison and took on a project focusing on fast life. This was a welcome extension of the slow investigation and showed healthy initiative and creativity.

The Sustainable Architecture Studio was not only a prolific course for students and a valuable experience for the instructors; it proved to be a useful platform for discussion regarding pedagogical targets and techniques for fourth-year studios at the University of Nicosia. Since the completion of the 2010 academic year, the university’s faculty has been using the knowledge and lessons learnt from the Studio as guidance in the objectives and planning of future studios. More importantly, the students’ high level of product has become a datum on which students’ projects are now being evaluated.
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Aesthetics of Sustainable Architecture
Design Studio “Aesthetics of Sustainable Architecture (ASA)”  
**Theoretical Positions**

The design studio deals with the aesthetic potentials and values of sustainable architecture and its practice. It is conceived in response to the current trends of designing sustainable buildings that are focused on mechanical systems and engineering. The studio therefore posits a crucial question, whether or not there are indeed aesthetic opportunities inherent in the environmental consciousness and the so-called sustainable design. Along the lines of this interrogation, the design studio is constructed around the theoretical positions in the articles in the author’s upcoming edited volume, “Aesthetics of Sustainable Architecture” published by 010 Publishers.

While it is undeniable that we must have in place the kinds of appropriate technical means in order to approach the environmental problems that may be attributable to and mitigated by architecture, the investigation and research that situate such mechanical systems within the disciplinary discourse of aesthetics have been overlooked. Therefore, the design studio seeks to deal with how we could put in perspective the sustainable thinking in architecture and how to incorporate them in such a concurrent way to what we consider a matter of aesthetics. The studio attempts building design with a strong emphasis on how the aesthetic aspect of sustainability could be formulated. In the studio, for the purpose of the exercise, the term aesthetics is simply understood as the expression of the design intent in building form that points to the way in which the building is conceived as well as put together relative to a specific purpose.

In the design studio, first the concepts of environmental consciousness in architecture are expressed in two contrasting branches: sustainability and durability. Sustainability refers to a process that can be maintained and continued over a foreseeable time span, or theoretically speaking, indefinitely, while durability refers to a state of being that lasts and functions as long as we could make it, if not forever. On one hand, by sustainability, we usually mean that certain conditions are fulfilled in the relationship between a site and a building, and that we have the kind of capabilities to continue to meet those conditions in the future. That way, ideally, we can continue repeating the process with no end. In this sense, the term refers to a structure or relations in balance so that the process does not exhaust itself or come to a halt due to a breakdown or degradation in the relationship. On the other hand, durability stands for how to build so as to
maximize their useful lifespan. In this case, the objective is more focused on the kinds of materials, techniques and assemblies in the production and use of the built object itself. Obviously, the two conceptual distinctions are, while structurally contrasting, not mutually exclusive and must be viewed as complementary, even symbiotic: A process cannot be sustainable if we cannot foresee the durability that affects the performance of the aggregate constituents in their supposed lifespan, while no durable measures can be accomplished if we cannot maintain a sustainable continuity of materials and techniques.

The two concepts in combination with the three main strategies in ecological thinking, namely, conservation, efficiency and regeneration, provide a concrete and substantive approach to designing a building in a sustainable and durable manner. First conservation attempts to reduce the amount of resources and materials that are used in production and consumption processes, thereby extending the reserves of limited resources. In architecture as well as in daily life in general, this translates to minimizing waste and to saving materials by reclamation and recycling. Next, the idea of efficiency is directed to maximizing the output or production from the given supply of materials and resources. That way, we expect to extract more use from the materials and resources. This strategy may be expresses in terms of the kinds of machines and devices we use in buildings such as the boilers for heating and the radiators that are designed to output more heat energy per unit of their capacity. Another common example in this regard is the km/liter rating for cars. Here by definition, the conservation and the efficiency form the duality for a same end: slowing down the depletion and therefore extending the useful lifespan of existing materials and resources. The third strategy, regeneration, attempts to return to the sources of our materials and energy and to compensate for what we extract, use and often consume in our industrial process, thereby replenishing the reserves we have. This strategy includes, for example, such resources as forests for timber, aquifers for water and other natural resources necessary for farming and food supplies.

Given the overall picture behind the sustainable concepts and strategies, in many instances the central ideas behind environment, sustainability and the design of architecture are often oversimplified, misunderstood and misrepresented.
On one hand, we often consider environmental problems within the limited context of lifestyle choices and economic gains, and on the other we do not adequately view our industrial model in relation to the natural cycles of birth and decay. Many environmental debates centre around the assumptions that we can alleviate, and even solve, the problems by replacing a selection of technologies, such as the fuels for electricity and transportation, the kind of engines in our cars or the kind of light bulbs in our homes, with more efficient ones. Certainly these improvements would help but fundamental questions remain in regard to architecture: What are the structural issues of sustainable development and how do we address them in a more fundamental manner? And what kind of changes and opportunities can we find in its aesthetics stemming from the revisions to our industrial model, a system in which architecture and design are often at the receiving end of the causality relationship?

For example, Rocky Mountain Institute (RMI), founded by L. Hunter Lovins and Amory Lovins in 1982, proposes a design intensive, productivity oriented approach, emphasizing the maximized efficiency of the systemic structure under the framework of the so-called “Natural Capitalism.” (NC) The RMI declares that its vision “is a world thriving, verdant, and secure, for all, for ever.” Furthermore, as its mission it points out, “...the efficient and restorative use of resources” in a manner that is “non-adversarial and trans-ideological, emphasizing integrative design, advanced technologies, and mindful markets.” In addition to the RMI’s NC, another recent contribution to the sustainability debate is the book by William McDonough and Michael Braungart, “Cradle to Cradle” (C2C). In this book, the authors examine and illustrate the inherent problems in the existing systems of industrial development of what they call a “cradle to grave” model and attempt to propose an alternative that is centred on closed-loop services of delivery and reclamation. Both NC and C2C propose a fundamental revision of our current model of industrial development, a move away from our pattern of disjunctive production and consumption, toward a cyclical, closed-loop process, where nothing is discarded and wasted. This idea, of a cyclical system of produc-
tion, use and re-production, as opposed to a linear, dead-end process of production, consumption and discard, is a key consideration in both initiatives.

Then there is the notion of the vernacular that professes returning to the kind of living that is more intimate with and less intrusive to nature is the only way to mitigate our current environmental problems. However, one crucial problem in the vernacular scenario is whether or not the notion, that is said to date as far back as the time of Vitruvius,7 is indeed applicable and even relevant to today’s technological, industrial and economic context. In regard to the vernacular being equated with the sustainable, the major points of argument appear to be that the vernacular maintain consistent renewal and supply of natural resources relative to a given locale; they have evolved to respond to the given climate; their traditional building processes help strengthen social and economic coherence; and they are flexible. However, given the drastic (and often catastrophic) changes that took place in the global conditions of ideology, politics, economy and climate in the past one hundred fifty years, all of these points seem exceedingly nostalgic and to offer no viable strategy without resulting in the fake authentic that is not unlike the Prince Charles’s call in 1980s for authentic English villages.

Therefore the studio focuses on emerging models of design and production that incorporate ideas for improving the existing technologies as well as those that replace our technological patterns with more efficient ones, rather than resorting to yet another “learning from” the vernacular. In this regard, the studio will adopt as its primary theoretical text, the author’s “Aesthetics of Sustainable Architecture” and deal with the dual pillars of the sustainable design, sustainability and durability, in terms of the three main strategies of conservation, efficiency and regeneration, and the kinds of related aesthetic potentials and opportunities that exist in them. Ultimately the design studio is expected to offer an alternative investigation through the connective territories that lie between design practice, its aesthetics, economic and ecological logic and the quality of life.

**Pedagogical Methods**

All design practices, however small or large they may be, attempt to create certain values by situating their production within a context of users and their cultures. These values also stem from social, political and economic environments...
of the context and are imprinted in public policies and business practices. These two parallel value tracks influence many levels of our design practice, from small ordinary objects to the scale of urban or regional planning. While an individual architect’s or designer’s work may be focused on the practice of aesthetics and functionality of everyday objects and space, in this studio we want to speculate on how such practice in accumulation can affect the larger whole by approaching sustainability as such a form of aesthetic-function relationship. Given the current debates in sustainability and the design of human environment, how then do we approach what we consider beautiful and useful, and how do we evaluate such objects or processes? How does the way that we make such evaluations evolve? What do these debates and ideas offer us toward new ways of finding beauty and usefulness and yet without destroying our environment in the process?

Published just within the past few years, one can easily find countless volumes dedicated to sustainable design. The central themes of those volumes range from ethical and philosophical issues, to technical manuals and to homemakers’ DIY guides to sustainable lifestyles. But what are the actual ramifications of sustainable design practices on aesthetics and how we construct our immediate environment? Are they fully represented by technical issues that are supposed to be simply supplementary and hidden behind a façade? Are they a patchwork of remedies we can implement ad-hoc as we move forward? Are they perhaps a call to Arcadia for a return to a kind of simplicity in our civilization, to a way of living in tune with the laws of nature? Or as some do argue, is aesthetics simply incompatible with and non-existent in sustainable design?

We identified the following areas of focus for the design exercise. They are interconnected without clear divisions and therefore each student is free to address one or a combinations of the issues.

**Energy**

It is well understood that the current environmental problems arise by and large from the extensive use of fossil fuels such as coal and petroleum and the mass emission of greenhouse gases such as carbon dioxide, nitrous oxide, methane and other pollutant particles. As it has been also well documented, the atmospheric changes will result in catastrophic climate changes, the most serious of which will be the increase in the global temperature and the changes in ocean currents as well as its acidity level.
The designs in this section are expected to touch on the use of energy in the production of materials and objects as well as during the operation of the built environment. From a design standpoint, how do the changing modes of energy production and consumption affect the formal and programmatic organization? What are the aesthetic potentials present in the consideration of new energy and its use? The design work may also critique and discuss the prevailing energy use and policies as well as social and cultural issues. The design attempts under this topic should not only help illuminate the core issues but also suggest the latest alternative thoughts that will affect the design process and its aesthetic foundation.

**Materials**

The second category concerns the extraction, production and use of the materials and the span of their useful lifecycle. Therefore the questions on materials are directly connected to energy. As a result the concepts involving the embodied energy level and the use cycles represent one aspect of the materials’ qualities. The aesthetic features and potentials should also be measured in relation to the materials’ performance, durability and potential toxicity. Within the context of the propositions in C2C, the materiality also represents the selection process that includes the given materials’ prospect to fit within a cyclical model, in which the production and the use of materials incorporate the process of many useful iterations.

The design work under this rubric is expected to discuss and expose not only the problems inherent in the current consumption-based use of materials but also those pertaining to our lifestyle choices and patterns. In this sense one of the important questions of materiality should be directed to not only what we use but also how we produce and use materials.

**Water**

The third issue concerns water resources and consumption, directly translated in terms of drinking water, sanitation and irrigation. Obviously, given the problems of diminishing aquifers in many regions and also given the health impacts attributed to water, the surrounding issues should be con-
sidered in regard to the water renewal cycles and from a conservation standpoint. In some geographical contexts, the lack of clean water for drinking and agriculture poses perhaps a more immediate serious threat than the greenhouse gases, leading to a wide spread of water-born diseases and food shortages from declining crop production.

In this category, the design focus is on the possibilities inherent in the process of the use and management of water. The designs should deal with not only the current state of the water-related problems but also the potentials in water development that could permeate through many aspects of design decisions.

**Technology**

In this section, the design studio intends to address how the latest design and modeling technologies and tools affect the thinking and approaches toward a new relations of materiality and its aesthetics. Given the advances in software and hardware engineering, we have access to more rigorous and accurate means of design and simulation. These technologies represent not only how efficiently we design and produce but also more importantly how the historical canons of architecture have changed in regard to its aesthetic foundation. We use advanced technologies in order to design more efficiently and to produce designs that are optimized for specific uses and performance as well as for the discovery of previously unknown forms.

Whether the latest means of design and simulation are implemented in order to increase the efficiency of labour or to maximize the performance of resulting products, it appears certain that what we use to design has changed the way we conceive the design process and its objective in a profound way. In this regard what is the relationship between the new technologies in design and the environmental consciousness? Do we simply use these tools in order to design and manufacture more products more cheaply in less time? Do we fuel and accelerate the rampant excesses in consumerism as a result? What are the potentials in the latest digital technology for the design and production of space and objects in regard to the sustainability of our built environment? Is there an inherent logic in the relationship between self-preservation, efficiency and form, as the proponents of the biomimetic process would suggest, for example?
For this category the students are encouraged to elaborate on the fundamental changes in design, manufacturing and use brought on by technological advances, and how such changes influence and reinforce the sustainable design practice and its aesthetics.

For the purpose of design exercise, in consideration of the above mentioned areas, the primary methods and processes in the design studio consist of:

**Analogical Foundation & Investigation**

In this phase, the students are asked to conduct an investigation and gather information on the status quo of the four areas. The students are expected to find and establish a certain base value that represents the performance of the currently available materials and techniques in terms of consumption and the reclamation value. In addition, the students are also introduced to and asked to investigate certain biomimetic potentials that may be employed as a point of departure for the design assignment.

**Comparison**

In the comparison phase, the students are asked to compare the performance and the formal qualities of given energies, materials and techniques. The primary objective in this phase is to gain an overall perspective on the different degrees of efficiencies in regard to a given life cycle of a product. Another crucial component of this exercise is to speculate on how and what if certain materials and products were replaced for a better performance, and how such changes would affect the formal and aesthetic qualities of a given design vis-à-vis the increased performance.

**Identification of Design Focus**

From the phases of a. and b. the students are asked to produce a concrete design agenda. Here the students are expected to develop a design agenda that explicitly incorporates certain principles and characteristics discovered in the previous phases. At this point the students are supposed to form a specific design objective as to what the building is meant to accomplish and how such an idea is expressed in the aesthetic qualities.

**Design & Deployment**

Here in the final stage of the semester’s design work, the objective is to produce a comprehensive set of design schemes that clearly identifies the four areas of focus and exhibit how they are addressed in the design
work in what manner relative to the site conditions. The crucial part of this concluding stage is not only to discuss the technical implements but also more importantly to demonstrate how the particular considerations regarding sustainability help give shape to the project.

**Intent of the Studio**

The main intent behind the studio is to revise the way sustainability is approached and taught in design education. The studio is in a way a response to the clichés that sustainable buildings are ugly or nostalgic and designed by engineers with no sense of aesthetic qualities. Also on the other hand, due in part to this clichés and due to some assertions by certain prominent architects that there is no such a thing as aesthetics in sustainable architecture, the studio attempts to redress a point of view based on the established historical patterns in that whenever we came across a new frame of consciousness, it was ultimately expressed in aesthetic terms, such as the Renaissance or the Modernism. In this sense, the design studio is a direct challenge that first of all regards the discourse on our sustainable future is indeed such a new frame of consciousness and that it fundamentally alters our world view. And secondly it is conceived as a way to express sustainable design as the next logical development in the advancement of the aesthetics of architecture. In this regard, sustainable architecture is thought of as a prime protagonist in not only giving form to our environmental balance but also contributing to its sustenance.

As for the thematic direction of the design studio, it does not assume that one approach or another necessarily offers a concrete “solution” per se. This position is based on the fact that in the course of contemporary industrial development, the changes and solutions are incremental and as such, any kind of assertions that professes a comprehensive solution is treated as a suspect. On the other hand, the studio is designed to offer a mosaic of perspectives that have been put forth by various scholars and architects, including NC and C2C as already mentioned, such as Kenneth Frampton and Peter Buchanan. Especially, Frampton’s references provide a wide range of views that are useful in situating the studio’s discourse beyond the common hype and labelling of “green.” In addition, his theory of “megaform” also provides a good basis to discuss suitability beyond the scale of individual buildings, where the way we form an urban continuity and its sustainable possibilities become a more pronounced feature than the workings of individual buildings in one system or the other.

On the other hand, Peter Buchanan’s assentation, that sustainability is not of aesthetics but a set of interactions between built form and its environment, also provides a useful point of departure for the design studio. Here Buchanan proposes ten precepts of sustainable building development and provides useful
examples that adhere to his so-called “ten shades” of being green. According to Frampton, in the foreword he wrote for Buchanan’s book, sustainable architecture is “… a nature/culture interplay in the deepest possible sense. Thus one looks to establish a continuous feedback modification, not only with respect to the one-off building but also with regard to the discipline as a whole.”

Pending Issues

One major obstacle that must be overcome in the education of sustainable architecture is the dominant perception, through media and such a certification process as LEED, that sustainable design is accomplished by putting together a set of prescriptive measures. There is no doubt that the media exposure and the sort of evaluation and certification measures help raise the consciousness of sustainable design. However this has in fact promoted a rampant commodification of the term as well even before the actual substance took a firm footing in common practice. In other words, in today’s culture of commodification, the appearance of sustainability is more important than the actual performance of a given design. Therefore, one of the fundamental changes in the education of sustainable design is to develop educational contents that emphasize a more holistic construct of the concepts of sustainability.

In addition, as already mentioned earlier, a common view of sustainability assumes that it consists of limited mechanical measures and parts that are put together in a way that is similar to selecting appliances from a catalogue. The problem in this regard is that the appliance concept in essence isolates and detaches the discussion of sustainability from the production-delivery-consumption chain in that the environmental appliances after all have to rely on the overall infrastructure of energy and materials. In this sense, the view of sustainable design in terms of mechanistic assembly of appliances presents yet another obstacle to a more substantive discussion on the subject matter.

The next hurdles in the education of is the lack of overall context where current technologies and their degree of efficiencies are put in concrete terms so as to be able to evaluate and situate the performance objectives in an appropriate and actual manner. It is indeed true that we have seen a deluge of alternative and improved technologies in order to raise the useful efficiency in a meaningful way. However it is crucial to point out that the combination of evaluation and certification, parts vs. the whole and the efficiency and performance objectives must be viewed and incorporated in the context of the overall design practice.

Endnotes

1. The design studio was initially conceived by the author at the Faculty of Architecture, TU Eindhoven, as a part of its international program. In the fall semester 2008, the design studio was launched with a covenant between the Municipality of Eindhoven and the faculty
in order to examine the city’s options in sustainable architecture. Subsequently, at the end of the covenant period in 2009, a publication project was initiated under the same title. After the initial four semesters at the TU Eindhoven, the studio concept has been moved to the TU Delft’s faculty of architecture where a new iteration will take its shape.


7. Vitruvius wrote of a certain foreign tribe’s use of an indigenous mud building technique that “makes their winters very warm and their summers very cool.” However he also concludes that the mud and thatch architecture is a “reminder of the fashions of old times” (Ten Books of Architecture, Book II, pp. 39-40).


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The Climatic City:
Irresistible Strategies for a Sustainable Future
Explorations in Sustainability

The School of Architecture at The Royal Danish Academy of Arts comprises several departments, each dedicated to specific agendas. Department 10’s position, entitled Conditions and Visions, is located at the intersection of an understanding of contemporary societal conditions, and the ability to articulate innovative spatial visions that respond to them. This approach is addressed through a discourse on what is commonly referred to as ‘sustainability’, a theme that encapsulates several of the key challenges of our contemporary moment, and the impending future.

While the ubiquitous use of the term ‘sustainability’ suggests an elevated awareness of a series of global challenges portrayed in increasingly apocalyptic terms – whether it is in corporate, governmental, research or architectural contexts, – it also defines an emerging orthodoxy. As a platitude demanded from the various agents of urban and architectural production, the term has developed into a necessary branding device for ‘correct’ and ‘responsible’ practice. Threatened by a considerable lack of specificity, the term ‘sustainability’ approaches a form of semantic exhaustion, in which its meaning and significance is increasingly elusive. Despite this exhaustion, an engagement with societal issues of sustainability still suggests a renewed relevance for the discipline of architecture, particularly after a period in which much of the discipline has been focused inwards.

In approaching architecture and urbanism within the context of these issues, we see two common pitfalls: the first involving the concentration of energy directed almost solely toward the definition of the term ‘sustainability’; the second entails attempting to provide a set of singular ‘sustainable solutions’ in the form of a new kind of “off-the-shelf” Neufert. In contrast, we are interested in an approach to sustainability that incorporates the problematization of the term itself. This has entailed looking critically and opportunistically at approaches to sustainability from the point of view of architecture as a discipline re-embedded in the broader issues of society – incorporating social, political, economical, and cultural as well as ecological dimensions. This awareness suggests for the discipline of architecture: on the one hand its re-grounding in the broad tradition of humanism; and on the other hand, the necessity for experimentations in defining an expanded role for the architect to react to emerging challenges. This conceptual framework suggests the privileging of a series of approaches in the development of the architectural project, involving:

i) highlighting quality (spatial, atmospheric, quality of life. etc) over quantity and the existing dominance of quantification within sustainability discourse;

ii) developing polemics around sustainability rather than interpreting sustainable design as a purely problem-solving task;
iii) exploring experimental approaches to specific problematics rather than the development of new orthodoxies to be applied to general questions;
iv) considerations of the purposefulness of resources rather than a purely result-based strategy; and lastly and perhaps most importantly,
v) maintaining the centrality of the generalist role of the architect, rather than striving toward a disciplinary model defined by technical specialization. This final approach is imagined in parallel with an acceptance of the need for conceptual specificity and strategic alliances with specialists.

In the 2010/11 academic year these concerns translated into a teaching program for a design-research studio for 38 students within the third and final year of the Bachelor studies program. Initiated by Charles Bessard, and conducted in parallel with the Institute for Urbanism and Landscape in the Architecture and Design School in Oslo led by Peter Hemmersam, the theme for the year has been ‘The Scandinavian City’. The study program included both a visit to Oslo by the Copenhagen-based students, as well as a visit to Copenhagen by the Oslo-based students, allowing the groups to interact with one another and engage in an active debate.

**Sustainability and Teaching: The Scandinavian City, The Climatic City**

Particularly since the global economic crisis of 2007/2008 – which placed the model of the *laissez faire* city of neo-liberalism under increasing suspicion – the Scandinavian city and the society and economy it supports has gained increasing weight in contemporary discussions as a potentially viable and sustainable alternative. With the Scandinavian cities located at the top of rankings in terms for both livability and sustainability in Europe and worldwide, a number of questions are raised: If the Scandinavian city represents a particular form of urbanization and “civilization” what can we learn from it, and its recent developments? What message can it deliver, and what is the potential relevance of this message, now and in the future? Could the Scandinavian cities offer models, for example, which achieve more sustainable forms of urban development without implying compromises in the quality of life or standard of living? Which contextual characteristics facilitated the Scandinavian cities to become the most sustainable cities faster than any other European capitals? Geographic? Economic? Or political? To which extent was the “green success” of the Scandinavian cities pre-conditioned by the urban and political tradition in the region? And to which extend it is the result of recent policies?

The starting hypothesis then of Scandinavian Cities offering potential models for overcoming the conflict between the agendas of sustainability and livability was advanced and expanded upon within the project framework of the studio. This was developed according to a multi-pronged urban approach – one that attempted to unite these concerns in what might be termed a sustainable welfare
strategy – a strategy that permits high mobility and international connections, while at the same time precluding excessive resource and energy consumption. Within this framework, projects could support both a sustainable-, and internationally competitive region appealing to ideal conditions for inhabitation, education, research and culture – forming a region of superior quality of life. Critically, such a strategy would also have to allow for many different population segments and cultures to thrive within the urban environment and surrounding regions, while creating space for interaction between them.

The output of ‘The Scandinavian City’ was envisioned as a polemical statement about the collective urban future, combining analytical research and design speculation – to be collated finally into the format of a book. The research component involved both an investigation of the underlying structures of the Scandinavian model, and an exploration of the differences between the various Scandinavian cities as different implementations of this model. Students were asked to engage in the historical and contemporary contexts within which these cities have emerged, and to position themselves vis-à-vis a wider debate on the future of cities through project assignments at different scales ranging from the overall plan of a prototypical city to the scale of an urban block.

Textures: evolutionary software and urban hardware
(Copenhagen Instructors: Anders Lonka, Deane Simpson, Dominic Balmfort, Mette Skjold and Charles Bessard)

‘The Scandinavian City’ project began with a four-week research assignment involving a survey of existing urban textures within Copenhagen and an analysis of the local evolution of two key characteristics of Scandinavian cities: their environmental profile, as well as aspects of their ‘livability’. Attempts to quantify these characteristics through green indexes and livability indexes reported and published by a range of consultants and NGO’s were investigated. Intended to provide decision makers with tools to evaluate their strategies, the hunch was that information behind these indexes might suggest how the Scandinavian cities achieved such high

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rankings. Was it a function of Policies? Legislation? Culture? Geography? Size? These indexes were combined with a visual history of the different key parameters in the development of the Scandinavian cities including politics and economy, environmentalism and lifestyles, growth and quality of life. This visual history was intended to identify and highlight key moments and milestones, crises and climaxes, in the historical evolution of the Scandinavian cities into so-called green and livable cities. Taking the shape of a gigantic historical fresco assembled by the whole group of students, it provided an evolutionary vision of what could described as ‘the software of the city.’

A range of contrasting urban textures within Copenhagen were surveyed and presented in the form of text, diagrams, drawings and models, allowing us to grasp ‘the hardware of the city.’ Working in groups of two students per texture, sites ranged from the medieval urban core to modernist formats in the city’s periphery, from residential to complex mixed-program areas, from the generic to the particular, and from the master-planned to the informal. Students were asked to assess the qualities and properties of the existing urban textures, by addressing the consequences of the various forms of urban organization through lenses such as density, typology, program, governance and so forth. How, for example, did the various typologies associated with these textures engender different qualities and conditions?

For each student, the assignment was intended to develop a base understanding of urban planning and design, including the various tools, typologies and terms of its discourse, history and potential future. Collectively, it produced a catalogue of urban textures that became a reference point for engaging in future urban issues – particularly those associated with the broader issue of climate change that would be addressed in the later assignment.
Battlefields: conflict and quality in the climatic city
(Copenhagen Instructors: Anders Lonka, Deane Simpson, Dominic Balmfort, Mette Skjold and Charles Bessard)

Figure 5. Battlefield assignment: introduction to urban flooding project. Students: Louise Pontoppidan Sørensen and Marie-Orit Theuer

Figure 6. Battlefield assignment: addition of new topography to address rainwater flooding in sensitive areas. Students: Louise Pontoppidan Sørensen and Marie-Orit Theuer
This six-week assignment required students to propose design interventions within sites in Copenhagen that represented future urban battlefields at the intersection of the dynamics of the climate change and quality of life. Beginning with the study of Copenhagen’s contemporary climate change goals, students speculated as to where these targets would have the greatest impact on urban development. Key battles were framed between various competing characters, materials and processes in the city – between old and new, public and private, top-down and bottom up, and so forth. This research phase culminated in an identification of key urban ‘battlefields’ in creating the future Scandinavian City.

The selected ‘Battlefield’ locations within Copenhagen became the sites for architectural interventions developed by students working in groups of two. Design interventions took place at the scale of the urban block, urban space and small settlement, and were directed toward not only the exploration of the potential of planning and design strategies to address climate goals and challenges – ones that are conventionally articulated in quantitative...
terms – but also toward the investigation of the potential for new urban and architectural qualities resulting from an alternative starting point. This implied the possibility to engage the spatial, material, atmospheric, and programmatic; as well as the social, collective, organizational, political and economic realms. Final proposals were presented in the form of models, drawings, diagrams and 3D visualizations predominantly at 1:500.

**Utopia: the welfare city of tomorrow**  
(Copenhagen Instructors: Anders Lonka, Charles Bessard, Deane Simpson, Mette Skjold)

During this twelve-week assignment students were challenged to design an urban utopia for the future Scandinavian welfare city – one that would not only contribute to addressing global climate problems and wider issues of sustainable development, but could at the same time foster new urban qualities and respond to the potential of the chosen site.

The site for the assignment was Papirøen, a 25,000sqm island currently used for newspaper storage located in Copenhagen’s Port across from the new Royal Theatre. The island is small in size but has a significant position in the port, since it forms the transition from the large pond of the inner harbour to the medieval city’s narrow harbour ways. It lies in the line of sight of both the southern and northern parts of the harbour, right where the harbour changes its direction. Combining residential, commercial and cultural program at a density of between 200% and 400%, the task suggested the design of both an urban structure and a performavit

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**Figure 9. Battlefield assignment: programmatic change according to rainwater level. Students: Louise Pontoppidan Sørensen and Marie-Orit Theuer**

**Figure 10. Battlefield assignment: model view of carpark, skateboarding area and temporary rainwater pool. Students: Louise Pontoppidan Sørensen and Marie-Orit Theuer**

**Figure 11. Battlefield assignment: rendering of public landscape intervention during winter. Students: Louise Pontoppidan Sørensen and Marie-Orit Theuer**

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Teaching a new Environmental Culture

landscape that could suggest an elevated quality of life, but with reduced carbon emissions. Such an approach entailed the formulation of positive and compelling visions that was not based around saving resources by reduced standards of living, but provided added value whilst providing a clear conscience.

Visions were encouraged to not only appeal to a few ‘saved’ individuals, but to attract a wide range of citizens. This translated into the general approach of fulfilling the needs of the many and not only the one – an approach essential to achieving targets for a low carbon future. The largest carbon load per inhabitant lies in personal consumption (private consumption connected to the way we live and the way we dwell, not including the house itself, but how we live in it and how we live generally). By effecting change for the individual, it may be possible to effect change in the system as a whole. Students were encouraged in particular to increase the qualities attached to the collective use and collective consumption of resources in order to make this the most attractive option, whilst at the same time significantly decreasing combined carbon emissions over time. Just as this urban landscape was to be designed and maintained to be constantly useful, cleaning water, air and soil, the community as a whole was to be designed to encourage compactness and enable key collective resources to become constantly useful.

A further layer of challenges existed in connection with the site itself and recent protests over the development of the area surrounding the site – representing a dilemma between the port land’s potential

Figure 12. Battlefield assignment: model view of project addressing site with polluted earth and sound pollution challenges. Students: Sarah Simone Frilund and Camilla Bibi Klingenberg

Figure 13. Battlefield assignment: model view of project addressing site with polluted earth and sound pollution challenges. Students: Sarah Simone Frilund and Camilla Bibi Klingenberg
as an economic resource and the desire to maintain the port as an unpretentious, recreational area supporting spontaneous activities. Such existing environments hold a fascination in their un-planned, non-orderly and spontaneous nature – encouraging non-programmed actions and appeals without dictating terms. Such qualities are often strong amongst dockland sites, but they are under increasing pressure along the numerous Danish coastline ports as they are gradually transformed from production sites to new city areas. Papirøen therefore becomes a relevant test site by which it is possible to examine connections with the water that maintain the port’s unpretentious environment, even after the industry is gone. Students were challenged to also address the following questions: How can we plan and design the seemingly unplanned? How can we reconcile the interests of investors with the city’s need for open space? How can the island’s surface be organized so it does not appear as an absolute whole, but leaves room both for what is there and what may come? How can local specificities be established while retaining the island as a single block in the harbour? How can port areas be designed attractively and in a way that is profitable but without eliminating the port’s uniqueness? This task, carried out in groups of three students, focused on a working method based solely on physical models beginning at 1:1000, followed by 1:500, finishing up with detailed utopias modelled at 1:200 scale.

Conclusion

The three assignments described above were intended to provide both an introduction for third year students to core aspects of urban planning and urban design, as well as an introduction to a wider set of issues and themes within the discourse around sustainable development. The progression through the three assignments tracked a shift from research into design, building up complexity as the course pro-
Teaching a new Environmental Culture

ceeded – building upon a set of tools and themes that allowed for the students to challenge existing sets of urban planning and design protocols derived from the conventional austerity narratives of urban sustainability.

Figure 16. Utopia assignment: model view of micro-climatic utopia. Students: Mette Damgaard, Anne Roer and Camilla Bibi Klingenberg

Figure 17. Utopia assignment: intention diagram. Students: Gry Taraldhagen, Liv Moodie, June Ravndal

Figure 18. Utopia assignment: city quality analysis. Students: Gry Taraldhagen, Liv Moodie, June Ravndal

Figure 19. Utopia assignment: suburban quality analysis. Students: Gry Taraldhagen, Liv Moodie, June Ravndal

Figure 20. Utopia assignment: neighbourhood concept model. Students: Gry Taraldhagen, Liv Moodie, June Ravndal

Figure 21. Utopia assignment: mid-term concept model. Students: Gry Taraldhagen, Liv Moodie, June Ravndal

Figure 21. Utopia assignment: final presentation model. Students: Gry Taraldhagen, Liv Moodie, June Ravndal
Alexia Luising, Peter Teeuw, Kristel Aalbers, Alexander Mooi and Henry van Bennekom

Faculty of Architecture, Technical University of Delft, Delft, The Netherlands

Research and Design for Sustainable Environment
Introduction

The Chair of SMART Architecture is one of the four sustainable Chairs in the Faculty of Architecture of Delft University of Technology.

SMART Architecture focuses on two main streams:
1. Sustainable Development in the built environment
2. Sustainable Solutions.

The first theme is the basis for research. How can architecture contribute to a development that foresees the needs of inhabitants, without confining the needs of future generations, inhabitants and others?

The second theme is the basis for education. What- and in which form- can architecture contribute to a sustainable physical environment? With the implementation of this Chair we want to state that sustainable design has priority in architecture.

The Chair will contribute to fast developments in this broad field and will focus on innovation. Students are not only taught in intellectual knowledge, but will also be stimulated to develop their own vocabulary.

The MSc 2 the Chair offers a package of elective courses: Research & Design for Sustainable Development. This package consists of three courses that are interdisciplinary but can be taken separately as well. Known as AR0083, AR0084 and AR0190 these courses focus on central themes of sustainable development, sustainable building and sustainable urban development. Their aim is to be relevant to students of all specialisations of the MSc degree programme of the Faculty of Architecture while still offering students the possibility to zoom in on their own main subject. The courses on offer are meant to be part of the elective courses of the Graduation in 'Technology in Sustainable Development', TiSD (or TiDO in Dutch), specialization. Additionally, students can graduate in sustainable studios.

Graduation in Technology in Sustainable Development

The above-mentioned courses can be part of the Technology in Sustainable Development graduation specialisation. Students from all faculties at Delft University can choose this specialisation and will receive a special appendix to their regular diploma if they conform to the following statement:

“The (TU) commission Sustainable Development has established the final course goals of this graduation specialisation. Students who finished the specialisation successfully, have specialised themselves recognizably in sustainable development, environment and technology, in such a way that they are able to:

• analyse effectively complex situations in which contrary interests play a role;
• control the main methods used in their technical discipline with which environmental and sustainability problems are solved;
• consider technological options to solve sustainability questions and to weigh these against each other;
• indicate which organisational social changes result from the chosen options;
• formulate new technological options and review these options on their effectiveness (technical, economical and social).”

The TiSD annotation is a result of the demand for graduates who specialise themselves in sustainability within the different work areas for engineers and their specialities. For architectural engineers this means that during the MSc study some demands have been met. These demands consist of free choice courses (11 ects) on the topic of sustainable development, a TU central colloquium of 4 ects, and a graduation project (Msc3/4) related to sustainable development.

Free choice course goals

Students from all four MSc specialisations at the Faculty of Architecture can participate ‘interdisciplinary’ and interact in the sustainable free choice courses. Each student works within his or her own field in cooperation with other graduation specialisations. The emphasis is on the integral (and ‘interdisciplinary’) design and research.

The courses prepare the student for his or her graduation, while each course is an independent whole. The course goals of the free choice courses are equal for every student and will expand the knowledge acquired in the Bachelor. These course goals refer to sustainable development, and connect the educational goals and end terms that apply to the (TU-wide) graduation specialisation Technology in Sustainable Development (TiDO).

The free choice courses are interconnected. Knowledge and skills attained in the sustainable development programme and in the workshops programmes can be applied and deepened in the design tasks.

Overview Free Choice Courses

The different master courses are organized and scheduled in such a way they can be chosen simultaneously.

The courses AR0083, AR0084 and AR0190 form a package.

Sustainable Development Programme- AR0083 - 3 ects

In a number of inspiring lectures on general and specific topics, knowledge will be acquired on the topics of environmental planning, environmental design and ecology. The knowledge can be used in discussions, research and design. Students will be required to prepare, for example by formulating questions in advance.

The course will be concluded with an essay and a take-home examination.

Sustainable Design - Time Based - AR0084 - 12 ects

During the programme design and design-driven research is conducted. Ground breaking design and research will be done. The design will occur within different time scales (200 years, 30 years, 3 months). The student chooses his
or her own design related research area. Design and research tutors will assist the exercise during central meetings. The character of the assistance can be described as workshop-like.

The final-products are regional, urban or architectural designs and a research report, both of which are assessed by a lecturer and a research tutor. The assessment is also based on interim testing and an oral presentation. In addition, a logbook must be kept with findings and the progress. All the products must be submitted at the final presentation.

**Urban Sustainability (Maximisation Method) - AR0190 - 2 ects**

The maximisation method is a method that focuses on design, where environmental themes provide structure for that design. Based on the design brief for a neighbourhood (approx. 2000 houses with facilities) and the available location, a workshop will be held in which several environmental themes will be maximised and combined to an optimised framework. Assessment is based on three presentations and the end product. The final result is a design for a district, neighbourhood and/or block with oral presentation and written commentary, capable of being understood without further explanation.

**End terms specified per course**

Students who successfully complete the free choice courses:

**AR0083 (former code AR0085)**

Have ready knowledge concerning sustainable development in general and sustainable building and urban development in particular.

The ready knowledge includes:

- knowledge of concepts and the conceptual framework of sustainable development and insight into the role of architects and urban planners in this regard;
- general insight into the mechanisms underlying sustainability problems and awareness of the risks associated with non-sustainable development;
- knowledge of building-related environmental techniques and solutions and insight into their social dimensions;
- overall insight into the dimensions (variables) associated with sustainable development (particularly in reference to the Dutch environment);
- insight into urban development and spatial planning issues in relation to sustainable development (particularly in reference to the Dutch environment);

**AR0190**

- are capable of effectively analysing complex urban development situations in which divergent environmental interests play a role;
- are capable of elaborating various solutions in urban planning and design for various environmental interests and weighing these against alternatives.
AR0084
are, for a given design location, able to:

• identify and analyse relevant environmental themes and sustainability issues in an urban, architectural or technical design (or in a strategic plan), for different temporal and spatial scales;
• apply an environmental design perspective and strategy to a design location;
• cooperate with people of other disciplines in design and research.

The environmental design perspective and strategy are central in this course. More specifically, the ability to apply this design perspective means that the student is able to:

• gather information about relevant environmental themes for a design location;
• use this information to extract relevant environmental design criteria for different temporal and spatial scales;
• identify construction-related sustainability issues and generate solutions to these issues;
• assess the relevant sustainability impacts of different construction-related solutions;
• create and present a coherent sustainable design (or strategic plan) as a deliberate combination of the different solutions.

AR0083 - Sustainable Development Programme

Introduction

Information will be imparted during this programme by means of lectures. The lectures discuss basic knowledge about sustainability and enthuising tales. This knowledge gained can be used for discussions, research and design. During most lectures debate plays an important role. The content of the lectures has a relation with the programme of AR0084.

The lectures emphasise the challenge of sustainable building; they serve herewith as inspiration for the design and the workshops. Students are asked to prepare for the lectures, i.e. by formulating questions for the lecturers in advance and by reflecting on every lecture by weekly assignments.

Programme

The sustainable development program will be mostly self-study. The self-study is initiated by a series of lectures and debates by a diverse selection of speakers.

Next to the lectures a reader with articles on sustainable building from the lecturers and other topics is available. Also recorded lectures from previous courses are available for the students.
• Lecture 1: Theme Social quality: Liveability, dr. ir. Machiel van Dorst, TU Delft
• Lecture 2: Theme: Building approaches: Flex Buildings, ir. Jacques Vink (Spacelab 2 architects)
• Lecture 3: Theme: Strategies: The challenge of Sustainable Building, Prof. dr. ir. Leo Jansen, TU Delft
• Lecture 4: Theme: Building approaches: Sustainable water design, Hiltrud Potz (OpMAAT architects)
• Lecture 5: Theme: Environmental quality: Living with nature, prof. dr. ir. Taeke de Jong, TU Delft
• Lecture 6: Theme: Economic quality: Sustainable Housing Transformation, prof. dr. ir. Anke van Hal, TU Delft, Business University Nyenrode
• Lecture 7: Theme: Building approaches: Building as a source of energy, Caro van Dijk, Paul de Ruiter Architects.

Assignment
The assignment for the course consists of two parts: An essay and a take-home exam on ecology.

Besides the main assignments every lecture ends with a small assignment containing a question on that week’s lecture; this as an encouragement to process the acquired knowledge and to discuss the statements made during that lecture. The results, an A6 postcard, are handed in at the next lecture.

The essay assignment for students consists of a question that is answered with the acquired knowledge during the lecture and by studying the reader. In a written essay students answer the following question:

• What would you like to be your position in the building scene in five years and what is your own role for the assignment for a sustainable city?
• Illustrate this with examples from the lecture series and give your own opinion about the point of view of each lecturer.

AR0190 – Maximisation Method

Introduction
The maximisation method is one directed towards design, in which environmental

Figure 1. Examples of A6 postcard assignments
themes set the structure for the design. On the basis of the brief and the loca-
tion, a number of environmental themes are ‘maximised’ in a workshop. The
themes include (e.g.): Landscape and Soil; Flora and Fauna; Water; Mobility;
Energy; Waste.

Design processes are often carried out in a highly individual way, which makes
it difficult after the event to find out exactly what happened. The process, from
the site analysis and the brief / the program of requirements through to the
design, takes place primarily inside the head of the designer(s). Sometimes the
concept is dropped from the sky and even the direct involved other disciplines
don’t know why this is the best concept.

The Maximisation Method makes it possible to:

• work on a interdisciplinary way
• make clear which themes are structuring and which themes have priority
• clarify the design process and show decisions made
• get a better result

Working Method

An outline of the ‘best structure for the environment’ is provided on the basis
of the environmental constraints in question. The made sketches are then ex-

Figure 2. The Maximisation Method: the design process seen in time
amined to see which reinforce and which contradict one another. Next, the various maximisations are optimised. It is also discussed which topics should be regarded as primary and which as secondary. This way a number of variants is developed for the location. These variants are used as the basis for design preparation and for maximisation at the neighbourhood and block level, thus the workshop concludes.

The exercise is held in the form of a workshop during a concentrated period of one or two weeks. The result of the course is a written report as well as an under layer with constraints for the design for the AR0084 course Sustainable Design, Time Based.

The time commitment in total is 56 course load hours. This includes approx. 18 hours contact time, approx. 38 hours individual study. This course is connected to AR0084. The workshop is also an integral start of the AR0084 course.

### Programme

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>week 1</td>
<td>Monday</td>
<td>Introduction maximisation / bicycle excursion study location</td>
</tr>
<tr>
<td>week 1</td>
<td>Tuesday</td>
<td>Workshop maximisation (unguided) / excursion to sample location Roomburg - Nieuw Leyden</td>
</tr>
<tr>
<td>week 1</td>
<td>Wednesday</td>
<td>Workshop maximisation (unguided) presentation maximisation / introduction optimization</td>
</tr>
<tr>
<td>week 1</td>
<td>Thursday</td>
<td>Workshop optimisation (unguided) presentation optimisation / introduction integration</td>
</tr>
<tr>
<td>week 2</td>
<td>Monday</td>
<td>workshop integration (unguided) / presentation integration</td>
</tr>
<tr>
<td>week 2</td>
<td>Tuesday</td>
<td>Hand in assignment</td>
</tr>
</tbody>
</table>

Figures 3. Examples of Student Work: Optimisations and Maximisation
Introduction

EnvironMENTAL design (eMd) is a perspective and a strategy for urban design in which the prime concern is the socio-ecological quality of life for human beings, plants and animals and sustainable development generally. A design strategy is understood as an explicit working method in which principles, aims and means are reflexively coordinated. The design principles of eMd are anything but rigid, however, and aim to retain maximum flexibility in working practice. Above all, eMd aims to encourage designers to engage in active research to find optimum ways of enhancing the socio-ecological quality and sustainability of the urban environment.

Thus, eMd seeks to actively enhance the quality not only of the human environment but also, in one and the same movement, the quality of life for the plant and animal world. With its key focus on establishing ‘biotic’ conditions for plant, animal and human communities, the eMd design process operates at the town/country, culture/nature interface and is concerned simultaneously with both architectural and ecological parameters. eMd is also characterised in being a process-oriented approach in which the designer explicitly takes the service life of a building, housing estate or town into account.

Finally, eMd aims to scientifically structure the design process, allowing designs to be checked and verified - by others (generally a posteriori), certainly, but also by the designer him- or herself, as an ongoing, iterative process of self-reflection and self-criticism.

Central theme

Central theme is the relation between:

- the planned time period of use and way of usage of an environMENTAL design and
- the choices made on different scales of the environMENTAL design: the urban planning (the chosen location), the architecture and the materialization.

For exploring the central theme, students will design on different timescales: 3 months, 3 years and 200 years. The sustainability (or durability) of the design will be related to structure and freedom on different scales. Depending on the timescale, the emphasis be on public space, building and urban compositions.

Each time period has its own boundary conditions and challenges.

A season: ‘focus on a particular though variant set of bioclimatic conditions.’
User  The use is temporary. It will only take a season, for example during winter time.
Climate  The whether type is constant.
Location  Small scale design can be part of an existing building or existing public space.

30 years: ‘Identity by Extension’
User  The life of the user consists of different phases.
Climate  There are different seasons.
Location  The design has an impact on the location; it can be a house or an infill. It has to sustain somewhere, but is also removable.

200 years: ‘do we dress for the crash or for the ride?’
User  Several generations of the population will use this design and in different ways.
Climate  The climate will change on the long term.
Location  The (infra) structure needs to be endurable.

**Working method**

Students will be part of a student design group made up of students from different disciplines. It is part of the course to allocate fitting tasks to the individual members of the group and to develop a clear group structure. At the start of the course the students familiarize themselves with the location (in this case a location in Delft, the TU North area) and collect relevant design information. An important part in this process is interviewing experts in the field. The group will discuss the progress with the tutor twice a week. At the end of the course students will present the design to policy officials in charge of the actual development of the land. Extra knowledge on the topics is acquired by fieldtrips and theme lectures.

During the course the group makes two fieldtrips. One to the XX-building in Delft. This is a Time Based office designed for a lifespan of 20 years. The other fieldtrip is to the Haagse Hogeschool, an educational building in the design location.
The theme lectures are offered on the following themes: microclimate, water and energy.

Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Students-instructor meeting</th>
<th>Subject</th>
<th>Students should prepare</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>Introduction</td>
<td>---</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>Location analysis (with AR0190)</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>Theory</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>PRESENTATIONS</td>
<td>“Analysis” presentation</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>Design season</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>Design season</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>Design season</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>Introduction 30 years</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td>Design 30 years</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>15</td>
<td>11</td>
<td>Introduction 200 years</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>15</td>
<td>12</td>
<td>Design 200 years</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>16</td>
<td>13</td>
<td>Synergy in time span</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>16</td>
<td>14</td>
<td>Design 200 years</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>PRESENTATIONS</td>
<td>“First design” presentation</td>
</tr>
<tr>
<td>17</td>
<td>16</td>
<td>Design</td>
<td>“Final design” presentation Submission of final report</td>
</tr>
<tr>
<td>18</td>
<td>17</td>
<td>Discussion on synergy</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>Design</td>
<td>Interview with experts</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
<td>PRESENTATIONS</td>
<td>“Final design” presentation Submission of final report</td>
</tr>
</tbody>
</table>

Figure 5. The time commitment

**Evaluation**

The elective package offers students the opportunity to gain more in depth knowledge on sustainable building and sustainable development. In the design courses this is stimulated by letting students work in teams with students of different backgrounds and specialisations. Also the opportunity to let students choose their own themes and scales makes it easier for students from different specialisations (i.e. urbanism or building technology) to participate. Discussion is stimulated in the design courses AR0190 and AR0084. Internal peer assessment takes place in the design studio during the course. At the final presentation a reflection of external peer is given.

The electives in the Master programme are based on the knowledge on sustainable building and sustainable development that is offered in the Bachelor programme. However only a part of the students that participate in the courses have also done their Bachelor Programme at the faculty of Architecture. The presupposed knowledge for the course may not match with the desired knowledge level from the participating students. This is partly overcome by offering a presupposed knowledge chapter in the AR0083 course reader. However screening future participants and giving advice on how to fill up the knowledge gap is desired.
Helen Maistrou and Dimitris Thomopoulos

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Environmental Issues in the Architectural Design Studio
Environmental Issues in the Courses of the School

Design education in the NTUA is sensitive to most environmental issues. Professors of design courses agree that the examination of environmental parameters should be realized in all studio courses. But in action, this is not always a clear parameter for the projects’ requirements. It therefore falls into disuse, under the pressure of the other factors forming the final result, given that students find it difficult to simultaneously confront all parameters coming into play within the architectural design. Besides, these parameters are weighed differently by each professor and each student group – something becoming obvious in the results of the student projects and in their evaluation criteria.

But, although the environmental parameter constitutes by definition an integral part of the architectural design and should always be introduced into the educational procedure, experience has shown that it would be educationally useful to highlight it in one of the design courses, in favor of a better understanding on behalf of the students.

At the same time, it would not be possible to include specialized issues concerning construction methods and computing systems within the framework of design courses; these should form instead the object of special technological courses which should also exist in the school.

The curriculum of the NTUA School of Architecture first acquaints students with an obligatory course for the 3rd semester, entitled ‘Environment and Spatial Design’ which introduces subjects and concepts regarding the man-made and natural environment and the repercussions it suffers from design. As also mentioned by the course guidebook, the course’s aim is to understand basic concepts and methods within the approach of the environment and ecosystems as well as to understand the causes behind its degradation.

In the 5th semester of studies within the context of technological courses, another obligatory course develops, among others, the issues of ‘Bioclimatic and Energy Planning’ through theoretical courses and corresponding exercises.

At the same time, the curriculum offers two electives covering environmental questions. The first, entitled ‘Environmental – Bioclimatic Design’ is offered in the 5th semester by the Department of Synthesis in cooperation with the Department of Technology. The course aspires to make students understand the importance of introducing environment-posed parameters into the synthetic concept, in all levels of spatial design. The second course, entitled ‘Special Environmental Issues’ is organized by the Department of Urban Planning in the 8th semester and delves into the repercussions that housing development and design have on the natural and man-made environment, on an urban scale.
This paper will present the reasoning, the evolution and the results of the first course, which is the only relevant course actively implicating professors from the educational Department of Synthesis in collaboration with the professors of Technological courses.

«Environmental Bioclimatic Planning and Design»

*Theory and Practice Compulsory by choice Module in 5th semester*

Through a program of theoretical courses and small design subjects (projects) on different design scales – from the building to the city –, this particular course has strived throughout these latest years to help students:

- understand the principles of Environmental Planning and Design and how they participate in the design process
- understand the role of design choices and the interest that can acquire the design process through highlighting the parameters of this design
- probe into the notions of bioclimatic design, through alternative methods of volumetric organization and formation of the section and facades of a building or complex, thus aiming at achieving optimum lighting and ventilation, thermal comfort, the quality of interior spaces, energy saving and the aesthetic interest of the final project.

**Manner of teaching – Scope of the exercises**

Being an elective, the course is taught for three hours per week: one hour is dedicated to theory while during the other two, the students work in groups of two or three on common exercises with the help of a group of teachers.

The course is supported through the presentation of architectural works whose design respects environmental principles, as well as through special courses concerning proper lighting, ventilation, cooling methods, the choice of proper construction and building materials, etc.

The presentations as well as the notions that the students are called upon to elaborate in their assignments are organized in themes and cover the following categories:

a) Basic notions
   - Bioclimatic architecture
   - Energy-efficient architecture
   - Environmental design
   - Green architecture
   - Sustainable buildings

b) Subjects pertaining to energy
   - Energy consumption of buildings
   - Energy saving
   - Use of mild forms of energy
c) Sustainability in the building’s cycle of life

d) Principles of sustainable design
   • Climate and microclimate
   • Harmonization of the building with the environment
   • Orientation / Lighting / Shading / Solar Geometry
   • Thermal comfort / Energy exchange between the building and the environment
   • Insulation of the building shell.

e) Lessons learned from traditional architecture.

Along with theoretical courses, the students’ groups work on common projects which are differentiated each year, in an effort to cover the spectrum of the fields where the aforementioned principles are implemented. The subjects chosen so far for the studio project can be placed into two basic categories:

a) Environmentally degraded urban public spaces.

The aim of the exercise was to redesign street networks in the centre of Athens, central squares and free spaces manifesting functional and formal degradation, as well as environmentally challenged riparian areas of streams within the urban tissue, all with a special emphasis of environmental parameters.

The students were called to study and use various synthetic tools in this direction, according to the specificities of each subject, such as:

Study to upgrade their microclimate through the use of lightweight seasonal lodgments and planting; these interventions offer cooling and shadow and operate as a filter to exhaust gas and noise pollution.
• Redesigning pedestrian and vehicle movement by means of widening sidewalks and streets of mild circulation, and using water surfaces and short waterwalls between the pedestrians and vehicles; the planting and use of lodgments offering cooling while delimiting movement
• Replacement of surface construction materials with new ones, light-colored, recycled and water-permeable
• Lighting and signaling redesign through the use of renewable energy sources
• Maintenance, promotion and utilization of these streams as natural elements and organic spaces within the city, through upgrading their immediate environment
• Arrangement of the gradients and the bed according to the seasonal water flow
• Connection of the riparian regions and the use of lightweight constructions with natural materials defining areas for walks, stops, informing and recreation and locally bridging their width
• Formation of seasonal constructions into streams inner part.

b) Environmental upgrading of existing buildings, such as school buildings or buildings of social housing etc, through interventions in their existing shell and surroundings.

This course was directly linked for a number of years with the design course (studio) of the 5th semester, in which students design a school complex; students are therefore given the possibility to immediately control their design choices. With one of its teaching rooms as the particular field of research, the school building designed in the studio was examined in reference to its environmental features. Specific alterations were suggested in regards to:
• the placement within the building plot and its volumetric and functional organization, in relation to the environmental features
• the elaborating of its section in regards to the lighting and ventilation possibilities
• the kind and placement of openings, in relation to the orientation and the sun-protection systems used
• the final elaboration of the surfaces in the shell of the building, but also of the courtyard space.

In most of the years, this elective course was combined with the participation of a group of students in a 7-10 days «Intensive Programme» of interuniversity cooperation organized by the Florence University within the context of the European Program Erasmus on the subject of Sustainable Design.

During the program, the students attended lectures by university professors within the context of a workshop and they jointly elaborated subjects ranging from the scale of urban planning to the scale of a building. Their projects as well as the communications presented in the workshop were published in international reviews.

**Outcomes of the Module**

The scope of the course presented is the understanding of the principles of Sustainability in Architecture and the highlighting of their importance for the design of new interventions in the urban space.

The architectural choices and design decisions determining at each time the placement, form and construction of buildings, the formation of their open spaces and the interventions in their immediate surroundings, should guarantee:
a) The harmonization with the natural and built environment, lifestyle and local climate characteristics.

b) The creation of closed as well as open quality spaces for living, with all necessary conditions for thermal and visual comfort.

c) The aesthetic quality combined with an environment-friendly construction.


Through the variety of the subjects elaborated, the realization of the aforementioned special course influenced substantially the thinking of all participants (professors, PhD candidates, students) and brought to light the importance of the studio as a central axis for the acquisition of environmental culture. Many of the students having attended the course participated with their projects in related exhibitions and contests and chose corresponding subjects for their diploma project, while many continued with postgraduate studies in this same field.

The experience from the realization of this particular course highlighted the view that environmental subjects should be incorporated and promoted in every synthetic subject of the studio, while at the same time reinforced by more specialized courses. Moreover, they should cover all design scales and result in construction elements throughout the period of study, from the first year until the diploma project, in the aim of fostering a broader environmental culture.
Adriano Magliocco

Faculty of Architecture, University of Genoa, Genoa, Italy

New Competences for an Environmentally Sensitive Architectural Education
Trans-scale and trans-disciplinary architects education for an environmental sensitive world

Traditionally in the Italian Architectural schools the topic of the teaching of environmental design and sustainable architecture has been approached, and developed, by professors of my discipline, Architectural Technology. This topic, environmental sustainability in territorial transformation and construction of architecture, is nowadays further evolving.

During the “Osdotta 2008” conference on Architectural Technology Doctorate where the professors of technology of the Doctoral Courses at the various Italian Faculties held their regular yearly meeting to discuss and exchange views, I was Tutor at Table 2 “Innovation of living forms at an urban and regional scale”. The discussion was focused on topics and the so-called “atypical” scales of intervention with respect to the consolidated lines of research of architectural technology. Some of the expressions used could appear to be misleading with the usual terms in the framework of the discipline (building technologies): urban scale, regional scale, both associated with the concept of “innovation of living forms”. A large number of research dissertations appeared to be conducted on an operational scale apparently extraneous to the usual ones, that is to say to architectural construction and management of innovation in the building process and in production. Are we in front of a field invasion of my discipline, driven by a desire of expansion and colonisation?

One possible answer is that the Architectural Technology sector, a pioneer in Italy when in approaching the complex context of environmental sustainability of human actions over the territory, has in some way taken control of the principles of sustainable management of the construction process, and further developed and promoted – for the variants of product analysis, process and design – from cradle to cradle according to a requirements-performance approach (characterising our sector), which is useful in obtaining coherent results, even in a far wider context, over a large scale, dominated generally by complicated relations between politics and the market.

Considering the audience of this paper (such a discipline is not presumably defined in the same way in all the European architectural schools and institutes) and before proceeding with other considerations, it is worthwhile pointing out that the disciplinary sectors have recently been restructured and the sub-division in force for several years “compacted”. The sector is today defined, within the disciplinary area No. 08 “Building and Architectural Engineering” as “08/C1”: Building Technique and Architectural Technology”, with the following declaratory statement:

“The sector is involved in scientific activities and teaching-training in the field of technical architecture, building production and architectural technology. In the field of technical architecture – building planning, the scientific-disciplinary
content, expressed in theories, methods and operating techniques, concerns the constructive feasibility of architectural invention, sustainability and performance quality of the building organism and its components, construction and management of the organism itself, as well as the new construction and recovery, re-structuring and conservation of the existing building, and the organisation of building production. The objective of the studies is to promote compatibility between design scope, requirements and regulations, quality control and performance, organisational requirements, socio-economic and environmental limitation and safety guarantees aimed to a useful and programmed design life, and a controlled ageing of the works through representation of the problems with engineering models, laboratory and “in situ” experiments and data analysis.

In the field of architectural technology, the scientific-disciplinary content concerns the instruments, methods and techniques for the architectural design of the various scales, as well as the techniques for transformation, realisation, maintenance, recovery and management of the natural and constructed environment (for the aspects regarding the sector).

Moreover, the aspects regarding the technological design in architecture are also examined following a requirements and performance based approach of the manufactured items and building assets; the invention correlated to the constructive conception of the works; innovation and technological experimentation in the view of social, economic and environmental sustainability.

The scientific content includes: technological culture and history; study of natural and artificial materials; study of building technologies and construction systems during their historical development; design and experimentation of materials, elements and construction systems; environmental design and sustainable design of buildings including their energy efficiency; management of the design process; design technologies, construction, transformation, maintenance and management of buildings; innovation of the product and process; critical assessment of design alternatives; requirement dynamics, performance aspects and control of architectural and environmental quality”.

(taken from Annex 3 of General Opinion No. 7 by the National University Committee, issued for the Review of Scientific-Disciplinary Sectors, at the Meeting of 04.11.2009).

Evidently a building process can be considered, as a function of the objectives of the analysis, by shifting the starting point to the end point as it is done, for example, in the Life Cycle Assessment for environmental assessment of products. When the topic concerns energy, for example, it is only possible to analyse the energy performance of the building during operation, or the energy content of the products used, but it is also possible to assess the energy recovery by thermo-valorisation and by life-end recycling of materials, etc. In other words, when
we have to deal with the analysis of the impact on an environmental process, it is possible to extend the analysis to other contexts in an increasing dimension according to the objectives.

The creation of instruments for active protection of the territory, or for the integration of socio-economic development actions with the objective of environmental protection – intending, for example, Strategic Environmental Assessment (SEA) for plans and programs, but also for the activities to be carried out in areas belonging to the Nature Network 2000 (Sites of Community Interest and Special Protection Areas) – are an evident sign of how our community, intended in the most widest sense (Europe) of the term, has finally understood that it is not sufficient to reduce energy consumption in buildings to reach a model of sustainable development. Does the number of sustainable buildings form a sustainable city? Most certainly not.

The prediction of the effectiveness of a design approach which reduces the consumption of resources implies the knowledge of processes involved up to the end of the chain: scheduling, planning, urban design, production, construction etc. This probably means having to deal with design procedures through processes which, even though linked with the topic of architectural construction, are developed through a trans-disciplinary experience.

What does this affirmation mean?

The introduction and evolution of the concept of sustainable design is leading towards, in a certain sense, a change in the way the designer works. Design is a typical multi-disciplinary activity, in which everyone is assigned with a specific task, the sum of which should allow the objectives to be achieved. It is quite often said that the architect is the “director” of the building process and this is most certainly true in limited complexity processes. When the complexity increases and the number of professionals involved increases, there is the risk that the overlapping of roles becomes more difficult to manage, Each one will try to carry out his or her own assigned role in the best possible way, at least one hopes, but it is possible and rather probable, that the specific objectives of each one contrast one with the other, if they are not “filtered-out” by a common logic.

However the concept of “trans-disciplinarity”, in my opinion, envisages that the single problems (i.e. sizing calculations for the structure, for a plant, etc.) are not tackled according to a pretence of individual optimisation as much as sharing the achievement of an objective – presumably the satisfaction of the customer – as a function of the economic-social-environmental context.

The trans-disciplinary approach (herein evoked but a long way from being indisputably defined), may seem on one side to be coincident with the habitual (and already very complex) multi-disciplinary approach, and on the other side it may seem ideal since it sets public interest (defined by the concept of “sustainable development”) as a filter of private interest.
Moreover this approach implies a vision, by the players of the process, less affected by roles and relationships (above all between professional and customer) and requires a propelling global vision of a problem which is generally defined locally. Therefore it requires a re-approach of the professional action to the category of “intellectual” services, by means of a cultural type action that implements the technique as a means and not as a purpose. In this way the professional will become a guarantor towards the community with respect to the works assigned and not a mere “armed wing” of the customer. In theory it should be this way but in reality the particular interests tend to prevail.

The impression is that a degree in architecture over the last few years has become more a preparation to the profession. This is not necessarily a negative element; I even defined, in the article published in “Experimentation towards integration” “Joint Workshop: ENHSA-EAAE” in 2009, the dissertation of a degree as a possible moment of passage from the academic world to the professional world. However one should not fall into the error of conceiving university studies as a professional school, thinking of the architect as a technician whose mission is to satisfy, by dribbling between the statutory obligations, customer wishes.

The trans-disciplinary approach is particularly important in those cases of territorial transformation with strong environmental values, in which technical decisions and planning actions are closely connected. For example, the possibility of carrying out activities within a site of high environmental value (like a Site of Community Interest) depends on the relationship between the advantages able to be achieved, in economic-social terms, and the risk of making irreversible changes to the territory by reducing the environmental its value. It is evident that in a case like this the political decision of intervention is closely connected with the technical possibility of developing that action without damaging the ecological asset of the area. Demonstration of the feasibility will induce the inclusion of the action in the planning procedures, otherwise similar results may be caused by different actions. The focus moves from the development of the action, as a possible alternative instrument, to the achievement of a development result that is probably obtainable with different actions.

As in many other cases this does not only imply being able to have a dialogue with various competent authorities, a frequent task for the architect, by accepting the reasons of the various professions. In the same way it is possible to say that it is necessary to move from “understanding their language” to “learning their language”, in other words to understand and share the reasons of other professions¹ and to believe transposing them into design².

From a teacher’s point of view this implies the shift from a strictly disciplinary approach, which however still remains to provide basic notions, to a teaching focused on far-reaching topics (to be carried out during the latter years and during dissertation), connected with architectural design but in which the develop-
ment of the design includes, besides formal, spatial and functional definition, an analysis of the ratio between expression of the particular requirements by the hypothetical customer and expression of the needs by the community, in whose territory the building is to be constructed.

Only actions which follow this type of process, in which the protagonist is the result (social-economic-environmental development) and not the means (building, infrastructure etc.) can be considered as “sustainable”.

Endnotes
1. This is not a new element: how can one forget the activities of Ian McHarg “landscaper architect” who in 1969 wrote the important paper “Design with nature”?
2. Over the next generations will the architects know how to share the common objective or will they remain associated with the role of “fashion designer” of architecture?
3. Intending community as the set of relationships between bioptics (therefore not only man) which, together with the abioptic presence, contribute to the formation of the “environment” in its widest sense.
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School of Architecture, University of Minho, Guimaraes, Portugal

The Environment as Part of Architectural Curricula in the University of Minho
Abstract

This paper tries to identify and characterize the places among the studies curricula of the Architecture graduation program at the University of Minho, where the environment appears as a major concern. Knowing that environmental aspects should always be considered as an integrated part of sustainability concerns in general, environmental issues in the University of Minho’s graduation are integrated in a Sustainability Module, composed by 3 Curricular Units: a “Studio – Sustainability”, a “Seminar - Sustainability” and a “Compulsory – Indoor Environmental Quality”. This Module happens in the first semester of the 4th year, integrated on the “Construction and Technology” scientific area, offered to approximately 1/3 of the students. The recent experience about the work in this module, that started just two years ago, is reported here.

Introduction

The University of Minho was founded in 1973 and began its academic activity in 1975/76. It is organised in 8 Schools and 3 Institutes located in two Campuses, one in Braga and the other, where the Architecture School is located, in Guimarães, two cities from the Minho region in the north of Portugal. The now Architecture School, since October 2009, began in 1996 as an Autonomous Department of the Engineering School, the biggest School from the University of Minho, also located in Guimarães. The Architecture Graduation Course in this university began its curricular activities in the year 1997/1998. The vicinity with the technical laboratories and skills of an Engineering School, present in many of its areas (from Civil Engineering, to Mechanical, Polymers, Textile, Computers, among others), and a matrix organization, assured an interdisciplinary approach to Architecture Teaching, where also Economy and Management, Philosophy and Culture (Aesthetics) and the Social Sciences are present (Geography Department is also located in Guimarães).

In 2006 the graduation Course (“Licenciatura” degree) was converted into an Integrated Master Course, following the directives derived from the Bologna Declaration for global competitiveness of European higher education and the Portuguese Law for higher education. The transition between the old and the new studies curriculum took 3 years and the new Curriculum is implemented since 2008/2009.

The training is based on practice and theory, exploring the teaching/learning methodologies set forth by the Bologna Declaration. The development of these competencies/skills implies an increasingly profound learning throughout the study plan/course based on: project activity, supported by design as a tool for conception and representation, and also by theory and history, which stimulates further reflection on architectural practice. The major underlying goal is for the training to promote creativity among the students, in order to generate and deepen innovative solutions at a technical and functional level, as well as acquir-
ing the adequate sensitivity/awareness for the aspects of communication and for socio-cultural specificities. A pro-active attitude looking at changes in economical and environmental contexts is strongly inculcated. Students are stimulated to present the results achieved from their work in a concise and rational way. They must reveal an enterprising spirit, teamwork ability, citizenship values and ethics.

**Architecture graduation Curriculum in the University of Minho**

The 1st cycle of the integrated master – 1st to 3rd years in a total of 180 ECTS presented in Table 1 – assures a basic architecture formation on all the aspects necessary to achieve a balance between the theoretical and the practical aspects of architectural training and guarantee the acquisition of the following knowledge and skills referred on the directive 2005/36/EC of September 7th 2005 on the recognition of professional qualifications.

Table 1. Curriculum of the 1st cycle

<table>
<thead>
<tr>
<th>Year</th>
<th>1st</th>
<th>2nd</th>
<th>Curricular Units</th>
<th>Hours of work / Year</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sem</td>
<td>Sem</td>
<td></td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Project I</td>
<td>350</td>
<td>12,5</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Contemp. Art and Arch. Movements</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Project II</td>
<td>350</td>
<td>12,5</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Anthropology</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Drawing Laboratory</td>
<td>364</td>
<td>13</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Geometry</td>
<td>196</td>
<td>7</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td>Theory of Arch. I and History of Arch. I</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Project III</td>
<td>350</td>
<td>12,5</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Drawing</td>
<td>196</td>
<td>7</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Project IV</td>
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</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Computer Aided Design</td>
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<td>5</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Construction Laboratory</td>
<td>364</td>
<td>13</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>History of Architecture II</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td>Theory of Architecture I</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Project V</td>
<td>350</td>
<td>12,5</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Structures</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Project VI</td>
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<td>12,5</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Construction Processes</td>
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<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Urbanism Laboratory</td>
<td>364</td>
<td>13</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>History of Architecture III</td>
<td>196</td>
<td>7</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td>Theory of Architecture III</td>
<td>140</td>
<td>5</td>
</tr>
</tbody>
</table>

180
The article 46 point (e) of the directive 2005/36/EC refers to: understanding the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale; adequate knowledge of physical problems and technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate. These competencies are specially assured on two curricular units during the 1st cycle of the University of Minho Curricula: Construction Laboratory and Urban Laboratory (13 ECTS each).

The Construction Laboratory Curricular Unit is composed of four modules (Structural Mechanics, Materials, Construction Technology and Physics of Construction), given in periods (sequential or alternately) and accounting for about 35 teaching weeks, where students should be able to apply the knowledge in a practical project during the whole year. The Module of Physics of Construction is where environmental aspects are developed in more detail, covering aspects such as: the environment and human needs; functional needs of human establishments; energy consumption in the building sector; rational use of energy in buildings; thermal properties of materials; thermal and visual comfort; Natural ventilation and indoor air quality; Natural illumination strategies in buildings; Moisture problems in buildings; Architectural acoustics; Building acoustics.

The Urban Laboratory intends to give to the students the main tools for reading (interpretative/analysis) and writing (intervention) in the territory, in its different forms, scales, places and spaces. Observing, Interpreting and Representing are the key-words, which identify such a kind of investigation about the territory. Drawing (representing) is meant as privileged instrument of observation/interpretation of the elements, the structures and their connecting logics; as it allows reaching an idea of synthesis about the complexity of the ways by which the territory is occupied, organized and used. The reading, as well as the writing, comes out of a constant process of section, which we call interpretation. In this way interpretation results as the connection between analysis and intervention, in a continuous shuttling between observation and proposal.

The cycle of studies that leads to the master degree must ensure that the student acquires an academic specialization resorting to research, innovation or expansion of professional competencies, as referred on the Portuguese Law 74/2006. Accordingly, the 2nd cycle of the integrated master – 4th and 5th years, presented on Table 2 – includes a significant percentage (90 ECTS) of specialization subjects (compulsory and optional curricular units), in three main domains separated in classes with around 1/3 of the students each (A “city and territory”, B “construction and technology” and C “architectural culture”) offered in three semesters. The compulsory curricular units are organized in modules, comprising a project signature called Studio, and two supporting theoretical signatures called Seminar and Compulsory. Each semester, students should choose between
one of the 3 different domains offered and, when selected considering their options and their average classification till the date, they should frequent all Compulsory Curricular units of the same module and at least one optional of the same area (Conditioned Option). In order to promote some heterogeneity on the student’s formation, between the first to the second semester of the 2nd cycle, students have to select a different domain from the one chosen in the first semester. This assures that in the end of the three first semesters of the 2nd cycle, they didn’t repeat more then twice the same scientific domain on the modules. Apart from this they can choose in the first two semesters one Optional that is from a different domain (Non Conditioned Option). The fourth and last semester (30ECTS) consists on a thesis - Dissertation or Project Work.

Table 2. Curriculum of the 2nd cycle

<table>
<thead>
<tr>
<th>4th Year - 1st Semester</th>
<th>Hours of work / Year</th>
<th>ECTS</th>
</tr>
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</tr>
<tr>
<td>Total</td>
<td>280</td>
<td>10</td>
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<tr>
<td>Contact</td>
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<tr>
<td>Seminar 1</td>
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</tr>
<tr>
<td>Compulsory 1</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>Conditioned Option 1</td>
<td>140</td>
<td>5</td>
</tr>
<tr>
<td>Non Conditioned Option 1</td>
<td>140</td>
<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>4th Year - 2nd Semester</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop 2</td>
<td>10</td>
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<tr>
<td>Seminar 2</td>
<td>5</td>
<td></td>
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<tr>
<td>Compulsory 2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Conditioned Option 2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Non Conditioned Option 2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>30</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>5th Year - 1st Semester</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
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<td>Workshop 3</td>
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<td></td>
</tr>
<tr>
<td>Seminar 3</td>
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<td></td>
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<tr>
<td>Compulsory 3</td>
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<tr>
<td>Investigation Project</td>
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<tr>
<td>Non Conditioned Option 3</td>
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<tr>
<td>30</td>
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<table>
<thead>
<tr>
<th>5th Year - 2nd Semester</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation Laboratory: Final Exam (Dissertation)</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Studio:

City and Territory  Construction and Technology  Architectural Culture
1  Landscape  Sustainability  History and Ucrony
2  Territory  Innovation and Technology  Manifestos and Utopias
3  Public Space  Pathology and Rehabilitation  Emerging Programs

Seminar:

City and Territory  Construction and Technology  Architectural Culture
1  Landscape  Sustainability  History and Ucrony
2  Territory  Innovation and Technology  Manifestos and Utopias
3  Public Space  Pathology and Rehabilitation  Emerging Programs
Compulsory:

<table>
<thead>
<tr>
<th>Module</th>
<th>City and Territory</th>
<th>Construction and Technology</th>
<th>Architectural Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From City to Landscape</td>
<td>Indoor Environment Quality</td>
<td>Theories and Tratadistic</td>
</tr>
<tr>
<td>2</td>
<td>From City to Diffuse</td>
<td>Special Structures</td>
<td>Radical Thinking in Architecture</td>
</tr>
<tr>
<td>3</td>
<td>From Public to Collective Space</td>
<td>Traditional Technologies</td>
<td>Contemporary Architecture Critic</td>
</tr>
</tbody>
</table>

Optional courses (Conditioned and Non Conditioned Options 1, 2 and 3):

<table>
<thead>
<tr>
<th>Module</th>
<th>City and Territory</th>
<th>Construction and Technology</th>
<th>Architectural Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Landscape in Le Corbusier</td>
<td>Acoustic of Buildings</td>
<td>Islamic City</td>
</tr>
<tr>
<td></td>
<td>Urban Quality Evaluation</td>
<td>Installations &amp; Lighting of Buildings</td>
<td>Architecture Aesthetics</td>
</tr>
<tr>
<td></td>
<td>Repres. of Urban &amp; Nat. Landsc.</td>
<td>Sustainability &amp; Durability of Const.</td>
<td>Port. Expansion – Archit. and City</td>
</tr>
<tr>
<td>2</td>
<td>Urban Economy</td>
<td>Lightweight Constructions</td>
<td>Archit. and Repres., Image &amp; Commun.</td>
</tr>
<tr>
<td></td>
<td>Instruments of Territory Planning</td>
<td>Econ. of Const. &amp; Build. Site Manag.</td>
<td>Soc. Hous., between Ideol. &amp; Form</td>
</tr>
<tr>
<td></td>
<td>Emergency Urbanism</td>
<td>Non Structural Materials</td>
<td>Archit. Visions of the Fut. in Fiction</td>
</tr>
</tbody>
</table>

Figure 1. Schematic representation of the 2nd Cycle Modules
### Sustainability Module

The environmental aspects are a direct outcome of programmatic, formal and operational choices made, or ignored, by architecture project. Sustainable environmental sensible design requires theoretical and historical knowledge, providing the critical framework needed for focused research and application. This should be done on several scales and approaches, from territory to specific components design, and should be done with an open mind and with several supporting tools and background knowledge. Sustainable holistic concerns should be applied in building design project when students have already acquired the fundamental principles of architecture. In the University of Minho Integrated...
Master this happens on the first semester of the 4th year, when students have just concluded the 1st cycle of studies (180 ECTS). An independent module integrated on the “construction and technology” domain, named “Sustainability”, is offered to 1/3 of the students. As shown on Table 2, this module is composed by 3 Curricular Units: a “Studio – Sustainability”, a “Seminar - Sustainability” and a “Compulsory – Indoor Environmental Quality”. Linked to this same module, some free optional Curricular Units are also offered: Acoustics of Buildings; Facilities and Lighting in Buildings; Sustainability and Durability of Constructions.

**Compulsory Theoretical Curricular Units**

The Compulsory theoretical curricular units included in the Sustainability module are synthesized in their respective learning outcomes, shown above:

**Seminar (Sustainability):** Basic concepts of sustainability, sustainable development and sustainable construction; Tools for evaluation of the sustainability of the constructions and its applications; Wide approach over the existing international normalization on the sustainable construction; Development of abilities for the selection of materials and more sustainable technologies for construction.

**Compulsory (Indoor Environmental Quality):** Functional needs of the human establishments; Energy consumption in the building sector; rational use of energy in buildings; Bioclimatic architecture - basic principles and concepts; Passive solar buildings; Buildings thermal performance; Thermal and visual comfort; Natural ventilation and indoor air quality; Natural illumination strategies in buildings; Moisture problems in buildings.

**Studio Curricular Unit**

The Studio Curricular Unit “Sustainability” will be explained in detail in this section. The period of studies of this Curricular Unit is one semester, around 20 weeks of contact teacher/student in classes of 4 hours, 2 days per week. As the module “Sustainability” in which it is integrated, it is located in the first semester of the 4th year. The expected learning outcomes are: selection of specific investigation tools in Sustainability and architecture; analyzing the chosen systems having in view the realization of a synthetic project exercise; solve and specify the project exercise by drawing, written and physical/virtual models; recognize the importance of interdisciplinary and team work; explain and argue about the own proposal and the colleague’s proposals.

Some theoretical presentations are included. The course teacher is responsible for the first and second lecture classes where the first approaches to an environmental sensitive project are presented but also discussed, promoting the dialogue and feedback from students. Other themes are presented by the teacher in specific moments of the project development, such as natural lighting, energy efficiency, cultural issues, among others, promoting also that students propose there own
“Themes” and reflect over them. It is proposed to the students, to investigate over projects, writings, artistic interventions and personalities and to discuss and present these in the classes. A bulletin board space is available on the class to each group of students, in order to allow the presentation and discussion over these investigations. The same is also possible on a virtual blackboard tool, available in University of Minho, that allow the information post by the teacher to the students, as well as forum, evaluation, discussion, presence control, among other available tools. Some guest lectures occur each year, made by personalities invited because of their expertise on some specific aspects related with the program or the “themes” proposed. In the year 2009/2010 a presentation about flexibility was made by a doctorate student working on this subject. A Turkish professor also came and, apart from a presentation over sustainable construction, was also invited to discuss over the student’s projects. In the present year of 2010/2011, two presentations were already made, one from a group of young architects working with a software tool developed by themselves in relation with the referred year’s program (modular student residence and hotel) that can help to integrate and evaluate some sustainable parameters into the conception phase, including some genetic algorithm applied to architectural program organization – including an workshop and an exercise with the students. Other presentations are done from architects or investigators working on the specific field of sustainability. Apart from theoretical and workshop presentations, other types of reflection moments are also included, like the visit of exemplar buildings in relation to the each year’s program. In 2008/2009 the program was a cultural center in an abandoned factory building, so the visits made were to two cultural centers located in former brick factories (Aveiro and Ermesinde, two cities in the North of Portugal) with significantly different project approaches. Other theoretical presentations are also introduced in the curricular units of Compulsory 1 (Indoor Environmental Quality) and Seminar 1 (Sustainability), promoting an interdisciplin-
ary collaboration with the Civil Engineering Department, responsible for these classes. The use of software and analytic techniques introduced in the taught courses is tested and consolidated through weekly design research exercises which will collectively form an overall sustainable approach.

The work is separated in two main periods in which different scales and approaches are explored. Between these periods several exercises are proposed to the students. The first period, called “sustainability as element of territory organization” is based on a previous territory analysis. This analysis consists on the first exercise, which lasts around 4 weeks and is done by groups of 3 students. It comprises a climatic analysis (solar exposure, dominant winds, rains, and temperatures), the pre-existences analysis (topography, volumetric and façade, constructive systems and vegetation) and a social analysis (vicinity to equipment, transport accessibility, including inquiries to possible future users, etc.). In Figure 3 is shown the example of an analysis of accessibilities to the most important transport interfaces and connections in the intervention area. In Figure 4 an example of a constructive system analysis of some neighbourhood buildings is shown.

The following and last 4 weeks of the first phase, the general organization of the intervention space, defining the general definition of the proposal in aspects such as, the landscape definition of the intervention site take place. One example is shown on Figure 5.

The 2nd phase, called “from territory to the object” consists on the detailing of part of the building developed by each student. is a project of a services building, focusing on issues of daylighting, passive heating and cooling control, embodied energy, other means and uses of renewable energies; new and traditional materials and constructive systems, their ecology and performance. Facilities are used for the construction of scale models and full-scale prototypes aimed at testing design ideas relating to studio project.

Paulo Mendonça
The program during these three years was always a Services building, focusing on several aspects of “Sustainability”: On this short period of existence, this Curricular Unit proposed a program that was always located in sites close to the University of Minho in Guimarães. In the year 2008/2009, an abandoned factory in the city center was to be converted into a Cultural Center. In the year 2009/2010, a building formerly occupied by the police and partially unoccupied was supposed to be converted by students into a residence/restaurant. The program in the year 2010/2011 is also a residence, but as a new building, including pre-fabricated and modular constructive systems, that could also be used as an hotel to allow more permanent occupations. This building should be easily transferred to other sites, if not needed anymore, or if should be converted into other uses. In all programs referred, additional spaces and uses should also be proposed by the students, and these should better illustrate the sustainability concerns to the future users and visitors of the buildings.

The difficulties found with the implementation of this course are related with the few year’s experience, with the lack of financing to support the study visits, the coming of invited guests or the software acquisition. The few or inexistent theoretical approaches to sustainability on previous years courses is also problematic, as most students don’t seem very sensitive or aware to these issues in a first phase. Also the construction knowledge of the students in the end of the 1st cycle of the Integrated Master, as it only has 3 years, seem sometimes insufficient for the level of detail and constructive innovative approaches needed in the thematic of this course.

**Optional Curricular Units**

The Optional curricular units in direct relation with the Sustainability module are synthesized in their respective learning outcomes, shown above:

Building acoustics: Environmental acoustics and noise annoyance; Room Acoustics; Airborne sound insulation and impact sound insulation; Turning compatible the acoustic requirements with the other building requirements; organisation of acoustics in buildings.

Facilities and lighting in buildings: Water distribution systems in buildings; Residual and rainwater drainage systems in buildings; Fire-fighting systems; Gas installations; HVAC Systems (Heating, Ventilation, and Air Conditioning) in buildings; Electrical installations in buildings; Telecommunications infra-structures in buildings; Natural and artificial illumination strategies in buildings.

Sustainability and durability in constructions: The programme consists on the development of several aspects of Sustainable Construction, concepts of Life-Cycle Evaluation, applying the principles of Sustainable Construction to the project work.
**Conclusions**

This paper tries to identify and present how sustainability is treated on the University of Minho’s Integrated Master Architecture Curriculum. It is specially referred the Sustainability Module of the 4th year (2nd cycle of studies) which integrates a Studio Curricular Unit, apart from Compulsory (Interior Environmental Quality), Seminar (Sustainability) and some Optionals (to be chosen as Conditioned from students inside the Module or Non Conditioned from students outside or inside the Module). The main objective of this Module and specially the Studio course is that students achieve an intrinsic sensibility to the integration in project of several aspects of sustainability, with a special focus on the environment, but also including economical and social/cultural approaches. The different scales of sustainability are explored, comprising the study and project of the built environment in relation to climatic, programmatic and operational conditions for different urban layouts, architectural typologies and detailing. Some examples of student’s work in the few years of existence of this Sustainability Studio are presented.
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Let’s Cook 24/7
(Put together a pinch of Nicosia, a few crushed Leeds seeds and stir well...)
Introduction

The aim of this paper is to present an attempt towards cultivating environmental awareness within the 3rd Year, 2nd Semester Design Studio at the University of Nicosia, Architecture Department. This specific studio has a concentration on building technology with sustainability as an inherent ingredient. The objective is to stimulate the students’ ability to generate creatively new ideas and forms with technology and construction as integral parts of their design process. Required output included advanced detailing and technical requirements involving selection of systems and materials, environmental control, energy savings, building envelope performance and social sustainability. An intense one-week workshop collaboration provided the catalyst towards attaining the aforementioned outputs.

The structure of the paper will follow a brief introduction of the design studio content and objectives, it will then continue with a discussion on the attempt to engrain an environmental culture and the steps followed towards that. A selection of student projects will then be discussed and the paper will conclude with a reflection on the authors’ educational approach towards developing an environmental culture.

The design studio

The design studio’s objective is to tackle issues of technology as it relates to architecture. ‘Technology’ is considered on both a theoretical/conceptual level, as well as on an application/performance level. By the same token the “environment” is considered as an overarching question within the link of technology.

Investigation and invention was at the core of the design studio. Through investigating and understanding the convention, students were asked to further develop and critically question the appropriateness of relevant issues/solutions. A deep understanding of convention would start a process of modifying, adjusting and developing in order to provide a customized innovative solution to a specific programming. Themes that emerged included the concepts of manufacturability, sustainability, bioclimatic performance, material development, logistics, modularisation, social and cultural relevance amongst others.

The project started by the introduction of a deliberately surreal and expansive brief. The brief required that a long list of seemingly ‘conflicting’ uses, are brought together in a singular building proposal. The total area of the programme brief was deliberately exceeding the total area.
requested for the building. The hidden agenda was the necessity to generate sustainable solutions; students had to come up with intelligent strategies in order to accommodate all the uses, maximise performance in terms of input/output ratio, critically restructure the life-cycle of the building and negotiate social integration.

The brief included activities directly related to the production and consumption of food, as well as operations that have an indirect relation with food (such as a boutique hotel or an anorexia centre). The theme was selected for its direct association with key environmental issues. The characteristics and deficiencies observed in the food chain could trigger responses for sustainable resolutions. Therefore the thematic richness and expansiveness of the introduced brief would potentially drive the development of a coherent, self-organising entity.

Programme brief elements were categorised in terms of required (approximate) net areas; small, medium and large as indicated below:

<table>
<thead>
<tr>
<th>Small = 50 m²</th>
<th>Medium = 100 m²</th>
<th>Large = 150 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal feeding</td>
<td>Let’s cook/let’s dish (socialising/meeting while cooking)</td>
<td>Retailing (selling packaged foods prepared by other departments within the building)</td>
</tr>
<tr>
<td>Slow cooking (drying foods)</td>
<td>Aromatic herbs garden/selective vegetable garden</td>
<td>Cooking school/educational/short-term stay</td>
</tr>
<tr>
<td>Community meals (soup kitchen)</td>
<td>Organic waste storage/compost/food excess recycling</td>
<td>Dining room (waiter served but no kitchen) – catered partly by let’s cook, home cook, fast food, alternative etc</td>
</tr>
<tr>
<td>Home cooked (living + working / offering meals) = 3 x units@50 m² each</td>
<td>Packaging re-use</td>
<td>Boutique Hotel: Food!!</td>
</tr>
<tr>
<td>Drinking x 3 (juice bar/health bar/alcoholic bar)</td>
<td>Fast food + Alternative foods (shared counter, dining space)</td>
<td>Weightwatchers + Anorexia/eating disorders centre</td>
</tr>
<tr>
<td>Packaging (cardboard/banana leaves/Japan/Thailand etc)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2
In parallel to the brief a similar approach was adopted concerning the site. Students were given a specific site, a very small vacant lot within the dense urban fabric of the medieval part of the city of Nicosia. The chosen site deliberately posed relevant challenges such as lack of space and accessibility, as well as a necessity to consider the process of onsite assembly for any proposed scheme.

Shifting the attention from urban issues towards technological and social sustainability resulted in more focused propositions. Qualities that would be traditionally conceived as universally accepted during a site analysis were in fact down played, thus turning the site into a dissolvable container; socially, climatically, organisationally. As a consequence, an active employment of the context is set in motion mostly by finely tuning the proposition and without explicitly responding to the site; doing more with less.

The studio evolved around what the instructors considered as the key drivers towards achieving the learning objectives. These intentions defined the way in which all the ingredients of the studio where introduced to the students, how the discussions evolved and how the individual student’s self- reflections matured and disseminated.

Generally students produce work and then evaluate; a process that makes them appreciate potential reciprocal fusing of one discovery into another. The intensity of speed and amount of production was critical. As a consequence of the way the brief and the site were delivered to the students, confusion was both inevitable and expected. “Confusion” for the instructors meant a positive stage of expansive options and issues for investigation. Instead of following a process of choosing and rejecting solutions, a longer process of distilling the multitude of findings was encouraged. Over-production would lead to an initial state of confusion but eventually it would lead to informed resolutions.

Added ingredients and elements, such as weekly workshops, were abruptly parachuted into the project, thus infusing new sets of questions and parallel conditions, specifically focusing on environmental resolutions. The element of surprise
acted as a catalyst. Almost every week in the semester a new workshop was introduced, with a specific output required within a very restrictive time frame. The normal spiralling development process of the studio as a whole continued evolving in parallel to the workshops. The common denominator of these workshops was the instructors’ favourite motto “Produce!-Produce!-Produce! ”.

The instructors understood the setup of the studio as a list of cooking ingredients, which the title of the studio “Let’s Cook 24” inherently suggests.

Requesting from students “cooking” without giving the “recipe” was in line with ingraining an environmental culture. An exceeding surplus of ingredients and implicit suggestions about “cooking” possibilities was delivered. Such ingredients included the programme brief and the given site in their “raw” state. These ingredients were constantly manipulated in a spiralling process. Students started bifurcating individual ingredients by developing the architectural consequences of particular brief elements in order to compose a programme narrative. They followed by sieving and re-attaching complementary ingredients; for example in order to configure relationships between satisfying the brief and implicitly developing environmental strategies.

Through intentionally delivering a small and restrictive site and the expansive brief, the instructors were expecting an environmentally conscious high rise solution but not stating it. A high rise proposition was an appropriate field of investigation that would prompt skills in complexity competence expected in a 3rd Year studio with a focus on building technology and sustainability. Therefore the issue of structural investigation according to programme narratives was added to the so far existing list of ingredients. All other findings (environmental, building services, transportation etc) were fused with an appropriate structural concept, once again not committing to a singular solution but continuously assessing options.

Throughout the semester a continuous shift between zooming-in (moments) and zooming-out (overall) enabled the students to grasp the scale of the proposi-
tion and to cross-fertilize findings. Through “moment” investigations the students also developed social strategies for the user, their environments and the neighbouring context. “Let’s Cook 24/7”: intense joint workshop

“Let’s Cook 24/7” is an experimental workshop that brings together students of architecture from Nicosia and Leeds in an intensive, one-week long project. This workshop took place towards the end of the semester where the student projects were already mature and ”packaged”.

The visiting team was from the Year 5 Design studio, Sustainability Unit, Leeds School of Architecture, UK. The Nicosia student proposals provided the “infrastructure” for the condensed Nicosia-Leeds workshop. The workshop acted as a ‘parallel’ condition to both the Nicosia and the Leeds projects infusing new issues, possibilities and resolutions. The common and individual concerns of the two studios resulted in the development of integrated strategies for sustainable environments through building technology innovations. The specific aim was the production of environmental performance driven facades that respond to climate, temporality and the occupation of the building, with innovative use of technology and materials.

The students were teamed up in groups of two: one from the Nicosia studio and one from the Leeds studio. Likewise, extending into the social aspects of educational collaboration, the visiting students were hosted in the individual residences of the local students, thus promoting further interaction. The workshop meetings were five, day-long sessions. Further collaboration beyond the week-long intensive workshops will be executed remotely. This will be a continuous and accumulative process of tuning and editing using e-techniques as a process that expands architectural education beyond the physical design studio.

The Leeds design-studio overall theme is “sustainability” and the specific outline focussed on ‘problematic’ and ‘forgotten’ areas of post-industrial zones around Leeds, Manchester and Liverpool and required extensive analysis through inventive research methods that would culminate in intelligent and integrated technological proposals. The students’ projects dealt with large scale urban strategies such as testing the city as a living breathing super-organism through an ecological / bio-mimetic approach. Ways of re-invigorating the city through innovative synergetic interventions were proposed by organizing mutually compatible functional elements on a continuous cycle; i.e. the city can grow its own food, collect its own water, provide shelter, clothe its inhabitants, and fuel itself.
The workshop required intelligent and appropriate applications of resultant previous research of both parties into a detailed section of the project. Students from Leeds brought knowledge of large scale systems, sustainable strategies, life cycle operations, issues that they developed at a city scale but haven’t yet tested at smaller building scale.

The Nicosia students had already explored various environmental propositions at a strategic level and as an infrastructure, but did not explore the effects on the broader environment and the tactics in dealing with them.

“Let’s Cook 24/7”: intense joint workshop – Selected student output.

Following is a brief discussion of selected student output that showcase how the workshop acted as a catalyst for propositional environmental strategies to mature into pragmatic resolutions:

**Project 1: “Celestial Programmatic Adaption”**

The programme brief was organised responding to the sun path, aiming at a 24-hour operation of the building with activities orchestrated as either dependant or independent on direct insolation. Specific square meters where allocated to every hour of the day, through the development of a modular construction system.

During the intensive one-week workshop the project developed a programme for the façade performance and used it as a generator for reprogramming the overall proposition. The project was driven by the students’ realisation that many environmental problems are centred around the production, consumption and resultant waste of food and energy. The main aim was to combat the possibility of turning the attention from large flat land areas for the production of food and energy to large vertical surface areas in the city, with minimum footprint.

Programme elements that require direct food input where thus combined with vertical farming whereas surfaces enveloping other programme elements were utilised for solar capture (for hot water and electricity). The resulting façade system included maximising the skin surface through wrinkling for solar capture, enhancing thermal mass, passive heating-cooling and verti-
cal farming. Resolution at the micro scale then re-informed the macro scale. User specific environmental needs were customized for the various building uses and already developed modular systems were enhanced with integral energy systems. Resolutions observed in the facades were further employed in internal components and further expanding into the neighbourhood, testing social sustainability considerations; intensifying and sustaining existing uses and culture.

**Project 2: “Repertory Membrane”**

The focus of this project was the development of an intelligent modular construction system. Through the workshop a double-skin façade system operating at the building scale incorporated a number of innovative approaches. An inflating-deflating skin membrane modulates luminosity to the interior in combination with a light shelf system. At the inflated state the double skin becomes luminous with a maximum thermal insulation (air) and at the deflated state the opposite. Variations were tested using physical models.

The same logic was carried through to other parts of the building, such as controlling the air flow through floor plenums and perimeter ducting. The floor system was further developed to follow the same language as the façade: a modular and standardized braced system. At a further micro scale, a nodal interface component for fixing the façade elements was invented.

**Project 3: “Algae: Edible Facades”**

The design concept is based on a high rise facility working as a food factory in every sense: packaging, preparation, recycling and provision of a variety of different types of food. The proposed structural system incorporated a diamond façade lattice.
The bioclimatic façade developed during the workshop is a triple skin consisting of internal double glazing, single glazed middle layer and self-supporting algae farm outer layer. The two glazed skins provide stack effect for natural ventilation of the building, channelling heat away from internal spaces. The algae will also diffuse the sunlight penetrating into the building, providing the first layer of solar shading. Algae was chosen for its high content of oil that makes it a very efficient source of bio-diesel fuels and the waste product after oil is removed can be burned as biomass fuel or feed other crops. In the context of food production and preparation algae can be used for: cooking oil, plant nutrition, electricity production.

The skin triggers the energy cycle as it relates to internal needs. The outer skin is divided into multiple panels, each individually controlled, providing algae directly to specific functions for processing.

The technical resolution consisted of a linear system of algae PVC tubes with copper connectors, fitted with telescopic blinds for shading algae in intense sunlight. The algae growing pipes were filled with water, acting as additional solar, thermal and acoustic protection. Developing the algae tubing to act as a rigid structural lattice to the façade, a cast aluminium connector was invented.

**Project 4: “Photosynthetic Façade”**

This project tested the limits of bringing elements of the brief and the detailed resolutions together, such as combining a retractable stair with a cooking bench. The extreme variability of the interior extended to the exterior at first through a malleable/transformable skin. This logic of extending performances of one element into another formed the basis of the workshop experimentations.
The façade was refined as a system of modular units with multiple performances. By differentiating south and north façade operations the aim was for the building to act as a living organism and even mimic photosynthesis. The façade was treated as the primary climate modifier but also the system by which all the performance criteria of the building were satisfied.

Within the hollow modular unit of the south façade hot air is exhausted into solar chimneys. Through the use of a black colour the same structural component provides solar water heating and distribution of hot water. On certain levels rotating cultivation panels replace unnecessary windows and on other levels photovoltaic farming takes their place instead. The same unit on the north façade stretches to full height windows and allows the transport of waste water, exterior fresh air intake, cold water distribution and extra space for vertical services. The façade module has compatible connections with floor thermal mass units for heating and cooling.

**Conclusion**

Reflecting on the student output following the completion of this studio the authors believe that the learning outcomes and objectives were successfully met. Most importantly an environmental culture was bred as a by-product from the students’ perspective; they felt that they were opening up a completely new approach to the subject matter and therefore this created a sense of pride and authority.

The need to deal with environmental issues was not prescribed to the students and especially not labelled. This could have led to preconceived ideas about what being environmen-
tally conscious should be. Prescribed solutions and direct applications of known systems where therefore discouraged.

Our educational approach towards developing an environmental awareness is through posing questions that carry within them inherently issues of sustainability, such as a given brief that suggests social organisations and intricate required performances.

When dealing with subjects that have been overexposed in recent academia and popular media, such as an environmental culture and sustainability, keeping a strategy that raises the issues in an implicit way can be more successful in reinventing supposedly known solutions and applications, as well as generating a more genuine embracing of the subject matter.

Note
The authors would like to acknowledge the contribution of Greg Keeffe - Downing Professor of Sustainable Architecture, Leeds School of Architecture, UK - for jointly organizing and running the “Let’s Cook 24/7” one-week intense workshop.
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Green Corridors: From Relational Opportunities to “Clean” Energy Production
Students’ laboratory for a green linear design

New practices into architecture for sustainability have changed design strategies. Consequently education changes too. So emerges the idea of design strategies which are not ready for professional practice, but they find into students’ works a first experimentation into an innovative way which will become usual in next future.

The need for a new environmental culture pushes us to experiment new designing strategy in didactic practice too. Education is the main objective, but each experimentation with students can also create opportunities for scientific and environmental research.

With a multi-disciplinary approach students are invited to elaborate a project with a vision for environmental issues, which involves sustainable approach, infrastructural outputs, landscape design. We force the reconsideration of different aspects not traditionally considered as problems of architecture schools, such as community habits changes, viewed as consequences of design.

This approach let them consider the variable relationship of the building with some natural elements like natural light, water and green. The experiment put in practices operative modalities in order to lower the levels of pollution and so increase quality of life.

The following notes are focused on an experimentation for a green recovery which has a main character in the linear dimension. So, even reducing the project area to a minimum quantity, the connection with a place will be incident. It derives by the long series of links offered by the main longitudinal shape.

The work affords problems connected with an idea of flexible, long, articulated ribbon characterized by vegetation, air and water as building materials.

The longitudinal dimension impressed students first of all for its psychological type of perception of space.

Different mutable conditions are given in a linear sequence for a line of changeable composition into an unique shape aggregating simple unities in variable way.

The corridor, as it flows through the constructions, proposes a kind of architecture which is related to the surrounded areas through a continuous filter of nature in the town, so buildings can meet each other underneath the vegetation and they will be enlarged in opened areas.

A hierarchical system of entrances integrates a selected plurality of external and internal images.

The entrance of natural light, water, air and green, go towards different directions. But the main idea is to have complex variable green volumes, which should remain recognizable, notwithstanding the effect produced by a continual, widespread and penetrable filter.
The aim of workshop was to lead back to the underneath connections which always should exist between architecture and its environment. The didactic experience was held in Construction of Architecture Laboratory (2nd year of Architecture Degree Course) bounded with a research that involves authors engaged in the re-qualification of a town located in the Canton area: Guangzhou’s city. The intervention area, probably an old river canal, lends itself to become a cross-linear system, in which both natural and built environment will take place. The experience aimed to create a new longitudinal void in the middle of a too dense area, which should connect points of wildlife areas with energy off-grid buildings. The architectural and technological experimentation portraits both what the users need and an improvement in sustainable performances.

To summarize the results, most students made their decisions considering how a long but narrow piece of nature can modify the idea of nature inside the town, changing the physical appearance of an urban context with new performances. The experimentation would so lead students to a new idea of “architecture” related to that one of “nature”.

**Social and technological sustainability: a new way of living collective spaces**

The focus is placed on researching the optimization of public areas and especially on how to organize those spaces in a technologically advanced way and with the full respect of energy saving.

In the Construction of Architecture Laboratory course has been explained to students that the sharing of services and reuse of natural resources would allow a substantial saving adapting to today’s need to preserve the health of the environment; also in order not to underestimate the social aspect, the involvement of users in the organization of spaces municipalities would allow them to personalize these spaces in relation to your personal living space, leading to an improvement of their living conditions without additional financial burdens.

Unfortunately today, the building structures of our cities are presented with severe impairments from the point of view of the housing quality and energy efficiency. For this purpose it was essential to examine the architecture ranging from the 50s to 80s, where you could see that they are related to the logic of pure expansion quantitative housing unit, heedless of environmental issues.

The result is an inadequate housing stock compared to the needs expressed by the community, mainly due to lack of relationship between the built volumes and open spaces of relevance. Hence the need to match the increasing demand for housing with a range of homes and common areas are able to meet the criteria of energy saving, using and exploiting natural resources, and are able to balance functions and spaces within which the user can be identified. To achieve an optimal balance of these needs was necessary to consider several case studies
that have developed over time, related to experiences of experimental design of living spaces from which to draw elements of originality in terms of innovation and competitiveness in relation to the free market. Among the most important examples we can mention the Unité d’Habitation in Marseille signed by the architect Le Corbusier in the 50s which houses 337 rooms, divided in 23 different types of apartments - from single family with four children - that are connected by walkways, courtyards and common areas.

So one of the most significant aspects of this project is the broad framework of services and common areas, whose birth can be turned back to the house in an attempt to apply industrial methods of mass production to address the problem of mass housing and how to handle the sharing areas. In order to design quality of open spaces, the indications of the place also need to be taken into account. The open spaces should be understood as an integral part of urban space and the transition between indoors and outdoors as an integral part of the architectural concept (Figure 1). Green spaces should be linked together and, while retaining their specific footprint, become pieces of recognizable places with different quality and intensity of use, without forgetting the living spaces for meetings. The inhabitants of places built in this manner spend at home one third of their time in more than the average. With the purpose of social equality, integration and sustainability, the relevance of public space should be divided and served by the widespread accessibility, strengthening, for example, the system public transport, both in terms of efficiency and environmental compatibility.

This issue was addressed in a larger scale for the neighbourhood located in the southern city of Guangzhou (Canton, China). The students have conducted their own trial, investigating the dual aspect of the design and social streamlining public spaces in a technologically advanced and in full respect of energy savings.

The idea that we find in the work of students, (Figure 2) was to focus on community and on the social highlights of the corridor, and to employ for these “special places” an off-grid technology, thereby producing high-tech places.

Essential to this integration and improvement of open spaces were the following criteria for project driven by a significant eco-oriented approach (Figure 3):
• Low maintenance;
• Achievement through the various species of ornamental and wild plant species (such as matrices and random variables associated penalty);
• Action and reaction between green and built with an introduction by garden areas;
• Reciprocity between areas with closed process and open process in the built environment
• Ability to engage people outside the barrier positioned in the garden to create a sense of isolation and community
• Being supported by the olfactory and acoustic environmental protection.

Figure 3. Main criteria for open spaces design

The common goal of the various projects is therefore to focus on community open spaces, the best sustainability technology performance with a strong communication detail.

The purpose is to focus on the “technological” aspect of collective open spaces, in relation to the fruition potential and social attraction and regarding the opportunity to make them high-tech places, designing (totally or partially) off-grid systems.

**Common spaces: functional and technological experimentation**

In the field of refurbishment organisational arrangements of open spaces must meet specific requirements dictated by the rules of collective life which are ever more oriented towards an increasing flexibility and need for to customize own connecting spaces. At the same time, the need for a comparison and integration
with aspects of environmental sustainability and economic feasibility requires, to local authorities and designers, both a research and a technological experimentation for energy efficiency and environmental sustainability. The main idea is to concentrate in the open spaces, with a strong communication capacity, the performance of technological sustainability, such as rainwater collection harvestings, geothermal and photovoltaic energy systems, energy production from food waste, innovative urban waste management. The visibility to these technological systems promotes both a research on local social identity and, at the same time, the rule of a demonstration project where research experiments everyday life, stimulating opportunities to involve local communities in transforming their environment too.

The eco-oriented design of common spaces therefore becomes extremely important in reducing the environmental impacts of the urban settlement itself, especially, if we think of all those activities related to housing which burden with the environmental balance of the neighbourhood contributing to create discomfort conditions for inhabitants, when they aren’t properly managed.

In Construction of Architecture Laboratory we decided to work on the theme of energy and environmental refurbishment of open spaces for collective use just to prepare next architects to provide answers ever more related both to the housing and environmental requirements described above.

Public spaces, energy efficiency and social sustainability are fully integrated in the design and implementation of Solar City, the Austrian district on the outskirts of Linz. An area of obvious environmental value that thanks to the new urban settlement, strongly backed by local authorities despite the scarcity of available resources, it has become a tool for monitoring and promoting the area itself. The name of the city well explain the aims pursued by the project: the intensive use of the sun as the main source of clean energy.

This choice will enable the urban settlement energy self-sufficient, when it’ll be completed. Prestigious names have contributed to this project that is focus on the central space dedicated to services, defined by Thomas Herzog, not by chance, “social magnet”².

This large equipped square, in fact, is functional not only for the district. It represents the symbol of the quality of urban space and creates within it several technological strategy, from the use of photovoltaic systems to the rational management of rainwater. Everything is organized within a sustainable mobility system which focuses on cycle - pedestrian usability such as the green rail. The squares, the equipped areas for leisure and social activities are both places clearly identifiable and place of quality designed as attractor elements not only for local inhabitants. The arrangement of some areas of relevance of the buildings, as well as of other public spaces in the neighbourhood, provides the participation of the people so that they could customize them to meet own socio-economic and housing needs.
The Green House project, which will be born in Milan (Lambretto - Minerva area), shares these organizational principles enriching them with an hypothesis more oriented toward the environmental experimentation. It is, as designers say “an innovative residential model that integrates living, productive and playful functions in a project which strongly focuses on sustainability and energy saving”3. A large greenhouse for the cultivation of vegetables and fruits that will grow vertically to a surface of 500 square meters, will be the attractor and catalyst element of the project, as expression of integration between rural culture and innovative technologies.

It is from the analysis of main projects, such as those described above, the students conducted their experimentation on the southern district of Guangzhou city. The design approach proposed in the Laboratory was, in fact, oriented to collocate neighborhood’s technological functions and plant design in the spaces for collective use. They do not currently exist but they will be the result of a proposed demolition of some residential buildings, in according with the competent Chinese authorities (Figure 4). These new open spaces were conceived in the student’ projects as equipped green corridor, more or less complex, within which the flows of people, matter and information move in a diversified way, however, sharing a common space. The different organisational hypotheses have an even greater meaning in a context like that Guangzhou city, which it needs to improve the quality of life and, therefore, the city itself. The building and population density is the most interesting data, especially if we consider them in relation with the cultural habits of the Chinese population. Except for a few shopping streets, the mobility system is represented by gaps, spaces often interrupted which they overlap with private houses. The low,
or the absence, of natural ventilation as well as the impossibility of solar radiation to reach these open spaces, wide just over an hallway, are a direct consequence of the high and sprawl urban density.

In the projects (Figure 5) this space takes on different configurations in relation not only to housing and socio-cultural needs of users but also to technologies, low or high, which the green corridor will host. Without going into the debate that for decades have focused on the different schools of thought about low and high technologies, it emerges the importance to take in account the ecological aspects of the project. In urban refurbishment, starting from the specificity of context, students should identify the most appropriate technologies both to reduce the environmental impact of human activities and to produce the energy required for their implementation. In this sense, the plant design of these green corridors could be developed as a off grid system (partial or total), that it is functional to the buildings which share this common and connective space, taking “nourishment” from it.

The project ideas developed by students, provide technological solutions in which, combining renewable resources available on site, electricity and heat clean energy is produced. Then it is conserved in order to ensure energy autonomy during periods when the sun, the wind and water are insufficient. Designing open space has led to focus on rainwater harvesting: using capturing surfaces (roofs and paved surfaces) students have proposed solutions aimed to rational management of water as resource: the re-use both for irrigation of green areas and sanitary use or to power passive cooling systems (Figure 6). The idea that student works have in common regards, therefore, the ecological footprint of the open space so that a virtuous circle is implemented: the energy produced by efficient systems with renewable resources, after powering the various circuits (activity), is taken again in the green corridor as food scraps/waste. By more or less complex technologies, they are transformed into a new resource to be used again.

Endnotes

2 The architectural design is by READ group (Renewable Energy in Architecture and Design) composed by N. Foster, T. Herzog, R. Piano, R. Rogers; to learn more http://www.linz.at/
3 To visualize images http://cohousing.it/content/blogcategory/23/24/.
4 To learn more about these issues: Dominique Gauzin-Müller, Architettura sostenibile, Edizioni Ambiente, 2007.
5 An interesting design experience is curried out by Mario Cucinella with “House 100K”; its prototype is available in Hydro LAb of the “Fabric of the Sun” in Arezzo (Emiliano Cecchini, physicist of research center).
Federica Ottone, Cocci Grifoni, Federica Ottone, Angela Leuzzi and Mostafa R. Khalifa

UNICAM
Ascoli Piceno, Italy

Architecture, Environment, Technologies and New ways of Teaching
Course Philosophy
Prof. Federica Ottone

1 To get and discover the different topics of the sustainable urban requalification from a first empirical observation of the context.

2 To identify the criteria that form the basis for a system analysis of the different components referred to the urban environment, with a particular attention to the natural environmental (water, air, earth) and anthropic elements (infrastructures, energy, mobility) which characterize the places.

3 To open a debate on the new needs induced by environmental energies, about the changes of life styles, to stimulate the students to develop a new panorama where the innovations are fulfilled through a dialogue concerning the environmental policy and civil society and with the formulation of examples in order to clarify the ideas.

4 To give back a different reading of the Physical City, oriented to find new creative and technical possibilities, just and realizable with the effective contribution of the public bodies and citizen participation.

We can sum up the syllabus of the Environmental Design Lab (a course that takes place in the first semester of the last year for the Master’s degree in Architecture) in these four points.

The topic: the Sprawl City

The urban contexts of reference are those of the Adriatic Sprawl City, a city that spreads out along the eastern coast of the Italian Peninsula, for miles and miles.

The Sprawl City is a model extensible to different contexts and world areas, even if with different connotations and forms of settlement.

The Sprawl City in Italy corresponds to a form of development that involves in equal proportion of both the big cities and the small urban towns, giving them areas with a different intended use (industry, commerce, and residence) scattered patchily over areas crossed by the facilities for mobility.

The main common features are:

- Lack of hierarchy
- Absence of any emerging elements that characterize it
- The presence of uncultivated open spaces or spaces left without any precise target
- Lack of the definition of public space as an element able to start relations and so:
- The absence of neighbourly relations.

The modifications of the Sprawl City occur rapidly but they are not noted because they are not referable to a planning where the modes, the times the results are known. The new interments’ proceed by addition without apparently disrupting the original lay out, but the existing sites are substantially modified after some years.
Course Methodology

“….The situations to which people act before they change their ways of acting can consolidate into habits and procedures... Life liquid such as liquid modern society is unable to maintain their shape or keep it on long route”(Human, Vita liquida, Laterza 2006 p.vii).

This panorama outlines a city in a continuous movement involving a methodology which does not give set rules.

“The certainty of uncertainty”

To operate in a state of uncertainty seems to be the only possible attitude nowadays. One would like to avoid the data that come from the analysis of the contexts like invariant and absolute elements; rather, the data seem like a set of very complicated relations and each student should focus on certain aspects. The environmental sustainability that we try to point out can be shown through a wide net of relations. The student must learn to act inside this net looking for new possible relations through a creative process.

“Teaching is a means rather than an end”

The didactics of the environmental design is mainly directed to the identification of the necessary tools to understand the sites and to give creative and technical explanations. The results of the designs derive from the good planning of the analytical phase and they are not considered an end but a step in a process of a continuous transformation.

“Excessive specialization prevents reading complexity”

The course has the aim of overcoming the vision focused on the single disciplines. Architecture, considered as the identification of new spaces inside the city acts as the background of complex themes leading, on the one hand, to problems of physical geography, on the other hand, to social economic aspects: different but strictly connected elements.

“The vision can generate complex new skills”

It is interesting to note that a wide and well constructed discussion that includes all the complexity of urban transformations can generate a creative process where the concept more than the mutation into a well defined project is the success of the laboratory. The knowledge of the place and of the eventual and different aspects, deriving from a careful reading not connected to single disciplines, can realize a programmatic document, of which is the first step for starting the project.

The planning stage

The emergence of a “dialectic ecologist” would really seem more useful than all the good intentions that designers have reserved to the ecological problem. There are no solutions but there are problems and possibilities. The concept that an architectonic project can offer solutions has always been denied since the

1. Richard Ingersoll, Questione ecologica in architettura, in Lotus n.140/2009

Teaching a new Environmental Culture
first stage proposed by the student. The dialectic layout possible by the constant
dialogue with the teachers of the design laboratory is realized with the help of
imaging new possibilities, through new projects.

While the solutions can be considered closed, the possibilities are open to the
configuration of newer and newer combinations.

For example:
Solution = renewable energy
Possibility = how is possible to integrate energy in architecture?

So, what is required is to bring out ideas that are directly linked with the
needs of people, ideas projected towards a future vision. The project is there-
fore a moment of transition between what was and what will be, and shall in-
clude devices that allow its modification over time, without altering the initial
contents.

*By the rule / solution is incompatible with possibilities*

The planning solution cannot hinder a constantly evolving process. The pro-
ject can find hypothesis of environmental transformation to develop through a
methodology based on the study of the context. This attitude is obviously incom-
patible with a traditional way of planning.

*The form is a norm / self-imposed solution*

Forms are a high consideration issues for architectural tutors, educators and
Learners. But may lose sight of the consideration for the sustainability over time and
in the vicinity of the local communities. Because of the form can be a constraint and
not an opportunity to change over time effective points below will be explained.

*Technology is a continuous creative process*

Technology moves the creativity and innovation to continuous transforma-
tions. Inputs data, outputs re-analyze, design and innovation techniques is im-
portant skills that architectural learners should gain all among years of educa-
tions. The opportunity to understand the effective technological methods are
affordable for both educators and students. Sustainability in Architecture can
be obtained through a close synergy between technology and planning strategy.

**Lab Practices**

Prof. Cocci Grifoni

This course is based on the assumption that there is an increasing need to
integrate environmental and energy performance considerations in the form-
making processes of architectural design.

This integration can be achieved through various methods that aim to in-
form design decisions by an assessment of the expected performance of building
which is based on measurable criteria such as energy consumption, solar shad-
ing and solar access, natural ventilation, or other atmospheric forcing. In addition
the course is aimed to deal with materials, techniques and technologies that
allow building systems, components and products to be achieved with special attention to either the energy performance or ecological quality.

Teaching environmental applied physics to students of architecture requires addressing a wide range of strategies, systems, and technologies typically associated with various aspects of sustainable design to achieve energy saving or carbon-neutrality.

Such a need responds to the growing interest of the built environment professionals in achieving a more sustainable and environmentally conscious built environment. On this premise the course is focused on “sustainability” and deals with the topics of the energy efficiency and the use of renewable energy sources at the building as well as at the urban level.

In fact, integrating sustainability considerations in the early stages of the design is recognized to be particularly important because of the high impact that design decisions taken in these stages have over the subsequent performance of the building or community especially when aiming for carbon-neutral designs.

By analysing the interactions between the climate and the building envelope, and considering the most advanced building and system technologies for the control of the internal and external thermal comfort, the tools for an energy conscious design and the criteria for the first sizing of the systems are provided. From the building to the region scale, the energy efficiency and the availability of renewable energy are discussed, with a special attention to solar energy, natural ventilation, passive devices and diffuse power generation.

The landscape scale, the urban scale and the building scale are the main formative fields that have been assessed during the course. This is an important aspect because students have to be capable of a “crosswise” analysis of the urban dysfunctions both towards completion and clearing planning based on the technological innovation (i. e, the micro-climatic control of the open spaces through greenery and plants and the re-use of the urban out-skirts) and towards reinterpretation and rehabilitation of the urban metabolic system through the strategic reuse of water and green (green corridors, urban parks, regional parks, district parks, cycle paths, etc).

The aim of this process is to provide theoretical, methodological and operative tools, at different scales, for exploring the architectural space, taking into account its building, technological, energetic and environmental dimension. In this way the environmental project bring the eco-building vision into reality and shows how green design and sustainable construction can achieve massive energy and environmental savings (up to produce energy) without forgetting the importance of architecture and aesthetics.

Achieving this goal requires the utilization of both passive design strategies and state-of-the-art energy efficient technologies to design buildings and residential neighbourhood that use much less energy than current practice, and
then to incorporate renewable energy generation systems into the fabric of the architecture to cover the remaining demand.

There are some significant issues addressing the course and characterizing the environmental design:

- **Site analysis**: it is important to identify the potentials and limitations of a specific site with regard to the availability of natural resources and the impact of adjacent building and/or natural elements.
- **Climate analysis**: it is necessary to identify the optimum passive design strategy or group of strategies for a certain local climate.
- **Solar access and solar control**: it is based on the principles of solar geometry and how to take advantage of the sun in colder climates (solar access) and to avoid it in hotter climates (solar control/shading).
- **Passive and active heating and cooling design strategies**: it is required to use the principles of climatic design and the main strategies for heating and cooling in each of the major climate regions.
- **On-site energy production**: it fundamental to employ the principle of on-site power generation and some simple methods of sizing some of these systems.
- **Life cycle analysis of building materials**: it is important to use available tools in identifying and comparing the life cycle assessment of buildings materials and systems (including embodied energy and other environmental impacts).

At the same time, the course uses several performance analysis and simulation software, each aiming at performing a specific analysis task. Simulation of whole-building energy use has been utilized to fully simulate the annual energy use of a building, and analyse the results to identify major energy consumption end-uses and how to reduce them. The purpose of these analyses is to support retrofit design strategies also for existing commercial and residential buildings.

In addition, the objective is to design a project that is more lively, inviting and comfortable. This approach seeks to optimise building and street proportions, street shading, open space, air movement and building materials relative to thermal comfort and Urban Heat Island mitigation.

To give an example, ENVI-met is an efficient tool which analyses micro-scale thermal interactions in urban environments. It is a user friendly tool that aims at reproducing the major processes in the atmosphere that affect the microclimate on a well-founded physical basis (i.e. the fundamental laws of fluid dynamics and thermodynamics). It is a three-dimensional non-hydrostatic model for the simulation of surface-plant-air interactions inside urban environments. It is designed for micro scale simulations with a typical horizontal resolution from 0.5 to 10 m and a typical time frame of 24 to 48 hours with a time step of 10 sec at...
maximum. This resolution allows a fine reading of the microclimatic changes, especially sensible to urban geometry and relevant for comfort issues and analysis of small-scale interactions between individual buildings, surfaces and plants. The vegetation is handled not only as a porous obstacle to wind and solar radiation, but also including the physiological processes of evapo-transpiration and photosynthesis. Various types of vegetation with specific properties can be used. The soil is also considered as a volume composed of several layers and the ground can be of various types. The atmospheric model prognoses the evolution of the wind flow (speed and direction), turbulence, temperature, humidity, short-wave and long-wave radiations fluxes.

Another used tool is an efficient algorithm (RIE index) used to evaluate the reduction of building impact. It is introduced by the City of Bolzano in northern Italy. It is an index that is intended to be a numerical index of the environmental quality. It is applied to a building lot to assess its environmental quality considering soil permeability and green extent.

It expresses the ratio between the elements modifying the land use and the management of storm water. The modification of the land use could be positive (improved water collection) or negative (smaller water run-off). The higher is the RIE index, the better is the management of the land with regard to the quantity of infiltrated storm water and to the benefits for the micro-climate and the environment.

**Critical Assessment of Obtained Results**

Prof. Federica Ottone

The objectives of the workshop are very ambitious because the environmental strategies that are put in place are not defined a priori. The methodological approach requires students to build a certain independence of opinion, through reflection to be implemented on different scales of intervention, from a large scale, in which the interdisciplinary aspects are prevalent, the small scale, in which skills related to architectural disciplines and technologies are being implemented through a design in all its parts. So, this fundamental freedom of choice, although based on objective and subjective considerations weighed and “weighed”, in some cases can produce a certain disorientation. If, on one hand you get great results during the study phase of the context, where the aspect of sustainability is declined in all of its repercussions on the other answers are found in some cases inconsistent with the initial assumptions.

Often students don’t understand that the laboratory is an ongoing process. It is often not accepted the idea that each step does not close a chapter of the course, but it opens another one that can also undermine the work done previously. This implies a change of mind of the students facing to the project. They are subjected to a difficult real mental exercise that forces them to a continuous step forward and back. Certainly this evaluation does not considered only the final design outcome, but
rather then looks if the project idea has caught the meaning of the proposed methodology. The process of approaching the idea is evaluated as much as the idea of the project.

Here we present a project as an example that shows good ability to link the two phases: the knowledge, analytical and design-proposal phase. One might even say that in these project the same preliminary investigation is a critical first step in which is contained in a nutshell the project themes.

In conclusion, the laboratory develops a very complex methodology. The accurate work carried out through direct talks with the students and mainly concentrated in the latter part of the laboratory, tends to overcome the inevitable checkpoints and to achieve very satisfactory results.

**Analysis and Project Tools**
Arch. Angela Leuzzi

The task assigned to students was more that of “design” a strategy of intervention, rather than develop defined architectural project.

Design process start from reading of environmental, economic and social data at local level in order to define answers, adaptable and resilient, for needs of users of the project; project which is interpreted as a hinge joint and connection between the complexity of the phenomena analysed and the simplicity and flexibility of the solutions it proposed.

The environmental design affects all possible levels of intervention: from urban scale to details and the project must, in principle, provide, within it, the possible development of the proposed interventions at different scales.

In particular, an environmental project can start with analysis conducted at a large scale and then drops to the design of micro elements, or, conversely, taking a cue from detailed analysis lead to a wide-ranging project. The development at different scales of the environmental project is due to a systemic approach arising from involvement of different disciplines in analytical and design phase.

The correct definition of setting of an environmental project starts with a focused and precise reading of data from the analysis of the environmental framework of reference in which the project area is a part.

In this sense, must be interpreted and set the stage analysis – cognitive of the area: each part is not analysed only in its intrinsic properties, but should be read in relation to its ability to deal with the whole context.

The project, in fact, can only be set from interpretation and development of system considerations arising from the direct observation and interpretation of data at our disposal.

To facilitate and guide students in collection and interpretation of data required for the project we have developed a complex matrix that would allow an orderly organization of input data and combining them for design purposes.

Federica Ottone, Cocci Grifoni, Federica Ottone, Angela Leuzzi and Mostafa R. Khalifa
The initial phase of completing the matrix provides the collection of data grouped into macro – categories and then the identification of problematic and qualifying characters:

- **Biophysical Characters**: collect all the data belonging to the biophysical system as a whole, analysing all the components such as soil, water and vegetation; for this characters we can individualize issue like water pollution, coastal erosion, presence of green fallow and strength like presence of rivers, proximity to beaches, presence of valuable natural areas

- **Bioclimatic Characters**: synthesize all aspects of the action of sunlight, humidity and ventilation; in this category we can have issue like excessive sunlight, wind exposure, shadows and strength like good exposure of the area, the presence of summer breezes, adequate ventilation

- **Anthropic Characters**: cover analysis of the building, the transportation system and services; here some issue can be: poor quality housing, poor or excessive population density, lack of mobility systems, and lack of social spaces as strength: presence of alternative mobility systems, good quality building system, and integration of traffic flows;

- **Economical and social Characters**: gather all the information on the conditions for sustainable economic and social aspects of the territory and population; for these characters we can identify issue like presence of discontinues industries, lack of social integration, presence of petty crime, immobility of the market and the following strengths: good social integration, high levels of security.

From the interpolation of data collected and processed through the first part of the matrix, we arrive at the definition of critical points, arising from reports of most problematic characters, and strengths, defined by the interaction of qualifying elements.

For example, we can identify critical points such as: environmental pollution, environmental discomfort, social and economical underdevelopment and strengths such as good functional integration of anthropic elements, ecological quality and environment, standardization of bio-climatic conditions.

By the interaction of critical points and strength we can define goal, or goals, of the project (such as integration of the project area in established urban context) and from these expected results in terms of impact on the region (better social cohesion, economic development, optimization of flows, architectural quality of the building).

Goals are then explored in detail through the definition of intervention strategies (improve mobility systems, increase services for users, improve the indoor and outdoor comfort, create spaces for socialization) and actions (separate the traffic flows and provide bicycle lanes and pedestrian paths, design - promote - implement appropriate services, improve thermal comfort in the sunny spaces).
Attached Example

**Project Outcomes**
Arch. Mostafa Rabea Khalifa

**Project _ Urban Addition**
By students (Alessandro Mancini and Riccardo Panata), 2nd year of architecture specialization

**Reading the city, understanding local situations and setting the goal**
In order to give new environmental possibilities and values for the city’s urban contexts, the students are going first with reading the city, in order to have a wide vision of the neighbourhood they are working with and surrounding areas. These give them the ability to focus on problems, what negative and positive features they have, identifying potentials of the site and setting up goals and working plans. So that, they need to bring all what make them aware of the city starting with chronological maps, going through archeological, green, urban satellite maps and finalize even with similar projects that were done in the same neighbourhoods or area surrounding. They don’t miss to get all environmental data related to climatic local conditions, wind, solar radiations, annual temperature and humidity. In addition, they take not only a wide panoramic views but also details for every corner they may give them inspirations for their goals.
Simulating goals and imagining possibilities

Setting up goals is the primary cause leads to successful environmental projects. In this project, the main goal was to reload spaces in order to re-qualify the neighbourhood of Annunziata (located in San Benedetto del Tronto, one of Adriatic cities in Italy), in all its architecture and urban environmental factors (common spaces, existing buildings, re-activate activities and creating sustainable interventions). From this they has a main theme of these re-qualifying methods with a (urban + addition) name. The main objective was divided to sub-objectives related to the triangle of sustainable environmental projects (social, ecological and human built environment). What makes goals clear and visible is simulating them into images, sketches or guides written on maps (Figure 3). These imagining processes, before/after imaginations make goals right up on students’ minds trying to find design ways to achieve them (Figure 4, 5, 6).

Using tools and Analysing methods

Identifying Tools and analysis methods taken in the first step after aware and set-
ting up of goals. In this project students used environmental software program, ENVI.MET (CFD), as a main climatic analysis tools in both pre-design (analysis) and evaluation (feedback) process. With this program they have ability to count how much of climatic comfortable features they must create in order to achieve human comfortable conditions in all site parts either internal or external spaces. It gives important data and simulated maps of wind flow, solar, humid and temperature related to existing situation or after design.

**Design processes**

Design processes divided to three main parts: setting concepts, experimenting concepts and re-qualifying concepts to be a final environmental project outcomes. Those three important steps should be taken into account, specially, when we design sustainable environmental projects which are formed by the triangle of sustainability (human needs, ecology and built environments). In this project the concept was (+) a plus space as a common integrated environmental space linked the three points of the triangle of sustainability (Figure 7). Then, they did experimentation on this (+ Plus zone) with the ENVI.MET (CFD) software in order to test how much the concept meets the human comfortable conditions (Figure 8, 9, 10). After getting feedback from experimental analysis they are able to identify final considerations and identify the final project concept (Figure 11, 12, 13).
From concept to details

Details are important outputs in parallel with final project concept because they give students responsibilities of how realizing project concepts in reality so they were going to identify details in all related project parts either environmental or technical details. In this project, it was important to know what kind of material environmentally efficient in outdoors climate that achieve the concept and how the way to fix it technically in order to design an integrated project (Figure 14, 15, 16).
İmre Özbek Eren

Department Of Architecture, Mimar Sinan Fine Arts University, Istanbul, Turkey

Environment and Sustainability in Architectural Education in MSGSU: Two Examples
The Faculty of Architecture of Mimar Sinan Fine Arts University, established 125 years ago, is the oldest institution in Turkey, in the field of architectural and fine arts education. The success of the Faculty of Architecture’s is reflected in the fact that faculty members of other architectural schools are composed of its alumni. Behind the exceptional educational environment in Mimar Sinan, one can find the co-existence of architecture and fine arts departments under the same roof since its foundation. Fostering the interdisciplinary and holistic idea contemporary educational approaches with conceptual and technical aspects of art and design defines the core of education at the Faculty of Architecture in Mimar Sinan.

The architects trained in the Architecture department which was founded together with the departments of Painting and Sculpture under the structure of “High School of Fine Arts”, the root of today’s Architecture Department, caused architecture to be mentioned in a western sense in our country. There is a half-century long gap between the Department of Architecture of the University and the Institution having started education of architecture afterwards. The Architecture Department has played an important role in training the staff who take part in architecture education as well as in making Turkish Architecture to a contemporary level. The distinctive and prominent characteristics of the department making the difference between it and the other equal institutions is the balance of art-technique and the programs followed to make this composition. This education policy was the most important potential power when the academy became the university.¹

Today, the mission of the Department is parallel to the world’s architectural education philosophy while it maintains/preserves the originality and identity. In 2003, the educational system has been changed into credit a system so as to align with the European educational system. The works have been going on parallel to the Bologna Process.

Architecture is a kind of lifestyle, so the universal problems and approaches can not be taken into consideration without these ongoing events. Sustainability is one of the major concepts that has to be considered in all parts of our lives. According to these concepts MSGSU’s architectural education is being developed and enriched either in compulsory or elective courses every year.

Many courses are related to the subject in MSGSU’s teaching programme, but in-line with the work, two courses are considered. One of them is a compulsory course while the other one is an elective.

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1st Case Study; A Compulsory Course: Architectural Design Issues

“Architectural Design Issues” is a compulsory course which takes place in the 5th semester in the architecture programme. The course is available for 100 architecture students due to the fact that it is open to two branches of the department. The course can be taken by Erasmus students which is preferred by the students due to the fact that it offers a wide range of approaches to architectural design issues in Turkey. The course has several tutors which change week by week according to their specializations.

The Aim

The course provides the students with the awareness of multi-dimensioned thinking in a wide scope besides intuition in architectural design, and developing creative and problem solving skills in the design process. So it is concerned with sustainability either with an ecological or social dimension.

The Content

The courses are done in a seminar system that aims to encourage the students’ active participation. The students may choose one seminar to focus on for the final presentation. The presentation has to mirror the students’ researches, conceptual approaches and their graphical expressions.

The course has different lecturers who have different fields of specialization. Every week one lecturer teaches the course related to its topic. The topics are given in the below:

- The Definition of Architectural Design Process and It’s Issues by, Prof. Ali Muslubaş
- Sketches in architectural design, its philosophy and using scale by Prof. Orhan Şahinler
- Design - Technology and Energy in Architectural Design Process by Assist. Prof Dr. Ahmet Tercan
- Socio-cultural Parameters in Architectural Design Process and Social Participation by Prof. Dr. Deniz İncedayı
- Philosophy and Architecture by Assoc. Prof. Dr. Besim Dellaloğlu
- Presentation of Architecture/Architecture of Representation by Lect. Erdal Özyurt
- Place Concept in Architecture by Assist. Prof Dr. İmre Özbek Eren
- Standartisation in Architectural Design Process by Prof. Dr. Nesrin Dengiz
- The effects of Legal Procedures as a Political Declaration on Architectural Design by Assist. Prof Dr. Emel Ardaman
- The Reflection of Politics on City: Examples From Different Capitals by Res. Assist. Dr. Murat Polat
- Communication in Architecture by Assist. Prof Dr. Recai E. Aynan
- Colour in Architecture by Assist. Prof Dr. Ayşegül Kuruç.
The other outputs of the course are;
1. To provide the students with connections to several fields of architecture
2. To provide the students with connections between interdisciplinary subjects and different scales of architecture
3. To provide a consciousness about several issues which affect the design process
4. To have the sense of conceptualisation and consideration of research subjects.
5. To present a subject in a graphical language
6. To develop individual or group working skills.

Teaching methods and Pedagogy

In the first week, the aim and the content of the course is explained by all the lecturers. By doing this, it is aimed to meet the lecturers, know each other and have an opinion about the course and its lecturers. Due to crowded academic population, an attempt is made to facilitate the students to contact any of the course’s lecturers. This approach helps the students feel important and gain their attention.

Every week, the contemporary lecturer makes connection to the previous course’s subject, so the continuity of the courses is maintained.

1. **What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?**

   The structure of the course is based on the theme that gives the students different viewpoints of architecture. Today we know that architecture is a part of life and it is a kind of lifestyle and way of thinking such as sustainability. The Environment is a whole that contains several components such as social, economic, ecological, physical, perceptual and so on. As sustainability is concerned with several dimensions of the environment, every course emphasizes a different subject of the environment. This kind of an approach gives the students an intellectual view that is essential for architectural design in the context of sustainability.

2. **How do I teach environmental issues and sustainability in the course or studio for which I am responsible? Why do I choose to teach in this way course or studio I am describing?**

   The architectural education programme in MSGSU has several design studios focused on different scales beginning from interior design to urban planning. Although theoretical courses behind these studios, the students need to read, look, walk, think, argue and present their opinions about contemporary architectural issues. Sometimes they cannot find enough time for these activities. The architectural design issues course gives the students a compact conceptual base so as to support them for these activities.
3. *What exercise(s) and design themes do I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?*

The content of the course is based on several topics about the environment. A brief resume of these subjects are given in the below:

The Definition of Architectural Design Process and Its Issues: The first seminar is based on the definition of architectural design processes done either in educational or in professional practices. This viewpoint provides the student with knowledge of the wide fields of the discipline of architecture. While the practices go on, several problems and interactions of different disciplines such as urban planners, lawyers, engineers and so on have to be faced and this provides the architects with an intellectually and environmentally sensitive practice.

Sketches in architectural design, its philosophy and using scale: Architectural design process has several scales. These scales change from 1/1 to urban scales 1/10000 or 1/5000. But these scales are not only the physical scales to draw in but also they have the conceptual meanings related to their contents. For example one student begins designing from urban scale, 1/5000 with its conceptual backgrounds such as the city ecology, economy or social structure. After going on in an order every scale has to be either drawn or thought about its related contents. Also every scale has to be feed by other scales during the design process. Sketches are very important during these processes. It aims to give the sense to students to combine the environment as a whole in sketches in the backgrounds.

Design - Technology and Energy in Architectural Design Process: It is aimed to analyse cases in and out of Turkey on a comparative basis; so as to provide the students with the significance of the “energy problem” and make the issue a part of the design solution. Also it is emphasized to take into consideration the different dimensions of energy so as to support the students to define the energy as a design issue and transform this issue to an architectural solution.

- Socio-cultural Parameters in Architectural Design Process and Social Participation: Social sustainability is emphasized in this seminar. It is aimed to demonstrate the effective role of participation of the end user in the architectural design process via global case studies.
• Philosophy and Architecture: Beginning from the ancient times, architecture has orthologic dimensions on the context of being in a space and being a human creature that lives organically and thinks sensitively. Today the philosophical approach is still important on a different level; globalization. Students have to consider the thinking background of architectural design on different fields

• Presentation of Architecture / Architecture of Representation: The globalization era has different characters from the previous ones. One of them is speed (time, interaction..) In this quick world the images are very important. So architectural images/presentations are important as manifestos of the architects beside the architecture’s itself

• Place Concept in Architecture: The lecture’s aim is to consider “place” concept in architectural design. It is important to understand all environmental components join to architectural design process as contextually to contribute the holistic approach in design process. The lecture’s method is based on approaching to different architectural and urban projects either from Turkey or world discussed in a comparative analysing

• Standardisation in Architectural Design Process: It is concerned either with the universal standardisation in industrial design or with the quality of design process. The seminar aims to provide the students with an awareness of universal applications concerned with architecture

• The effects of Legal Procedures as a Political Declaration on Architectural Design: Beginning with mankind, legality is a part of community life even when there were no written laws. There had been always legal procedures to regulate the community and city life. Considering these legal procedures for different cultures provide the students with an insight into how city life, social, economic, politic or cultural life and architecture are connected to one another
• The Reflection of Politics in the City: Examples from Different Capitals: Politics have been an important part of the socio-cultural environment. The role of politics and its effects on city planning is considered as a part of the environment

• Communication in Architecture: As architecture is a kind of language between the subject and object, it has to be considered how the codes of architectural language from the sender are transferred to the receiver/user

• Colour in Architecture: The aesthetic dimension of design process is emphasized. The perceptual environment is an important part of our lives. Colour as a basic part of the aesthetic and its effects on mankind and environmental perceptions are considered.

4. How satisfied am I with the course on the environment and sustainability I teach? How could I improve my course?

The course is done related to its aims. Every year, the content is enriched by the lecturers parallel to contemporary architectural subjects.

2nd Case Study; An Elective Course: The Interior Spatial Organization And Use Of Colour in Vernacular Architect

"The Interior Spatial Organization and Use of Colour in Vernacular Architecture" is an elective course, which takes place at the 7th semester in architecture programme. The course is available for 10 architecture students and 2 students from Departments of Urban Planning and Interior Architecture. Although the quota of the course is twelve, Erasmus students can also take the course and have the chance to visit a common house type of vernacular architecture in Turkey. The two tutors of this course are assistant professors in Building Design Division, and specialist on colour and interior space.

The aim of the course

The main objective of this course is reading and analysing the local architecture in rural areas through the spatial organizations and use of colour.

The content of the course

Vernacular architecture, interiors of houses, furniture and equipment, colour perception and use of colour in vernacular architecture are contents of the course.
The outputs of the course

At the end of this course the students are expected to develop the awareness of conservation concerning vernacular architecture with respect for cultural and natural values, ability to take measurements and conduct a questionnaire, and skills to present the analysis of both use of colour and spatial organizations. The other outputs of the course are;

- Better understanding about spatial characteristics of vernacular architecture
- Creating awareness in effects of cultural and social differences in interior equipment and colour preferences
- Increasing familiarity with furniture and equipment in houses of local architecture
- Providing tools to build inventory based on queries and stories of the local residents
- The towns, which have local architecture characteristics in rural areas, are chosen for fieldwork. The spatial organization and use of colour in these houses are examined and analysed in order to form references and roadmaps for old and new buildings.

Teaching methods

- In the first four lessons, the tutors give theory about vernacular architecture, furnishings and use of colour in interiors, perception of colour. In the fifth week, after organizing the travel and making contacts with the local authorities; the tutors and group of students visit the town chosen for the course. The first day is spent by visiting the municipality and taking documents, seeing around with the guide and deciding for groups, due to the complexity of the houses and of course due to students’ will to work in them. The tutors make groups of 3 or 4 students considering students’ skills regarding taking measurements, etc. The following days, the students note measurements, conduct survey and take photographs. The tutors try to arrange all students to stay in a pension which has characteristics of vernacular architecture, so that the students would not only take measurements but also use the spaces of the same kind of a vernacular house. While conducting the survey, the students have contacts with locals and have another perception of environment. Usually the last day, it is planned to see to the noteworthy historical and natural sites and places close to the town. This might help students to perceive the chosen built vernacular environment in terms of regional scale
- The following weeks after the field study, the students work on organizing the data they have. The tutors decide the patterns and all data of a house is collected under five topics, drawings, photos, the colour inventory and spatial analysis
The last three lessons the tutors give knowledge about the method for colour inventory and spatial analysis. All work is finished in A3 format papers, bound and photocopied for every student and tutor.

**Pedagogy**

The students decide in the first lesson if he/she is to give up the course. The field study is the most important part of the course, but even if the student could not join it for some reason, the tutors reintroduce him/her to one of the groups and complete the course. The students share many things between themselves and with the tutors during the travel and at the stay in the town. They even prefer to study together at nights in the town. Not only because of the group studies but also the common problems at the field study, or the problems in transportation or stay make students more close friends and they enjoy more working together. The tutors take care of them during the fieldwork, considering the psychology and wellness of each student.

1- What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?

The vernacular architecture is shaped by natural environment references like topography, climate and material. Therefore, while analysing the spatial organizations, the students can find out the relationship between the forms of the houses with environment and will realize that how vernacular architecture succeed/achieve the sustainability by not exhausting the natural sources. Staying in the field area for a few days, the students will also have chance to contact with locals, to taste the local foods. They have a chance observe the social-cultural environment by conducting a survey even only for the house they work. The students can also discover the colour harmony in interiors and on facades. The use of organic and natural colours and local materials form the identity of the place.

We teach this course because I think, the development is understood as structuring especially in rural areas which is a danger for conserving the local architecture.

2- How do I teach environmental issues and sustainability in the course or studio for which I am responsible? Why do I choose to teach in this way course or studio I am describing?

The theory of the course gives knowledge about the difference between the terms “local”, “vernacular” and “traditional” and gives a few examples about vernacular architecture from world. Vernacular architecture is in harmony with its environment. The students will discover how the use of natural colours and colour of local materials give local identity to the settlement. Using the local materials around, the vernacular architecture already achieves sustainability. After the building completed its use and broken down, local materials which it
is made of, such as stone and wood do not make a waste, as they return where they are taken.

We choose to teach this way, because we think before designing something new, the students should have a background about the housing culture of the country they live in. While analysing the present situation of local architecture, they will both observe and state the local solutions for climate, topography and material. The course is especially focused on interiors of local architecture, the furniture and use of colour, where the personal choices and the social relations take place.

What exercise(s) and design themes I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?

We do not propose a design theme to students. The course is about observing and stating the conditions of the house, the spatial organizations of rooms, common spaces, gardens, courts and the use of colour inside. When they return back from the field, they analyse the statements they made in field area through tables and graphics.

The students are expected to take measurements of a traditional house and conduct a survey with the owner of the house. In the survey, they also have to state the solutions for the heating and supply of water.

The spatial analysis and colour inventory helps students building a broader perspective in perception of space. The spatial analysis gives an idea about the proportions of open, half-open and closed spaces, storages, fixed furniture and functional use of the house. Stating the use of colour and materials help stimulation of new interpretations based on colour inventory.

The spatial analysis of a house

How satisfied am I with the course on the environment and sustainability I teach? How could I improve my course?

In field study, the students will develop awareness in sustainability of environmental values in rural settlements. It is also possible to observe
how the vernacular architecture already utilizes basic principles of sustainability. Studying on a local house, the students will also have chance to discover the settlements in rural areas are compatible to the topographic features, and it is planned according to climate data and natural structure.

If we can have more contacts with local governments, the course will be more effective. In order to improve the course, we can give more knowledge and examples about not only the spatial organizations but also the construction of vernacular houses. It is also in the programme of the course to visit a studio of a local carpenter or invite him in order to tell his furnishing or structural applications in interiors.

The course will be more successful if the university and the local governments support the students by sponsoring accommodation, travel and giving briefs about the town in an organized way.

The conclusion

There are many other courses in MSGSU, like these courses, which aims to develop environmental awareness; even some do not have the terms “environment” and “sustainable” in their titles, they evaluate these terms in their contents. It is an institution in university that, the students are expected to develop their projects considering the environmental issues and sustainable development in Architectural Design Studios.

Since the sustainable development is an important issue especially for the rural areas in Turkey and the artificial environment has not in the desired level of quality, helping students developing knowledge and awareness on these subjects will be an important goal in high priority at the Department of Architecture in Mimar Sinan Fine Arts University.
Nikos Panagiotopoulos

School of Architecture, Aristotle University of Thessaloniki,
Thessaloniki, Greece

Introducing Sustainability into the Architect Curriculum - Experience and Drawbacks
Architects and Architecture educators assume a leading role in preserving the environment and the planet’s resources. Today it may be possible to state that the architectural community has reached the point of recognizing that sustainable design as a fundamental issue of architectural education. The question is how to introduce the notion of sustainability into several courses of architectural curricula at an early stage. The dominant approaches put forth for discussion today are: 1) the conviction that sustainability is inherent in Architecture and we have to seek for it in the vernacular and the work of the great masters, 2) the reshaping of existing contents and the introduction of additional interdisciplinary courses and 3) the introduction of the notion of integral design and management into building design and construction at an early stage, accommodated by a radical reform of the curricula. The paper describes step by step the experience of the team of teachers of Architectural Technology at the School of Architecture of the Aristotle University of Thessaloniki. As a conclusion, criteria are suggested in order to achieve the goal of an overall integration.

Introduction

It was 14 years ago, when UIA/UNESCO issued the ‘Charter for Architectural Education’ (UIA/UNESCO, 1996). Today the need to teach sustainable design is widely recognized by the educational community, at least in principle. More or less, all Schools of Architecture have introduced courses such as ‘Energy Conscious Design’ or ‘Bioclimatic Architecture’ which mainly deal with the technical aspects of sustainability, focusing on the issue of energy management. Yet there is a general acknowledgment that sustainable design concepts are far from having been incorporated into the regular curriculum. It is time to discuss once again about our teaching methods, mentality and goals, in order to help ourselves into new teaching concepts.

Differing emerging approaches to introducing sustainability into an architectural program are becoming apparent. These are described and commented upon in this paper. Certain criteria are proposed to assist in the task of the integration of sustainability into architect curricula.

Approaches to introducing sustainable design into the architecture curriculum

To examine how to achieve integration of sustainability into an architecture curriculum, it may be useful to discuss the different approaches representing at the same time different schools of thought and lay them down for comparison, study and criticism.

The first approach is based on the belief that sustainable design is fundamental and constitutes a part of everything we do in Architecture. Therefore

Nikos Panagiotopoulos
it permeates the entire curriculum by its very nature. The cardinal factor that informs Architecture and determines sustainability is design. This approach assumes that sustainability, or rather sustainable design is inherent in all aspects of all course work. This approach supports the premise that sustainable design is so fundamental to architecture that it should not be necessary to address the subject outside of the normal theory and practice. The same premise, however, implies that the entire faculty fully comprehends the complexity of sustainability and will act on their own accord. Does it mean, then, that the faculty will enhance the curriculum by intuition, so as to introduce sustainability into all aspects of teaching? This assumption may be entering the sphere of metaphysics.

The second approach develops out of courses concerning environmental control systems (ECS). These courses provide the technical knowledge required to develop an understanding of the interaction between the building and the climatic conditions outside and deal with the modification of the exterior and interior microclimate for purposes of human use and comfort.

This approach leaves the curriculum largely unchanged. The importance of environmental topics in related courses is increased and carries over into a number of courses including the design studio. This approach is effective in the case of faculties with an understanding of the technical aspects of the subject material. In this case it remains the responsibility of a few to introduce the subject into the core of the program. Yet, in most Schools these individuals are not in the position to fully integrate the subject into the design studio, as they are not the same ones who teach design theory. Furthermore, this approach emphasizes the technical aspects of sustainable design, understating the need to place the issues in a larger context within the program.

The third approach is to fully integrate the subject into all the course work and state it in the curriculum. This requires that the complete curriculum be completely reviewed and revised to introduce sustainability. This approach ideally includes the entire faculty in the subject of sustainability and ensures the integration of the subject into all the course work, including the design studio. This presumes the commitment of the entire faculty to the exploration of the subject of sustainable building and a common desire to achieve integration. This degree of common action may be difficult to achieve without effective leadership or influencing outside factors.

The Experience at the Faculty of Architecture in Thessalonica

At the Faculty of Architecture of the Aristotle University in Thessalonica, the issue of integration of sustainability in the architectural curriculum is not a novel matter. A team of teachers at the Department of Architectural Design and Technology have been pursuing the goal to achieve this integration during the last eight years, in a slow and arduous process, with long discussions and also quite
a bit of controversy. The team was confronted with various adversities. Most of these adversities are common to most schools in different countries:

- Environmental modules are more or less of technical nature, detached from design studios. In addition, in most cases emphasis is given on quantitative rather than qualitative matters, with the result that lessons are less popular, being related to numbers rather than design, social matters or ethics
- Many tutors have limited training in matters regarding sustainable design and sustainable construction. As a result, many are reluctant to introduce new topics to the curriculum, endorsing the established attitude of the architect as that of an artist, detached from earthly problems, solely dedicated to the arts. Sustainable design is considered ‘aesthetically unattractive’, while non-sustainable examples are being promoted as aesthetically eligible
- Training and research are carried out in a fragmented manner. This comes to a striking contrast with the nature of sustainable design, which is a complex task, integrating a multitude of fields and parameters and requiring interdisciplinary teamwork
- There remains a prevalent notion of sustainable design as fashion or at best a rewarding ‘hobby’, without any feedback on ethics, society and culture
- Difficulties particular to our Faculty refer to the structure and mentality of our curriculum, notably the lack of prerequisite courses. This makes it difficult to structure a process of adequately interrelating technical knowledge with the design studio
- The social, cultural, and aesthetic backdrop, in which students live, is characterized by a frustrating lack of examples of sustainable practices and works. In addition, the consumerist attitude of most citizens contradicts the ethical turn which is a prerequisite for embracing the principles of sustainability.

Given the above circumstances, sustainable design was introduced gradually, in the sense of the second of the aforementioned approaches, i.e., through technological courses, both existing ones, such as Building Physics and also new satellite courses of more or less technological nature. This approach was none of our choice; it came out of necessity, affected on one hand by a non-sustainable social, cultural and academic environment and on the other hand by our persuasion that sustainability should enter our modules, our studios and our teaching. We took advantage of the fact that we are the team who teach the main Building construction studio, called Building Construction Technology (12 ECTS) to gradually assimilate knowledge from satellite courses into the aforementioned course. Our experience is presented in this paper, with the hope that it might prove useful, either because other schools are confronted more or less with similar problems, or maybe even because this discussion might induce some thoughts about how things would have been dealt with in a better way.
To achieve our goal of merging issues of sustainability with the design and construction studio, we have taken a series of steps:

- **Building Physics (3 ECTS)** is an obligatory module and unfortunately not a popular one, as it was related to number crunching and technical matters. It always functioned as a satellite module, not directly affecting the design studio. Yet one must consider that:
  - Building Physics informs energy conscious design to a great degree. Without the basics provided by this field, any architectural strategies towards a proper energy management appear as smart concoctions, whereas, in fact, everything relies on **simple physical principles**
  - Building Physics provides information and knowledge on how buildings work, thus being a main pillar of building design and construction.

  The content of **Building Physics** was re-formed, so as to focus on the performance of the **building’s skin**, including several issues related to **energy management**, plus **sound control**. Waterproofing was integrated in energy management, in connection to heat insulation and construction technology, as well as in construction, as it informs the design of many building components. Equally, fire protection was studied as a parameter of design and building construction. This new concept of Building Physics established a synergic function to Building Construction. We had the ability to do this, because the same team teaches construction to the same students for at least one and a half years, monitoring their progress as well as their response to pedagogical procedures.

- An **optional** course was introduced, titled ‘**Resource Architecture**’ (3 ECTS), with the intention to educate students about **integral building design**, expounding the definitions of natural capital, human capital and natural resources. The course included energy management, water management, life cycles of materials and sustainable town planning. It was asked by the students to formulate proposals for the improvement of a very strategic section of their school. In addition the course supported a series of research theses covering a wide spectrum, ranging from technical issues, such as refurbishment and accommodation of international sustainability certification systems in the design of specific building types, to works on sustainable communities and the social and political premises of sustainability. The response of the students was tremendous, with numbers of attendants growing larger by the years, until eventually it was no longer possible to maintain the dialectic character of the course, which was our initial wish. It became evident that the next step was due

- The next step was to organise a workshop called ‘**Energy Efficient Skins**’ (9 ECTS). The course was manned with qualified personnel from different disciplines. Its intention was to educate students in the analytical study and comprehension of energy efficient building design. The contents were
related to energy management, renewable energy resources and energy efficient building design. Once again the students were one step ahead and expressed the will to go one level further. They qualified examples of sustainable design with a specific focus on the management of all natural resources, that is to say energy, air, ground, water and materials. The course outcome has also shown to everyone, teachers and students alike, that sustainable architecture can also be good, even remarkable architecture.

- The new course was modified in order to include contents from ‘Resource Architecture’, our optional course. The latter, had fulfilled its purpose to raise awareness in matters of integral design, having concurrently initiated a large number of research theses. Yet it was no longer viable because of its own limitations. As a result, the two modules merged into one, renamed ‘Sustainable Skins’ (9 ECTS).

- At the same time, the principles of energy efficient design were introduced into the course of Building Construction at the very first stage, with the requirement that it be integrated into the building design and construction. Our ultimate goal is to merge all contents into one continuous learning entity, which should integrate building design, construction and resource management into a single process of learning, thinking and acting.

In this manner, although we evidently followed the technological ‘environmental control systems’ approach, we still managed, to a degree, to promote our conviction that sustainability should be an integral part of architectural education, including architectural theory and history, architectural design and building construction. We are still working towards a commitment of the entire faculty to this principle.

Suggestions for promoting the integration of sustainability in architectural curricula

Given the differing approaches to the introduction of sustainability into the architecture curriculum and our experience so far in attempting a series of steps to this goal, we recognize the need to establish a set of criteria to assist in the process of integration:

- The complete curriculum should be reviewed and revised to fully embrace the notion of sustainable design. The entire faculty should participate in this process
- History and design theory courses should introduce and underline environmental and cultural contexts. The students should develop a conscience based on the knowledge of how people have been using land and resources through the course of human history
- Technology courses should begin by propounding design strategies based on the adaption of buildings into their environment, rather than promoting tech-
nological solutions in order to ensure human comfort. Natural resources like solar energy, wind, water, and geothermal energy should be placed in focus.

- The issues of how buildings work, how they interact with their environment, have to become common knowledge. The basics of thermal transfer, daylighting and air movement should be introduced in the beginning of every design studio.
- The fragmentation of knowledge results in academic isolation. The need to interact with other disciplines is paramount in teaching, research, and practice. Sustainability is an interdisciplinary activity, underlined with the need for cooperation and teamwork.
- The research on how buildings interact with the natural and social environment must be on-going, including master’s courses and PhD students.
- The curriculum must promote connection by providing the opportunity to seek elective, liberal subjects and to participate in community life. The global community is engaged through language. The curriculum should encourage the study of languages and cultures and promote travel and study abroad.
- The process of accreditation should be accordingly adjusted. A definitive requirement should be established, that students possess skills and knowledge defined by a set of criteria, which incorporate sustainability.

Endnotes
Dietrich Schwarz

Institute of Architecture and Planning, University of Liechtenstein,
Vaduz, Liechtenstein

Sustainable Design
**Cultural**

Durable appreciation of buildings and urban densification combined with infrastructural improvements define the basis for socio-cultural revaluation.

Phases of life, new models of living together Economic powerful regions: strong migration, integration, individualization > Loneliness Economic week regions: emigration, loss of culture.

**Economical**

Efficient construction and maintenance guarantee positive return of investment for architectural projects. A building that requires minimal operating energy is characterized by a well-balanced interaction between its skin, structure, building technology and service procedures.

**Ecological**

Sustainable Design is hereby defined as the quest for an optimized energy balance throughout the entire lifecycle of a building. Beside heating and cooling demand, grey energy and recycling energy are considered as integral components of planning. The choice of materials is further affected by environmental impact and emotional phenomenology, which close the circle to cultural sustainability.

**Studio Themes**

**Constructive Ornament**

Precise construction leads to beautiful detailing. The phenomenology of the materials leads to sensual aspects of spaces. Focusing on the tectonic rules of the material, efficient and aesthetic buildings are developed beyond an understanding of architecture as decorative surfaces.

**Multitasking 1 to 20/200/2000**

Since the building envelope is one of the key issues, construction in scale 1/20 is not done at the end of the design process. Parallel to plans and sections, urban design and construction are developed over the whole semester. Still, scheduled periods help to focus.

**Quality of Life**

In the end architecture was invented to increase quality of life. We wonder about true values and think about a paradigm shift from “more quality of life - more energy consumption” To “more quality of life - less recourse consumption”

**Learning Sustainable Design**

**Learning Objectives**

The Concentration ‘Sustainable Design’ is part of the Master of Science in Architecture Degree Program of the Institute of Architecture and Planning of the University of Liechtenstein. Going straight forward to detailing of the buildings envelope,
Students develop an aesthetic expression by sensual construction. One could name it tectonics. The projects will be developed on the basis of the strictest Energy-Stan-
dards. The design-course will be supported by the four mandatory courses in Building
Physics, and Structures, Mechanical Systems and Material Ecology. These mandatory
courses are structured in three parts: communication of basic principles, application
thereof through the use of particular software, and project related integration.

Integration
The mandatory courses are integrated by experts. The goal of the integration
is to use the acquired knowledge of the lectures in the design studio project. Each student works out the key elements of his/her project to reach the goal of
high level energy efficiency and a sustainable building structure.

Goals
Sustainable design requires energy-optimized constructions. The aesthetic is
mainly influenced by a precise handling of details. The design project of Studio
Schwarz shows the connection from sensualism to material and further on, to
construction.

Team
Prof. Dipl.-Arch. Dietrich Schwarz, Professor Sustainable Design
Dr. Daniel Gstöhl, Leader of Research Sustainable Design Dipl. Ing. Robert Mair,
Scientific Assistant Sustainable Design
Project Studio Sustainable Design
Professor Dietrich Schwarz
Winter semester 2010/2011
Bregenz 47° 30′ N, 9° 45′ O

Urban Identities - City of Music and Culture
The yearly theme of our studio is redensification of city centres. We do not
mean that in sense of building mass and inhabitants only, we are interested in
a redensification of specific urban identities. That means, we will examine urban
space of Bregenz from first day on. What are existing qualities of the location?
Where do architectonic cracks disturb the atmospheric fabric? What does post
world war II modernity contribute to that phenomenon nowadays?

Project Studio Schwarz - Sustainable Design – Assignment
Existing Identities, also known as genius loci, shall be traced and answered
by tectonic expression of the projects. Contrary to an understanding of façade as
an image, we seek for constructive ornamentation which evolves by consequent
constructions. Therefore we start at the very beginning of the project in detail
of scale 1/20. The question of sustainability asks for meaningful and smart solu-
tions. An emotional approach of genius loci is brought together with technical knowhow. On the one hand, to reach a professional level of design on a tough real estate market today and on the other, to guarantee long term appreciation by the public, in the future. Cultural sustainability is the keyword.

Perspectives for social sustainability are the starting point of our architectural programme. Therefore we had a talk to the chief of town planning department:

“We are famous for our Bregenz Festival at Lake Constance. During July and August, town is fully booked. Musicians would need specific housing, very urgent. That issue is burning! Housing and cultures, especially music related, have a great potential within the old centre. Also for the rest of the year, there are definite demands.”

Dr. Bernhard Fink, Sept. 16th 2010

The programme of housing for musicians with complementary uses as sound studios can be seen as a powerful contribution to the cities profil of culture and music. Low quality building stock will be replaced upon strategic spots down town.

**Semester Structure of the Design Studio**

winter semester 2010/11

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<td>13.10 / 14.10</td>
<td>Material: façade and construction 1/200, 1/20</td>
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## Integration of Building Technology

**Winter Semester 2010**

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Master-thesis students have to integrate all 4 subjects individually.

Structures / Building Physics / Mechanical Systems / Material Technology

## Research

**Fluidised glass façade elements for an active energy transmission control**

**Duration** May 2008 to May 2011

**Coordinator** Institute of architecture and planning

Teaching a new Environmental Culture
Main Research Sustainable Planning and Construction
Field of Research Sustainable Design and Construction

Description
A glass façade system which controls the energy flows within the transparent building envelope will be developed. The facade enables the perfect comfort in the building, while simultaneously reducing the energy demand. Two fluid filled layers will be implemented in the glass facade. These two layers are regulating all energy flows. The inner fluid layer keeps the surface temperature constantly at room temperature. The outer liquid layer controls the solar radiation by absorption. The predominantly challenge in this project will be the absorption of the fluid driven forces within the glass panes. Furthermore the whole building services have to end up in a compact and simple plug and play system. The system integrates floor heating, cooling ceiling, solar collector, shading device and insulating façade in one element. The transparent facade increases the energy efficiency of buildings in every climate zone and enables the use of renewable energy - solar energy - at the whole façade area.

Reference to Practice
Architects and engineers receive a standardised product, which crucial increases the efficiency of their building. The user-friendly plug and play system - glass, window frame, building services - enables the use of renewable energy in an easy way. Because of the active control, the system can be used in every climate zone at every building type.

Keywords
• Architecture
• Building physics
• Renewable energy
• Sustainable design
• System development

Principal Investigator
• Prof. Dipl. Arch. ETH/SIA Dietrich Schwarz

Project Manager
• Dr. Daniel Gstöhl

Sponsor
• Forschungsförderungsfonds der Hochschule Liechtenstein
• GLASSX AG
• Hilti AG
• Hovalwerk AG
• Internationale Bodensee Hochschule
Partner
- Eckelt Glas GmbH Saint-Gobain Glass Solutions
- GLASSX AG
- Hilti AG
- Hovalwerk AG
- NTB Interstaatliche Hochschule für Technik Buchs
- Saint-Gobain Deutsche Glas GmbH

Conference Paper
Sally Stewart
Mackintosh School of Architecture, Glasgow School of Art, Glasgow, United Kingdom

Insider not Outsider; Integrating Environmental Thinking in Thesis Design
Abstract

This paper examines strategies evolved to support architecture students in developing sustainable thesis proposals during their final year of professional architectural education.

While in recent years we have had considerable success in establishing an integrated approach in encouraging sustainable thinking to become embedded within the third year of the undergraduate architecture programme, it has proved much more difficult to replicate the same outcome within the graduate programme.

In their fifth and final year students are expected to be able to undertake and sustain as a self-directed design project, the design of a thoroughly researched building of reasonable complexity and ambitious architectural intention, encapsulating a critical architectural position and maturity of judgment. Although offering a degree of freedom not present in earlier years, the final year is also where students demonstrate their ability to meet key criteria at the threshold of professional practice and approaching qualification. This paper explores strategies developed within the current fifth year studio, locating students within a series of European cities with differing environmental conditions, demanding the development of an understanding of appropriate sustainable responses while producing proposals which integrate context, programme and technology.

Through a series of steps, including an analytical study, the building of large-scale model, an extended field trip and discussions with local practitioners, the structure aims to provide a working method that can be adapted and customized depending on the conditions encountered. The methodology also aims to encourage students to develop their powers of observation, awareness of the local, and although moving from familiar territory to develop an approach allowing them to operate as insiders rather than mere tourists.

Introduction

Contemporary architectural education requires architecture schools and educators to deal simultaneously with both consistency and radical change. On one hand the external context in which architects operate is changing dramatically particularly in responding appropriately to climate change, an issue that has grown exponentially in importance. New attitudes and responses are required both within the profession but more importantly in the minds of student architects, who face future careers where this issue becomes the key lens through which all development is examined. On the other hand despite acute financial pressures, the recognized processes of iteration and reflection that underpin studio education cannot be fast tracked, and few models have emerged that ultimately equip the architect on their journey to becoming a master of their craft.
While in recent years within the Mackintosh School of Architecture, we have had considerable success in establishing an integrated approach in encouraging sustainable thinking to become embedded within the third year of the undergraduate architecture programme, it has proved much more difficult to replicate the same outcome within the graduate programme. As in many schools the student population in fourth year is made up from continuing students and new comers in equal measure, diluting to an extent the impact of any expected knowledge or process carried on from earlier years. Therefore projects in fourth year demand a diagnostic element in relation to technology and climate change, as well as an agenda that places sustainability in all its contexts at the heart of discussion and design practice.

In their fifth and final year students are expected to be able to undertake and sustain as a self-directed design project, the design of a thoroughly researched building of reasonable complexity and ambitious architectural intention, encapsulating a critical architectural position and maturity of judgment. Although offering a degree of freedom not present in earlier years, the final year is also where students demonstrate their ability to meet key criteria at the threshold of professional practice and approaching qualification. This paper explores strategies being developed within the current fifth year studio, which through locating students within a series of European cities with differing climatic conditions and agendas relating to climate change, demanding the development of an understanding of appropriate sustainable responses while producing proposals which integrate context, programme and technology with the goal of achieving sustainable final design thesis proposals.

I. Moving from the status quo

For many years the focus of the final year for architecture students within the Mackintosh school is the conventional thesis project sometimes known as a comprehensive design project. Working from an open starting point students develop a hypothesis that can be tested through the vehicle of the design of a building that addresses context, programme and technology. Conventionally the thesis project extended across the final year of study and delivered a parallel technical study demonstrating the key environmental, structural and tectonic decisions taken. The thesis starts from a combination of choices: that of the architectural issue or theme the student chooses to explore, and that of a building type and of a site that are vehicles to turn the topic into a project. A successful thesis integrates these aspects in a demonstration of design ideas, skills, imagination and ambition. One of the challenges of the thesis is that of developing and sustaining a line of architectural enquiry over the session, that links the intellectual development of the project with a growing architectural sensibility through encountering practice. It also marks the watershed between the academic education and...
the profession, highlighting skills gained, interests established and individual paths to be pursued now and in the future. As Richard Sennett distinguishes, “The modern era is often described as a skills economy, but what exactly is skill? The generic answer is that skill is a trained practice. In this, skill contrasts the coup de foudre, the sudden inspiration. The lure of inspiration lies in part in the conviction that raw talent can take the place of training.” (Sennet 2008: 37). The thesis is seen as a self initiated piece of study, the culmination of the student’s journey towards becoming an independent learner. At the threshold of the Part 2 of RIBA/ARB exemption there is an also an external professional expectation of what students should be able to achieve. “Projects will be more complex, design constraints more severe and set within an intellectual framework which establishes, tests and concludes a hypothesis with regard to the context in which it is made. Projects will incorporate wider contextual issues and address ethical design concerns. Including the needs and the safety of building users, constructors and the community.” (RIBA: 39).

However the freedom of the thesis also entails substantial drawbacks and can provoke considerable anxiety and confusion in students. In a programme where considerable effort in earlier years goes into the honing of project briefs and the selection of associated sites, the student has few opportunities to choose these for themselves and subsequently becomes reliant of staff to filter these variables on their behalf. While this might focus the design parameters of a given project, it also means that student find themselves novices in this selection at a point where a full session’s work is reliant the project they construct for themselves. The place of technology – actually a composite of many very different elements – environmental science, construction, materiality, structures, results in the need for a range of different research questions, but one threshold idea - the need for a low carbon brief. The technological context student must navigate is also far more complex that even 10 years ago – then awareness of simple HVAC principles and services might prove sufficient Now there are burgeoning technologies, technique and systems. This means that the required knowledge systems are different – students need to know how to discover, sort, evaluate and analyse information to identify and develop appropriate knowledge and to a evaluate performance. Although considering feasibility of the project is a significant study in its early weeks, this often led to a sense within the student that the project is less than perfect, not what they have encountered before, rather than giving confidence to embark on the scheme and detailed phases.

Donald Schon characterises the architect as one engage in a process of reflection, “Practitioners are also makers in the more general constructionist sense... They frame problems and shape situations to match their professional understanding and methods, they construct situations suited to the roles they frame, and they shape the very practice worlds in which they live out their professional
lives.” (Schon 1987: 43). If we therefore wish to produce reflective practitioner within your student group we must think how they can take control of their thesis, as an example of future practice.

II. Working with cities

Within our Diploma programme we aim to continue the threads woven through the Undergraduate years, an interest and engagement with architectural history and the sociological factors shaping the built environment, development of an approach and knowledge of architectural technology that informs and underpins design decisions, and the ability to support ideas through research. While fourth year work explores Glasgow as its urban laboratory, using the city as its three dimensional textbook, fifth year students have had the opportunity to locate their work in any context they wished providing they can substantiate their choice. Given this freedom, many students still chose to work in the immediate area, sometimes driven by assumed familiarity though more often or not by the availability of information and local insights. The challenge was made more difficult by the anxiety presented by perception of having to present an airtight case for a thesis and project which might only be understood or formed in outline, and without specific supporting expertise.

In order to encourage and kick start the process of looking more widely, beyond familiar territory, a new strategy has been deployed over the last two sessions. The strategy aims to support students in identifying a thesis and working towards producing a built response, by offering the possibility of exploration beyond the city and Scotland, supported by collaboration with peers and possibly students, staff and practitioners.

Given the situation of fifth year as the threshold between their formal education and the profession, the project also acts as a stepping stone between supported and independent learner. In this finding the balance between the new and the familiar is key, working beyond the comfort zone but in an informed and confident manner. “When the practitioner takes seriously the uniqueness of the present situation, how does he make use of the experience he has accumulated in his earlier practice? When he cannot apply familiar categories of theory or technique, how does he bring prior knowledge to bear on the invention of new frames, theories, and strategies of action?” (Schon: 65)

Our strategy has been to identify a series of cities that offer interesting and varied contexts in which to locate thesis projects. If this alone was the extent of the shift it could be argued we were only revisiting typical situations and projects, albeit relocating them to a new location. However in selecting locations we looked towards cities where we had existing well established relationships with schools of architecture through exchange partnerships or long term connections with recognised practices. This has allowed us tap...
into local knowledge and practical experience as well as a considered and well-tuned understanding of the social and cultural context in which the work might be located. In the first year projects were based in Porto and Barcelona, with Glasgow offered as an option providing a level of comparison. In this session Beijing and Venice have been added to the possible destinations and locations for projects. Each city offers and particular environmental situation and well as topography and urban form. In each location an area of the city is identified in discussion with staff from the local school of architecture, an area providing particular urban challenges and of a scale that is practicable to study as a group. Students are asked to select one of the cities in the knowledge that their thesis project will be located there. They are also aware that although the work may be group based to begin with, ultimately they will move to finding an individual response to the circumstances on the ground. In this the aim is not to import the idea of a programme but to develop an understanding of what might be needed, sustainable, justified from a reading of the unfamiliar place. Through a series of steps including a detailed analytical study, the building of large-scale model, an extended field trip and discussions with local practitioners, the structure aims to provide a working method that can be adapted and customized depending on the conditions encountered. The methodology also aims to encourage students to develop their powers of observation, awareness of the local, and although moving from familiar territory to develop an approach allowing them to operate as insiders rather than mere tourists.

III. Strategies on the ground

While the choice of significant cities offers a focus to the thesis, the detailed investigation of a quarter or area provides the assessment of what might enhance the existing amenities or repair fragmented communities. Key to this is a careful and systematic observation of the current situation carried out on site as a group, augmented with simultaneous conversations with local practitioner as to the accuracy the findings and possibilities for development that the areas might provoke. Rather than act unilaterally, student are encouraged to work together to form small scale master-plans that have the advantage of greater effectiveness and cohesion, as well as producing working relationships and dialogue between adjacent sites and neighbouring students. The master plans begin to develop during the field trip when possibilities can be discussed with local practitioners, allowing early reactions to be gauged and possible options to be teased out. This requires encouragement and can seem antithetical to the bigger thesis idea where one building can offer the big fix. However within masterplans students soon find a balance of interests and programmatic interests that is often difficult to achieve otherwise.
In Barcelona the high density and social mix within the Poble Sec district persuaded student working there that their efforts should be targeted at increasing the amenity while creating areas of public realm currently not present.

Across cities there are also very different issues that come to the fore, key to buildingfluently in that place, particular to local circumstances and yet linked wider economic, social, cultural and environmental questions. These can become the starting point for the detailed investigations required to support the thesis. In Venice for example, understanding how to build in water becomes an obvious given, but equally so is an understanding of how scale, materials and language impact the design of the façade, the street, the alley, the campo, all which requires insight if aiming to act as an insider. When this information has been assimilated and becomes the starting point for framing a design project, it leads to quite different choices as projects emerging as legitimate and sustainable additions to the urban mix. Within Venice the emergence of the overwhelming imbalance between tourists and residents led to an interest in the trades and guilds that can trace their existence back to renaissance times. This in turn led to projects examining how a specialist trade or historic practice such as boat building or annual regattas can support and provoke the regeneration of the locality.

Developing large-scale models (1:500) of the areas in question has also allowed a greater appreciate of the grain and determining characteristics of the urban fabric. Although these have required considerable time and resources their regular use at tutorials and reviews has allowed complexity and diversity of each situation to be readily assimilated. The models, through their scale, accuracy and careful manufacture act as proxies for the context when working back in the studio and offer a greater opportunity for objective evaluation of the impact of a proposal and its contribution to the area rather than a too narrow focus on the individual proposal through lack of compelling context.

IV. Conclusions

Working consistently on a series of cities over the two year period has also allowed the chance to explore radically differing but adjacent areas, such as Poble Sec and Eixample in Barcelona, which a less sustained engagement would not have allowed. This has also allowed student to reference and build on previous student proposals in a way that was not possible in the past. Small groups working in each city has also allowed more peer discussion and support which was not possible previously when few projects shared contextual, environmental or community based drivers.

Our strategy, while already offering a more positive structure for the development of thesis schemes still requires further development. While discussion of the key technical challenge within each project begins at an early stage it is often only at an advanced stage that this is recognized as a potent driver of the design
alongside contexts and programme. Climate change still remains an issue to be kept alive at the early stages of the project development if it is to impact the final proposals in any significant way. In many ways these are questions that the teaching team must to address be able to make the thesis design a sustainable, compelling and attractive element within an architectural education.

References
Chiara Tonelli

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To Teach the Environmental Culture
in the Schools of Architecture:
The Mediterranean Context
The Philosophy of the Course

Perception of environment and sustainability in architecture

In today’s world respect for the environment means designing buildings that do not use an indiscriminate amount of energy, albeit produced by renewable sources. In the past hundred years the globalisation of the construction industry and the fact that technical systems now could control our indoor comfort has led to the increasingly pervasive construction of homologised buildings with little regard to their climatic, cultural and material context. In fact, the production of PV solar energy combining with the use of high efficiency systems (heat pumps, condensing boilers, cogeneration plants) are not enough to offset the waste produced during the entire lifespan of today’s buildings.

The didactic philosophy in the faculty of Architecture of Rome TRE aims at teaching the design of buildings inspired by the local traditions, strictly related to the Mediterranean one, and its material culture, yet within the framework of modern-day dialectics.

It is worth noting that in Italy there is a tendency to import building models from countries in the north of Europe. Although these countries conduct highly advanced research on self-sufficient housing, they base their models on a climate and building traditions very different to those in the Mediterranean. Italy, especially central and southern Italy, needs to assert a building model suited to its own climatic, economic and social environment. For that we like to orient the work developed in our courses and studios towards this approach, in order to face local needs and let students be able to operate in a global warming alert.

Therefore, considering that to deal with local tradition is related to sustainability, it is very important since the beginning of the academic curriculum to orient students in the logic of optimization of the local climatic and material resources.

As it will be better deepened further, cause the didactic framework of the faculty has changed, I will deal with a new teaching course in which I will introduce as design subject a single house unit, that I consider the most appropriate theme to be investigate at the first years of the curriculum. In that meaning the Mediterranean house become the model to be taught in the latitude of Rome. And this is a useful topic also for foreign students coming in with Erasmus.
Priorities and values on which the teaching focuses

Since this academic year the teaching will focus with priority on the “Mediterranean housing type”. In order to define it we can attempt to identify comparable traits of the housing units developed by populations living in southern Europe, north Africa and the Near East. The “thin red line” through all these countries was the Roman Empire which lasted for at least 600 years and left a common indelible heritage in the way people lived and organised their domestic space. The Roman “domus”, daughter of the Greek house and mother of the Arab, Catalan and Campidanese courtyard-house, can be considered the most popular and recurrent residential housing type in the Mediterranean.

Characterised by the introvert nature of the rooms facing the courtyard rather than the street, the patio house developed because there was a need not only to enclose the area where the house stood, but to defend it from intruders. Since defense was its primary design consideration, the enclosure was solid and had no openings except for the door. The housing units were built inside the enclosure and, generally speaking, faced in a direction which gave them the best lighting and air quality or protected them from winds.

The main element is the courtyard, often used as a garden, around which there was a portico, another crucial element; the rooms were arranged around the courtyard and allowed the inhabitants to carry out numerous activities, albeit in a covered area. Other constructions, adjacent to the original ones, followed the same principle.

The materials used for construction are normally found in situ and therefore change according to the characteristics of the terrain. Apart from volcanic or calcareous stone, many people use raw earth not
only in north Africa, but also in the south of France, Spain, Sardinia and the regions on the west and east coasts of the Adriatic sea. Two main methods are used: pisé or rammed earth (material forced into a formwork) and adobe, or mud-brick. The masonry is normally protected by a more or less thin layer of plaster made of lime and local inert material that gives the house its characteristic light colors. The employ of wattle and daub structures is also frequently used, above all for partition walls. Ceilings are made of wood. The roofs normally have very slight pitches because it hardly ever rains; structurally they have brick vault systems or wooden systems and require a fairly thick layer of insulation.

Openings are small and, generally speaking, are just holes in the solid wall, while the porticoes and loggias, rampant stairs and pergolas are more spacious, well-ventilated and architecturally embellished.

In short, the main characteristic of what we could call a Mediterranean house, apart from the layout of the domestic space, is the homogeneous nature of the walls, because only a few materials are used for the various components of the building.

These main topics are the common ground of the design studio’s requirements that we will introduce in our didactic, keeping in mind that this traditional model should be updated to respond to contemporary needs.

**Adopted Pedagogy and Educational Method**

**Techniques and strategies for the development of the course**

The faculty of Architecture of the University of Roma TRE held since the Academic Year 2002/2003 at the second year of the graduate course in Architectural Sciences an autonomous module on Environmental Design of 8 ECTS, taught in advance from the others 27 Italian faculties where it is usually trained in the last years.
Regrettably the Faculty decided to abolish it. This decision has necessarily been accepted because of course environmental contents could be put in any class. But this is not always true, as it is possible to prove with the issues carried out by the students in the design studios run before the Environmental Design class: two performed during the first-year of studies, another one achieved during the first semester of the second year. Very few of these projects take into account the environmental culture:

- some of them apply the design exercise in an unreal site. So it is impossible to train any environmental assess;
- some others consider the sun exposition in the wrong way, opening widely the west and east facades;
- another part works on not sustainable materials or techniques, as a wide reinforced concrete utilization or all glazed wall in our latitude;
- another part works on protected area -where it is not allow to build up- designing concrete structures built on the ancient roman walls.

Thence in the Environmental Design class we guided the students to reassess these design issues with an environmental methodology. In the last academic years the course was organised as follow:

- theoretical lessons on three levels: the site, the building, the solutions to the most recurrent problems;
- three levels exercises started in class and finished at home;
- lectures by experts on a chosen topic. In the last two years specialists on brick masonry were involved to deal with: the traditional way to construct
with brick and the innovative solutions envisaged; the technological detailed application of tile for roofs, walls, internal partitions; the research on brick production line and LCA; the performances on thermal inertia, insulation, acoustic implementation masonry can assure; ect.

The aims of the course vary. The most important was to train critical skills in the selection of optimum materials and manufacturing solutions for respecting the environment. In fact we think useful to provide to students of self orienting tools within the framework of the technological future, rather than giving a few guidelines on current production.

Since this class stopped I will change my course and teach in the Technology Design Studio, always at the second year of the curriculum, that since this Academic Year will be shared between Architectural Technology (8 ECTS), my discipline, and Building Physics (2 ECTS). In this studio a completely design is required. As previously wrote, we envisage to focus on the design of a self-sufficient, assemblable single-family house based on Mediterranean bioclimatic criteria that is in line with the language of aesthetically modernized tradition. In order to create a comfortable indoor temperature and air quality in accordance with current standards we have to resort to a hybrid building which combines active systems for the production of clean solar energy for lighting, heating and domestic hot water (contents follow by the Building Physic teacher) with thermal inertia. This means designing a building with “mass” and a largely passive function. In that way, although not expressly required, we try to transform this class in a specific environmental issues course. In fact we firmly consider the environmental education part of the general education, but of course it should be better to have a specific class in which this culture has to be introduced in order to apply what learned in any further studio.

**Exercises**

In this section I deal with two different exercises: the former was run in the Environmental Design course in the past three years, the latter is the theme for the new Construction Design studio.

General and special characteristics of the exercise in “Environmental Design” course.

Chiara Tonelli
In the “Environmental Design” course students were required to perform an exercise developed in three subsequent levels. The first part of each level started in the classroom, with the teachers support, then the work was completed at home. The exercise was carried out in coordination with the theoretical lessons.

The topic of the exercise was the environmental assessment of a previous student’s project carried out as follow.

The first level dealt with a biophysics and bio-climatic analysis of the site in which the building was conceived. This phase was linked to lessons on: historical born of the environmental awareness; national and European legislation; meteorology and climatology; morphology of the site: mutual influence between materials of the site, urban context, vegetation and water presence, sun orientation and wind effects.

The second phase dealt with the analysis of the building design supported by lessons on the traditional and contemporary design approach, on the relationship between the building and its context (wind, solar exposition, vegetation), the envelope behavior, the low impact solutions, ....

The last phase dealt with construction detail aspects and technological solution. The lessons related to dealt with the research frontiers on building components, insulation materials, life cycle assessments for materials and buildings, ....

The design students tangibly improved after this work.

Submission requirements

The exercise acts as a check list both for new buildings as well as for existing ones. The exercise, supported by theoretical lectures given also by selected experts, is developed in three levels. Each level is assessed by 30 points, awarded following the range listed below next to the content. Each step note contributes to the final note, in order to keep students involved during all the course enrolment.

The first level deals with the analysis of the site, with the aim to understand how the general climate conditions are affected by the urban context in which the building is conceived.

The first stage of the exercise requires what follow:

- Localization (0-6 points) (Figure 1)
  - localization of the building area
  - rules on the building area

Figure 7. 3rd level of the exercise: issues of the new environmental oriented project. Facades of a single-family house (student Valeria Vitale)
- size of the surrounding buildings

- **Climate factors (0-6 points)**
  - high low and average local temperature, considered during the last 10-15 years in the four seasons
  - seasonality, provenance and intensity of the main winds
  - rainfall in the last 15 years measured per month
  - average Umidity

- **External elements (0-6 points) (Figure 2)**
  - consistency and season behavior of vegetation
  - water presence and its influence on the area
  - albedo range for some of the urban environment materials and assessment of its effect on people and buildings

- **Solar exposition of the site (0-6 points) (Figure 3)**
  - sun exposition during the 24 hours studied to determine always in shadow and in sun areas and
  - in order to simplify the evaluation the sun exposure is calculated at the time of 9, 12 and 15 of the following days:
    - 21\textsuperscript{st} of December;
    - 21\textsuperscript{st} of June/23\textsuperscript{rd} of September;
    - 21\textsuperscript{st} of March.

- **The wind effects (0-6 points) (Figure 4)**
  - the main winter wind effects are evaluated in order to visualize problems arising.

All the climatic data analyzed separately in the different tables are linked in order to determine the local microclimate and to orient the redesign of the building considering the influence that the local environment could have on the site.

The second level deals with the building analysis, aiming to locate what’s wrong on the project and to outline some effective solutions. The orientation of the building, the solar gain efficacy on the south wall, the day-lighting level, the natural ventilation, the U values of walls and windows are evaluated.

- **The building (0-6 points) (Figure 5)**
  - plans, facades and sections of the building
  - zoning of its different parts and functioning (time of opening, number of people using it, ...)

- **Daylight & solar gain (0-6 points)**
  - the new Protocollo ITACA methodology is applied in order to:
    - verify the direct solar gain (very few projects already present indirect solar gain or greenhouses);
    - assess the efficacy of day-lighting, measuring the window dimensions

- **Natural inner ventilation (0-6 points)**

- **The envelope materials (0-6 points)**
• thermal trasmittance of the wall and the windows compared to the u law values

• The main problems arising (0- 6 points) concern:
  o natural ventilation efficacy
  o sufficient day-lighting
  o conformity to law of envelope U values
  o increasing of passive gain
  o employ of low impact materials.

The last level of the exercise aims to give a solution to the most important problem outlined in the previous steps. The design scale should arrive at 1:5 and concerns construction and technological details. Passive solutions are welcomed.

• References & Best practices (0- 5 points) (Figure 6)
  o students are required to provide many references to projects that solve the same problem is asked them to solve. This point is very important for two reasons:
    ▪ with appropriate references students could replicate solutions already experimented and evaluated;
    ▪ the choice of right references shows immediately the capacity of the students to focus on the aim, finding good solutions for her/his topic.

• The solution (0- 15 points) (Figure 7 & Figure 8)
  o Many sheets showing the new environmental oriented project at different scales, until detailed drawings.

• The improvements (0- 10 points) (Figure 9)
  o Schemes are required in order to show the functioning of the project.
    ▪ The new U values are calculated to demonstrate the better performances reached
    ▪ Tables on the chosen materials are provided.

The exercise guarantees the fulfillment of the educational objectives of the course and allows for the best grasp of its overall philosophy by the students.

General and special characteristics of the design theme of the “Construction Design” Studio

In the “Construction Design” Studio a different approach will be given, in order to provide skills to the student in designing technologically. For that we will aim to make available more in deep solutions for our climate, in the convince-ment that the global warming will bring a big part of the world to deal most with summer conditions than with winter problems.

At present the housing models imported from the north of Europe are highly impermeable to avoid heat dispersion. However in hot, humid Mediterranean climates this can cause deterioration of air quality inside the house, making
it unhealthy. Only sophisticated mechanical ventilation systems can solve this problem, and we prefer to avoid them. To assess the passive cooling strategies a dynamic simulation will be considered, runs by the Physic Building teacher. An energy-saving and sustainable design must pay careful attention to ambient conditions and be able to "exploit" any resources provided by the environment. The outcome of this approach is, necessarily, an architecture - its form, type and materials - strongly influenced by its surroundings.

Therefore a bioclimatic design approach that exploits local resources and the climate will be adopted to ensure energy-saving and comfort and at the same time attempt to control three different aspects:

1. climate and the environment;
2. type;
3. technical and constructive issues.

With regard to these three aspects, some of the main characteristics of the design approach that will be apply in this studio are listed:

1. the Mediterranean climate has fairly severe seasonal variations (temperature, humidity, windiness, solar radiation) that affect the building in different ways and require flexible solutions that can adjust to these seasonal variations and microclimatic changes. A strategy to ensure proper solutions to vis-à-vis changes in weather conditions during the year will require the use of mobile systems which modify the ratio between transparency and solidity, and insulation of the building skin during the day or seasons. This means that the skin must allow for variations and that the building must include open spaces (patio, loggia, veranda) so that it is possible to create several areas whose function and shape change according to the seasons. Special care will be taken to solar orientation of glass surfaces in order to achieve good natural lighting and exploit direct sunlight during the winter, but the latter needs to be properly regulated during the hot summer months. Instead of copying very transparent Nordic buildings designed to let in as much natural light as possible, our approach focuses to the adoption of a...
“closed” solution, with solid walls and screened openings. The design of the size, exposure and position of the windows will also take natural light into account, using sidelighting, corelighting and toplighting techniques. Glasses and shading systems will have different performances depending on exposure and internal layout;

2. to control the typological aspects a balance between a compact form in winter (based on a favourable ratio between the surface and volume compared to thermal dispersion) and open in summer (based on the possibility of using natural ventilation) will be addressed. The reference will be the patio house, a typical Mediterranean type, since this will provide compactness and exploit the two best exposures, i.e., towards the south (to exploit the winter sun) and towards the north (to have a “cool” façade in the summer which will send natural ventilation through the building);

3. solar energy will be passively exploited directly (windows), indirectly (heat accumulators) and thanks to a suitable mass (thermal inertia) to preserve the heat provided in winter (solar captation without inertia is inefficient because there are very few hours of sunlight in the winter and transparent surfaces disperse a lot of heat when they are not directly sunlit) and to mitigate peak temperatures (reduction and timeshift of the entry of the thermal wave) in summer.

Submission requirements

The design of a small Mediterranean housing unit will be required, focusing on these objectives:

- low-cost, energy-efficient houses;
- identifying long-lasting, low-maintenance building and technological solutions;
- highlighting use of local materials that are typical of the area where the buildings will be constructed as well as consolidated building techniques, updated and revised, and aesthetically pleasing architectural styles;
- reducing dependence on industrial productive systems to a minimum since the latter are expensive, even if powered by clean energy, and identifying low-energy consumption solutions;
- selecting active plant systems solutions based on the performance levels required by Italian and EU incentive policies;
- assembling and combining the designed units to create micro districts suited to current town-plan strategies which consider densely packed cities a more sustainable solution compared to widespread, loosely spaced dwellings. This will make it possible to extend the scope from each individual house to the district, involving social sustainability (communications between individuals, telework), sustainable mobility, collection and disposal of waste, etc.
Difficulties encountered in running the presented course

The biggest difficulty encountered in running the “Environmental Design” Course was the high number of students and topics the teaching staff dealt with:

- more than 100 students;
- almost 10 different design themes: museums, libraries, housing complexes, single houses, refectories, offices, laboratories, schools, ...;
- many different sites, with diverse climatic specificity: Rome city center, Rome boundaries, seaside, countryside, other towns, other countries, ...;
- various problems to solve: thermal gain, day-lighting, passive cooling, materials, building shape and orientation, ....

In that way errors are possible and not always the staff, composed only by a teacher and 3 assistants, has been able to face problems in the best and appropriate way.

Chiara Tonelli
For that we think that in the next experience we will focus on the same project in the same site, in which everyone has to respect the same environmental issues. In that way will be possible to go deeper with the environmental control of the solution.

At the opposite the previous experience was very good in avoiding from the course the conceiving of the building design: to not design the shape and the distribution of the building permits to save time and spend it on environmental issues and the applied methodology could be useful also for existing constructions.

But the fact to introduce a new design theme could help to focus more on orientation, volume, dimensions, internal distribution in order to enhance natural ventilation and passive cooling, to avoid thermal dispersion, to orient in the best way the building.

The integration of the course with a new module, although very small, of Building Physics is in our opinion very important and will give to the students an overall vision of the problem, permitting also to calculate and measure the results.

A balance between these two approaches could not yet be achieved and we need two wait at least two academic years in which we could test the didactic method.

But to make a general conclusion we can assert that the environment has to be considered as an issue for education, that the environmental teaching should begin in the first years of the curriculum for more conscious and competent architects, and that the environmental culture could be taught at any stage of the architecture curricula and in any module, class or studio, but it needs an exclusive class in order to avoid the lack of it.
Emmanuel Tzekakis

School of Architecture, Aristotle University of Thessaloniki,
Thessaloniki, Greece

Environment: a New Challenge for Architecture
A. What are we witnessing today

Today’s environmental issues influence the design of buildings significantly. This is the result of a slow development lasting more than 50 years. The field of Building Physics of the sixties, led slowly to the Bioclimatic Architecture of the eighties, then, around 2.000, to the concept of the Energy Efficient Building and now, ten years later, we are facing stricter European regulations and the prospect of the Zero Energy Buildings of 2020.

What are the schools of architecture doing about these changes?

Over the last years the architects, as well as the schools of architecture, are beginning to realize the consequences of these developments. The European Directive 2002/91/EU summarized well ten years ago what is to be taken into account by the designers of the 21st century buildings:

- Building envelope thermal insulation
- Airtight construction (natural ventilation, energy reclaim systems)
- Orientation, sunlight, natural lighting
- Heating installation, warm water, air conditioning
- Low energy consumption devices and products
- Passive solar systems, protection from sunlight.

The same Directive introduces the concept and use of energy certificates, for the information and the benefit of the users.

The new buildings have to have now a restricted energy footprint. That reflects considerably on the work of the architect. Thus, the days of qualitative environmental design, a practice favored by many architects, are over.

The initial reaction of most schools of architecture was more or less typical. A new set of lectures in the curriculum was necessary.

What are we (architects) thinking about it?

The reaction of the schools is (usually) following the reaction of the architects. Architects believe that architectural design addresses (mainly) problems of function and form and the interaction between those two items. The environmental design issues are basically function issues. The (initial) result is the fact that the meaning of function, as we knew it until now, is gradually widening, in order to include these new requirements.

What causes this widening process of the function problems?

New scientific knowledge is one of the causes. A good example is building physics. Since its conception it introduced some new items to be considered by the architect.

New social sensitivities are another of the causes. A very good example is the need to address the problems of disabled persons.

The environmental issues are yet another cause for the widening process.
All these new issues are to be considered and their impact addressed by the architect.

But are these issues really new? We all know that the design of buildings has always been about addressing the problem of protecting humans from natural and other hostile elements, the problem of creating a controlled environment. Buildings always needed heating and cooling, buildings always consumed energy. One could easily add quite a few other items to this list.

So the question is what is really new?

- New knowledge, allowing us to realize and measure the energy that is needed for the construction of buildings, for the fabrication of building components, for everything that is incorporated in the buildings.
- New realizations, allowing us to see the very slow building stock replacement rate, the lifecycle of the buildings and the direct environmental consequences of our designs.
- New situation, where the architectural freedom of the past is yet even more restricted by new requirements.

To deal with all that, however, the architects have at their disposal a new wide range of tools.

- New technologies, providing us with
  - New more efficient building materials and products
  - New more sophisticated construction methods
  - New smart or adaptive materials
  - New digital design and modeling tools
- New approaches to design made possible by the new conditions and the innovative thinking of the architects.
- A new design environment that is the result of a society that is more sensitive to environmental changes, more aware of the consequences of its actions to the environment, resulting in increased pressure to the building designers. This pressure from the part of the society is balanced by the support of the industry, with new solutions and products.

What is needed now is a suitably competitive education, still in preparation, combined with a better communication system between schools of architecture.

These changes create the need for a new approach from the part of the schools of architecture. A good and obvious approach would be to prepare towards:

- A sustainable design, addressing many disciplines and
- A sustainable architectural design

leading towards:

- A sustainable architecture and
- A complimentary sustainable education.
This seems like a good time for major changes for the schools of architecture, based on the need for sustainability. The real question facing the schools of architecture is how to react. Better:

- What to change
- What to introduce
- What to leave out
- How to do it
- What comes next.

B. What we are doing

The School of Architecture of the University of Thessaloniki has an Architectural Technology Team, with four PhD candidates,

G. Tsaras
G. Liamadis
A. Gouzkounis
V. Papadimantopoulos

and six faculty members

K. Oudatzi, Architect, Dr Eng
N. Panagiotopoulos, Architect, Dr Eng
N. Manou, Architect, Dr Civil Eng, Ass. Professor
M. Vogiatzaki, Architect, Ass. Professor
M. Malindretos, Architect, Ass. Professor
E. Tzekakis, Architect, Professor

The lectures we offer, each lasting one semester, are as follows

2T103 - Introduction to building technology
2T121 - Building technology: analysis – design
2T131 - Building technology: construction – site
2T141 - Architecture and technology of building skins designed with building physics criteria
2S159 - Sustainable building skins: architectural design and technology
2T401 - Mechanical and electrical facilities

with environment related terms are underlined.

Our approach is based currently on the following two concepts:

- Design and construction are two sides of the same coin
- Environmental design makes both sides of the coin more complex.

With our curriculum we try to achieve the following goals:

We try to do this with:

- Lectures that are addressing multidimensional problems (as design always was)
- Lectures that focus on understanding the basic facts and using the available tools
- Using the “building envelope /interior design” approach
Teaching a new Environmental Culture

Foundations

Bearing structure

Ceilings, balconies

Stairs

Old Walls

New Building envelope

Structure Floors Structure Internal space

False ceilings E/m installations

Joints

Roofs

Doors, windows

- Using the “mobilization of the students’ workforce” approach.
  Students form a very large and efficient working force. They may contribute greatly in periods of major changes. The following figure is a good example. It shows the differences in energy consumption for various configurations of housing units, prepared by our students 5 years ago.

3.941 KWh/a

- To try to keep the architect educated
  By preparing a new MSc in Environmental Design as a separate course, because
    - It moves faster, follows the changes easier
    - It has increased adaptability
    - It focuses on the problem
    - It can be more competitive
    - It has more productive students
• To try to keep the architect in the centre by introducing some laboratory work and experience,
  o In energy as a key factor in building envelope design.
  Energy introduces some complex design requirements
  Energy introduces some new building envelope design approaches:
  o In acoustics as a key factor in interior building design
  Acoustics require some complex acoustic comfort requirements
  Also some complex construction approaches
  Acoustics is a key factor in large spaces for public events design
  Those who will have control today over
  o Materials
  o Constructions
  o Calculations
  o Software tools
  o Team work direction
  Will control the design process tomorrow.

In a recent presentation on design issues, a proposal was put forward, to introduce some real world simulation methods in the work of the students of architecture. One good approach would be for the school to simulate some of the missing design parameters for the benefit of the students. Such very important and missing parameters as is civil engineering, mechanical engineering or consultation with experts. A better approach would be to organize a more realistic simulation by instructing the students to work together with students from these other faculties.

This approach would be very interesting in the case of the environmental issues, that are more complex and require deeper knowledge.

C. What the schools of architecture can do to meet these challenges
  o Reevaluate, the importance of lectures or even fields of the current curricula
  o Restructure, the curricula, according to the reevaluation
  o Promote, the new environmental requirements, in order to make them understood by all
- Mobilize, the students in this change, as they are more able to respond to new challenges
- Integrate, environmental issues in all design studios and especially sustainability issues.

This is the time to move forward:
- From the current concept of Design + Construction
- To a new concept of Design + Construction + Sustainability
  A real and new complex challenge for architects!
Ezequiel Uson Guardiola

Department of Architectural Projects, Escola Tecnica Superior d’Arquitectura, Universitat Politecnica de Catalunya, Barcelona, Spain

Architecture and Sustainability: Design Tools and Environmental Control Techniques
What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?

This course assumes that the architecture of the future will be subject to two types of influences: ecology and high technology.

From this premise and consistently with the principles of sustainable development, the master provides a training focused on understanding, awareness and knowledge to minimize the impact on their environment, buildings in particular and urban growth in general not exceeding the limits of ecosystems support, while maintaining at the same time comfort conditions. Therefore, this postgraduate program is focused on graduates in Architecture, Senior Engineers and Graduates in Environmental Sciences, with the following educational objectives:

- To provide formal training on Sustainable Architecture and Urbanism
- To teach strategies for reducing the environmental impact of urban development, considering the complete cycle of life and the ecological footprint
- To be familiar with the latest technologies, tools and techniques of computer calculation, evaluation and design for energy saving, with knowledge of the current energy certificates in the European Union level
- To learn from innovative experiences in this field developed in this and other countries in the world
- To promote the exchange of knowledge between a multidisciplinary group
- To increase the professional field of study participants, giving them skills that will be valuable in the management and project management relating to the use and application of new technologies in architecture.

What exercise(s) and design themes I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?

The course is developed through lectures given by professors in charge of each module, and guest lecturers from other conferences, which also include:

- Practical classes for the learning and use of software tools for virtual simulation of physical phenomena and energy rating
- Practical application of design and calculation tools to incorporate the principles of bioclimatic design in the project process of the building
- Theory and practice for sizing energy efficient installations with the active use of renewable energy
- Theory and practice of digital technologies for control and regulation of buildings and urban environments.

Students perform multiple exercises for the application of theoretical knowledge received, and they also develop a personal research on a topic related to the unprecedented program of the course by a dissertation.
During the course, there are organized multiple visits to buildings under eco-neighbourhoods and sustainability criteria.

The energy rating of the Passive House standard is taught by lecturers from the PHP platform in the region of Flanders. The course itself is taken for three days in Belgium.

There are also sessions with specialized companies, to show the products and their applications.

During the course, is carried out a workshop in which they have to use, directly on a real project, all the theoretical concepts, design tools and techniques of environmental control.

A part from the organized visits to buildings and installations which are planned along the year, the course also includes a one week length study trip (the Green Tour) to visit examples of eco-neighbourhoods and buildings in other countries from the European Union.

The master program is divided in two graduate programs that can be performed independently. For the upcoming 2011-2012 academic year is scheduled the following dates:

**A Graduate Program 1**

**Architecture and Environmental Urbanism**
Duration: 225 hours + 35 optional hours + 40 non-school hours (modules A and B)
ECTS Credits: 35
Date of realization: from 5 October, 2011 to 12 March, 2012
Diploma: For obtaining the diploma of a graduate 1, it’s required to present a dissertation at the end of Module B.

**MODULE A - Environmental parameters in urban and architectural design.**
Number of ECTS Credits: 17.5
Date of realization: from 6 October, 2011 to 22 December, 2011
Program:

- The sustainable development: the dimensions of sustainability
- The environmental tradition in the history of architecture
- Climate and architecture, the parameters of comfort
- Design of solar passive and energy consumption in different climates
- The embodied energy in the buildings and the cycles of life
- Sustainable Urban Development, eco-neighbourhoods
- Implementation of the Strategies of sustainable architecture in the developing countries
- Case study: analysis of examples and tutored visits to buildings already build
- Analysis of the climatic conditions, calculation of solar radiation, natural lighting and thermal loads using the following soft-wares:
• WeatherTool
• Meteonorm
• Ecotect
• DesignBuilder
• Dialux.

MODULE B - The energy efficiency and the renewable energies use in buildings and urbanism
Number of ECTS Credits: 17.5
Duration: from 9 January, 2012 to 12 March, 2012

Program:
• Consumption and Environment
• Applications of technology in the facilities of air conditioning and service
• Review of facilities in buildings and in Urban Planning
• Renewable energies and the reuse of energies and materials
• Project architectural applications: the Biomass and biogas
• The wind energy
• The Solar Energy
• The solar thermal energy
• The reuse of wasted and run-off waters
• Technical energetic Certifications and current legislation regarding the incorporation of sustainable Criteria and Alternatives in conventional applications
• Analysis and Evaluation of products presented by specialized companies.
• Case study: analysis of examples and tutored visits to buildings already build
• Calculation of energetic and thermal behaviour, natural ventilation in buildings and urban environments, using the following soft-ware:
  • Ecotect to advanced level
  • FV Expert
  • Phoenics
  • Leader and Calener
  • DesignBuilder
  • Passive House Standard.

At the end of the second Module, during the month of April, it’s scheduled a trip for visiting case-studies in other countries of the European Union. The “Green Tour”.

Graduate Program II - Applications of New Technologies the Digital Age of Sustainable Construction and the Proposed Architectural
Duration: 225 hours + 35 not optional + 40 non-school hours (modules C and D)
Number of ECTS Credits: 25
Realization Dates: from 14 March, 2012 to 20 June, 2012

Ezequiel Uson Guardiola
MODULE C – The integration of the new field of digital age in the architectural project: domotic and intelligent buildings
Number of ECTS Credits: 15
Duration: from 14 March to 21 May 2012
Program:
• Control and regulation in different systems of a building.
• Infrastructures and networks for transport and for the control of telecommunications systems
• The automation and the energy saving, calculation and amortization of installations
• Home automation Systems, applications
• Centralized management of buildings
• Calculation of energetic and thermal systems behaviour. Programming and automatic simulations, using the following soft-ware:
  • Simulation or calculation thermal loads (HAP and Other)
  • Programming of EIB systems (ETS and others)
  • Calculation of lighting systems (Dialux to advanced level and Others)
  • Automatic simulations (LOGO and Other).

MODULE D - Workshop
Number of ECTS Credits: 10
Duration: from 23 May, 2012 to 20 June 2012
Program:
This module is a workshop where the aim is to develop a project using all the knowledge obtained during the curse.

The single theme that will be developed by the different projects during the 2011-2012 academic year is “Running towards the goal zero emission”.

For the critics and assessment of the Masters Main Project there will be invited some representatives from the academic world and from other institutions involved in the object of the project.

Project Delivery and critics settled at the end of June 2012.

What exercise(s) and design themes I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?

The aim of the practical exercises is to put in practice in real projects all the theoretical knowledge given in the master lessons. Throughout the year, the following exercises are scheduled:

**Software practical exercises**

It is about putting into practice the knowledge acquired about software programs, by applying them in testing the passive response of some of the important buildings of the Modern Movement and later.
Solar radiation in Lleida’s Sport Pavilion

Natural lighting analyse on Wohnhaus from Tomas Herzog

Solar radiation simulation in Bellvitge’s block

Shadows analyse on the Kaufman house from Richard Neutra

Wind effect simulation in Can Sant Joan neighbourhood

Ezequiel Uson Guardiola
**Practical exercises**

Application of the knowledge acquired in the theoretical lessons about energy efficient installations, using at the same time renewal energies.

Bioclimatic design project: temporary accommodation for a researcher in an ecological reserve.

It is about projecting a tiny apartment (50 m²) adapted to the climatic environment of its location, as a temporary stay for a researcher.

Materials and specific construction techniques from the site will be used, in order to minimize the environmental impact of the building.

Software simulation programs explained in practical lessons will be put into practice.

Work content: there will be included information relevant for the understanding of the area where the proposal is located:

- Summary of climate data
- Chart of the different variables performance along the year
- Psychometric chart indicating the strategies to be taken
- Solar radiation curves for surfaces in different orientations
- Calculation graphic to calculate solar protection
- Control of temperature variation on a typical day
- Site Images
- Conclusions of the criteria to be taken into account.

Final thesis of the First Postgraduate Course - Research

The individual research is about combining images and text, the extension not exceeding 4000 words (20 pages DIN A4, other images and graphics not included in it) on a topic chosen by the students themselves, related to the matters taken during the first and second module of the Master.

Each student will propose the dissertation topic that wants to develop and will send it by e-mail before October 30. It will include an abstract with the title, the student’s name and an explanation of the research that is willing to study (not exceeding 200 words).
Once accepted by the management theme of the course, a tutor will be appointed to each student.

Passive house Course
During the month of December there is a course of 2-3 days, in order to study the standard Passive House which is considered energy efficient, combining formal lectures and visits.

$$U_w = \frac{(U_g \times A_g) + (U_f \times A_f) + (\psi_{\text{spacer}} \times l_{\text{spacer}}) + (\psi_{\text{in}} \times l_{\text{in}})}{A_g + A_f}$$

Thermal conductivity calculation, passive house courses

**Master’s Main Project:**
The main project is an exercise developed along the course. It is done by teams up to 6 students.

As noted above, all the projects should follow the topic chosen for the 2011-2012 academic year, which is “Moving towards the aim: zero emissions.”

The project will be developed using strategies of sustainability. It is proposed the following index about the requirements:
1. Climate Analysis: Weather conditions of the site should be evaluated.
2. Passive solar architectural design.
   - Orientation and sunstroke: Design of the building with passive solar design criteria to take advantage of the sunlight during the winter and protect it from solar radiation in the summer
   - Air-cooling strategies by natural ventilation (cross ventilation, thermo-ventilation, patios, night cooling, etc.)
   - Use of natural lighting
   - Flexibility in project design. Easily adaptable solutions to the various changes of use.
   - The use of dry construction systems in order to reduce the waste
   - Use of industrial systems, light and heavy
   - Preferential use of materials with low embodied energy, preventing toxic compounds and promoting the recyclability
   - Assessment of costs of manufacture and commissioning work for energy savings
   - Possible roof garden, a type which works also as a tank to store rain water, acts as an insulator, regenerates the atmospheric air and allows water reuse
   -Separated water supply system
   - Insulation and thermal inertia. Increase of the thermal inertia by choosing appropriate constructive facade solutions that give good response in the summer. (ventilated façade)
   - Domestic Waste treatment: Forecast of storage space for separating domestic waste inside the house or in common areas.
   - Water treatment and reuse of grey water.

   - Energy efficient facilities with centralized systems to produce DHW
   - Use of renewable energies: DHW production systems using solar panels (60% of total consumption). Electricity production system by photovoltaic panels (5-10% of total consumption)
   - Home Automation. To plan a home automation which make possible domestic energy efficiency, safety, comfort and telematical management service
   - Mechanisms to reduce water consumption in bathroom fittings (tubs, showers, bidets, sinks, toilets and kitchen sinks) and in electrical household appliances
   - Environmental Certification. Checking environmental certification using some of the systems and programs: CTE Leader and Calener, Passivhaus system, LEED, etc..

5. Home Automation:
   All control systems and home automation should be incorporated.
   In the workshop of module D, the final Project will be designed, parting from the review of all the work done previously.

Environmental rehabilitation of housing in Barcelona
Project Delivery and critics settled at the end of June 2012.

*How satisfied am I with the course on the environment and sustainability I teach? How could I improve my course?*

We are very satisfied after imparting the master over the past eight years, we have shared knowledge over 250 students from over 30 different countries in the European Union, Latin America and Asia.

We have been able to establish a high degree of satisfaction from the students participating in the Masters through anonymous surveys conducted periodically.

Year after year we try to improve the content in order to position the master as a reference in studies on sustainability in architecture in graduate studies at the European Union.

The work results from the students has been successful, some of them have been published in specialized magazines and have been presented as papers in remarkable congresses. The background acquired has enabled former students to get places to teach in universities and professional success materialized in some awards in national and international competitions.
Griet Verbeeck

Department of Arts and Architecture, PHL University College,
Diepenbeek, Belgium

Enhancing the Sensitivity of Architectural Students for Energy Aspects in Architecture
1. Introduction: Philosophy of the course

The course presented here is part of a 5-year master degree programme (3 bachelor years and 2 master years) in architecture at the PHL University College in the region of Flanders in Belgium. After a basis of applied mathematics and physics in the first bachelor year, a course on building physics is given in the second bachelor year. The approach of this course is presented and discussed here. For this course, the content is built up starting from the different types of heat transfer to understand the way heat is lost and gained in a building. Then, the different flows are combined into the heat balance of a building to finally show how this heat balance is the basis for the prediction and assessment of energy consumption and summer comfort in a building.

Although this might seem a basic scientific course, it also is the ideal course to teach students the basic principles of energy behaviour of buildings and to enhance their sensitivity for the energy saving potential in buildings. And although energy is only one part of the sustainability puzzle of a building, it still is one of the most important parts due to its impact on finite energy resources and climate change. Furthermore, in Belgium, energy is the only sustainability aspect up to now with legal requirements to be met by new and renovated buildings. For our students, this course is their first contact with the energy aspect in buildings and therefore, apart from teaching them the basic principles of building physics, I try to use this course to enhance simultaneously their sensitivity for energy aspects.

I am responsible for this course since the academic year 2007-2008. Originally the course was set up as a theoretical course with lectures, little exercises during the lectures and some practical classes to exercise the theory. However, after one year of teaching I decided to assign a large individual project work to the students at the beginning of the academic year to maximally stimulate the students to think about energy consumption and energy saving potential of buildings. The lectures are presented as theoretical background for this assignment and during the practical classes guidance is given step by step for the execution of the assignment. As can be read below, the assignment is also set up as an introduction for the students into energy related research methods. Simultaneously throughout the assignment, students contribute to the ongoing energy related research as they deliver very useful data.

First the approach of the lectures is presented, then the assignment is described as well as the way the practical classes support the assignment. Finally, the interaction between energy related education and research is presented as well as the opportunities for improvement.
2. Course approach
2.1 Lectures

The theoretical lectures are started with a short introduction on the challenges of finite energy resources and climate change in order to draw the context of rational use of energy and energy efficiency in buildings. After this introduction, the basic design approach for energy saving buildings by means of the Trias Energetica is presented [1]. The principle of the Trias Energetica is very simple and straightforward, but it proved to be very effective to design low energy and even zero energy buildings [2]. It consists of the following 3 subsequent steps:

1. Minimize the net energy demand: by minimizing the heat losses (through insulation) and optimizing the heat gains (through solar irradiation) the need for heating can be minimized. This step completely focuses on the building envelope without considering any heating or cooling installation or renewable energy system.

2. Cover the net energy demand as much as possible by renewable energy resources

3. Use the most energy efficient heating systems to cover the remaining part of the net energy demand, which is not covered by renewable energy resources.

Figure 1 summarizes the principles of the Trias Energetica.
As the Belgian climate is moderate with larger heating than cooling needs, the principle of the Trias Energetica is mainly applied to reduce the energy consumption for heating during winter, but it can also be applied to reduce the energy consumption for cooling during summer.

As in building physics the main focus is on the building envelope and HVAC systems are not considered, this course only focuses on the first step of the Trias Energetica. However this first step of minimizing the net heat demand has the highest impact on the architectural concept. Furthermore by presenting the three steps of the Trias Energetica as a whole, it shows the students the relation and consistency between the different courses in their curriculum. Up to now the course on HVAC systems is given in the first master year, but this will be changed in the future, as will be explained in section 4.

After the introduction on the Trias Energetica, the content of the course is built up starting from the different types of heat transfer, being conduction, convection and radiation, directly applied to the building envelope. Knowledge of these basic principles of heat transfer is indispensable to understand the way heat is lost and gained through the building envelope. After this, students know the concept of the U-value and the R-value of a component of the building envelope (1D heat transfer) and know the negative impact of thermal bridges in the building envelope (2D and 3D heat transfer) and how to assess and improve it. With this knowledge they are able to calculate the insulation level of a building. In line with the European EPBD, the Flemish government sets legal requirements to the insulation level of a building and provides free software to officially control the compliance with these requirements. Within this course, students learn to calculate the insulation level with this software in the frame of their assignment [3]. This way, they learn to know the concept of the insulation level according to the Flemish regulations and simultaneously they learn to work with the official software they will have to use afterwards in their architectural practice to proof compliance of their designs with the regulations. In between they also can use the software to control their own design projects in bachelor and master years.

After these lectures on heat transfer and insulation level, the heat losses and heat gains through the building envelope are combined into the heat balance of a building. Knowledge of the heat balance is indispensable to understand the way heat is lost and gained in a building by conduction, ventilation, solar irradiation and internal heat production. Focus in these lectures lies on the use of the heat balance for the prediction and assessment of energy consumption and summer comfort in a building. Students learn the very simple concept of the degree days method to predict energy consumption, which will be used in their assignment. They also learn the main passive principles to avoid summery overheating in buildings, such as the impact of orientation and glass area and the role of solar shading. These passive principles form in fact the first step of the Trias Energetica for cooling.
Finally, the penultimate lecture focuses on transient heat transfer phenomena such as the impact of thermal mass in the control of the indoor climate in buildings, whereas the last lecture is completely used to give an overview of the course and to answer specific questions of students about the theory.

These 20 hours of theoretical lectures, given during the first semester, are summarized in a syllabus which is made available for the students through the internal digital blackboard system. In addition, a blog has been set up since August 2010 to collect all kinds of information on energy and other sustainability aspects of buildings that might be useful for architectural students. The idea for the blog has arisen because many master students came to my office in search for useful information on sustainability aspects of buildings for their design projects. Therefore, this blog is not only intended for bachelor students, but also for master students and even professionals [4].

During the second semester, the course of building physics treats air and moisture transfer and focuses mainly on the importance of good execution to avoid moisture damage and on the basics of building ventilation. This part of the course is not further discussed in this paper.

2.2 Assignment

Already during the first lecture, after the introduction, the project assignment is explained to the students. It consists of a small task and a major task.

2.2.1 Examples of good and bad practice

The small task consists of searching for good and bad examples of execution of insulation. For this task, students are asked to attentively look at construction sites when accidentally passing by and to take pictures of good and bad examples of execution of insulation. At the end of the semester, each student has to submit a collection of pictures, with notation of the address of the construction site and short description of the (good or bad) way the insulation is installed. Main aim of this assignment is to teach students the importance of good execution by forcing them to look around and to pay attention to the execution at construction sites anywhere. This way, they
learn to look at what happens in practice and learn to distinguish between good and bad building practice. At the same time, a database of pictures of good and bad examples is built up by the students which can be used in the lectures (figure 2 and 3).

2.2.2 Energy performance analysis

The major task of the assignment consists of an in-depth analysis of the energy consumption of a building by means of monitoring, calculations and proposals for improvement. Each student has to choose a dwelling that is very familiar to him/her, mostly their parental house. For this dwelling, they have to do the following subtasks:

1. To make an inventory of the building characteristics (type of wall, type of glazing, presence and thickness of insulation, glass area, roof area, wall area, type of ventilation system, type of heating system, ...), the lighting and household appliances and the occupant behaviour. The latter is very rudimentary by noting the total number of persons in the household, the number of persons staying at home during a normal day, the number of persons being outdoors during a normal day, the number of small children and the number of students in the household. This information is mainly used for research purpose (see section 3).

2. To monitor the electricity and gas or fuel consumption on a weekly basis (from October till May).

3. To calculate the insulation level of the dwelling with the official software and compare it with the current legal standard.

4. To estimate the energy consumption of the dwelling with the degree days method and compare it with the measured energy consumption.

5. To give proposals for improvement of the building envelope in order to meet the current legal standard.

Advantage of working with their parental house is that they already have some experience with the building, whether it is comfortable in winter or not, whether they (or their parents) assume that it is an energy devouring or rather an energy saving dwelling, etc. Some students (and parents) think that a dwelling with ordinary double glazing and some centimetres of insulation is already well performing. However, by confronting these assumptions with real data of

Figure 3. Example of good execution (photo: R. Spitali)
energy consumption and a calculated insulation level, they get a better insight into the real performance of their dwelling. Other students (and parents) know that their house is badly performing, but do not know how to improve it. For them, this analysis is a good start to effectively search for the best ways to improve the energy performance of their house. Often afterwards, students come with specific questions on how to improve their house in reality.

Furthermore, students learn to work with the official software and simple energy estimation tools, which can be used later on in their education and architectural practice. Simultaneously, they learn to know the limitations of these tools, as they can see the deviation between calculated and real energy consumption. That there is a deviation between calculations and reality might be obvious for those familiar with energy calculation tools, but not always for students. Finally, through the assignment, students learn to think about the energy saving potential of renovation, with a focus on the building envelope.

2.3 Practical classes

As already mentioned above, the practical classes (total of 8 hours) are mainly supporting the assignment. Only the first practicum is dedicated to little exercises on calculating the U-value and the temperature gradient in walls, floors or roofs. The second practicum is dedicated to the calculation of the insulation level of the parental house with the official software (of which the use is already explained during the lecture on the energy performance regulation), whereas the third practicum is dedicated to the degree days method and the comparison between calculations and measurements. Finally, during the last practicum students can ask specific questions related to their assignment.

2.4 Student assessment

For this first part of the course of building physics, students are assessed in January by means of a written theoretical exam (with books closed, for 50%), a written practical exam (with open books, for 30%) and their assignment (for 20%). During the first lecture of the second semester, feedback is given to the students as a group on the theoretical and practical exam whereas for the assignment students receive personalized feedback by mail. This feedback has to be integrated in the assignment of the second semester. This assignment is much smaller, as it only consists of the processing of the monitoring results, gathered between January and May, and of searching for examples (pictures) of different types of moisture damage.

Figure 4 and 5 give the percentage of students with a certain score for the assignment only and for the total score for the first semester of the academic years 2008-2009 and 2009-2010. As can be seen from these figures, most students have a higher score for the assignment only (mean score of 70%) than for the
course as a whole (average score of 58%). This is due to a lower score for the theoretical exam (average score of 55%) and for the practical exam (average score of 56%). This could mean that students still do not master very well the fundamental principles of building physics and energy consumption. This will be further discussed in section 4.

3. Interaction between education and research

Integrating scientific research into education and vice versa is essential for an academic master degree programme. Students should acquire research skills during their education and results from ongoing research should be integrated into the courses.

Through the assignment, students learn essential research methods related to energy research, such as monitoring and simulating energy consumption of buildings. These research methods, together with surveys of the occupants, form the basis for performance assessment and post-occupancy evaluation of existing buildings. Performance assessment and post-occupancy evaluation are crucial elements in the continuous development and improvement of low energy buildings. Obviously, in regular research projects more elaborated simulation tools are used and monitoring data are analyzed more profoundly, but this cannot be realized in the frame of this course. However, this assignment serves already as a preparation for students who are interested in energy related research in the frame of their master thesis report.

Apart from acquiring research skills, students also indirectly participate in energy related research, as through their assignment they gather very useful information on real building characteristics, penetration rate of household appliances and energy efficient systems (heat pump, wood pellet boiler, solar panels, solar collectors,...) and data on real consumption of gas, fuel and electricity by households. The information from all students (ca. 50 students per year) is brought together into a database that can be used as information source for other research projects.
Students are also attracted to research projects where this information is analysed. In the academic year 2009-2010, two different research projects have been executed by students:

1. Two master students established the database with the collected data from 2008-2009 and analysed these results. These results already give some insight in the dependency of energy consumption on construction year or compactness, as figures 6 and 7 show. These results have been presented to the students during one of the theoretical lectures on energy consumption in buildings to show the usefulness of their gathered information. The database will be extended every year with new data in order to improve the statistical significance of the results.

2. Five bachelor students analysed the electricity consumption from the data of 2009-2010 and compared it with an existing simulation model for electricity consumption in households, developed at the Catholic University of Leuven, Belgium in 1997 based on similar energy audits by students [5]. Input data for the simulation model are the number and type of appliances and the composition of the household. Their analysis showed that despite the fact that household appliances in general are more energy saving than 13 years ago, the electricity consumption per household is generally higher than 13 years ago: mean monitored electricity consumption of 10.252 kWh/year versus mean calculated electricity consumption of 7.652 kWh/year according to the simulation model of 1997 (figure 8). This is probably due to the fact that a household has much more electrical appliances nowadays, of which some are not taken into account in the model. With the view of the future evolution towards zero energy houses, good knowledge of the electricity consumption in houses will become more important and the information gathered by the students can form an important input to update the simulation model. Also for this research, the database will be extended every year with new data in order to improve the statistical significance of the results.

![Figure 6. Dependency of energy consumption for heating on construction year](image1)

![Figure 7. Dependency of energy consumption for heating on compactness](image2)
4. Opportunities for improvement

Although the course of building physics with the assignment can be considered as a first step in the environmental education of our architectural students, there is still quite some room for improvement. Especially the fact that students up to now do not have to apply the acquired knowledge on energy performance into their architectural design projects, except for their final master project, and that only in the first master they have a course on HVAC systems, is considered internally in our university college as weak points. Furthermore, other environmental aspects of buildings such as material use, land use, comfort, water, etc. are hardly ever integrated in their designs. There is a theoretical course on ecology within the context of urban planning, but without interaction with the design studios.

As we consider it important that there should be continuous attention to the environmental aspects in architecture from the first bachelor until the last master year, we are reshaping the curriculum, especially the energy and sustainability related courses. This reshaped curriculum will normally start in the academic year 2012-2013. The reshape is still in the conceptual phase, but the idea is to start already in the first bachelor year. Here, the more theoretical course of physics will be reformed to integrate the basic principles of the Trias Energetica and the basic principles of building physics and HVAC for dwellings. The knowledge on building physics will then be extended in the second bachelor year and the
knowledge on HVAC systems for dwellings in the third bachelor year in order to make the students capable of controlling the compliance of their design of the third bachelor with the Flemish legal requirements on the energy performance of buildings. The master years will then serve to deepen the knowledge on energy performance and HVAC systems (passive house concept, zero energy concept, more complex HVAC systems) and other aspects of sustainability, such as material use, water use, land use, urban planning, etc. The idea is to achieve this by means of a course where lectures to increase their theoretical background are combined with design exercises to teach students to integrate sustainability aspects into their designs. Up to now however, we are still in search for good examples of design education focused on sustainability.

5. References
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Teaching a Sustainable Approach on CTU-Faculty of Architecture
What do I teach in the course on environment and sustainability or in the environmental and energy sensitive architectural/urban design studio I run? Why do I teach what I teach in the course/studio I am describing?

For the last 20 years, teaching of the sustainable development at the CTU, Faculty of Architecture has been on the level of the “master approach”, emphasizing mainly an individual approach to the students’ creative abilities.

While in other, geographically close architectural schools e.g. Fakulta architektúry STU, (Slovak University of Technology, Bratislava), or Fakultät für Architektur und Raumplanung (Technische Universität Wien), teaching of sustainable architecture has been provided by specialized institutes, it has been rather spontaneous on the CTU, Faculty of Architecture. Mainly it had taken place in studios led by teachers with personal architectural experience in green building realizations.

Since 2008, FA has been undergoing a systematic change of its sustainable architecture teaching system as well as creating logic ties between individual subjects, based on the confrontation of previous FA teaching style and experiences from architectural schools abroad. This change has been taking place at several levels: bachelor and masters’ degree courses, studio work, PhD program and research.

The goal of FA is to systematically intensify its’ students’ motivation to implement ecologic principals of architecture into the architectural design in compliance with the improvement of quality of life and therefore increasing the quality of education on the CTU, Faculty of Architecture.

Creating “Ecology I“, a new requisite course in the first year of a bachelor degree study, is one of the keystones of the restructuring process. This course introduces sustainable building topic to the first year students, in order for them to be able to verify the principles of the integral design within the framework of the studio projects that follow in the curriculum, mainly in Basics of Architectural Design I. and II., Residential building studio and Public buildings studio. The „Ecology I“ covers the history and philosophy of sustainable development, the relationship between human and the environment, architectural and energetic building concepts including designing methods, healthy interior environment, building materials, geopathogenic zones, greenery and transportation.

How do I teach environmental issues and sustainability in the course or studio for which I am responsible? Why do I choose to teach in this way course or studio I am describing?

The prime goal of the subject is to introduce the first-year students to the context of sustainable building. To quote Thomas Herzog: “This kind of design is not the matter of style. It must be based on knowledge.”
The subject introduces the question of sustainable development in architecture to the students in a very complex way and prepares them for the application of their knowledge to design and other concurring subjects, concentrating on individual aspects of sustainable development. The student is led to critical thinking so he/she would be able to understand all the ecologic, cultural and social aspects of sustainable development and analyze their influence on architectural design.

In the opening of the subject, the students are acquainted with the history of the sustainability concept, the philosophical basics, and sociological, financial, environmental, technical, political and architectural context. The show of exemplary buildings is included. The lectures will walk the student through the entire concept. They will cover everything from the ecologic effects of urbanization and metropolisation, sustainable space management of the city, the cultural environment and its spiritual features, architectonically-energetic and technical concept of a house, building materials, healthy inner environment and greenery to the influence of traffic on the environment quality. The lectures end in outlining the impact of the ecologic aspects on the architectural expression of a building and the ways of sustainability evaluation of the project. Environmental building case studies documenting the individual aspects are the pillar of the whole lecture program.

The core of the course consists of 13 lectures, which focus on the following topics:

1) Introduction to the philosophy of sustainable development
   History; sustainable development; sustainable life; sustainable architecture; ecological architecture. Philosophical principles; sociological; economical; environmental; technical; political and architectural context; global life quality degradation; sustainable life and consumption hedonism. Figure out your ecological track.

2) Ecological thinking of Europe. Attractive examples

3) Cities and environment
   Town planning: streets, squares, cities. Historical and contemporary urban units and the sustainability of their character. Suburbanization and urban sprawl (logistics, shopping and entertainment centers, leisure). Ecologic consequences of urbanization and suburbanization. The city as a live or-
ganism – the search for balance between the city and natural environment, energy and waste flow. The relationship between the building form and the demands on (natural) environment, natural resources and energy. The struggle for sustainable city: what kind of city lay-out is actually sustainable. Discussions on possible ecologic forms of a city and the life in it.

4) Landscape and water
Landscape and its spiritual dimension. Humans within urban and “natural” environment. The preservation and creation of the genius loci, places with strong emotion, landmarks. The historical footprint of the landscape, locations. Urbanism and cultural landscape in relationship with water and greenery.

5) The architectural and energetic concept of a house.
The principles of sustainable architecture (what, when, where, how and why), the space and function concept, shape and size of a building, lay-out, ventilation and heating, windows, renewable and alternative energy resources, water, waste, greenery. Low-energy, passive houses, zero and active houses.

6) The technical concept of a house.
The effectivity of architectural concept from the engineers’ point of view. The lifetime of a house and its individual parts, their maintenance, modernization and renewal. Open and enclosed energy supply systems of a house.

7) Contextual architecture
Cultural, social and financial context of a building, climatic context of a building, social anthropology, unified or individualized architecture, social availability of architecture, state policies and funding.

8) A healthy house
The dependence of human health on the building, the Sick building syndrome, the environment comfort and its evaluation, inner microclimate (hygrothermal, light, acoustic, toxic, electrostatic, ionizing) and the ways an architect can influence it, pathogenic zones and Feng Shui.

9) Building materials
The degree of influence of building materials on energy consumption, waste production and CO2 emission. The impact of building material exploitation on the landscape, and environment pollution. Ecologic and hygienic aspects of building materials, design from the life-cycle point of view, renewable and non-renewable resources, water, energy, recycling, reuse, natural and recycled building material examples, the benefits and drawbacks, natural materials in contemporary architecture.

10) Greenery as an architectonic and urban element
Green facades, roofs, earth-covered houses, parkways, wind barriers, city greenery, green blocks as compact mass, habitable greenhouses and inte-
rior greenery. The building greenery optimization in view of the energy consumption of a building, and the interior climate quality.

11) Transport and availability
The impact of transport on architecture, urbanism and life style. Train / tram / car / pedestrian. A bike – the new phenomenon. Water traffic. Positive and negative examples. The dependence of different forms of settlements and cities on one side, and the demands for transportation on the other. Cities of industrial times functionally divided into zones and the impact on transportation. Are poly-functional cities the alternative? Or short distance cities? Ecologic effect of individual types of transportation. The social impact of individual car transport. The impact of transportation on the residential environment quality, examples of unsuspected effects of large-scale transportation projects.

12) Finances
Buildings in figures and numbers. The impact of ecological concepts on service expenses, the financial motivation of environmentally friendly architectural solutions.

13) Summary
Ecological aspects of buildings and their impact on architectural design.

Summary
Ecological aspects of buildings and their impact on architectural design, architectural design evaluation systems, examples of contemporary architecture in relationship with ecology.

For education purposes Lecture notes “Health and Beauty – Natural Materials and Healthy Buildings” were published at the CTU, Faculty of Architecture. The lecture notes regard architecture from the philosophic and aesthetic point of view and in regards to sustainable and healthy development.

Students’ interest in the new subject of Ecology was also reinforced by a cycle of expert lectures organized for a wider range of students. Its primal goal was to introduce different approaches to the problem of sustainable architecture and to initiate debate, which has been slowly developing in the past few years at the CTU, Faculty of Architecture. Eight architects and engineers from different European countries, to whom the subject at hand is a matter of heart, accepted our invitation; Haiko Meijer (Onix), Bill Dunster (ZEDfactory), Douglas Mulhall (Erasmus University Rotterdam), Stefanie Reuss (Transsolar), Günter Löhnert (solidar), Césare Peeren (2012Architecten), Per Monsen (Gasa) a Thomas Herzog (Herzog und Partner).

What exercise(s) and design themes I propose to the students of the course I run? Why do I suggest these exercises for environmental culture to be developed?
The subject Ecology I is based on lectures, individual study and analysis. Each lecture ends in a moderated debate between the students and the lecturer. The final exam is in the form of a multiple-choice test. The test consists of 35 questions randomly chosen out of a set of 400 test questions.

In the following years, the students can choose studios concentrating on green architecture in sequence with Ecology I. These studios are led by teachers with personal architectural experience in green building projects. During the architectural studios in the bachelor degree program the student can verify sustainability principles on residential and public buildings of smaller scale and small urban design. This includes “10 elements of sustainable design” including an energy scheme. Prepared formulas enable the students to understand and evaluate basic principles of sustainable design, including the A/V ratio, passive and active solar technologies or thermal balance of the building. Final evaluation tests the combination of architectural concept with energy concept and use of materials.

The main topic during the master’s degree studios is an integral design in projects of larger scale and town planning. It includes solar architecture in new buildings and reconstructions of existing ones. Students are encouraged to test sustainable principles on buildings of larger scale – this includes using special-purpose software. Using case studies and essays on different aspects of sustainable design supports these practical exercises. The students’ work outcome is published on Greenlab webpage. The main purpose of this webpage is to collect useful information on sustainable development, and also to enable the students to publish pieces of knowledge they gained through their studies.

*How satisfied am I with the course on the environment and sustainability I teach? How could I improve my course?*

Ecology I became part of the curriculum only in the academic year of 2010/2011, therefore its evaluation is premature. The goal of the CTU, Faculty of Architecture, is to change the students’ sensitivity to the environmental issues. Creating “Ecology I” course, is one of the first keystones of this restructuring process. Ecology I is therefore understood to be the preliminary course to the contemporary sustainable development problem. At the moment, the key goal is to improve the interconnection between the successive requisite and elective courses and studios of the bachelor and master’s degree, the PhD study and research at the CTU, Faculty of Architecture.
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A New Culture of Teaching Urban Design
Environmental Aspects embedded within Urban Sustainability
The second half of the last century was marked by a radical questioning of extensive growth patterns in view of finite resources followed up by the launch of the idea of sustainable development. Time has passed and these ideas have penetrated mainstream architectural and urban design discourse; but often the conversation is empty of meaning, relying on overused terminology and vague concepts.

Higher education can play a pivotal role in helping society to adopt a holistic approach to sustainable urban development. Universities have the human capital and knowledge resources to contribute to positive change.

Higher education far outweighs the size of the educational sector through multiplier effects, as university graduates are disseminating and implementing learning outcomes. Environmental aspects need to be embedded into curricula and syllabi in an integrated way, stressing the interactive linkage and interdependence of all sectors and their synergy effects as well as showing new paths in using ecological potential for developing new economic and social strategies. Universities have the research resources to develop innovative solutions to current and emerging challenges of urban sustainable development, and they have the power and network to exchange knowledge with researchers and stakeholders on the international, national, and local level. They function as catalysts for disseminating sustainable urban development, beyond the boundaries of higher education, through establishing local knowledge resources and discussion.

The theoretical course History and Theory of the City is understood as such a catalyst for disseminating sustainable urban development and contributing to positive change. It is a major core requirement of the Bachelor of Architecture of the University of Nicosia, Cyprus, offered within the fifth semester of eight semesters of studies.

**History and Theory of the City**

**Teaching Philosophy, Objectives and Learning Outcome**

The major focus of the course is the complex and multi-layered fabric of the city and the system of forces that continuously reconfigure it against the background of theoretical approaches which reflect the international debate of the 19th and 20th century. Therefore its philosophy is based on an understanding of cities as complex systems of interconnected urban layers which are constantly changing and adapting to new settings and needs. Physical and non-physical urban layers are not read and understood as autonomous parts, but as interactively linked.

The course is teaching a holistic urban planning and design approach, arguing for balancing and re-balancing multiple dynamics towards reaching an urban sustainable development, generating virtuous and breaking vicious circles and...
creating chains of synergy effects. Its main goal is therefore to enable students
to read, analyse, evaluate and engage with the urban complexity.

In order to reach this goal, the course is directed towards three main objec-
tives which are to establish a broad basis of knowledge on urban layers, patterns
and city shaping forces, to familiarize students with sustainable urban planning
and design methods and models, and to develop the students capacity to ad-
dress the complex, multi-layered fabric of the city and to intervene effectively
and sensitively.

Those above mentioned objectives are reflected in the general learning out-
come. After the completion of the course, students are expected to be able to
efficiently analyse the urban fabric - identifying the different layers and com-
prehending their various interactions-, to critically comment on existing urban
fabrics and urban design proposals in terms of their spatial, social, economic and
environmental impact, and to describe the basic system of forces shaping cities
and sustainable urban planning and design methods and models.

Course Description, Content and Activities

The course outlines major aspects of urban design and explores its various fields
of action - from historic and inner-city to suburb and edge city. Students study
contemporary international and local urban design through case studies of urban in-
terventions and new urban concepts. Theoretical approaches, reflecting the interna-
tional debate of the 19th and 20th century, give insight in different perceptions and
ideals. The course aims at training students as interdisciplinary thinking, responsible
and critical architects who are able to link urban design to architecture and other
related disciplines and to correlate with local Cypriot urban context and conditions.
First objective is, as outlined earlier, the comprehension and management of the
constantly evolving multi-faceted and multi-layered fabric of the city.

The structure of the course is based on key concepts of urban design - a vari-
ety of interpretations and perceptions of city - which are reflected in the contem-
porary multiple city. The course subjects discuss different lines of debate such as
the contextual city, the sustainable city, the functional city, the regional city etc.
Theoretical debate and its development through time are related to the traces
the various urban models left or are still leaving behind, nowadays sedimented
in continued effective urban layers. The reflection of these past or still ongoing
discourses allows for a better understanding of present-day urban phenomena,
debate and design and is discussed in close relation to its manifestation in physi-
cal form and the forces which continuously modify the city shape.

The course is set up as an interactive lecture involving students as active
participants in class. This helps to keep students` attention focused on the lec-
ture and gives them the opportunity to practice and to accumulate knowledge
actively. Students are made to think about and to apply lecture material through
participating in discussion and carrying out in class exercises. Assignments are closely linked to preceding lectures and phased. Assignments are based on homework, cut into phases, and presented, discussed and evaluated in class, leading students step by step through the main stages of the assignment.

The way the course activities are structured also offers effective means for monitoring. Students’ presentations, exercises and discussions in class offer the opportunity to assess the general students’ progress, to point out errors, and encourage self-correction. It also allows a flexible adaption of lecture content and practice, as it provides an indication of what is necessary to include anew, to re-teach, to re-model, or to practice further. It also offers the teacher the possibility to assist in developing individual assignments further and keeping them alive through feeding in ideas and suggesting further bibliography and thus paying attention to an individual student and not only to the entire group of students.

**Teaching Method**

The course module *Theory and History of the City* is the only compulsory theoretical course within the bachelor degree in architecture at the University of Nicosia which is devoted to the subject of urban planning and design. It offers the unique and temporarily limited opportunity to reach all undergraduate students. It is therefore considered as crucial to concentrate on building a necessary and profound knowledge base, to reach a basic understanding of urban issues and to systematically develop adequate, basic skills. Out of the range of urban concepts, the course deals in depth with two main subjects - the *sustainable* and the *contextual city* concept which are both regarded as essential and intertwining.

As a start various aspects of contextual urban approaches are discussed, focusing on their specific point of view and argumentation, their specific history, their relation to other past or simultaneous concepts as well as to contemporary urban debate and practice. Once the course has succeeded in sensitizing students to the necessity to engage with the urban context, it proceeds to explaining the concept of urban sustainability which is understood as an integrated approach to urban, physical and non-physical layers and their interdependencies and interactions.

Students are hence systematically familiarized with the main urban layers - buildings, the traffic system and green and open spaces -, always in relation to major urban design aspects such as historic, social, economic, climatic and environmental aspects. As the graphic depicts, the subject becomes gradually more complex as more and more urban layers and design aspects are linked. The imminent question is therefore how to teach a holistic approach to urban sustainability. How can teaching provide guidance, since complexity and linkage are necessary attributes of the holistic philosophy, but at the same time inherently confusing?
To develop a successful methodology of teaching such a complex matter, a new teaching approach was developed and tested within the course. The teaching methodology, I developed, was first to start with a reductionist approach focusing the students on specific urban design aspects. This was supposed to help them to establish a general knowledge which then would allow them to penetrate a greater variety of urban issues and discover the interdependency and connections between them. At that stage, I thought to introduce a small number of successful examples of built projects indicating holistic approaches with a huge variety of specific activities. The students` constant confrontation with new urban layers, but always referring to the same examples, was thought to pair high recognition value with a recurrent moment of surprise.

**Transparency**

A complex subject needs to be made transparent. Transparency evolves when structures and relations become visible. A reductionist approach was therefore used for a start, familiarizing students step by step with the specific urban layers and urban design aspects, so as to develop a broad knowledge base and problem solving skills on a basic level. Students were visually exposed to multiple practical examples, learning the key characteristics of urban patterns through specific layers or design aspects and getting trained to recognize them.

**Complexity**

As depicted in the diagram below, complexity arises through simply opening up the range of subjects. As complexity can become rather confusing, it is important to use a methodology which allows students to get the full picture. The chosen instrument was the constant linkage of the detailed explanation of specific subjects from various points of views with a few well chosen best practice examples following the in-depth investigation. Those best practice examples were used to explain the specific subject in the applied context, but also to illuminate its linkage, hence its impact on other already investigated subjects, or respectively their reciprocal influence on the subject treated. Students were so enabled to discover complex relationships and virtuous circles. It proved to be rather marginal, if students were first familiarized with a specific urban layer at which in the process was looked upon from different urban design aspects, or vice versa with a specific urban design aspect which then was examined in relation to the various urban layers. Crucial criteria for choosing examples were a holistic approach with a huge variety of specific measures as well as successful realization and evaluation, proving the validity of the arguments used. Concentrating on and constantly repeating a few best practice examples proved to be helpful, as constant repetition enhanced their recognition value and familiarized students gradually with the chosen projects.
Transparency and complexity: from a reductionist towards a complex approach

**Best Practice Examples**

As explained above, it was considered as crucial that those chosen examples were following a holistic approach and had been successfully implemented. Furthermore it was important that they were consequently and coherently published, providing visual material explaining the overall integrated approach as well as specific measures through diagrams, plans, sections, perspectives and photos of the realized project.

The project *Munich Riem*, a new development of a mixed used area on the ground of a former airport, was chosen as a major case study, as it fulfilled all the above described criteria. Its mission statement follows the principle of sustainable development formulated in the *Global Agenda 21* and the *German Local Agenda 21*. It has been started in 1991 with the announcement of an urban competition; its first building phase has been complemented in 1998 with the opening of the new *Munich Trade Fair* and its implementation has been finalized in 2005 with the opening of the *National Garden Show Munich Riem*. The whole process of its conceptualization and implementation has been presented in a series of publications with the title *Messestadt Riem – Oekologische Bausteine* (Fair City Riem – Ecologic Building Blocks). The publications provide all planning data, graphic diagrams, diagrammatic plans and sections, aerial views and photos of the realized project which are necessary to explain the general urban concept consisting of the building concept, the open space concept, the traffic concept, the energy concept, the water concept, the waste concept and the soil protection concept. Aims, conceptualization, implementation, and outlook are coherently presented throughout all concepts.

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Learning Motivation

Learning motivation needs to evolve out of personal interest. Personal reference has the potential to catch the students’ personal attention and to support dialog and discussion. Interest was aroused and supported through referencing to local context the students were familiar with. It motivated students to develop critical thinking skills - comparing existing local conditions to the best practice examples presented - and stimulated a vital discussion. As the course progressed, and more and more urban layers and design aspects were interlinked, the students developed critical thinking and problem solving skills on a much more advanced level.

Structuring and Visualization

An efficient comprehension of the urban complexity, the essential parts of the urban structure, and their multiple interconnections demands a clear structure and an efficient visualization. The course content was systematically structured. Urban layers or design aspects were presented within a continuous series, and organized in a systematic, recurrent and recognizable form. Out of a variety of media such as graphic representations, plans, sections, elevations, photographed examples etc the respectively suitable were chosen to communicate concisely and effectively the relevant characteristics.

Adaptation and Course Efficiency

Teaching content and approach were constantly adapted to observations and conclusions made during the progress of the course. Discussions with students provided an indication of how to re-model the course structure and how to adapt the course content concerning what is necessary to include anew, to teach in more detail, or to dispense. The undertaken experiment proved to be successful, as the majority of students got excited about participating in class, memorizing the major aspects of urban sustainability, and then starting thinking critically about and entering a discussion on the urban environment they were living in.

Seminar and Assignment

The assignment is closely linked to the lecture and asks students to apply and exercise what they have learned in class. It focuses on a study that communicates the complexity of the city, its composition, organization and modus operandi as well as the role of each layer within the urban network. The aim of the project is the identification of the urban fabric - the recognition, assimilation and critical understanding of the various layers cities and urban design concepts consist of and their close relation and interaction. Students are asked to dissect the urban body of either an existing highly complex urban fabric, its layered space composed of multiple layers and overlaid scripts from different time periods and
cultural, political and economic backgrounds, or to analyse and dissect the concept of a complex, contemporary urban design project.

The assignment is conceptualized as homework, cut into phases and presented, discussed and evaluated in class leading students step by step through its main stages. In a first step, students are expected to identify and record all physical and non-physical urban layers, such as the historic fabric, the built structure, the open space network, existing usages and activities etc, and to present each of them as one easy readable graphic plan. The method as well as a variety of possible layers is presented to the students through choosing a typical example and dissecting it in front of the students. Then students are asked to use the shown method to dissemble the given urban fabric by themselves at home and to prepare a presentation. During the following session one student is arbitrarily chosen to present his findings to the audience, followed by a discussion during which students can fit in additional findings and ask questions. Such an in-class discussion offers the possibility to point out general and specific errors and encourage self-correction. Furthermore it shows the allovers students’ progress providing an indication to the teacher of what is necessary to stress and to explain further.

Following this group discussion, the second step is introduced to the students where they are shown how to layer through creating various sets of layers. It is stressed that for each set, layers need to be chosen specifically according to their linkage and interdependency. On the basis of the typical example presented in the previous lecture, a variety of possible sets and their main characteristics are presented out of which one specific set is used to explain the graphic method of layering and the way this analytical method assists in comprehending and critically commenting on the interrelations between the layers. Again students need to apply what they have learned in class at home and present and discuss amongst them and assisted by their teacher the results in the following class.

In a third step students are asked to synthesize their previous record and analysis, hence to summarize the layers and their layering, and to critically interpret the discovered interrelations within the specific sets of layers as well as the complexity of their overall sum. The aim of this phase of the exercise is to communicate visually and in written the complex urban fabric pointing out negative mutual influences as well as positive synergy effects.

In a fourth and last stage students are asked to create urban scenarios on the basis of the results of the previous phases, suggesting measures to heal and/or to eliminate negative effects and to effectively develop further existing synergy effects provided in form of a visual presentation and an additional explanatory text.

The exercise offers to students the opportunity to practice and accumulate knowledge actively. It encourages them to start and cope with a complex task introducing them step by step to a more and more complex matter and keeping
them on track. Furthermore it involves students as active participants keeping their attention focused and provides to the teacher effective means to monitor the general and individual students’ progress and to adapt the content of the lecture and the guidance through the exercise flexibly.

**Critical Appreciation**

The first experience, after teaching *History and Theory of the City* according to the newly set up methodology, was very positive, as the majority of students got excited about participating in class, memorized the major aspects of urban sustainability and then started thinking critically about and entering a discussion on the urban environment they were living in. Despite the positive resonance, it proved to be necessary to constantly change and adapt the course in order to increase the teaching effectiveness. The following paragraphs describe the difficulties encountered and suggest measures for improvement.

**Time Schedule and Course Structure**

The course module *Theory and History of the City* is the only compulsory theoretical course of the bachelor degree in architecture at the University of Nicosia, which is devoted to the subject of urban planning and design, offering the unique opportunity to reach all undergraduate students. In the past, it was temporarily limited to a 13-week lecture meeting students only two hours per week which caused two significant problems. First problem was the limited time offered per week which aggravated the efficient set-up of a seminar structure combining lecture, in class discussion and exercise as well as homework presentation and review. Second problem was the 13-week duration which hindered an effective knowledge transfer to the urban design studio running parallel. Both were resolved on an organisational and administrative level concentrating the course within the first half of the semester and developing a 7-week seminar based on four hours per week. This helped to develop the intended course structure and gave students the opportunity of putting their theoretical knowledge to practice in their urban design studio.

**Class Participation and Homework**

The seminar is closely linking lecture and assignment and asking students to apply and exercise what they have learned in class. The assignment is conceptualized as homework, cut into phases and presented, discussed and evaluated in class leading students step by step through its main stages. The structure of the seminar is based on a homework presentation in class, which is limited to one or maximum two presentations per class and followed by a discussion during which students can fit in additional findings and ask questions. The in-class presentation and discussion give the teacher the possibility to point out general and
specific errors, to encourage self-correction, to monitor the students` progress and to adapt the lecture content. Efficient teaching is therefore highly depending on active participation and sufficient work input.

The seminar structure in combination with the teaching methodology effectively encouraged active participation in class. Students were enthusiastically memorizing and critically applying and discussing the major aspects taught. The major difficulty encountered was the students` personal contribution through homework. Only very few students fulfilled their individual tasks and were hence ready to present their findings in class. Two related causes were identified which were the students` general work overload and a missing assessment of each phase.

One effective method to reduce the general work overload is to co-ordinate parallel running classes. Student workload estimation based on learning outcomes in relation to ECTS credits is the base for an effective co-ordination of one semester. The student workload needs to be monitored and verified through feedback from students leading to an adjustment of the educational activities and assessments of individual courses. Co-ordination must also include an effective scheduling of submission dates in order to avoid peak load. So far, yearly coordinators have been appointed to provide efficient co-ordination at the Architecture Department of the University of Nicosia. The development of an effective method of monitoring student work load has been started.

The workload of the specific class has been estimated based on learning outcomes and the related ECTS credits. Additionally students were asked to specify their working hours each class. The verification and evaluation of the collected data is still in process as the module is not yet completed.

In addition to workload control and course co-ordination students need to be motivated to perform. One method is to grade the students` performance each time they present in class. An arbitrary selection method makes sure that all students are highly motivated to perform well and to prepare the homework they were asked to do. This method will be applied and tested in the future.

**Language Difficulties**

English is the language of instruction, which is used at the University of Nicosia, as courses are not only offered to local but also to international students. Students benefit from learning the terminology, which is internationally used in the disciplines of architecture and urban design, but, as most of them are not native speakers, teachers often face various difficulties and challenges concerning reading comprehension and written and verbal expression. Professional English teachers must be entrusted with the improvement of English language skills. In the past general compulsory English language courses have been offered to all first semesters studying in the various programmes of the University of Nicosia. In practice, such general English language courses did not prove to be very help-
Teaching a new Environmental Culture

ful, as they did not focus on special subjects, texts and terminology related to the studied discipline. Therefore it is intended to set up an English language course which concentrates on the specific needs of students studying architecture.

Teaching and improving the students’ English language skills is certainly not the responsibility of the specialist subject teacher, but as weak language skills can challenge teaching outcomes and success they need to be considered in setting up a module. There are few measures which can be additionally taken by teachers teaching a specialist subject such as urban design. Teachers must be very careful to constantly explain all used vocabulary which is not supposed to be part of the general knowledge. They should allow students to ask questions in class and use texts which are appropriate to the language level and the level of study. Furthermore they should focus on preparing a well planned and designed visual presentation which can support students efficiently in overcoming their comprehension difficulties.

Outlook into the Future

The Architecture Programme of the University of Nicosia started to develop a continuous programme of concerted course contents in the key areas of environmental and sustainability education. The concept of sustainability and environmental consciousness is in the phase of being established as a central recurrent theme in all relevant courses - architectural studios and parallel running theory lectures. Within their architecture studios students are systematically introduced to an increasingly complex urban context. Parallel theory courses are feeding in necessary theoretical knowledge such as Landscape Architecture, offered in the second year of studies, which concentrates on concepts of landscape design, the developing of an awareness of environmental issues and the students’ capability to link landscape architecture, architecture and urban design. It is scheduled as a co-requisite for the studio Architectural Design II which exposes students for the first time to a greater urban context with a lower degree of complexity and asks students to analyse and respond to an existing built and natural environment of a river landscape in an urban context. Both courses are preparing for the urban design module, offered in the third year of studies, which is made up of the urban design studio and the above described theoretical course Theory and History of the City.

The unit culture of the fourth year of the architectural studies differentiates fundamentally from the studio culture of the first three years of study. The unit system introduces students to a new culture of learning based on student centered, process oriented research where interdisciplinary thinking, multiple viewpoints, flexibility and openness have the potential to open up innovative thinking and creativity. Students are offered the possibility to choose out of a range of units according to their individual interest or pathway.
**Sustainable Urban Design Unit**

In the future it is intended to complement the continuously developed subject of urban design through the offer of a unit on *Sustainable Urban Development* which then will be ideally accompanied by a series of theoretical lectures on *Sustainability, History and Theory of Sustainability* and *Advanced Urban Design* (major elective). It is planned to invite fourth year students to research on local urban sustainable development based on academic paired with student centered research, which has the potential to generate a positive research climate of mutual stimulation and innovation with academics providing knowledge, experience and contact and students opening up fresh views and challenging accepted positions. The unit will seek to share good practice with international researchers and authorities with precursor role in implementing urban sustainability and to open up dialogue and knowledge exchange with local stakeholders, strengthening links to public authorities, practitioners and industry in pursuit of sustainable urban development. The unit is intended to concentrate on the setting up of course teams encouraging cross-faculty, cross-university, and cross-disciplinary initiatives in research.
Academic Research

Student centred research can be ideally supported by academic research which has been already started by the University of Nicosia. The focus of the research is on local Cypriot urban sustainable development investigating on the status quo of the national spatial and urban planning system and legislation in correlation with the urban development in order to identify major challenges and goals. Major objectives are the development of national strategies, the identification of patterns of unsustainable and the provision of scenarios for sustainable urban development through case studies. Long-term goal is the development of a general sustainable urban development framework and adaptation of the spatial and urban planning instruments in correlation with legislation and the national spatial and urban planning system.

Platform for Knowledge Exchange

Student centred research can be both supported by and enrich cross-disciplinary, international and national knowledge transfer. A public platform for knowledge exchange and participation, which is intended to be developed in the future, has the potential to stimulate exchange and to raise at the same time public awareness, to create planning transparency, and to install a culture of trust in policy and planning. A network platform can facilitate the exchange of demand-driven knowledge and experience on the local, regional, and national level with feedback from users as the essential driver of the platform. It is planned to generate a publicly available on-line database constantly collecting relevant and comprehensive, detailed and up-to-date knowledge. The e-library should comprehend best practices, successful policies, and applied research and provide links to existing networks on a national, European, and international level.
A "B Curriculum" for a School of Architecture

1. The present text accompanied a presentation made at the conference on the education of the environment held in Cyprus in May 2010. The author did not wish to develop this presentation further to comply with the guidelines for authors.
The curriculum syllabus of a school of Architecture usually has a rigid structure, submitted to disciplinary pressures and to an obvious difficulty to admit novelties or other knowledge approach. Along with this, the risky actions carried out within our school building and premises act as a source of new knowledge that merges and turns into what we called “B curriculum”.

Who can deny that the experiments done to save energy inside our school, to check the illumination standards, to moderate the use of drinkable water, to minimize the remains generated by the teaching activity, to change the community mobility pattern, to trust the summer comfort to the air movement against refrigeration cycles, to play with the buildings inertia to have an intermittent heating system are not part of an architect’s education?

Up to what extent a student of architecture who has experimented these changes in his/her own university life will not put into practice some environmental concepts in his/her prospective career?

Thus, the School of Architecture becomes a “campus-lab”, an inhabited laboratory where it is possible to try different approaches to study the use not only of the school facilities but its premises as well. This type of research is possible due to the fact that the university community is ready to admit a higher tolerance level of error providing it takes part in the experiment itself and if it believes that the loss of comfort will be solved as part of the rehearsal itself.

Learning how to handle the environmental aspects of Architecture is a core field of our “B curriculum” as it is ready to give a prompt response to the challenges presented by our local and national community. Due to this

By way of illustration we may say that our School of Architecture accomplishes the present environmental regulations or any other local and national challenges required so far.

The “A curriculum syllabus” incorporates into some disciplines acquired or deeply consolidated knowledge while the “B curriculum” goes a step forward rehearsing, evaluating and incorporating new improvements. The challenge of a lively School of Architecture is to generate permeable membranes between the two kinds of knowledge sources.

Who takes the initiative of the already set up new experiments? Within a university structure there is nothing else more profitable than being aware of the active nodes of the community: lecturers, students or administrative staff. Providing these members with the right space for their development turns to be the simplest and most creative alternative.

A new idea generated by a single member of the community acquires the level of a project when it holds concepts like viability, limits, restrictions... that is, when the idea is born with the aim of being put into practise. When this happens, the role of the person who runs a school of Architecture consists of facilitating these flows.

Joan Puigdomènech
During our presentation we will provide some examples carried out in our school as well as some organised attempts to make the A and B curricula permeable within our university project called STEP.

Even though the obtained results prove to be interesting, we believe that the processes, which are in constant change, can be even more interesting from the educational perspective.
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