European Commission Socrates-Erasmus Thematic Network

ENHSA European Network of Heads of Schools of Architecture

European Association for Architectural Education

Aristotle University of Thessaloniki, Greece
National Technical University of Athens, Greece

Transactions on Architectural Education no 22

Visions for the Future of Construction Education

Teaching Construction in a Changing World

Maria Voyatzaki
Editor

Initiations

Conceptualisations

Interactions

Expectations

Visions for the Future of Construction Education: Teaching Construction in a Changing World

Maria VOYATZAKI
Construction Teachers Sub-network Coordinator

The EAAE-ENHSA Construction Teachers' Sub-network had its first workshop in May 2002. Construction teachers from many European schools of architecture presented and discussed the content of construction teaching and its role in the framework of European contemporary architectural education curricula. In May 2003, at the second workshop of the Network, the discussion focused on teaching methodologies using as vehicle to approach the subject individual presentations of key construction exercises taught in more than forty schools of architecture around Europe. Both of these two workshops contributed to formulating a clear view on the different versions of contemporary construction education offered to students by European Schools of Architecture. Both of these two workshops contributed to answering the question of *'where we are'* with regard to the teaching of construction and to the competences this teaching can ensure our graduates.

The theme for the third workshop of the Construction teachers' Sub-network emerged from the question of *'where we are going',* as a direct result of the debates held at the previous workshop. Consequently it was agreed by the participants that such a question could become an interesting platform to investigate the future of a competent construction education in Europe. A construction education sensitive to the rapidly changing values and attitudes of our contemporary culture; responsive to the needs created by the transformations of our daily lives; alert to the incredibly fast development of technological possibilities and infrastructures; conscious of the tremendously rapid transformations of the logics and the ideas which generate contemporary architecture; attentive to an increasingly unstable labour market and a more highly specialised professional practice; informed about the amazingly wide range of brand new construction materials and techniques; aware of the deterioration of the environment and of the imperative necessity for a built environment, less energy-consuming and more sustainable, but always sensitive to the traditional values of the act of building and insightful as well as respectful of the historic roots and cultural richness of the construction culture of a place.

The main objectives of the Third EAAE-ENHSA Construction teachers' workshop entitled *'Visions for the Future of Construction Education: Teaching Construction in a Changing World'* were to investigate the extent to which the teaching methods and practices we are actually applying in our schools to educate students in construction are able, to effectively and efficiently cope with the new demands imposed by a fast changing world; to inspect whether with the construction education we offer them, our students are ready to handle successfully their professional life in a demanding, competitive and extremely unstable profession; to scrutinise if our teaching strategies, knowledge and methods are really as diachronic and time resistant as we think, or whether it seems necessary to re-think their values and objectives, to re-formulate their structure and contents and to re-structure the means and the techniques of their transmission. Moreover, to reconsider the limits of our teaching responsibility in light of the not very rare remark that construction is far from being the favorite subject of our students, or in light of the not so rare frustration that governs our graduates when undervalued and intimidated at the start of their professional careers due to lack of the necessary competences in contemporary building production.

The aim of the Workshop was to capitalize on previously gained experience by nourishing it with the visions for the future of construction education in Europe. **In other words the workshop aimed to facilitate the transition from present facts to future possibilities or from 'where we are' to 'where we are going'.**

As a vehicle for this facilitation two parallel and complementary topics were proposed.

The first one concerned the expected profile of young architects after graduation which would allow them to confront the world of architectural practice in a changing society where common demands tend to be subjected to constant reformulation. **The competencies and skills** or essential requirements provided through construction teaching to effectively work in the real and changing world.

The second topic concerned **the educational methods** that would ensure the acquisition of these competences and skills. In other words the ways (teaching methodology as well as structure of courses) in which the competences and skills of a graduate could be ensured.

As in every year, the workshop was debate oriented. Participants were invited to contribute to the debates, to present their views, ideas, experiences and proposals on the two above-mentioned topics.

Five keynote speakers enhanced the content and debates of the workshop. Namely, Dimitris Papalexopoulos, from Athens School of Architecture started off with a lecture entitled 'Teaching Construction for the Transformable', followed by a lecture entitled "Digital Tectonics – Design and Fabrication of Gridshell Structures", by Chris Williams from Bath School of Architecture and Civil Engineering, UK. The second day opened with Cyrille Simonnet's lecture "'New' Materials and 'New' Architecture: New Uncertainty', from Geneva Institute of Architecture, Switzerland and closed with Ed van Hinte from the Hague, the Netherlands whose lecture was entitled 'Smart Building'. Last but not least, Bjorn Sandaker from Oslo School of Architecture, Norway delivered a lecture entitled "Designing by making: Strategies for Developing Architectural Concepts by means of Process Skills".

The debates were organised in workshops dedicated to each of the two topics (competences and methods) in conjunction with the following four themes:

Theme 1. The Teaching of Construction and Contemporary Architecture,

Theme 2. The Teaching of Construction and the New Materials and Techniques,

Theme 3. The Teaching of Construction and the Environment, and

Theme 4. The Teaching of Construction and the Rare and Traditional Knowledge

The four themes were tackled autonomously and independently of one another and were organised around four respective sessions. Their synthesis however occurred in the final conclusive session.

More specifically **Session 1 entitled 'The Teaching of Construction and Contemporary Architecture' posed the following questions:**

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be capable of following the attestations and changing trends of contemporary architecture, the architecture that charms the students of today?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of following the attestations and changing trends of contemporary architecture, the architecture that charms the students of today?*

An emerging question that constituted the focal point of the debates in the Workshop was whether a new architecture would demand new construction techniques, which would involve redefining teaching methods, content and creating new subjects. The reason why the session primarily focused on new architecture was that the attestations and changing trends of contemporary architecture, represent the architecture that charms the students of today, which is a reality that both design and construction teachers have to come to terms with.

What teachers identify as a strong characteristic in contemporary architectural projects and even more in their digital approaches often discuss the shift from an 'assembly kit of parts' as this was associated mostly with the Modern Movement to 'the desire for formal variation and uniqueness' associated with the new paradigm. From the debates it became apparent that there was a degree of concern regarding the information management of new technologies in view of its continual input and speed of transmission, which although contributed to easy access or availability, it was felt that it required teaching or teacher mediation in order for the information to result in the kind of knowledge or tool that students can use or apply accordingly. This, understandably, was perceived as a tremendous challenge for teachers without underestimating the difficulties involved in keeping abreast of new developments. Strategies based on individual experience were suggested, including a shift of paradigm from 'what to teach' to 'how' and 'why', thus a move from content-based teaching to process and research-oriented teaching. Furthermore, Prof. Papalexopoulos asserted that professionals, practitioners and academicians have an important new role to play in structuring, contextualizing and organizing databases for learning purposes, which certainly puts them in

control or give them a better grip of the infinite knowledge base educators are expected to possess. In addition, there was a general consensus that teachers undergo constant self-evaluation in the form of 'benchmarking' as suggested by Prof. Tzekakis.

The answer to the question of whether a new architecture demands a new construction pedagogy could be found, for a number of participants, in the change of attitude of construction educators. The norm to teach certainties in construction pedagogy, a well founded tradition, is no longer appropriate as argued by Prod. Gamelgaard. Construction teaching has to come to terms with teaching uncertainties in the same way that contemporary design teaching does. To achieve that it was suggested by some participants that the starting point to investigate the unknown is to give up images existing in the mental stock of students. Hence, according to them, one of the tasks of construction teachers is no longer limited to teaching of basics in construction but is primarily based on teaching students how to experiment. Teachers have to teach their students how to learn by finding out for themselves. This idea is supported by the fact that contemporary examples in built projects have shown that innovating when anticipating the materiality and constructability of a concept strengthens the concept itself (Prof. Melet). This premise alludes to a more profound discussion of the interrelationship between theory and practice or concept and materiality, which is what the new paradigm is trying to introduce. The design studio seems to be the catalytic milieu for this coexistence. However, as the controversy -between those who believe that construction should teach the basics as opposed to those who believe that construction pedagogy should teach the research of the unknown- seems to have no winner a school curriculum must strike the balance towards accommodating the two.

On this premise, the emerging question was on the adequate profile of the teacher who can best serve the purpose. Two schools of thought surfaced. The one suggested that by bringing external consultants the gap could be bridged. The other one challenges the question of who can actually help by focusing on the existing teachers but with a change of attitude.

As a result of the debates on the question of how we tackle construction education given the infinity of knowledge base, a school of thought proposes the involvement of consultants from practice to help teaching with their expertise, a simulation of what happens in real architectural practice. This view has its opponents and the explanation lies in the fact that ordinary consultants who happen to be conservative due to their compromising with the limitations imposed by reality could inhibit students' imagination. Moreover, the involvement of external consultants in the studio seems to make some educators feel uncomfortable as they see a threat of being substituted and downgraded to part-time teaching staff, a development that might deprive the studio from the full-time confirmed teacher profile (Prof. Shotton).

However, some educators seem to be protective of their premises and do not wish to involve the building industry as they believe that research is genuinely rooted in education and not beyond it and starts at an early stage of education, not at post-graduate level. There are however supporters of the opposite view who in fact believe that novelty which is primarily a result of research in the building industry is what legitimizes and necessitates the feedback from industry's research output in construction pedagogy.

Encouraging of imagination in school seems to be a necessary skill students should acquire to be able to be in the forefront of the contemporary architectural scene.

The fear expressed lies in the fact that fascination transpired in the new paradigm might threaten the teaching of the basics. This discussion splits construction teachers into two opposing camps, with a moderate one between the two. The first one suggests that construction teaching has to teach students to dare experiment, to pose valid questions and to learn how to find the answers. This view clashes with the second one which suggests that a school curriculum has to concentrate on the teaching of the basics, whilst the third view suggests that a balance should be achieved between the teaching of basics and experimentation. In the debate, construction teachers with an engineering background suggested that the work of a multidisciplinary team is necessary in practice nowadays and what is necessary to be taught is a basic language that would allow architects to cooperate and negotiate their ideas with other expertise.

Session 2 entitled 'The Teaching of Construction and the New Materials and Techniques' posed the following questions:

- *What should be the necessary competences and skills acquired through construction education that*

allow architecture graduates to be capable of following the rapid development of the building industry in producing new materials and new construction methods respectively?

- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of following the rapid development of the building industry in producing new materials and new construction methods respectively?*

The two broader questions were condensed in a basic one: does the materiality of new architecture imply the need to use new materials? Two issues relating to the question dominated the debates of the workshop in order to shed light on this question. One was associated with the relationship between form and material and the other on the definition of materials and the emerging need to define a common vocabulary and terminology.

The first issue gave no definitive answer to the question. What was stressed however was that certain architectural forms allude to certain materials – a Corinthian column relates directly to marble- which brings us to the deduction that unknown architectural forms may not be related to the already established palette of materials but urge to further search. Moreover, we have to appreciate that the already known materials were produced to provide stable and unchangeable forms. The emerging question was whether or not these known materials would be capable of materializing mutable and changeable forms. The next question was what comes first: the invention of new materials allowing for new forms to be materialized or new forms promoting research in new materials that can materialize them. The participants of the workshop debated on the questions but did not reach any definite conclusions.

At the workshop, the discussion on definitions split construction teachers into two: those who understand new materials as the so-called smart materials and those who refer to plastics, composites, raisins, fibers that have been around for quite sometime but have not been as extensively used as the classics (masonry, reinforced concrete, metal, glass, timber etc.). A new view was added to the relativity of the word 'new'. This view sustained that a traditional material could be considered new if it employs unconventional construction techniques that take it beyond its natural properties. This view supported the discussion on the smartness of certain traditional materials in a given context even though widely acknowledged as mundane (Prof. van Hinte). Nevertheless it cannot be denied that despite the validity of such classification, it was stressed that there is undoubtedly research that yields to brand new materials that are generated from computer programmes in which the designer inserts data -the requirements and specifications of a material- and the material produced is new and unique. Alternatively the same method is used to modify the genetic code of known materials by giving them new properties. All this indeed is at an experimental stage. Nevertheless small scale applications will certainly allow more generalisable applications in the future given the time necessary.

Returning to the discussion of teaching construction in the design studio as in the first (2002) and second workshop (2003) of construction teachers, it was pointed out that in teaching materials in context, one can design any of the above typologies of material he/she wishes to explore and employ. This view gives rise to the invaluable abstract notions associated with materials. A fear was expressed that by talking about materials in isolation as if the only thing we have at hand is a palette from which we choose, designers run the risk of disengaging themselves from the poetic, sensual, tactile qualities and the like that materials are associated with. The need to define the architectural content of materials was also stressed.

In practical and operational terms it was argued that there is neither time in a school curriculum nor sufficient knowledge that construction teachers have in order to teach new materials, therefore, one could use the teaching of basics on materials as a prelude and teach the students how to find information on new materials. The discussion was again linked with that of the previous session, that is whether we teach basics through rules or whether we teach inquisitive minds beyond rules and limits. The first view was supported by the observation construction teachers made on the inability of a number of students to recognise materials when they see them, which proves that there is a lot to be done in relation to familiarizing students with the so-called known materials before exploring the unknown if time was ever dedicated to them and knowledge was possible to acquire. The fact that construction educators do not feel that sufficient time is dedicated to materials in a school curriculum may indicate that there is an attitude towards what is considered necessary knowledge for a school graduate and material knowledge seems to be low on the priority list. The solution proposed at the workshop to eradicate the problem is to teach materials in the design studio. The encapsulation of the

anticipation of materials in design teaching can only attribute to materials the meaning and 'smartness' they deserve.

Session 3 entitled 'The Teaching of Construction and the Environment' posed the following questions:

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be responsive to the sensitivities and consciousness of our society towards the environment, sustainability and energy conscious design?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be responsive to the sensitivities and consciousness of our society towards the environment, sustainability and energy conscious design?*

Participants pointed out that teaching environmental issues as part of construction teaching is most of the time useless to students as it can raise issues unrelated to the context in which they would eventually operate. Climatic and other environmental particularities ought to play a crucial role in student conscience. It was suggested that a way to achieve that is to teach regulations on the environment implemented in a country, thus putting environmental issues in context. This was opposed by two arguments. The one sustains that regulations may put the environment in a geographical context but they certainly do not integrate it in a design context and anyhow regulations are for the practice of architecture not for the education of students in the discipline. The view that sustainability should be taught in the design studio has many supporters who stress that what is important when teaching sustainability is to cultivate an attitude towards the environment in a broader design context. More specifically, it was proposed that one of the objectives in a student design project should be the sustainability of their proposal. In fact, the project should be assessed on the controlled energy consumption and passive energy systems it employs as well as its low maintenance cost and energy saving. Moreover, it was proposed that in the teaching of materials we can add to their inherent properties their sustainable qualities. The encapsulation of sustainability in the design project was also supported by the following argument: since the creation of form is central when design is taught it has to be stressed to students that there are appropriate and adequate forms that ensure the sustainability of an architectural proposition better than others. One should not fall into the trap, set up consciously or unconsciously by the building industry, of 'dressing' an unsustainable building in terms of its form with sustainable 'clothes' as Porf. Hickey pointed out.

The next issue that dominated the debates in terms of sustainability but in relation to the previous session on new materials was recycling. It was suggested that introducing students to new materials or existing ones is not enough. In fact for a more sustainable built environment the issue of recycling of materials should be central. However, an unresolved concern remains the conflict between recycling and regulations, and as unresolved it is more of a problem in education. How can we teach an important issue when its validity is still unclear? The persistence at the European level to certify the environmental behaviour of buildings through regulations and specifications clashes with the idea of recycling old materials already worn out and impossible to officially certify from existing buildings.

Session 4 entitled 'The Teaching of Construction and the Rare and Traditional Knowledge' posed the following questions:

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be capable of encouraging the creative encapsulation and synthesis of particular knowledge deriving from the construction culture of a place to new construction logics and practices?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of encouraging the creative encapsulation and synthesis of particular knowledge deriving from the construction culture of a place to new construction logics and practices?*

Although the importance of conveying to students rare and traditional knowledge was stressed it was admitted that its teaching can be unattractive –as students are mostly fascinated by the new and unknown- and this has to change. Participants coming from countries with a strong historic background and a protective/ respectful attitude towards historic buildings pointed out that a school has the obligation to cultivate the necessary

ethos in its students to appreciate the old not only in terms of handsome forms in context but also in terms of its structural and environmentally conscious virtues. The question of sustainability, intelligent use, awareness and appreciation of materials in contemporary architecture can borrow wisdom from the old where technological limitations turned to the architect's advantage. Special courses dedicated to the teaching of rare craftsmanship and 'endangered' techniques should be ensured as a way of preserving them. Moreover, it was suggested that achieving all the above can be constructive if a well-organised databank is built up, circulated and enriched to all schools of architecture.

Last but not least it was pointed out that rare and traditional knowledge will remain neglected if in the minds of students we set artificial barriers between the old and the new and we do not see the continuum that has allowed our society to move forward either by the virtues characterized or the mistakes made in earlier times.

The general conclusions acted mostly as preconditions for the above mentioned discussion to be feasible. More specifically a necessary clarification was made with regard to the new nature of design studio teaching and this clarification has to do with the fact that information technology has intruded and dominated this milieu. This has to be taken into account when we talk nowadays of the design studio. This new nature of design and its teaching not only does not threaten the convergence between design and construction teaching – a schism which has shadowed architectural education for far too long- but, in fact, it encourages it.

A fresh idea put forward was that of performance-based design as a product of experimentation and invention. This was linked with the need for the creation not only of a database of building case studies but also of architectural practices.

The increased self-awareness each school ought to develop alongside facing the challenge of information technology towards shaping consciously the profile of their graduate will allow them to compete creatively and constructively in the rapidly developing world of architectural education.

Two keywords dominated the concluding sessions and these were inclusiveness and polarization. Inclusiveness seems to be necessary in teaching design and construction simultaneously and coherently. This can prevent the artificial polarization that has been created in schools of architecture.

In the search for the root of many problems in construction education, nowadays, the question of staffing a school of architecture seemed pertinent. Due to pressure to generate research schools employ researchers with no construction experience, a policy that might prove to be problematic in the pedagogy of the subject matter.

Another issue regarded ways that have to be identified to manage the infinite information that has been gathered. As it seems we could do with the information we have at hand with no need to invent new information as long as we can manage the existing one effectively and creatively. Finally, the bitterness of construction teachers of being unmapped in a school or rather not as appreciated as design teachers was proposed to be overcome by the establishment of a refereed journal which would allow them to publish good quality research output (Prof. Williams).

Last but not least it was suggested that discussions on the future of construction pedagogy are invalid if students are not part of this discussion, as they themselves are our future.

Sixty two construction teachers from 19 different European countries participated in the event this year. The expected outcome of the workshop was to attempt a mapping –not necessarily a synthesis– of the visions for the future of construction education. Furthermore, it was expected that certain levels of consensus could be achieved in relation to some commonly agreed landmarks recognised within the subject-specific area of construction. In any case, it was the mission of a construction teachers' network to identify and record these landmarks. This way construction teaching in each school can select and combine the landmarks in different ways, by taking complementary or alternative options by following different paths. Last but not least the network was able to encourage diversity, while respecting the freedom and autonomy of schools.

Preface

The present volume contains the keynote addresses, participants' contributions on the allocated themes and the debates that emerged from these presentations, in the context of a meeting organised by the EAAE (European Association for Architectural Education) the ENHSA (European Network of Heads of Schools of Architecture, Socrates Thematic Network) the School of Architecture of Aristotle University of Thessaloniki and the School of Architecture of the National Technical University of Athens.
The meeting is the third of a series of workshops of construction teachers entitled *'Visions for the Future of Construction Education: Teaching Construction in a Changing World',* hosted by the School of Architecture of the Technical University of Athens, from 27-29 May 2004.

On behalf of ENHSA and EAAE special thanks are extended to the five keynote speakers whose presence and contributions enhanced the content and debates of the workshop, namely Dimitris Papalexopoulos, from Athens School of Architecture, Chris Williams from Bath School of Architecture and Civil Engineering, UK, Cyrille Simonnet from Geneva Institute of Architecture, Switzerland, Ed van Hinte from the Hague, the Netherlands, and Bjorn Sandaker from Oslo School of Architecture, Norway.

Professors Spyros Raftopoulos and Miltiadis Tzitzas from the host institution deserve the participants' gratitude for providing their handsome neoclassical, historic building embraced with their hospitality and warmth, alongside their resourceful resolution of organisational matters.

The Workshop's high note was the final day, where participants were guided to the Acropolis by Professor M. Korres from the National Technical University of Athens School of Architecture, a specialist-researcher in the Parthenon. For the success and infinite information offered generously to all, Professor Korres is to be deeply thanked.

Last but not least many thanks are owed to Mrs Lina Di Ciocco-Kirittopoulou who, as of last year has transcribed our tapes and formalized and edited the dialogues and discussions into written texts for this publication.

Dimitris Papalexopoulos

Dimitris Papalexopoulos is an architect, born in Athens Greece. He is Assistant Professor, at the School of Architecture, of the National Technical University of Athens.
He is responsible for courses on architecture and information technology and especially on hybrid buildings. His research is founded on building knowledge management. He has participated in many exhibitions and congresses, on the relation of Architecture and Information Technology. He runs a design practice for a number of years. His works include renovations and new buildings in the private and public sector. He has won 12 awards in architectural competitions. His recent design work refers to the integration of space and information technology, teleconference / telework spaces, smart buildings.
Sites:www.archsign.gr, www.ntua.gr/archtech

Chris Williams

Chris Williams studied engineering at Cambridge University and then joined Ted Happold's group at Ove Arup where he was responsible for the structural analysis of the gridshells for the Mannheim Bundesgartenschau, architects Carlfried Mutschler + Partners and Frei Otto. In 1976 he joined the Department of Architecture and Civil Engineering of the University of Bath where he has continued his research into tension and shell structures and the geometry of structural action. In recent years he has defined the geometry and analysed the structural behaviour of the Japanese Pavilion, Expo 2000 (Shigeru Ban, Frei Otto, Buro Happold), Millennium Dome Central Show nets (Mark Fisher, Atelier One), the Weald and Downland Museum gridshell (Edward Cullinan Architects, Buro Happold, Green Oak Carpentry Company) and the British Museum Great Court Roof (Foster and Partners, Buro Happold, Waagner Biro).
Site: http://people.bath.ac.uk/abscjkw/

Cyrille Simonnet

Cyrille Simonnet was born in France and lives and teaches in Switzerland at the Institut d'Architecture, Université de Genève. In 1978 he acquired a Diplôme in the History and Theory of Art at L'Ecole des Hautes Etudes. The same year he completed a course in architecture (DPLG) from the School of Architecture in Grenoble. In 1982 he acquired a DEA in the History and Theory of Art from Paris, EHESS. In 1994 he acquired a Doctorat 3ème cycle, in the History of Art, Paris, EHESS. Cyrille Simonnet was involved in archeological excavations in Karnak, Egypt (1978-1980). Between 1988 and 1991 he was a researcher of the Dessin-Chantier Laboratory, of the School of Architecture in Grenoble. Between 1991 and 1994 he was responsible for the Office of Architectural Research of the Ministère de l'Equipement et du Logement. He served as maître assistant, at the Ecole d'Architecture de Grenoble. He is professor at the Institut d'Architecture, Université de Genève since 1996. He is the director of the same Institution since 1998. He was the director of the network of researchers 'cultures constructives', from 1994 until 1998. He is a member of the 'Groupe de Recherche sur

l'Architecture et les Insfrastructures' (GRAI), laboratoire de recherche habilité Ministère de la culture, Versailles. He is also member of the comité de rédaction de la revue d'architecture Faces (Switzerland). Cyrille Simonnet has published a number of articles on architecture, the history of construction and the history of building techniques as well as on questions related to the environmental issues of big infrastructures. The most well known of his books are "Le béton armé : origine, invention, esthétique" (300 p. Ed. Parenthèses, 2001) and "L'architecture, ou la fiction constructive » (180 p. Ed. de la Passion, 2001).

Ed van Hinte studied Industrial Design at Delft Technological University. From 1981 until 1988 he was partner in a small design studio. From 1980 until 2000 he was a freelance journalist for a variety of magazines and newspapers in the area of industrial design. In 1996 he won the Jan Bart Klaster Award for art criticism. A year earlier he joined The Eternally Yours Foundation concerning product longevity. From 1997 onwards he published several books as a writer and editor, among them 'Lightness; the inevitable renaissance of minimum energy structures' and 'Smart Architecture'. Currently he works as an editor for 010 publishers in Rotterdam, and he teaches at 3D design department of the Academy for Fine Arts in Arnhem.

Bjorn Normann Sandaker

Bjorn studied Civil Engineering, Art History and the Theory and History of Architecture. His Ph.D. thesis was entitled "Reflections on Span and Space: Towards a Theory of Criticism of Architectural Structures." You can appreciate from this title and from the combination of his studies that he "sits on the fence" so to speak between architecture and engineering. Therefore, on this closing day of the conference, this final lecture should please everyone, particularly those who may have been feeling some frustration, as Rene detected earlier. Bjorn worked as a consulting Engineer and Researcher, but since 1988 he has been teaching at the Oslo School of Architecture and in the capacity of full Professor for the last two years. He is co-author with Ann Hagen of two well-known books, "Structural Basis of Architecture" and "Steel Structures and Architecture". The lecture he is about to deliver is "Designing by Making: Strategies for Developing Architectural Concepts by Means of Process Skills".

The keynote speakers appear with the order they intervened.

Construction Education for the Transformable
Athens, Greece

Dimitris PAPALEXOPOULOS

The Transformable

Contemporary architecture deals in her leading trends with transformable environments and buildings. Architecture has to respond to a continuous change of the structure and nature of activities sheltered. Designing the time is one of its main preoccupations.

Building elements absorb data furnished by the interior / exterior environment and the user and respond modifying the buildings behavior. Buildings are data-carriers and data processors, and permit to their user to interact with them. Environments change through interaction with their users.

Yet locality design and definition remains architecture's principal objective. But locality is redefined through its participation to bundles of networks affecting its identity structure, prompting it to evolve through time.

Interactivity integrating IT catalyses the old notion of **flexibility,** leading to the **transformable,** its techniques and aesthetics. The flexible was segmented, the transformable is continuous, parametric and fluid. The joint was the hero of the flexible, sensors and actuators guide the transformable. What was called envelop is now called skin. Lightness is replaced by parametric transparency. What was clearly seen as a *combinatoire,* is now hidden in nanotechnology devices. Composite materials are evolving to smart materials. Kas Oosterhuis sees architecture as an activity "giving shape to the flow of data", as an act of sculpting the immaterial (Birkhauser 2004), instead of being the theater of visible technology.

Tools, Technologies and Education / Research Directions for the Transformable

IT **for** the Building

Interactive membranes replace facades. A covering high interaction surface able to exchange information with the inside and the outside of the building is applied. Reference could be made to Toyo Ito and the "Bluring Architecture" concept, or to "Polysurfaces", topological surfaces with variations and deformations depending on exterior or interior situations.

Construction education needs to integrate the use of surface modeling software. Mapping could refer to the surface alteration and the smart materials and morphing to the surface deformation and changeability. Also Blobs or Metaballs and Space Wraps refer to the interrelation of building elements and the changeability of the whole as depending of the transformation of partial elements, as Francesco da Luca and Marco Nardini pointed out in Behind the Scenes (Birkhauser 2002).

Those design technologies tend to a rethinking of our form strategies in order to integrate intelligent systems modifying themselves in accordance to the user's needs.

The CAD/CAM integration opens a new era for the architecture / industry collaboration. It could be considered as the end point of a movement leading from the prefabrication to open industrialization and from that to mass customization.

Construction education needs to integrate the teaching of file to factory techniques as:

- Production by subtraction.
- Production by addition.
- Reverse engineering, as a reintroduction of the model into design.

The transformable does not limit its presence to the "architectural object" per se. Space is evolving through design and even through the production/construction phase. Information management technologies give the opportunity to a multiplicity of actors concerned to participate in the design process, to work in team even if in the conventional design/construction processes belonged to different phases. **Collaborative design** is the key word and collective intelligence is at work. Through CAD/CAM techniques design and production are synchronous and they mutually affect each other.

Collaborative design, based on information flow management, is organized around **the project's database.** Transformable buildings and environments keep track of their past, present and virtually future existence by organizing data in a form of a **building's memory** data base. Project's data base and building's memory data base are linked in the same flow.

Construction education needs to integrate the teaching of databases creation and use. In that sense **Building Description** and **Metadata Definition** are essential components of the course's design.

IT **in** the Building

Sensors and actuators refer to the **designing of the interaction** with the building. Information is thus considered as "building material".

Sensors based on **MEMS** (Micro Electro Mechanical Systems) technology, react to context stimuli by producing information and connected then to a processing information system could activate actuators for a response.

"Sensing" opens at least four areas of investigation:

- Sensing could refer to the **whole building** as Oosterhuis proposes with Transports, or **part of the building** as the 'Dynamic Skin" (Zerefos, thesis, 2004).
- Sensing could be **voluntary,** operated by the user at will (to open or close the windows according to inner temperature), or **involuntary** integrated in automatic building processes (regulating air-conditioning).
- Sensing could simply **add** information to the perceived reality by the user (informing about the need to regulate the temperature), or **create** an immersive environment in an augmented reality context (interior of Saltwater Pavillon or Archeoguide in Ancient Olympia projecting virtual temples restoration on the physical context).
- Sensing is also about **locating people** in smart environments that respond to their preprogrammed needs.

Through **Nanotechnology,** Smart Materials will propose in the next 10 years an interactive architecture defined as a "service" rather than a stable physical object. Smart material techniques , as defined by Antonino Saggio will affect "glass and some new marbles, even the physical characteristics of walls may interactively change in texture, porosity, the capacity to absorb sound or colour" (Antonino Saggio, *"New Subjectivity: architecture between Communication and Information"*)

The virtualisation of composite materials towards smart materials was demonstrated in Yannis Orfanos dissertation (School of Architecture, NTUA, 2003, www.mtua.gr/archtech)

The integration of the problematics mentioned above has been partially tested in a graduate course of the 9th semester of the NTUA School of Architecture ("Information Management and Architecture", http://www.ntua.gr/archtech/inman01/index.htm). In this course, the end product of a research on building databases, Building Memory, was applied (fig. 1), in relation with the postgraduate course of the School of Architecture N.T.U.A. ("Architecture and Information Technology, from total to global design", www.ntua.gr/archtech). In a parallel session, in the same 9th semester course, a group of students explored the virtual space as a structuring tool of the information for modern building materials and industry products (fig. 2,3 and 4)

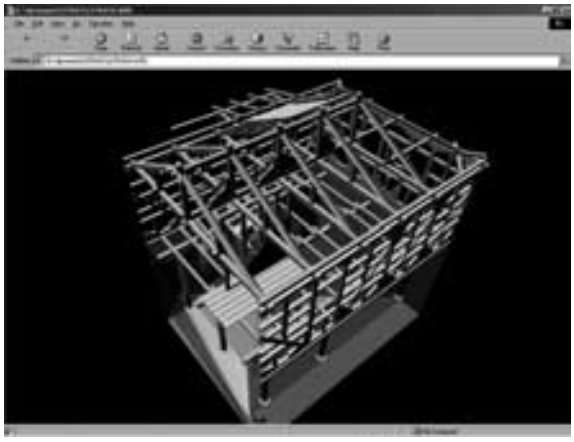


fig. 1

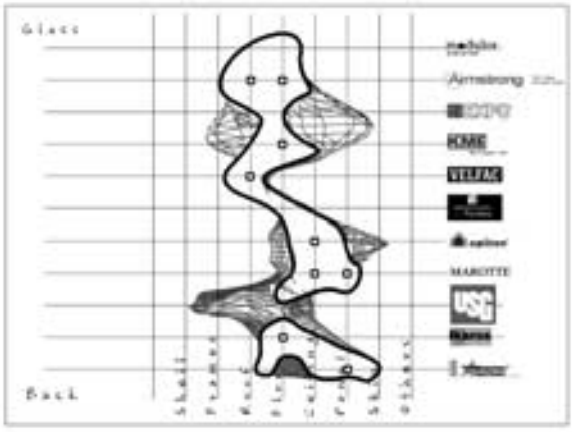


fig. 3

fig. 4

Conclusions for the Construction Education and Research

1. Architectural education in general and construction education in particular have to promote the *Design / Construction continuum* as it is catalyzed by I.T.
2. In the "transformable" perspective, construction design has to preview the building's evolution, and assume that there are always "design moments" during the building's life.
3. In that sense five themes need particular attention and could be supported for integration to the existing construction courses:
   - Collaborative design, distributed in space and time, organized around a 3d model of the building and the continuously evolving project/building database.
   - Collective intelligence in construction, where dbases from different projects are linked.
   - A "from file to factory" approach that integrates the mass customization concept into construction education.
   - A programmable/swarm building approach, integrating Disappearing Computer concepts, seeking the building as an artifact having a physical existence plus a sensors/actuators device.
   - Smart materials, supporting interactivity.

Needless to argue for the necessity to integrate the transformable perspective **into** existing courses and not to establish it in isolated education – research islands. Also one cannot speak for collaborative design without believing that **tele-education networks** must be established. Platforms, tools and Learning Objects for e-learning must also be developed in close collaboration between Schools of Architecture, seeking not only the higher education courses but also the education through lifetime. The transformable perspective could be helpful in that direction.

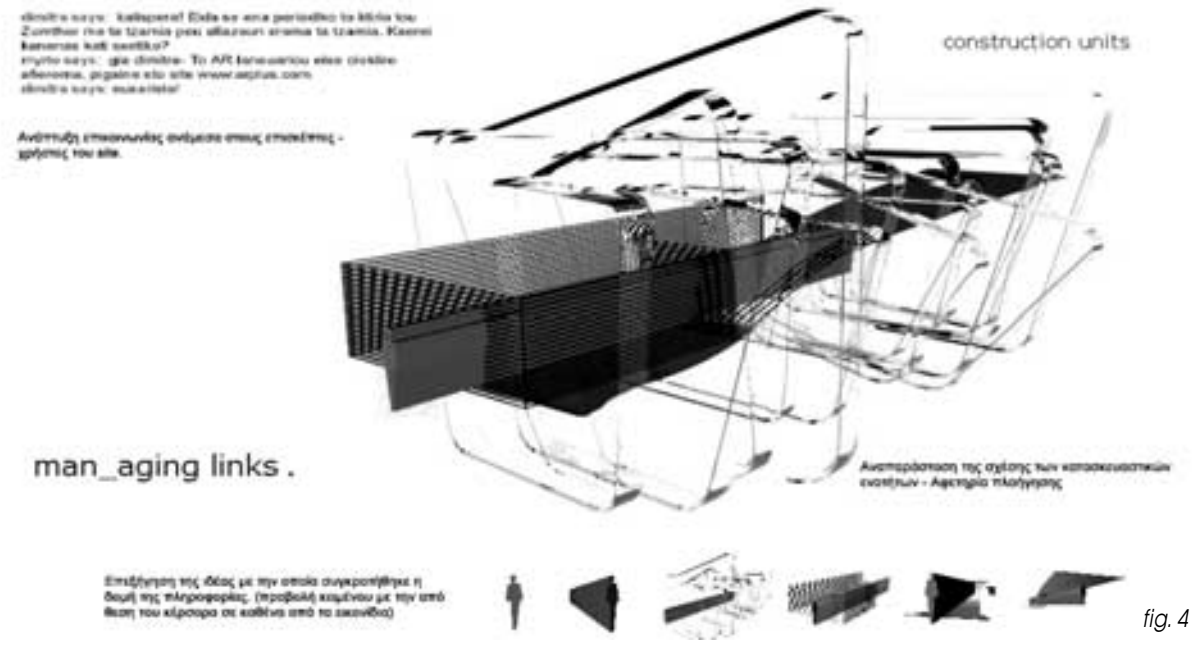


fig. 4

Computers and the Design and Construction Process
Bath, United Kingdom

Chris J K WILLIAMS

Introduction

This paper discusses some of the ways in which computers can be used in the production of information for the construction of objects from aeroplanes to gridshell structures. This raises some interesting questions concerning the education of future engineers and architects.

Figure 1 shows a 'sinusoidal spiral' and the computer program which produced it. The program is written in International Standards Organisation C++ and will run on any computer with a C++ compiler (Unix, Linux, PC, Apple etc.). It produces a dxf file which is admittedly an Autodesk (AutoCAD) standard, but can be opened by MicroStation, VectorWorks and many other applications.

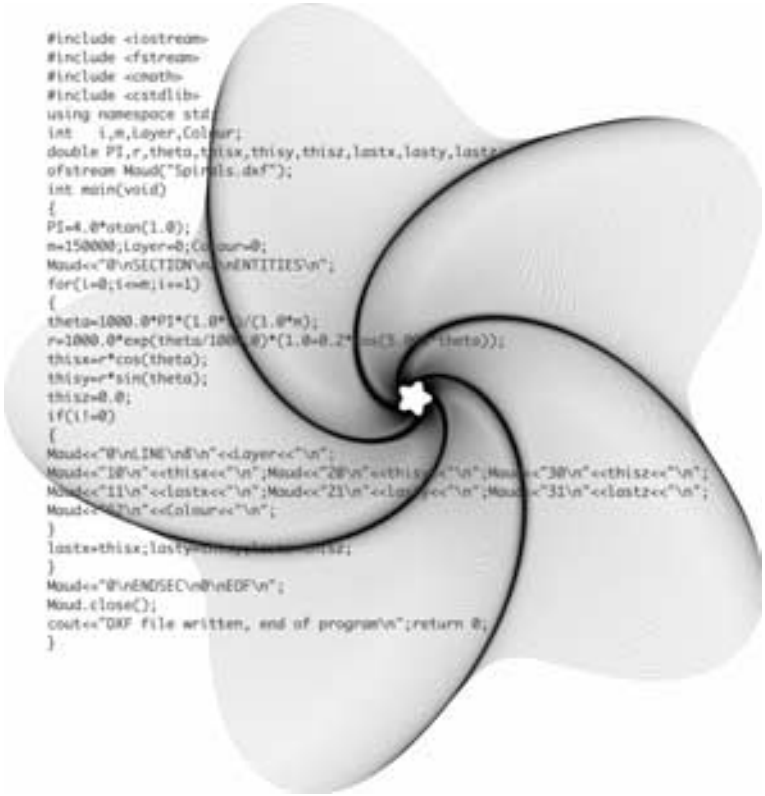


Fig. 1. Sinusoidal spiral and C++ program

This figure raises two issues. Firstly, if such a simple program can produce such a complex result, why is computer programming never taught to architects? Secondly, how important is it to try and promote the use of software which is under the control of bodies like the International Standards Organisation rather than commercial organisations?

Graphics software comes from two main sources: the entertainment industry (films, computer games etc.) and the aerospace and automobile industries. Software from the entertainment industry is ideal for producing images and sketch designs, but not for the production of detailed information for construction. Following the discovery of B-splines by I. Schoenberg in 1946, CAGD (Computer Aided Geometric Design) was first developed in 1960's by many people including Paul de Faget de Casteljau at Citroën, Pierre Bézier at Renault, J. Ferguson at Boeing and C. de Boor at General Motors.

Even though this paper is about the use of computers in design, one should not overstate their importance. The objects in figures 2 to 8 were all designed without computers, except, perhaps for the Boeing 707. The Citroën DS and the Boeing 707 were designed in the 1940's and early 1950's and the Boeing 747 (figure 9) first flew in 1969, a few months after the moon landing. Computers would have been used in the design of the 747, but they would have been much less powerful than the cheapest computer available today.

Computers have no intelligence but enormous calculating power. Humans, and other animals, have enormous intelligence, but limited calculating

Fig. 2. Masonry aqueduct

Fig. 3. Pont du Garabit, Léon Boyer, Maurice Koechlin, Gustave Alexandre Eiffel

Fig. 4. King's College Chapel, Cambridge

Fig. 5. Palm house Kew Gardens, Decimus Burton and Richard Turner

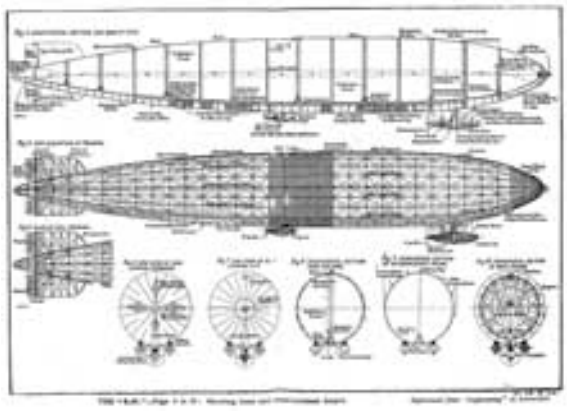


Fig. 6. R80

Fig. 7. Citroën ID19 (similar to the DS)

Fig. 8. Boeing 707

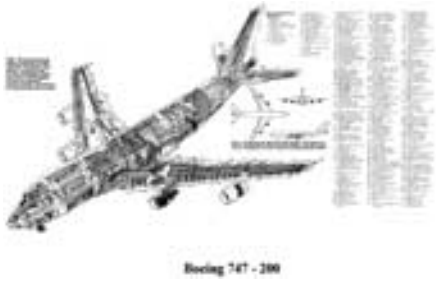


Fig. 8. Boeing 747

power in terms of arithmetic. But just walking about requires the analysis of all sorts of data from the senses and the control of innumerable muscles. This is way beyond the most powerful computers with the most sophisticated software. All that computers can do is to follow simple rules quickly and reliably. A piece of software may contain thousands of rules and this gives an illusion of intelligence.

One of the first uses of computers was for the analysis of structures, using theories that have been developed continuously from the 16th century [1] (figure 10). As a student in 1970, I was taught computing on an IBM 1130 (figure 11) and more time was spent teaching programming to engineering students then than now. This is because the assumption then was that engineers would write their own programs, whereas now the assumption is that they will buy them. Day to day calculations were done on a slide rule, (figure 12) which was the engineer's badge of office, like a doctor's stethoscope. Pocket calculators were introduced in the early 1970's and the slide rule was obsolete by the end of the decade.

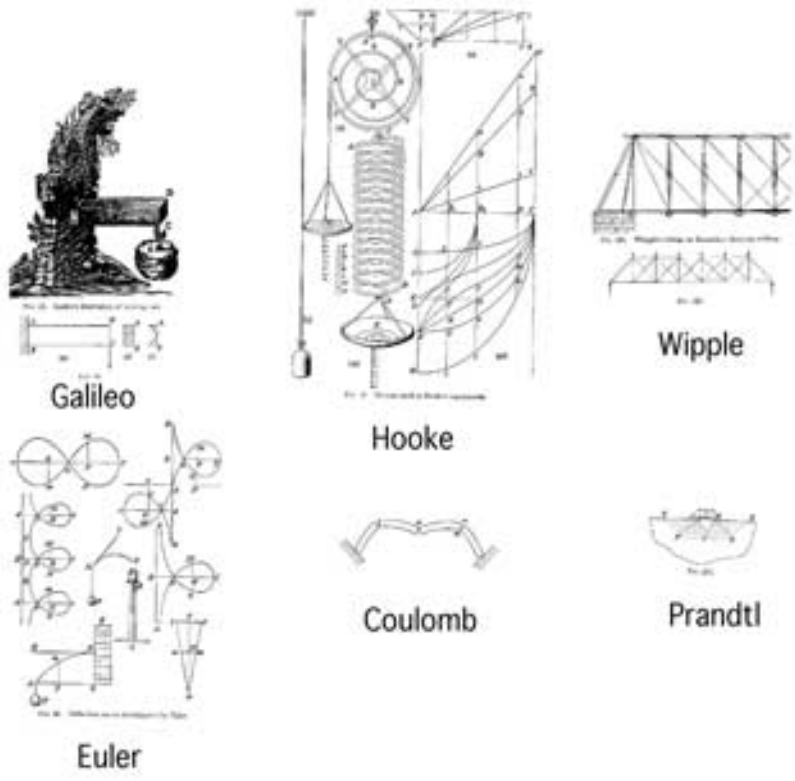


Fig. 10. History of Strength of Materials, Stephen P. Timoshenko

Fig. 11. IBM 1130

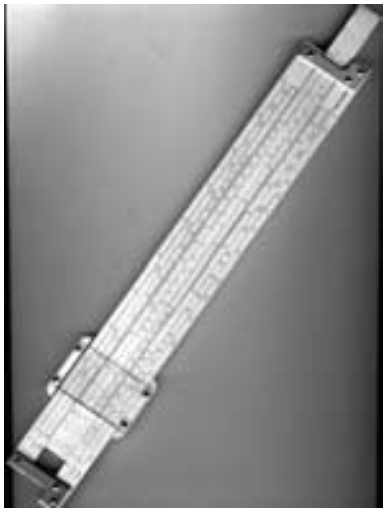


Fig. 12. Slide rule

Algorithms

The Oxford English Dictionary [2] defines an algorithm as 'A process, or set of rules, usually one expressed in algebraic notation, now used especially in computing, machine translation and linguistics.' Each rule of an algorithm must be open to only one possible interpretation, which means that no intelligence is required in using the rule.

When a person designs an object they will consciously or unconsciously adopt a set of rules. These may be some rules of proportion or the principles of structures or fluid mechanics or limitation on cost or the materials available. The rules are extremely unlikely to be in the form of an algorithm, they will be vague, incomplete, contradictory, open to dispute and require a great deal of intelligence to interpret. One of the main functions of the professions is to make sure that their rules are so complicated that only their members and their expensive software can interpret them.

Running the same program will always produce the same result, even if it contains a random number generator, unless the program is 'seeded' by some number that is never repeated, like the date and time. However, the first time a program is run the result may not predictable, because a change to one rule out of thousands may have far reaching effects.

Physical Analogies

So, given that one can only expect an algorithm to produce a design for one aspect of a complex object, how can one proceed to construct an algorithm? One possibility is to mimic some rule of the nature as pioneered by Gaudí in his hanging tension models that were inverted for his compression vault structures. Frei Otto continued this work in his experiments on hanging chains and soap films (figure 13). These techniques lead to the design of the Mannheim grid shells (figures 14 and 15) and the Munich Aviary (figure 16). Even though physical modelling was used for these projects, in the end their geometry and structural action was determined by computer analysis. At this time, in the 1970's, there was a fierce debate, particularly in Germany, between the more free thinking model makers and the computer programmers. This debate is now over and sketch models are used for initial design, but all final fabrication information is computerised.

Fig. 13 Frei Otto, Institut für leichte Flächentragwerke (IL)

Fig. 14. Mannheim Bundesgartenschau hanging model, Frie Otto, Ove Arup (Happold, Liddell, Williams)

Fig. 15 Mannheim load test

Fig. 16. Munich Zoo Aviary, Frei Otto, Buro Happold, Mike Barnes

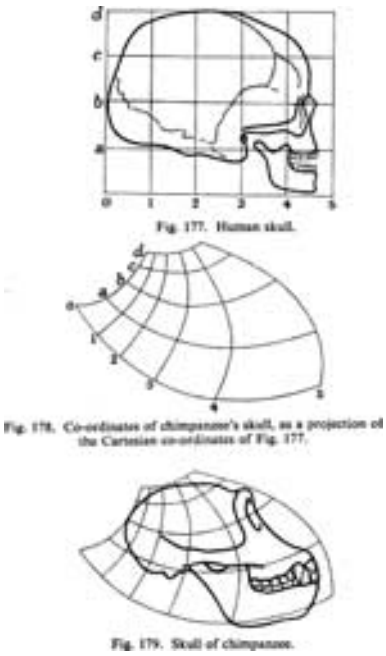


Fig. 177. Human skull.

Fig. 178. Co-ordinates of chimpanzee's skull, as a projection of the Cartesian co-ordinates of Fig. 177.

Fig. 179. Skull of chimpanzee.

Fig. 17. From 'On growth and form' by D'Arcy Thompson

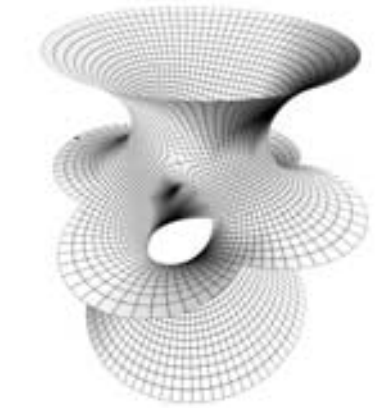


Fig. 18. Costa Minimal Surface

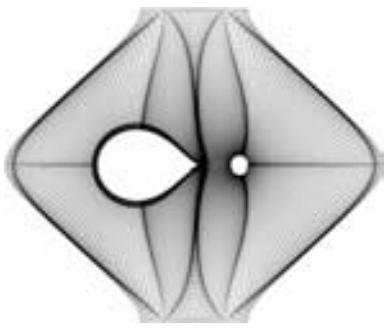


Fig. 20. Shell structure

A similar debate is now taking place between over the use of wind tunnels or of computational fluid dynamics in the analysis of wind loads on structures. In the end the computational approach is bound to win.

The work of D'Arcy Thompson[3] (figure 17) is a continuing inspiration for architects and engineers interested in the physical forces driving the form of plants and animals. Figure 17 shows conformal mapping which is a topic intimately connected to minimal surfaces (soap films) through $i = \sqrt{-1}$.

A recently discovered minimal surface is the Costa surface [4,5] (figure 18). This surface is described by

$$x = \frac{1}{2}\Re\left\{-\zeta(w) + \pi w + \frac{\pi^2}{4e_1} + \frac{\pi}{2e_1}\left[\zeta\left(w-\frac{1}{2}\right) - \zeta\left(w-\frac{i}{2}\right)\right]\right\},$$

$$y = \frac{1}{2}\Re\left\{-i\zeta(w) - i\pi w + \frac{\pi^2}{4e_1} - \frac{\pi}{2e_1}\left[i\zeta\left(w-\frac{1}{2}\right) - i\zeta\left(w-\frac{i}{2}\right)\right]\right\}$$

and

$$z = \frac{1}{4}\sqrt{2\pi}\,\log\left|\frac{\wp(w)-e_1}{\wp(w)+e_1}\right|$$ where $w = u + iv$, $\wp$ is the Weierstrass elliptic function[6] and $\frac{d\zeta(w)}{dw} = -\wp(w)$. The lines on the surface are in the directions of the principal curvatures given by lines of constant α and β where $\alpha + i\beta = \int \sqrt{\frac{1}{2} + \frac{\wp^2(w)}{\wp^2(w) - e_1^2}}\,dw$.

The catenoid and helicoid are both minimal surfaces and a surface can be continuously bent from one to the other without stretching and at the same time remaining a minimal surface (figure 19).

Fig. 19. Bending of catenoid to helicoid

Figures 20 to 25 are design studies produced using complex analytic functions again related to conformal mapping and $\sqrt{-1}$.

Fig. 21. Filigree bridge

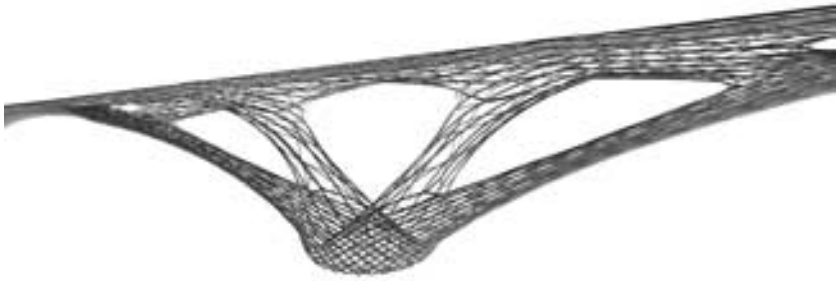


Fig. 22. Tube bridge

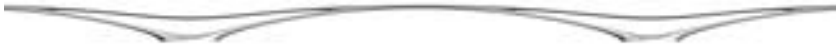
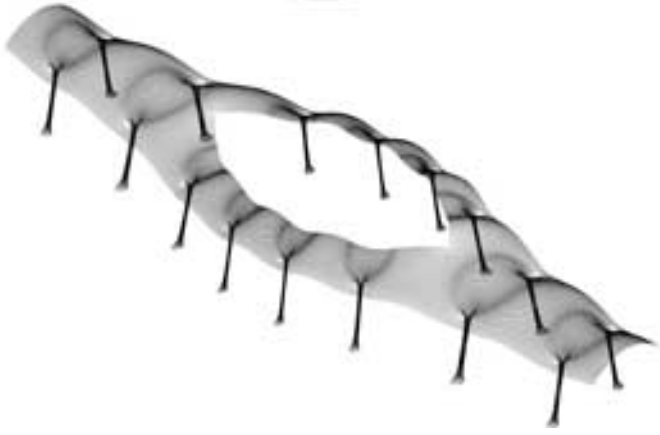


Fig. 23. Slender bridge

Fig. 24. Conformal map roof



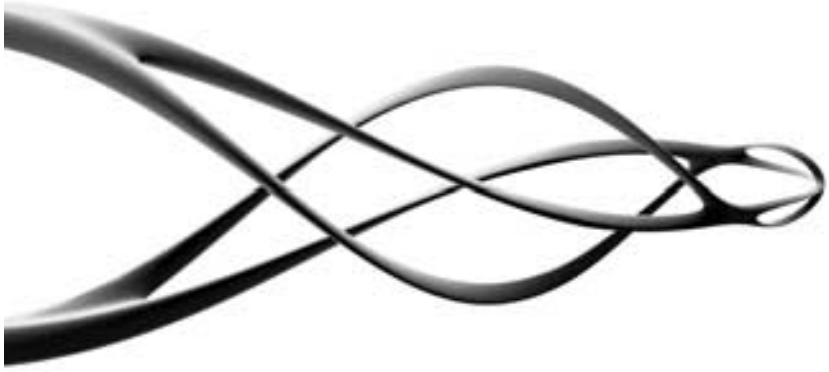


Fig. 25. Sculpture

Fractals and nature

Mandelbrot [7] describes the application of fractals to the derivation of form. The fractal image was produced by the successive refinement of a square grid of points on plan in which the height of each new point is the weighted average of the surrounding existing points plus a random number times the current grid spacing.

Fig. 26. Fractal mountains

The British Museum Great Court Roof

The algorithm used for the geometric design of the British Museum Great Court Roof (figure 27) used a number of different types of rule. Initial studies (figure 28) used the relationship, (Green and Zerna[8]) $w = \varepsilon^{\alpha\beta}\varepsilon^{\lambda\mu}z_{:\alpha\lambda}\phi_{:\beta\mu}$, between the load, w, the stress function, ϕ, and the vertical coordinate, z, to derive an 'optimum' structural form. However, this approach was abandoned because other constraints could not be accommodated.

Fig. 27. British Museum Great Court Roof, Foster and Partners, Buro Happold, Waagner-Biro

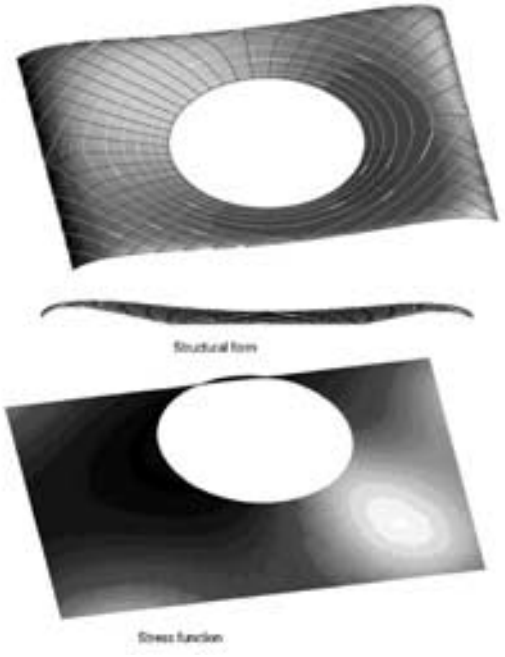


Fig. 28. British Museum Great Court Roof, initial stress function studies

The final form is described by the three functions,

$$z = \frac{h\left(1-\frac{x}{b}\right)\left(1+\frac{x}{b}\right)\left(1-\frac{y}{c}\right)\left(1+\frac{y}{d}\right)}{\left(1-\frac{ax}{rb}\right)\left(1+\frac{ax}{rb}\right)\left(1-\frac{ay}{rc}\right)\left(1+\frac{ay}{rd}\right)},$$

$$z = H\left(1-\frac{x}{b}\right)\left(1+\frac{x}{b}\right)\left(1-\frac{y}{c}\right)\left(1+\frac{y}{d}\right)\left(\frac{r}{a}-1\right) \text{ and}$$

$$z = \frac{\eta\left(\frac{r}{a}-1\right)}{\left(\begin{array}{l}\frac{\sqrt{(b-x)^2+(c-y)^2}}{(b-x)(c-y)}+\frac{\sqrt{(b+x)^2+(c-y)^2}}{(b+x)(c-y)} \\ +\frac{\sqrt{(b-x)^2+(d+y)^2}}{(b-x)(d+y)}+\frac{\sqrt{(b+x)^2+(d+y)^2}}{(b+x)(d+y)}\end{array}\right)}$$

weighted and added together. x , y and z are the Cartesian axes, $r = \sqrt{x^2 + y^2}$, and all other quantities are constants (figure 29). The weighting functions also vary with position in plan. The first function gives the change in level between the circular Reading Room boundary and the outer rectangular boundary. The second two functions differ mainly in their behaviour at the corners, one is smooth and the other gives a concentration of curvature. This was important for the structural action – the roof is supported on sliding bearings and exerts no horizontal thrust on the existing building.

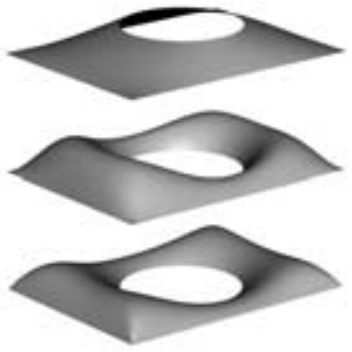


Fig. 29. British Museum Great Court Roof, functions describing surface

The position of the nodes of the steelwork grid upon this surface was determined by a relaxation process applied to a 'numerical grid'.The coarser structural grid is obtained by joining diagonal nodes of the numerical grid. The relaxation process involved moving each of the nodes on the numerical grid until it was the weighted average of the surrounding nodes. This process was repeated for the whole grid a large number of times, until the grid stopped moving. The weighting functions varied with position, mainly to try and limit the maximum size of glass panel. Figure 30 shows the grid before relaxation and figure 31 after relaxation.

Once this process was complete the structure was analysed in a number of ways – including the application of a stress function corresponding to the roof trying to work in compression and tension only (figure 32). However sharp folds indicated that this is not possible and therefore significant bending and torsional moments are to be expected in the structure – as confirmed by more conventional analysis methods. Figure 33 shows the roof in a collapsed state, one of many such studies which were performed as the design progressed.

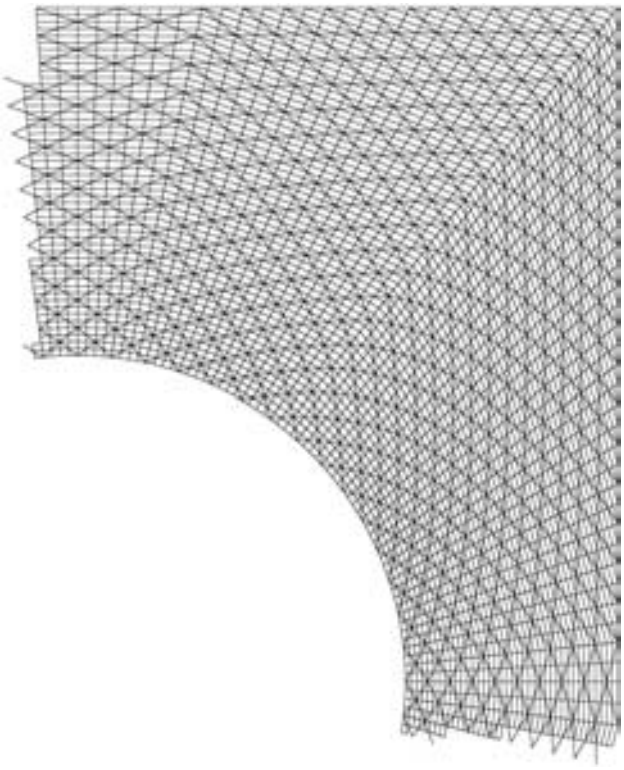


Fig. 30. British Museum Great Court Roof, grid before relaxation

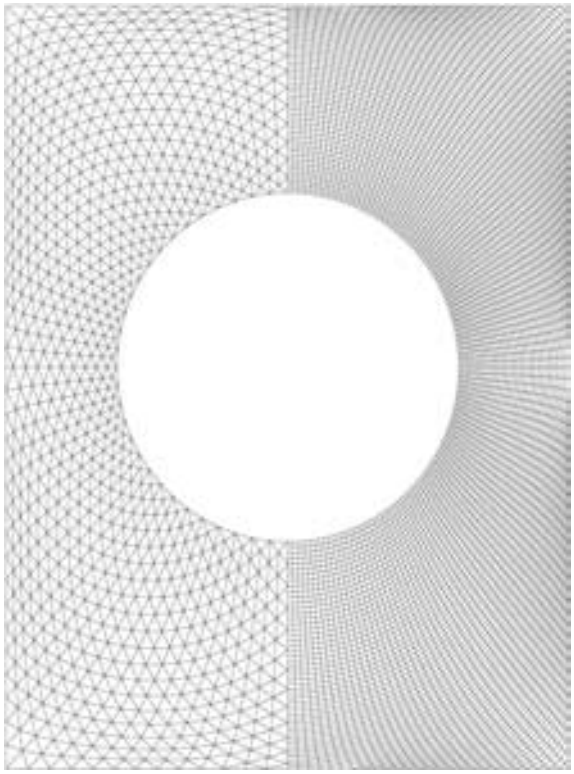


Fig. 31. British Museum Great Court Roof, grid after relaxation

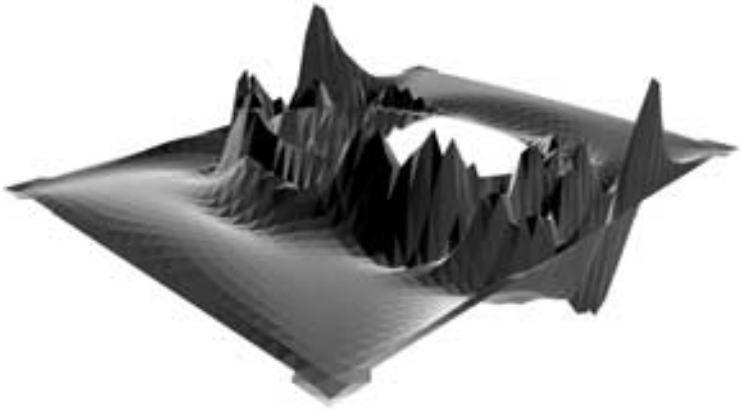


Fig. 32. British Museum Great Court Roof, final stress function studies

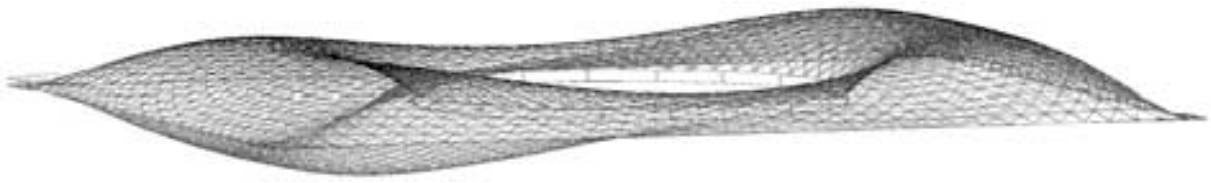


Fig. 33. British Museum Great Court Roof, collapse mode

Conclusion

It is difficult to know exactly what conclusions to draw. There is no doubt that objects that are designed are influenced by the design process itself. Now designs must be influenced by the computer software that is produced by people other than engineers and architects and by companies who have to respond to the market. I suppose all that I am saying is that some individual engineers and architects should be encouraged to write their own software if they are to maintain control over the design process.

References

1 Stephen P. Timoshenko, History of Strength of Materials, Dover Publications, New York 1983

2 The Oxford English Dictionary, Clarendon Press, Oxford 1989.

3 Thompson D'Arcy W. On Gowth and Form (abridged edition), Cambridge University Press 1962.

4 Costa, A. "Examples of a Complete Minimal Immersion in of Genus One and Three Embedded Ends." Bil. Soc. Bras. Mat. 15, 47-54, 1984.

5 Ferguson, H.; Gray, A.; and Markvorsen, S. "Costa's Minimal Surface via Mathematica." Mathematica in Educ. Res. 5, 5-10, 1996.

6 Wittaker, E. T., and Watson, G. N. Modern Analysis, 4th Ed., Cambridge University Press, London 1935.

7 Mandelbrot, B. B., The Fractal Geometry of Nature, W. H. Freeman & Co., New York, 1983.

8 Green, A. E. and Zerna, W., Theoretical Elasticity, 2nd Ed., Oxford University Press, 1968.

New Materials, New Conception Processes: A New Uncertainty?

Geneva, Switzerland

Cyrille SIMONNET

When we visit a construction site, when we enter one, it seems that all we see is what we have always seen before: the crane, the concrete mixer, stocks of cement and metal, formworks for preparing the concrete, diverse standardised or prefabricated components, such as frames, fragments of objects, decorative panels, parts for a façade...

Where are the "new" materials? If indeed they exist, their use is still pretty much under wraps. Rarely are they seen at a typical or traditional construction site. At least that is the layman's impression, which, come to think of it, that is what we all are.

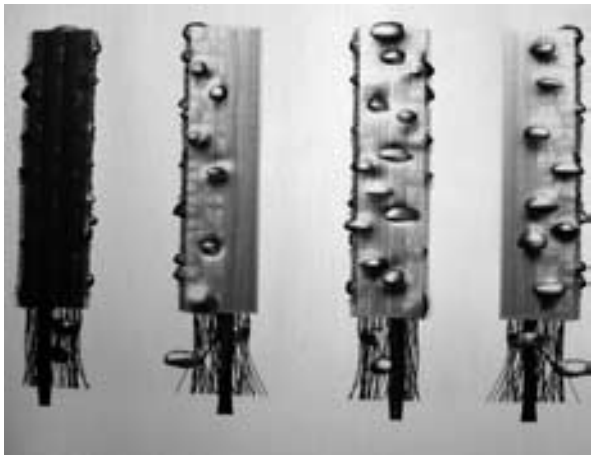
Nevertheless, we know that the producers of materials, the "big" ones, such as Arcelor (steel), Lafarge (cement), St Gobain or Pilkinson (glass), have been involved in cutting-edge research with regard to the materials they handle and its uses. In 1997, an important exhibition dedicated to the "Art of the Engineer" was held at the Georges Pompidou Centre. At this exhibition one could see extraordinary glass, so sensitive that it varied in hue instantaneously, going from complete transparency to total darkness with the mere touch of a button. We are also aware of the research done on new generation cements such as Ductal from Lafarge containing micro-fibres and used in high resistance cements that have the capacity of competing with metal beams. Wood has also been the subject of impressive handling. Having been ground, mixed, boiled, coated in resin and sometimes in chemically dubious mixtures, it has become a reflection of matter instead of the matter itself. Take for instance the pale, plastic laminated photocopies made from questionable materials that we are given in the guise of wood flooring for our homes. Nevertheless, wood enjoys a good reputation; it brings to mind all sorts of positive and reassuring images and speaks to us of the environment, sustainable development, and quality of life.

It is important to be fair, nevertheless. We need to recognise the energy shown by manufacturing businesses (not construction) for developing new products or adapting existing ones. It is also important, however, to recognise that the construction sector, in spite of impressive or extravagant projects, represents a production sector that is relatively archaic in terms of technology. By "archaic" we mean a sector that is a manufacturing one and that is not industrialised; one that is not automated and that uses a large amount of manual labour, not very qualified or organised (with regard to trade unions). This is true at least for the large projects, which represent approximately 60 % of the capital invested in construction (in France). This means that the product resulting from labour has not been "objectified" by the wheelwork or by the automatism resulting from the machine, but that it remains "subjective" due to the use of instruments that tend to simplicity such as the trowel, the grab and the hammer. In other words, instruments that prolong the amount of time of direct contact that a

Sur le chantier, tout se réalise à la main
(droits réservés)

L'outil, simple, prolonge directement le geste
(droits réservés)

Travail à la chaîne dans une usine de conditionnement
(droits réservés)



François Roche, (Un)Plug building, Paris, La Défense, 2001, vue dans le contexte
(Architecture non standard, Paris, CGP, 2000)

François Roche, (Un)Plug building, Paris, La Défense, 2001
(Architecture non standard, Paris, CGP, 2000)

Publicité pour un nouveau type de verre

manual activity has with the material being worked on. The attempts to industrialise building have, in general, failed and this due to reasons both linked to urban and economic matters; to certain requirements of quality of life. We are all well aware of the disastrous consequences that the crane's dictatorship has had on the construction site.

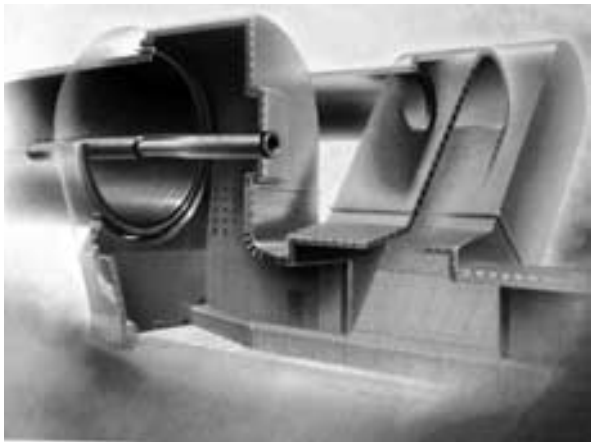
To speak of "new materials" necessarily implies to also address their production. And it is in this respect that we become aware of a contradiction. Powerful resins, glues, plastics and admixtures are being used. They have been carefully developed and created to make the most of the use to which they are destined for. An example of this would be the use of glue rather than mortar for brick laying as is being done in Holland. But this concept and its realisation, even though it is a part of the overall production of a building, of architecture, is barely a factor in the organisation or in the specific development of construction in the sense that we traditionally understand it.

This contradiction deserves to be analysed. It involves both technology and economics. It is important to make a distinction between these so-called sectors of production because even though it might be a generous and nice gesture to champion the new materials, it is nevertheless important to realistically consider the ways in which the objects of our modern society are produced in situ.

This would be an opportune moment to mention the apparently notorious role that these, once again, "new" projection and communication instruments, such as computers and digital design -what is already known as digital architecture- have played in the development of architectural conception. Already museums, publishing houses and all the other large promotional entities have seized the somewhat baroque production tendencies of these projects of an indefinite and uncommon shape. Moreover, they are being made by architects that have fallen under the spell of digital technology and who are also experts in the use of these digital instruments meant to free the conception process from traditional Euclidean geometry. Indeed, it is important to insist precisely on this issue of geometry. For a number of centuries it has been the most appropriate intellectual instrument for carrying out architectural projects, irrespective of the sensibility or ideology behind it. In the most banal sense of the definition, geometry is a means of representation. What we architects and builders call a "projection" (project, projection) that allows for a rigorous enough representation of the project's elements (drawings, cross-sections, elevations, details) that are subsequently handed to the enterprise or craftsman in charge of building the project. Moreover, the drawing known as the *working* drawing has a very clear mandate: to represent in two dimensions the elements that make up a building in an appropriate language so that it can then be deciphered and translated by those who will build it. It is also interesting to note with respect to the new trends previously alluded to, how projects derived from these trends reach this stage. For example, Bernard Cache, founder of the *"Objectile"* group and a representative of this new way of working, has developed an ambitious process (to quickly explain), that aims to by-pass the traditional project-realisation stage by making the two ends of the chain work together following with the aid of a computer programme meant to simultaneously

Publicité pour un nouveau type de verre

Le modèle de la grue moderne a été mis au point au début du XVe siècle par Brunelleschi (droits réservés)



Publicité pour des ciments nouvelle génération

Microstructure du béton

Une « machine » propre au monde de l'industrie (droits réservés)

guide the formal concept process as well as the instrument making the concept. This instrument is a sort of planing machine that can be operated simultaneously in various directions and can operate in three dimensions, guided by the same software that also guides the concept stage.

Thus, the equivalent of the labourer is a machine-instrument. If it were more universal and if its worth had been proven, it would turn the century-old dream into a reality, namely to industrialise the construction of a building. Indeed, according to the *Objectile* method, the machine (machine-instrument) would be placed between the stage of the study (the concept of the object) and the production of the concept, therefore occupying an important place and requiring a new kind of labourer who, as in the production of the automobile, for instance, would only have to serve the machine, monitor it, take care of it and feed it. In some respects, the *Objectile* project, still utopian, leads us to recall Jean Prouili's, vision proffered some fifty years ago. He also wanted to industrialise the construction of a building. He had also bought and adapted machines (the folding press) to favour the direct contact between the concept and its execution. He would say that the "true" concept drawing needed to be done on a scale of 1/1 and traced directly onto the material that was to be worked on (such as sheet metal) and that this was all that was required to guide the machine capable of making the concept.

To simplify, being able to bring together to process of the concept with that of production, was the ambition of the aforementioned protagonists. In general terms, we are talking about a truly industrial project, in the sense of economic theory. To "objectify" the production factor, is to detach the labourer, who may rely too heavily on his expertise, from the subjective nature of the gesture, in favour of a process guided by mechanical precision and rhythm.

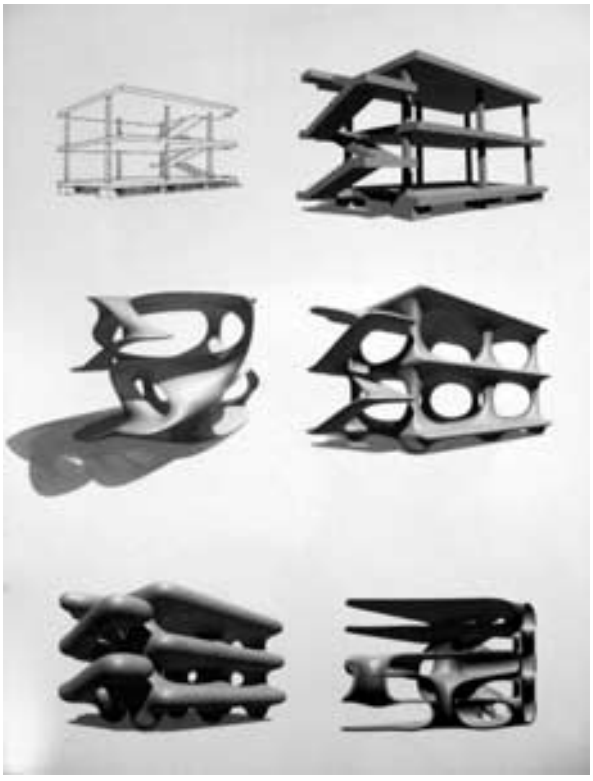
Let us return to the topic of new materials, now that the question regarding production has been elucidated. Production that couples, in particular, the building sector to manufacturing, and not to industry. The question we would like to address is: what can the arrival of new materials and new methods of conception offer if the production process has not changed, namely the archaic quality that persists in manufacturing? Another related question: will these new trends modify anything with respect to the above-mentioned method of production? Presently, we have a *trompe l'oeil* impression that makes us join the two movements, relatively independent from, or so we believe, the arrival of new materials and the modalities of representation and conception,(equally novel) due to the development of the use of computers and digital architecture as instruments. In other words, everything is taking place as if both currents were advancing together and as if they were going to revolutionise, in the medium term, our milieu, or more specifically our production sector.

To conclude, we would like to point out a fairly surprising paradox. Presently, the activities or the constructive applications stemming from digital architecture are taking place in the most traditional working environments and construction sites. Moreover, this activity, which remains tied to craft, is frequently encumbered by geometry or machines that are inadequate for tracing and for large formats. Let us think, for instance, of the difficulties encountered by those who worked on *Café Georges,* the new restaurant

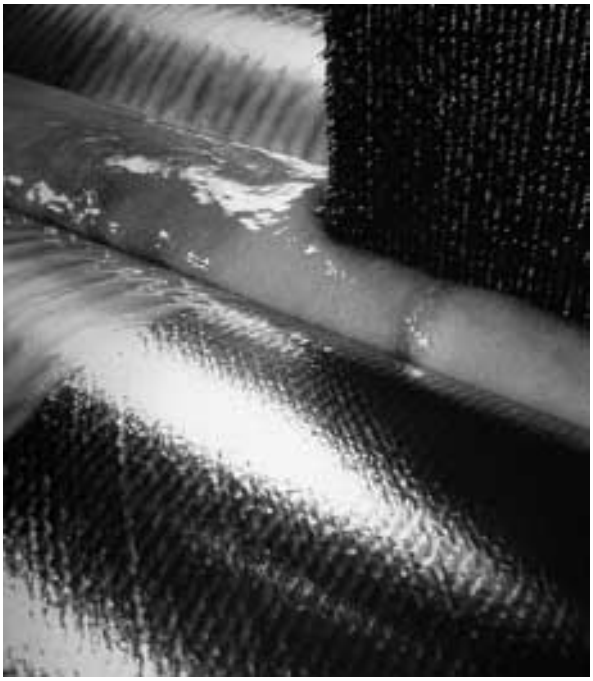
Turka Library, 1998, Michael Saae, USA
(Archilab, Orléans, 99)

Nouveaux matériaux : nappage des composites à l'usine Dassault à Biarritz
(L'Art de l'ingénieur, expo CGP, Paris 1997)

Les tentatives d'industrialisation du bâtiment se sont en général soldées par un échec
(droits réservés)



DR-D lab, Stuttgart, Maison Dom-in(f)o, 2002
(Architecture non standard, Paris, CGP, 2000)



Fibre de carbone imprégnée par une résine de polymère
(L'Art de l'ingénieur, expo CGP, Paris 1997)

at the Georges Pompidou Centre in Paris, a spectacular example of "blob" architecture where the complex surfaces are easier calculated and grided by computers than by welding equipment, limes or a sander. Whether it is the complex folds of Greg Lynn or the supporting structures of Frank Ghery, the production technique remains basically the same. The materials are not delivered from the factory; they are made and adjusted at the construction site using the most conventional methods. Like large scale sculptures, buildings with a "digital" appearance are being built the old-fashioned way: with instruments, that are not very sophisticated; using hoisting methods, scaffolding and work posts that can be found in any typical production site.

At the same time, oddly enough, apparently traditional construction sites such as those of "traditional" French homes (regulated and managed, in actuality, by important groups like Bouygues, Phénix, Fougerolles), sometimes make use of powerful prefabrication, tailored systems for various components such as windows, isolation panels or barn-like roofing. All can be made practically overnight, distributed in lean supply chain fashion, all delivered in a kit, according to the wishes of the client who can basically have his home built à la carte.

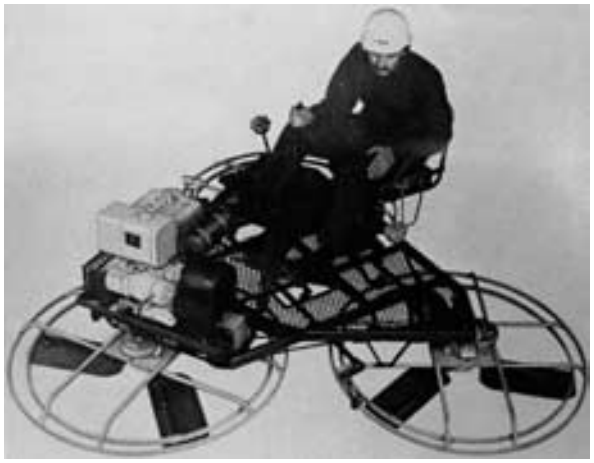
We are not trying to be pessimistic or nostalgic. Our opinion is based on an analysis that education in architecture schools should, we believe, consider more fully the question of construction. Software has been able to penetrate more easily the project studio than the new materials have been able to do, the latter often confined to civil engineering labs. Nevertheless, it is important to address the topic that is ignored by architecture students: production at the construction site. The technological conception and the economic one are closely linked and point to the architectural project's fundamental subservience to them.

Vue d'un chantier moderne traditionnel (photo C.S.)

Vue d'un chantier moderne traditionnel (photo C.S.)

Jakob et Mac Farlane, Café au Centre Georges Pompidou, Paris, 1998

Jakob et Mac Farlane, Café au Centre Georges Pompidou, Paris, 1998



Man-riding trowel. Exemple de tentative de mécanisation du travail sur le chantier (droits réservés)

Smart Building
The Hague, The Netherlands

Ed Van HINTE

1 Game computer lid

Like you can read in my bio I don't have a background in building or architecture. I am very good at not being specialized in anything. Recently I designed a game computer without a screen, and this is the lid of the box it comes in. Material: plastic granulate baked in an oven on a tray, like gouache.

Material was meant for floor tiles graduation project Academy.

Became a total disaster. Baking in batches didn't work and one by one took to long. Did look good and would be sturdy material that because of its roughness would keep on doing so. Long lasting >> the lid. Also shows that the borderline between material and structure is fuzzy. Material is becoming something that you design together with the structure and the process, rather than something you choose.

2 Computer

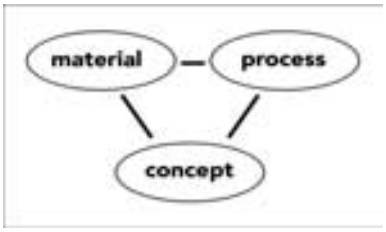
Brief explanation

3 Trinity

It demonstrates that a material and concept have to match the process by which it is made. And also that a different concept can work with the same material and process. This is a very important picture in all kinds of design.

In building it is a starting point too, and it is becoming more so because lightness is gaining importance. Humans used to have to carry everything, animals helped, machines helped better, but now energy consumption is getting more and more limited. Expensive, so lightness is important for affordable transportation.

Show some architectural viewpoints, just to get into the building groove.



4 Van Nelle

Buildings: architectural affinities. The starting point of modern functionalist building: steel glass, geometry

5 Hong Kong bank

Norman Foster direct hereditary: Appropriate technology, although we can observe that Foster likes to show structures that look appropriate (modern, industrial, ingenious) and that technology has to comply with those looks, even Norman Foster.

6 CCTV Beijing

Now this building, now being built in Beijing, designed by Rem Koolhaas, spectacular structure 230 meters, massive amount of complex floor space. Ove Arup's office spent a year doing the calculations, steel beams along the tension lines. It is the Dutch affinity with concepts. Building as a logo, plus accommodating open organizations because of less elevator separations.

7 WoZoCo

By MVRDV. Building for elderly people. Same lust for simple concepts, resulting in not very efficient structures, but they also show anything is possible.

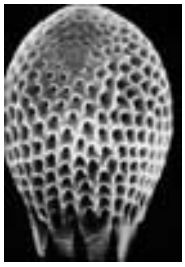
8 Frank Gehry

An architect in his very own right. He sculpts buildings and all structure is subordinate to that. Another spectacular creation for a computer intelligence lab at MIT.

9 Lars Spuybroek

Here we have an architect who I fascinated by what you can do with computers.

They can visualize any shape and even create interactive virtual buildings. Alas, when you actually want to build something like this, you are still left with artisans, welders for instance.



10 Radiolaria

Nature is an inspiration to some architects, and it is true that plants and animals have a much more refined structure than what architects can do. This is the outside skeleton of a specimen of a kind of animals called Radiolaria, a few millimeters. They make their own outside skeleton.

10 Calatrava Lisbon

Santiago Calatrava probably is the most capable architect right now in deriving the structures of buildings from bone and plants. I hope to see his stadium in Athens on Sunday. Now these images all show buildings by a certain architectural elite. They all put the mark on the concept. Only in the case of the likes of Calatrava are we getting something that has to do with structural efficiency. Of course the bulk of what is built all over the world has very little to do with all this. It is simply a pragmatic business that is quite successful despite its ongoing inefficiency.

11 Vinex

In the Netherlands housing development is relatively efficient and mostly controlled by government. Strange things occur because of that. A friend of mine bought ground that was destined for free architecture. Together with friends: let's do the same. That is more efficient. They were not allowed to build the same houses on a row (4 million) because free architecture is not meant for that.

12 Tirana

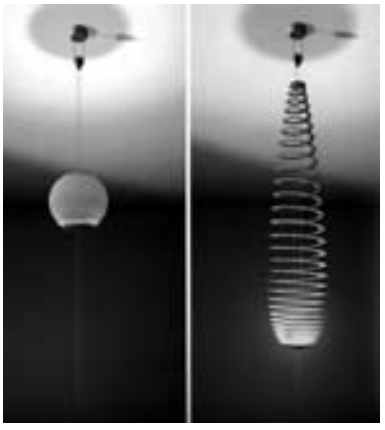
Pragmatic modernist architecture in Tirana.

13 Rubble

Basically building is a relatively primitive and inefficient process. It involves a lot of labour and cheap materials. This could change in the future, judging by the general direction of technological development.

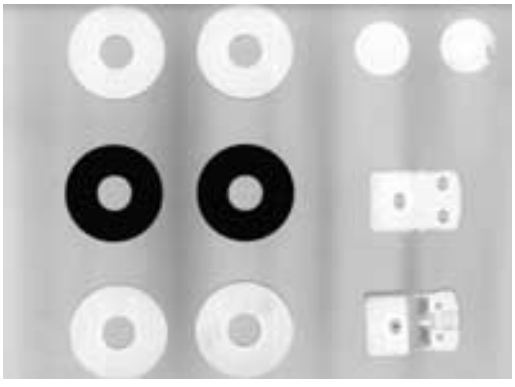
14 Ron Arad SLS

The other extreme is a process entirely controlled by a computer. Selective Laser Sintering. The software contains a model that controls a laser device that melts together plastic granules, layer by layer to build a product. Architectural models have been made in similar ways. This technology will not acquire a large enough scale for buildings, but the computer and robots are already used in building high-rises and tunnels and for cleaning.



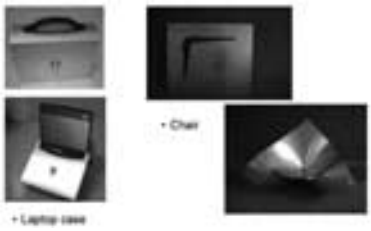
15 Piezo

Some things will become more automated. Piezo electric ceramics and other materials are used as sensors in feed back systems.



16 Nitinol

Feed back systems need actuators too. They can be made with motors or materials that can exert forces. Nitinol or memory metal. Now this is where you are going to have to be careful: the effect may be tempting, but does it really do something meaningful. Sleeve nonsense. Explain.



17 Hylite

Materials have to make sense. Some 10 years ago a Steel giant in the Netherlands came up with Hylite, a laminate of aluminium and polyprop. It would be light and easy to process in for instance the car industry. Aluminium in thin layers however is quite vulnerable. A few heavy hailstones and the hood of your car is dented. They still try to find applications, concepts.

18 Straw

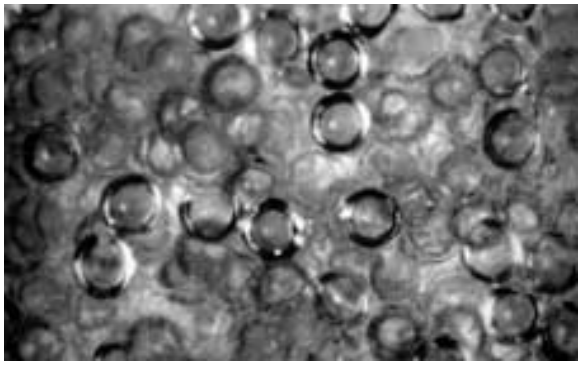
Ah, one of these effects. Temperature sensitive plastic. The cold drink colours the straw. Won't make any difference if the drink has the same colour. Fun!

19 Composite glass

Now this is an interesting combination of glass and a metal honeycomb structure. Relatively light, compared to glass. Lets light through in a special way. Deals with the obsessions of many architects for translucency and transparency. Important part of their conventions.

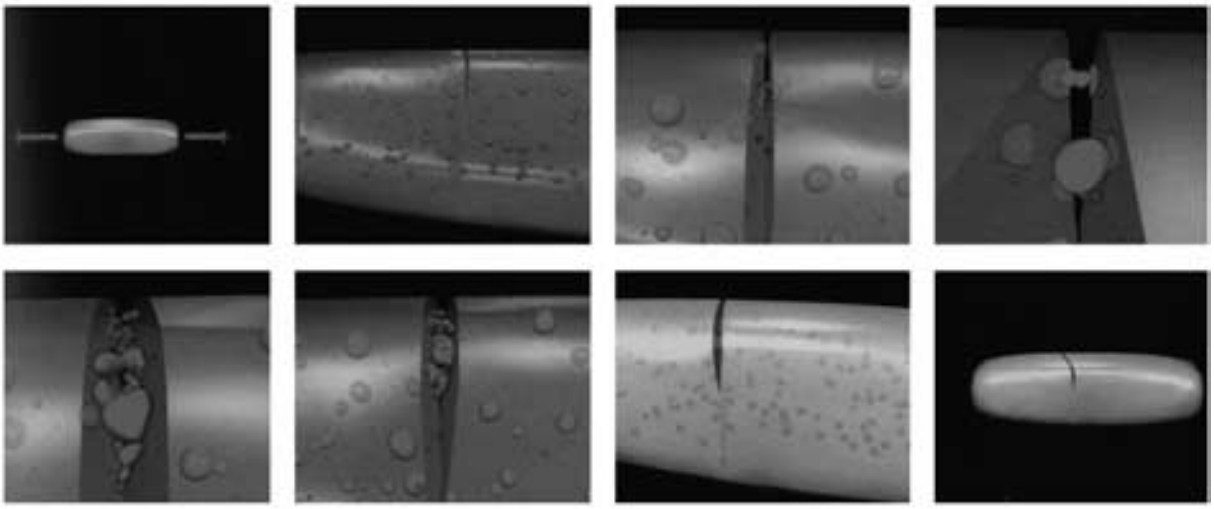
20 Translucent concrete

A Dutch architect once wrote about 'sappy', the ideal material that would instantly solve all architectural problems. This comes close. It is translucent concrete and they're currently experimenting with it. As far as I'm concerned: effect. Why would everything have to be translucent? There's nothing wrong with a bit of darkness here and there.



21 Self repair

Feed-back systems include materials or structures that can repair themselves when something goes wrong. This is an illustration of self repairing polymer. If there is a crack little bulbs of resin undergo a chemical reaction that forms fresh material to fill up the gaps. There are experiments like this going on in concrete too.



22 Leak stopping

Last week I found an interesting new idea to stop underground leakage. This is a picture of the test site. They prepared containers with holes in them. What they do is feed carbohydrates and sugar into the ground. It will concentrate near holes and there bacteria will consume it. They love candy. Consequently they excrete a slimy substance that closes the hole. The article didn't say anything about the smell.

23 E-ink

You probably know that flexible screens are almost ready for the market. No doubt this will be the beginning of developments that cannot entirely predicted. Clothing with screens. Entire curved walls with screens. Some architects like Lars Spuybroek expect something like virtual architecture or buildings that automatically adapt visually to the weather or, sound or whatever. Scientists are also thinking of interactive room atmospheres. You can choose imagery according to your emotion. Personally I would hate that.

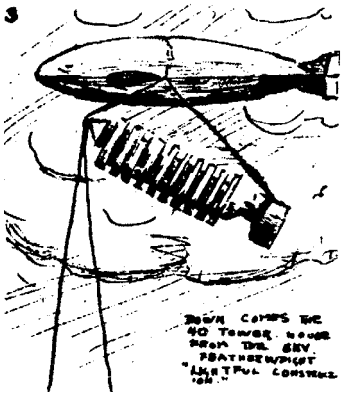
24 Polymer muscles

Artificial insect from the structural point of view. Explain. Another option to make buildings more intelligent. Feed-back and interaction.

25 Zeppelin Hangar

This is not about the airship but the material behind it. Airships are quite inefficient vehicles, but they could be interesting cargo lifters: low speeds, short distances.

Flexible composite. Cloth made of glass fibre plus Teflon. Composites are combinations of two or more different materials. This is where material really becomes a structure or a construction themselves. Reinforced concrete is a composite, but usually the name is given to a combination of fibres (glass, Kevlar, polyethylene, carbon) and a resin, both thermosetting and thermoplastic. Several functions are combined, and who knows maybe there will be composites that are also screens and heat insulators. This one is strong, light, flexible and translucent. They have the potential to become new building materials, because they can be very light.



26 Zeppelin Buckminster

Lightness is gaining importance. Buckminster Fuller foresaw that and it is an angle I like to choose. The rationale behind that is quite simple: in primeval times man had to carry everything himself. Everything had to be light because of it. They chose light materials and invented composites. Then they learned to employ animals. Later machines that became stronger and stronger to carry all the more heavier loads. Around WW II heaviness was at its peak. After that artifacts are becoming lighter again to accommodate efficient transport. Since energy is becoming more and more expensive this trend is likely to continue.

27 Tension

You know that lightness results from structures in which tension is the dominant stress when loaded. Some materials are better qualified for pressure, like stone, some are reasonably good in both, like metals. Fibres are the best in tension. Weight provides fibres with form. You could say that Antonio Gaudi marked the change from pressure to tension. Historically that would be wrong, but it is a nice symbol.

28 Gaudi down

Gaudi designed a building with pieces of string and weights to mark the loads. They can still be seen in Barcelona.

29 Gaudi up

Then he went to his masons and said: make this for me, but do it upside down. This simple principle worked, well, partly. You cannot just turn tension into pressure. For pressure you need thickness to prevent buckling. And as soon as you introduce thickness you get tension forces. Stone and cement cannot deal with that so there are cracks in some of Gaudi's structures.

30 Dymaxion house

Richard Buckminster Fuller was the master of lightness and tension. He designed this dymaxion house. Eight floors, complete with furniture. The whole building weighed 8 tons and could be placed on its sight with a zeppelin, theoretically.

31 Tensegrity

He invented the principle of tensegrity, by which you can build a stiff structure with cables loaded with pure tension, interlinked by pressure bars. This principle is omnipresent in nature. Even our own bodies can stand upright because of tensegrity.

32 Dartmoore bridge

The development to lightness can be illustrated with bridges. This is the most primitive kind, found in England. About 1200 years old. Pressure and bending. Bending forces are not very healthy for stone because of the tension in the bottom. I also found broke bridges.

33 Arch bridge

Here we have a beautiful example of a classic bridge in which all forces are exclusively of the pressure kind. There is a limit to the span. The English engineer Brunel became a master in this kind of bridges, and other kinds too.

34 Suspension bridge

Suspension bridges like this can be found all over the world. Recently they experimented with building such a bridge in Peru, with a special kind of grass that grows in the mountains. Local people built it in two days, from harvesting the grass to the finished bridge.

35 Foster bridge

The bridge near Tate modern in London by Norman Foster look ingenuous, but this is doubtful. The cables that support the deck are almost flat, which I suspect allows a bit too much torsion. They did have problems. Apparently when every body walked the same pace, and people do that, the bridge started moving.

36 Golden Gate

One of the most beautiful suspension bridges: San Francisco. Elegant. One disadvantage, they have to paint it over and over again to prevent the steel from rusting.

37 Golden Gate construction

This illustrates how they laid the cables, that by the way are not twined but parallel so that the steal threads can move along one another.

38 Messina strait bridge

There are limits to steel. It can weigh too much. The plan to build a bridge between Italy and Sicily with the longest suspension bridge ever, spanning 3,3 km between towers has financial trouble. It is estimated to cost 5 billion euros. Experience shows that with an average of 45% budget overrunning in large projects this will be nearer 7 billion. But more importantly, the span is over the limit of what steel can do.

39 Messina computer simu

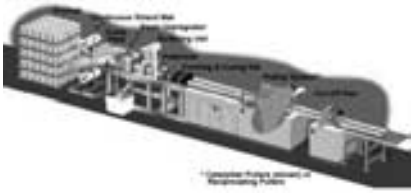
There is a good chance that this construction, if they ever try to build it, will collapse under its own weight. On the other hand carbon cables could work. Theoretically a carbon suspension bridge can span about 12 kilometers, simply because of a better ratio between strength and density. There is an important technical problem to be solved: anchoring a carbon cable.

40 Composite bridge

Composite bridges are being built. This one is in England. The deck is made from glass reinforced resin. An important advantage over steel is that the material doesn't need any maintenance.

41 Pultrusion

The process by which the deck is produced is called pultrusion. Fibres and yet to be set resin are laminated and pulled through a press and immediately cured afterwards.



42 Pultrusion

43 Air, etc,

To make light building structures you basically need polymer fibres and intelligence, and air. Regardless of material or shape, the art of constructing lightweight structures thrives on intelligent distribution of mass, and thereby the points of gravity application, over space. Foam is a good idea. Generally air is a worthy material, provided it is enclosed. Other gases or fluids can do the job too.

air
polymer
fibres
intelligence

44 Gas thieves

In this case the foil is used to contain gas in China. These people have stolen gas from an open well to use ate home, for cooking.

45 Casa basica

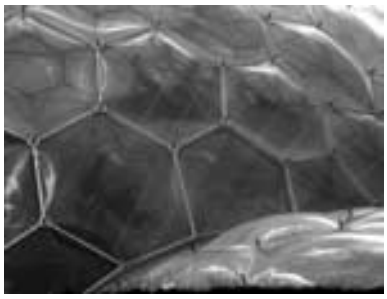
A spanish designer Martin Azua designed this very basic house from foil and air.

46 Airquarium

Another interesting air and polymer structure by Axel Thallemer of Festo Corporate design. He doe quite interesting experiments. Air and water.

47 Eden

Translucent buildings.



48 Eden detail

Not with ever popular glass but with Teflon foil cushions filled with air. Because of that the carrying structure can remain light.

49 Knotted chair

Fibres are quite interesting because they require working processes that are uncommon to those traditionally designing and building constructions. This chair by Marcel Wanders, now a design classic, illustrates that. It is knotted according to an old macramé technique. But the braid is made out of Kevlar, for the sleeve, and carbon fibres are inside. The whole structure is drenched in epoxy resin. The braiding and knotting thing is old, even the chair looks old, but it could not have been made before 15 years ago, because of the materials.

50 Wound stool

The same is true for this stool by Hella Jongerius. The high tech fibre is wound around a mandrel and consequently embedded in polyurethane with varying elasticity: the top is soft, the rest is stiff. Coiling or winding is a simple way to work fibre, but it may become useful even for very high buildings. I'll show this in a few minutes.

51 Exhibition hall

One of my favourites, also by Festo a German company in pneumatics. It is an inflated structure, in the sense that it has an pneumatic exoskeleton, like radiolaria. It is about 60 meters long.

52 Skeleton

Intelligence in a feed-back system is involved her. The skeleton is controlled by pneumatic muscles, the blue things. They contract when more air is pumped in. The muscles provide dynamic stability.

54 Chimneys

Now I will introduce to you a new process of building high structures, it is still in the laboratory stage at the laboratory for Lightweight structures, part of the faculty for aerospace engineering in Delft. The idea is based on a shape derived from this familiar form.

55 Sydney

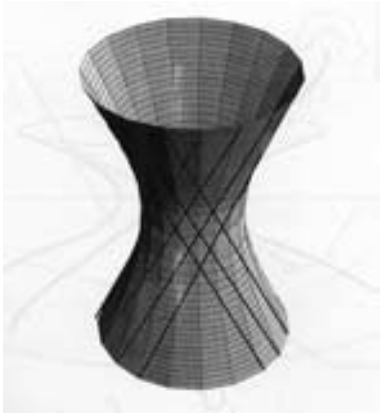
It is applied in more pure tensegrity forms like this tower in Sydney

56 Kobe

There is a central column with straight tension strands in a regular configuration to keep it upright.

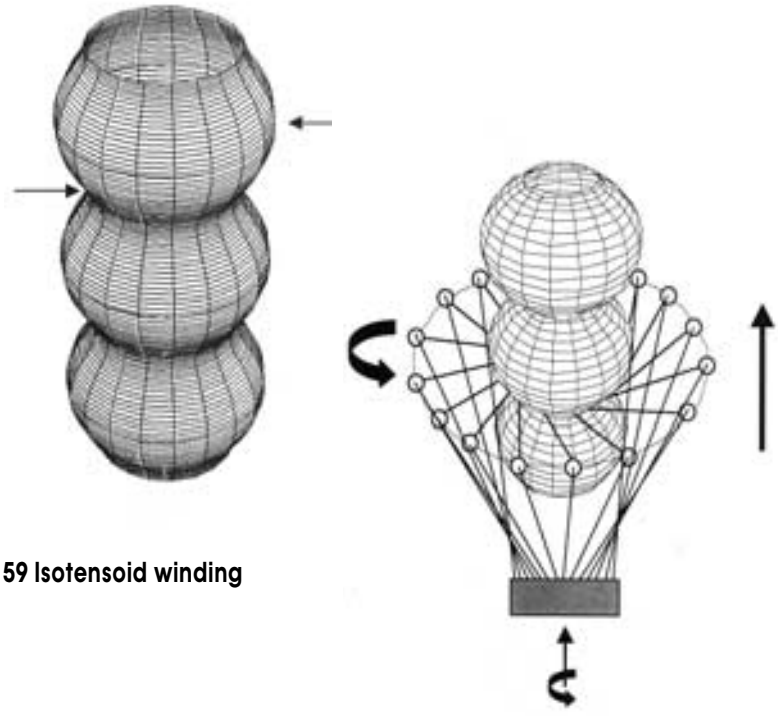
57 Hyperboloid

This hyperboloid is in fact mathematically the limit case of a shape like this

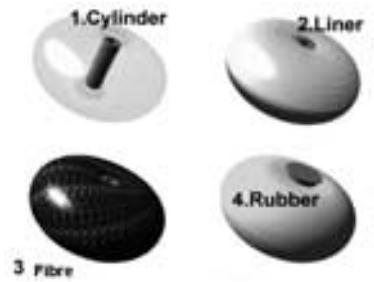


58 Isotensoid

Isotensoid, it is characterized by the fact that it can be produced by winding fibres around a mandrel in a regular arrangement and when this shape is hollow and a fluid or pressurized gas is inside, the fibre will have the same tension everywhere, hence isotensoid.



59 Isotensoid winding



60 Lifting cushion

The principle is in use on a very small scale as a lifting cushion

61 LPG tank winding

And in a newly developed LPG tank.

62 LPG tank

The tank, consisting of plastic, fibres and latex, had trouble to be certified. The responsible team figured that it would be unsafe, since well, plastic. This hypothesis proved wrong. The ultimate test: throw a full tank in the fire and behold: no explosion. It just burned quietly, because the plastic melted. This shows that the properties of separate components do not determine the property of the hole structure.

63 Koussios

Anyway, a high structure could be made like this, extremely high as a matter of fact, because the outside wall would be under constant tension stress it wouldn't buckle. Several of these columns together could be the towers to support a building hundreds of meters high. And since pressure is easy to measure there could be a simple feedback system to trace and compensate for leakage.

64 Sequoia

The system would work like a tree: since water dries the skin it shrinks and therefore is put under tension stress that prevents it from breaking when there is a storm.

65 Airlift

A building like this could be built from the top down for a change. There could be a fleet of airlifts, like this floating saucer, one of which could contain a coiling, impregnating and curing robot. It would be the opposite of digging a hole. But this is pure speculation of course.

Designing by Making: Strategies for Developing Architectural Concepts by Means of Process Skills

Oslo, Norway

Bjørn Normann SANDAKER

The general idea, of course, is that all our thinking and reflections during this event, should be in the perspective of "the future". That we somehow should try to foresee a likely development of our profession for the day after tomorrow or in the next years.

What do we know about the future? Nothing! Or, next to nothing. This means that we are confined to make guesses, which might be qualified, but they will still remain guesses. In this situation we usually extrapolate our present experiences and project the trends and realities of today into the future. If I am asked to give an advice on how to make plans for construction education today, which should apply to students in the next five years, my answer would be to identify a strategy, or rather an attitude, that I am fairly convinced would work, and would be seen as useful. This attitude and the knowledge which is implied, should go beyond and go deeper than the level of pragmatic building construction methods which change rapidly.

I will try to outline some elements of such a strategy, and will emphasize questions of the construction process and of the relationship between a conceptual design and that process. This is about the transformation of materials into construction elements, and of the transformation of construction elements into works of architecture. In another word: it is about technology.

What I can state right away is this: In the future, will continue to teach the properties of materials, we will continue to teach mechanics of materials, we will continue to teach statics and structural systems. Those topics are all at the bottom-line of all construction education, like syntax and grammar in the language of architecture. Large parts of those topics would seem not to undergo rapid changes, but remain a solid basis on which we can develop a more flexible but specific, state-of-the-art education program on construction aspects adapted to the master level.

On what principles should this be based?

I think that the different ways in which different persons will answer this question, to a large extent depend on their views on architecture, or more specificly on the rôle of structures or construction in architecture. Some architectural cultures, or -isms, hold architectural construction to be merely a matter of pragmatics, some necessary tool to keep the building standing upright, and which has no pretensions other than holding the floors, walls and roof in the intended position. Within such an architectural climate, I would guess that among the most important teaching issues would be a thorough knowledge of standardised and efficient building systems and products as seen from the point of view of the building contractors. This attitude doesn't seem to imply a vision for the future other than to follow

closely the progress being made in the mass production of building systems and components.

I, for one, take a very different view on architecture and construction. I believe that the structure should play a vital rôle in constituting architectural expression, and that structural elements have the capacity to do so, both with respect to the overall form or shape of the work of architecture, by the very presence of structural materiality, down through the hierarchy of different scales to the structural detail. I believe that the way in which the building *is made* matters a great deal, and that architecture which takes this as a premise may hold a special quality. I therefore take this view as my basic attitude towards structure and architecture when I discuss construction education.

A consequence of this view is a distinction I make between "building structures" on the one hand and "architectural structures" on the other. I postulate that there is always a balance, a very delicate balance between spending time teaching the practice-based knowledge characterising the former, and the more conceptually-oriented latter. I think of the two attitudes of construction, which at least to a certain degree are different, as differences of purpose and of context. While "building structures" are concerned with issues like common building practices, with cost-efficiency and technological efficiency (cheap and easy construction), with structure as a tool, I think of "architectural structures" as having a wider purpose. A true "architectural structure" has a certain individuality, it is part of the architectural concept, it has the potential for conveying architectural meaning by being designed within an architectural framework of a specific expression, whether that be "lightness", "novelty", "materiality" or some kind of "structural iconography". "Architectural structures" belong, not to one architectural style or trend or movement in particular, but characterise the construction of all architecture with a consciousness towards the tectonic.

To further prepare a philosophical platform from which to reflect on the right steps for the future, I will postulate that the study of structures and

of construction from an engineering point of view, besides the creative design aspect, can partly be seen as a scientific study and partly as a technological study, and that those are different. The first is the study of load, force and form which essentially follows strict rules based on mechanics and mathematics.

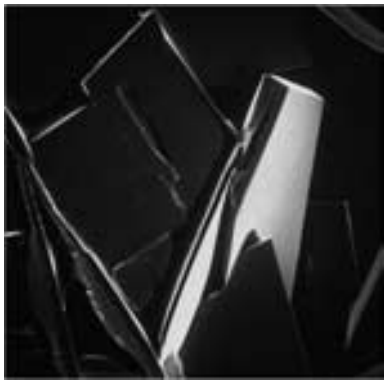
This study of statics mainly operates on what I call the *global form* of the structure, which is the structural system or composition taken as a whole. This level of form is subject to design tempered by scientific/mathematical knowledge. Design proposals are subject to visual or computational analysis in order to predict stability, stiffness and strength for reasons of safety, but also as part of a visual or aesthetic assessment of the proposal at hand. This training usually starts off with studying simple structural systems, and ends up in the study of more refined, sophisticated ones. It seems to me, however, that much of the elaborated and computerised contemporary architecture basicly depends on a limited number of fairly simple structural principles. This likely fact tells me that it is probably wiser to train students by studying a large number of *variations on basic principles,* than spending too much time inventing ever more peculiar structural ideas.

It should, however, be seen as a particular quality of both students and teachers to avoid being conventional, and I want to promote creativity particularly in the study of materials and the constructional potential of various materials. It is good training to try out familiar or known materials

in unexpected situations as well as new or unexpected materials used in situations which are familiar. And I might also add that I find the study of known materials in new combinations highly interesting as a training in how to cope with a possible future of unfamiliar structural settings.

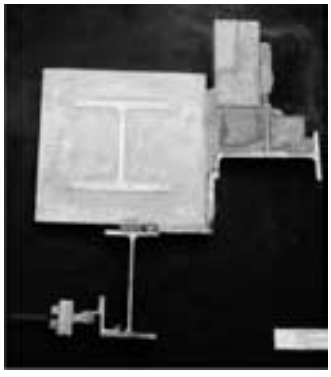
However; and now I come to my main point, *in addition to* training the ability to study constructions as loadbearing, global systems, I think that a serious *technological* study is highly relevant, but often sadly neglected. By this I mean that a knowledge of how things are made, or can be made, is fundamental to bringing architectural projects forward, and this aspect is probably much underrated in architectural schools. An understanding of the means and ways of materials production and process may prevent the architect from being a victim of standardised solutions which make our architectural environment increasingly more similar, not least with respect to structural detailing. A technological study basicly adress what I call the *local level* of form, informing the design on a *detailed level.* This is design in a context of technological know-how. It is on this design level that individual, material specific and often contextual solutions may result. Studying manufacturing processes gives the architect the knowledge and the confidence to propose and design individual solutions fitted to a particular context. It may also prevent the architect from being reduced to playing the rôle of a follower, always being subject to a reality defined by others.

A more process-oriented teaching, aimed at a strengthening of architectural concepts, will pay a lot of attention to what is going on in the building industry, particularily in the part of that industry which shapes materials and makes products. The students should ideally have intimate knowledge of how laminated wooden sections are made, how glass panels are produced, toughened and laminated, how steel can be cast, how aluminium is extruded etc. They should also as far as possible be given opportunities to handle material processing by themselves, so that some personal experiences are gained. By learning a lot about technological processes, the students will be much helped in seeing the difference between what the industry mostly do, and what they are really capable of doing. What they mostly do is a sum of demands from the market, standardised solutions that sell in large numbers, products that adapt more or less well to most of what is currently being built. What their equipment and machinery make the industry capable of doing is another matter. I would very much like for the future to see students and architects with skills that can challenge the industry to make things they usually don't do. Again, I am trying to avoid seeing education as following as closely as possible the outside reality, but instead having visions for an education which inspires investigation and interest, that challenges established truths, and may enable architects in some respects to engage in construction innovation.

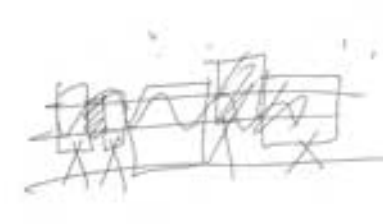


And behind it all is the importance of the material. A deep knowledge of materials, and a love for materials, is the back-bone of both the engineering and the architectural professions. This is where the two should really meet. Irrespective of the diffences in professional attention or focus, or perhaps just because of this difference, the two should fruitfully combine in letting the material be a central issue, that which architecture is made of. The strategy I am trying to outline communicates an attitude towards materials that sees materials from an operative, functional point of view, but also having an expressive capacity. Students should be trained in identifying the problems at hand which are overcome by help of materials. We should not start to ask *what* material to choose, but rather *what kind* of material. We should seek out the problems, not jump to solutions. This is probably partly what Peter Rice had in mind when he said:

"This is what I would call examining the nature of things. It is a study of the nature of the structure, rather than the image, which yields the greatest puzzle and the greatest satisfaction when it is understood".[1]



Solutions can often be found in the form of standard products, but architecture would gain from more individuality and variation. Variation will inevitably happen as a result of a conscious shift of focus from the "finished design" to the actual construction process, if that process is thought of as "problem solving" in a particular context, rather than an assembling of standard products which almost fit.



Why this attention to the building process?

I see this as a strategy for preparing students for the future. It is a strategy to avoid a further marginalisation of the architect by educating him or her to know as much as possible about a very critical phase of a project, a phase where the architect is very vulnerable and often in the hands of other expertise who takes charge. I am taking about the difficult *translation* of complex concepts into physical reality. At some point the digital model in the computer or the hand-drawn sketch should be seen as a piece of architecture having size, weight, strength, texture and smell. The form is given shape and dimension. The lines of the drawing become contours of some element to be made of real materials.

It is a translation that takes place, but it is also a transformation. I consider it my responsibility as a construction teacher to contribute to the

knowledge the students need in order to make such a transformation with the ideas and intentions for the concept intact or whole. Transformation is in fact what technology really means. In some contemporary architecture in particular, having a complexity of space and form made possible by computer graphics, will we find highly demanding concepts that take great knowledge to further develop into buildable, consistent structures of material substance. I consider this transformation from designed ideas to worked-out plans for actual construction to be, not only a part of the work of an architect, but a *vital* part of the architect's work. It is by this process the architect can take charge of the final result, and make sure that things move forward according to the intentions. It is also by this process that the results can be individual, varied and reflecting the particularities of an industrial culture that show differences from place to place.

How should we do a construction education where one of the goals is that of looking at the actual construction process as a design problem?

Firstly, it is not a question of offering a method that leads to a certain design solution. It is more like following a strategy that will enable students to find out by himself or herself by trying things out and seeking relevant information. It is a strategy that by critical analysis, investigation and questioning will lead to a well thought-out result that may have a surprising form. The more apparently simple the solution seems to be, the easier it is to cling on to preconceived solutions. This is why it is important to make known structures from unusual, or little known materials. They will provoke you to think. Sometimes, we specifically ask the students *not* to make something "beautiful". What is thought to be "beautiful" is almost always designs that are known and pre-accepted. If you want to innovate, you shouldn't make "beautiful" things! (Still, if solutions seem to be "appropriate" with respect to its function and the context, new solutions will after a while be considered "beautiful"!)

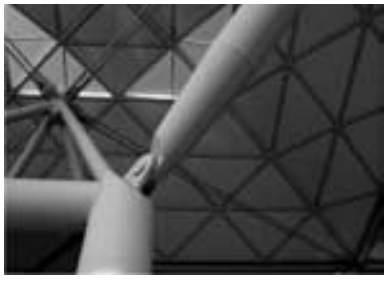
Project reviews should according to this strategy always address also that which you don't see, that which is behind walls and roof ceilings. Architectural critisicm ought to take seriously constructional matters, production and building process.

A part of this strategy is also to propose design exercises that not even the teachers are having a clear idea of what might be the result. This is a way of eliminating as much as possible any preconceived notion of what to expect. Designing and making a stair-case made of nothing but

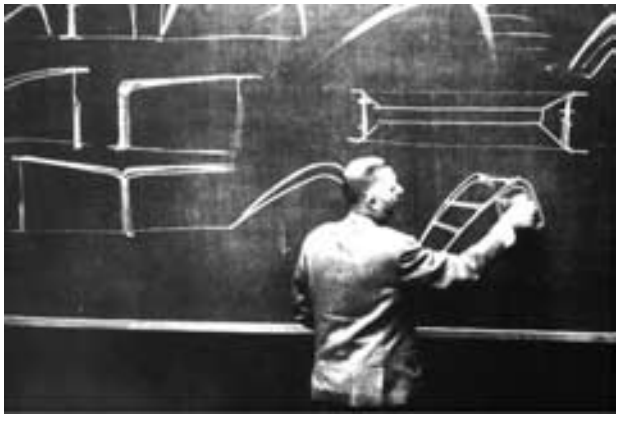
1mm steel plates might be such an exercise. This would call for a re-thinking of stair-case construction, and might put both students and especially teachers off-balance, which might be a good thing!

At Oslo School of Architecture we are quite fortunate to have very generous work-shops for making things, separate work-shops for wood, metals and plastics as well as a large construction hall where building parts and whole structures are made in full-scale. Besides, we have this fabulous Rapid Prototyping machine where small parts like structural details are made by sintering. 3-D drawings from the students' computers are fed into the digital brain of the RP-machine, and out you get the real thing made in a material of your choosing, well, almost of your choosing. The machine sinters plastics, steel and ceramics according to what kind of piece you are making, and what function it has. We are therefore very well equiped in Oslo for a construction education which also takes the actual construction process into account.

I will postulate that taking an interest in production and material processing, today seems to be engaging "traditional" knowledge and values because it seems to be against important architectural trends. When I see this as a strategy for the future, it is because I believe that to engage in the act of building, in how to build, is something that will remain an important aspect of architecture. It is not trendy, nor fashionable, but precisely because of that, is this a knowledge and a skill which may be seen to last.



This strategy advocates an architecture which reflects a concern for the construction process. I would like to exemplify these ideas by referring briefly to one figure who can be seen as a very prominent representative of a tradition of builders and constructors, for whome the process was all-important, namely Jean Prouvé.



As it is, the case of Jean Prouvé seems to exemplify a somewhat extreme technological approach to structures. Born in 1901, Prouvé had a working career spanning six decades of the 20th century, sixty years in which he worked closely with architects of three generations. Being neither an architect or a formally trained engineer himself, he called himself a "constructor", which he truly was.

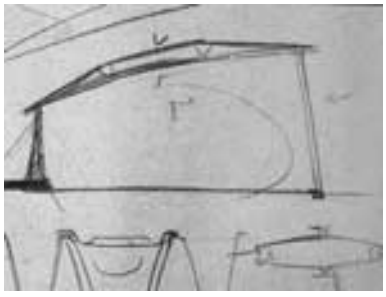
To be able to recognise the particular contribution of Jean Prouvé we must look at structural design at a detailed level. It is by observing the particular shapes of the structural cross-sections, as well as the detailed construction of façade panels, that we are made aware of the influence on structural form of the preferred material of Jean Prouvé, namely thin sheets of steel. The material, however, influences only marginally on the overall, or the *global form* of the structure, but instead has a major impact on how those building elements are actually constructed. *The material shows itself for what it truly is on the more detailed, local level of structural form.*

From the point of view of actually testing out the ideas of industrialised, sheet metal building production, the years 1935/36 saw a great success: With architects Eugène Beaudouin and Marcel Lods, and engineer Vladimir Bodiansky, Jean Prouvé designed and built a house for the Roland Garros Flying Club at Buc in France. This was probably the first ever totally industrialised, prefabricated building; structure, external walls, roof, internal partitions and stairs were all made from folded steel sheets. All of this was made in Prouvé's own workshop. The requirements were for a very quick construction and that it should be a demonstration of contemporary architecture. Based on the initial sketches, Prouvé was able to make a prototype of a slice of the building which was erected inside his workshop. After being approved by the architects, they started to work out the final design and the construction drawings.

The simple, rectangular building volume was constructed by the use of a steel skeleton of columns and beams forming cubes of 4.5 m, with also an additional midpoint roof beam. Again, there is nothing of particular interest in this overall structural shape. *On the local* form level, however, we can trace Prouvé's technological mastery: The whole structural frame is made by 3 mm steel sheets, folded so that they form stiff structural elements.

The *jointing* of beam and column, however, had to provide a bending stiff connection in order to brace the whole structure. This particular difficulty was solved by welding pieces of steel tubes to the inside of the column, so that bolts were able to go through, fixing the beam by those. In addition to the stiff column and beam connection, the façade panels provided additional bracing of the finished building.

The particular visual quality of the custom-built structural elements and joints is evident. Beam and column are fitted together, carefully adapted to each other down to the last millimeter. To this structural joint, façade panels are fixed with the same precision. This is perhaps one of the major advantages of the use of sheet metal constructions. As Jean Prouvé said late in his life; "one has to be very competent to know, for example, what it is possible to obtain simply from a tipper press. It is only when one uses



the press as a starting point that constructive inspiration can happen". While accepting this statement as the opinion of a man who depended on a characteristic *intimacy* between the idea and the manufacturing, we may note that he, by referring to his tools, his machinery, addresses the actual *construction* work rather than the inspired conception of a *structure.* His concern is mainly the know-*how* rather than the know-what. He deals with the *technology* of building production and activates primarily the local level of structural form.

The façade for the Roland Garros Flying Club was equally inventive. Towards the airfield were large glasspanes. The rest was covered by huge steel façade panels spanning the whole length between the columns, and consisting of an outer and an inner sheet with insulation between them. To give them enough strength, the two sheets were connected by leaves of sheet steel. Prouvé at the time was panic-stricken by joints; without the modern plastic filling materials, joints were filled with cement. Naturally, this cement would crack when the panels started to move from temperature changes. Consequently, he made the panels as large as possible, 4.4 by 2.25 m, reducing the number of joints. Vertically, the panels were connected along the columns, taking advantage of the recess in the cross-section of the columns. The joints were finally covered by specially made joint covers, a solution which was not foreseen during the design. The windows were fitted into the supporting structure in exactly the same way.

In 1954, Prouvé made the exposition pavillion for the Centennial, the 100th Anniversary of Aluminium. It was a rare occation in that Prouvé himself was the architect, working with two engineers; Henri Hugonet from the aluminium industry, and Armand Copienne, who was doing the calculations and the working drawings. The site was the Quai Alexandre III in Paris, with a width that restricted the Pavillion to 15 meters span. For a man like Jean Prouvé it must have been annoying to be told by the building committee to "design forms in his own style". What he did was rather to design in the "style" of aluminium *detailing,* to let this pavilion uncompromisingly become a demonstration of the potential of aluminium in its various forms. He subsequently used aluminium sheets, extruded aluminium and cast aluminium in different parts of the structure.

Prouvé sketched a large number of different solutions. What he finally decided on was a four-pinned post-and-beam structure, depending on an external strut for stability. The façade facing the Seine is taller than the one on the other side, and the roof is slightly raised at mid-span. It is not a very exciting structural concept we observe, even if some of his sketches seemed promising. The design of larger-scaled, particular structures was probably not one of his strongest talents. On the *local* form level, however, there is no doubt that a master of metal construction has been at work.

114 U-shaped beams span from column to column. The beams are made of 4 mm thick sheets of aluminium, where the two sides are kept at a distance by small aluminium struts. In Jean Prouvé's workshop, they had a pressing machine specially built for this project. The beams are produced in three parts that are connected by help of specially designed splice plates and screws. Those beams also act as rainwater gutters. Two

neighbouring beams are connected by brackets of cast aluminium and bolted. Between them, curving aluminium sheets span the small distance.

The multipurposed columns are extruded. Their intricate shapes reflect their purpose both as vertical loadbearing, as supporting the wind-load, as accommodating the fixing of the façade, as well as their function as drainage pipes. This is a typical example of the often used principle of Prouvé of integrating several functions in one component. At the foundation level, the extruded aluminium column is welded to the cast-aluminium pin-joint.

There is no time here to go into the many structures of his working life. The best ones were created when he was able to draw, to experiment, to make prototypes and to manufacture in a single, uninterrupted process. Jean Prouvé was always critical to the separation of designer and producer, a speciality of the building industry as Prouvé saw it, and very unlike the process of designing and building cars, aircrafts and numerous other industrial products. He had high regards for designers/builders like Auguste Perret and Pierre Luigi Nervi, a list that might also have included Robert Maillart and Edouardo Torroja.

Prouvé's influence on the projects he was involved in was definitely strongest on the level of detailed construction, on how structural cross-sections were shaped, how elements were fitted together, how facades were assembled and adjusted to the main structure, how ventilation and water transport were absorbed by structural components, etc. This area is also where he has made a lasting impression on later generations, and where we can find inspiration today. He was exemplifying perfectly the ability to develop architectural concepts by means of process skills.

Lastly, I will show you a work of architecture made by two former students at Oslo School of Architecture, who are presently both teaching there. It is a church in the outskirts of Oslo, called Mortensrud, and the architects have been Jan Olav Jensen and Børre Skodvin. This is a much praised building; it has received prizes both in Norway and internationally, and is widely published. In many ways this piece of architecture can be seen to embrace values and ideas held by Jean Prouvé. It is a building which tells the story of how it is made, and it is by taking the process and the materials as a premise for the design concept that its particular qualities arise.

Basicly, the lay-out is quite simple: The owners wanted the church "to look like a church", which means they wanted a traditonal plan that did not incorporate rooms for the parish's social events, which has been so very common in the Lutheran churches of Scandinavia. Rooms for social gatherings other than participating in the Sunday Mass were therefore mainly located to a separate building.

The materials are rough slate stones, glass, steel with no surface treatment other than having been oiled, a concrete floor. It is a combination of traditional and very modern materials, working together to make an unmistakenly contemporary expression.

Very simple-looking, even primitive.

Columns change position, giving way to the surfacing rock. A very pragmatic design decision, but it introduces some tension in the project.

Support details for the glass façade of the architects' own design. The geometrical problem of the strut was to change from a vertical to a horizontal direction, hence the twist.

All in all, I think this piece of architecture expresses the quality of having knowledge and a love for materials, as well as skills in the working of materials, making materials yield to the actual practical problems at hand.

A very pleasing and consistent design, that I think illustrates very well my ideas and visions for, at least a part of what I see as being important for a construction education for the future.

References

1 Rice, Peter: "An Engineer Imagines". Ellipsis, London 1994 (1996), p. 146.

Henry van de Velde, Higher Institute of Architectural Sciences Antwerp, Belgium

Lucien DENISSEN

Environmental Education

About the Educational Process

The educational process can work out on 2 stages :

Stage 1: Understanding the Building Ecosystem
Delevering skills to design sustainable buildings

Stage 2: Research by design

Stage 1: Understanding the Building Ecosystem

The teaching tool for stage 1 is creating a knowledge-base on sustainability by :

1. Principles :
   - getting more conscious about local and global sustainability
   - encouraging the willingness to do something about it.
2. The analysis of representative buildings (case studies)
3. The study of comfort & health, building conceptions, equipment, materials

A building has to be seen as a system with a continuous flow of natural and manufactured resources :

- The "upstream" affects the environment on the input side.
- The "downstream" pollutes the environment on the output side.

Upstream		Downstream
Materials		Reuse or dumping
Energy		Combustion byproducts
Water	**Building**	Black & graywatersewage: groundwater pollution
Air, wind		Polluted, heated air
Rain		Reuse / inondation risk
Consument goods		recycling or dumping
Sun		Risk for overheating

Are to be examined:

- urbanisme: interaction between the building and the physical and social context
- construction process: does the building activity impact the environment?
- LCA of the used materials
- is the design conception economic ? flexible ?
- the environmental control performance : hvac system, comfort, health and well-being, consume of (renewable ?) energy
- pollution caused by the building : air, water, waste, maintenance _ technical live span

So the objective is : to create an understanding : how can buildings be "designed for the environment" ?

This knowledge is not a goal on its own, but just a tool to be able to pursue alternatives for sustainable design.

To acquire the ability to work out sustainable design solutions, students should find the skills and knowledge-base on sustainability.

This knowledge has to consider different phases : the site planning, the design and building phase, the exploitation an even the destruction of the building.

It deals with conception, materials, internal comfort and health, energy and waste flows, flexibility, deconstruction and reuse.

Stage 2 : Research by Design

Generally architects and also students first think about their artistic aspiration and focus on form-making.

But after those preliminary stages, students should be aware that decisions made on the drawing board have long-term environmental consequences.

So they are less unquiet about form, but focus their attention on sustainability, to be used as an engine for design.

This attitude can generate a new kind of architecture, thus a form, not really dictated by ecology, but in which ecology mostly can be recognised as a natural way of live, an evident approach.

Running the whole process with some result, gives the student more self-confidence, very usefull in future assignments. So a new generation is born, conscious of their responsibility.

And the ultimate goal, increasing sustainability in the building sector, can be realised.

How to Implement Environmental Education in the Architecture Curriculum?

There is a universal consensus on the importance of environmental education in architecture.

But at present we encounter in general the absence of a clear pedagogical framework : the question what, when, and how to teach specific subjects related to environmental sustainability cannot be easily answered.

How can we approach this deficiency ?

- Architecture departments could make an inventory of the current status of sustainable architecture in the areas of education, research and design practice.
- integrate environmental reflections in the vast number of disciplines, that covers architecture: design,technology, history, theory, practice
- Particular environmental technology course, dealing with: principles, materials and construction, environmental control technology, case studies.
- Random information: participating congresses, field trips, inviting guest lecturers
- Particular design studio assignements, taken into account the environmental control: sustainable design conception, working out construction, defining (sustainable) materials, considering their LCA, drawing flow diagrams (hvac, sanitary installation, lighting), integrating

equipment, thinking about construction and deconstruction, and flexibility, taking in the waste flow (liquid and non-liquid).

Students must realise that this assignement is not made to badger them, but that it concerns problems that rise in each project, at a certain stage.

The next slide shows the outlines of sustainable architecture, to be involved in education.

Far from being complete, the thereupon following slides illustrate some of those topics. It's a complicated but controllable matter, in which a well conceived educational plan has to bring clarity.

THE OUTLINES of SUSTAINABLE ARCHITECTURE

SUSTAINABLE DRAFT	multi-use	minimalising materials
	flexibility	design for assembly + disassembly
	design for maintenance	
	reuse	recycling
LCA (Life cycle assessment)	materials	
	equipment	
WINTER COMFORT	reducing thermal losses	
	optimising ventilation	
	increasing performances of equipment	
SUMMER COMFORT	a good concept	
	(passif) cooling (if actif : renewable !)	
WASTE CONTROL	building waste	household refuse
	effluent	historical pollution

LCA

MATERIALS : PHASES of LIVE SPAN :

A. raw material B. production C. construction D. use & maintenance E. demolition F. converting waste

CRITERION FOR CLASSIFICATION

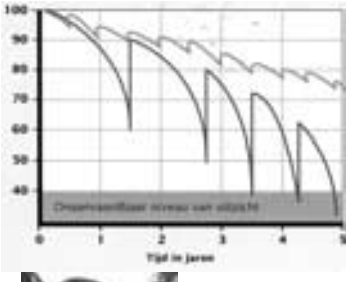
1. ENVIRONMENT → ECOTOXICITY

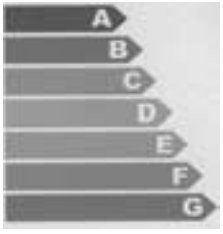
biotic and abiotic material	A
pollution (ozon, metals, etc.)	A+B+C+D+E+F
waste	A+B+E
nuisance (smell, noice, etc.)	A+B+C+D+E+F
disturbance of the biotope	A+B
energy consumption	A+B+C+E
reusability (material, comp.)	E
fit for maintenance	D
technical live span	D
economical live span	D

2. HEALTH → HUMANE TOXICITY

physical (e.m., radon, el.static)	A+B+C+D+E+F
chemical (solid, fluid, gas)	A+B+C+D+E+F
biological (parasites,allergy)	D
ergonomy (ex. weight)	A+B+C
safety (accidents)	A+B+C+E

EACH CRITERION : level, points
TOTAL / material : Σ of (preponderate) points

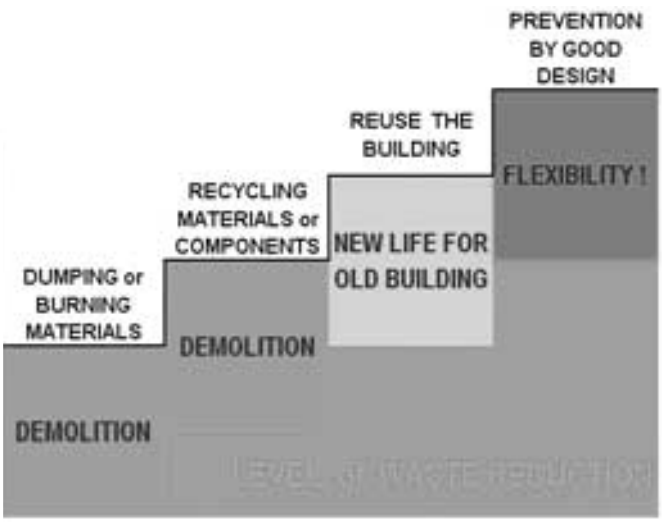




Henry van de Velde,
Higher Institute of Architectural Sciences
Antwerp, Belgium

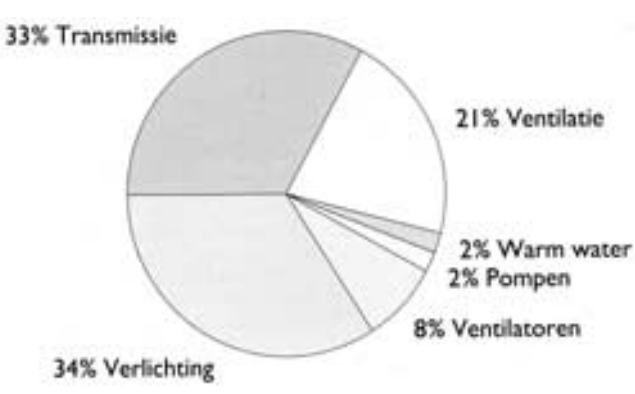
WASTE due to BUILDING ACTIVITY and DEMOLITION

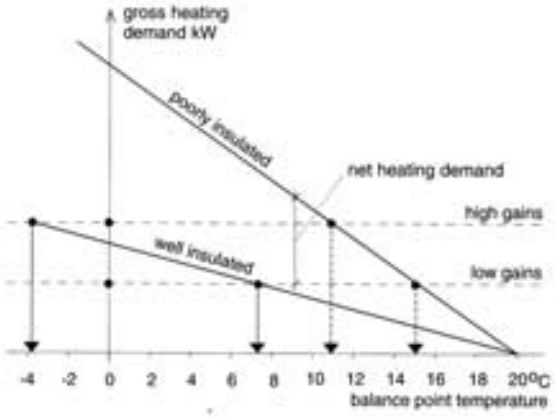
Waste isn't waste until it is wasted !



Building and demolition waste has to be sorted, and if possible be reused or recycled !

WINTER COMFORT : REDUCING THERMAL LOSSES





$$Q = Q_c + Q_v = \Sigma U \,.\, A \,.\, (Y_i - Y_e) + 0.34 \,.\, \beta \,.\, V \,.\, (Y_i - Y_e)$$

4 STRATEGIES :
- 1 - Use heat gains by PASSIVE SUN ENERGY
- 2 - Reduce conduction loss by designing COMPACT VOLUMES
- 3 - Diminish U by INSULATING, WITHOUT THERMAL BRIDGES
- 4 - Reduce ventilation loss by HEAT EXCHANGE pulsion/extraction

Henry van de Velde,
Higher Institute of Architectural Sciences
Antwerp, Belgium

INSULATING EUROPE

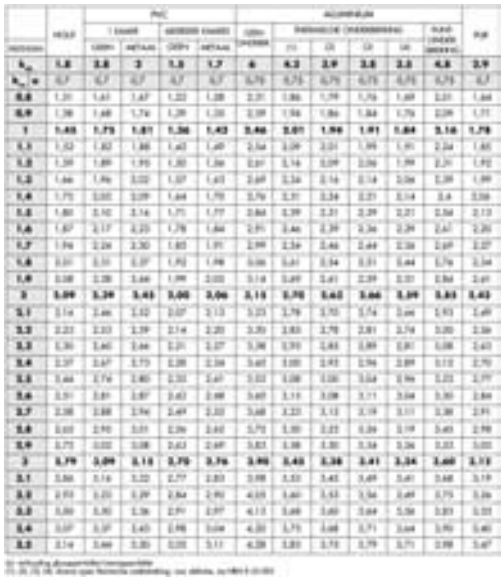
INSULATION THICKNESS in FACADES

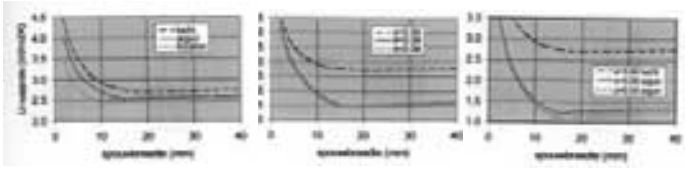
INSULATION THICKNESS in ROOFS

Source :

EURIMA

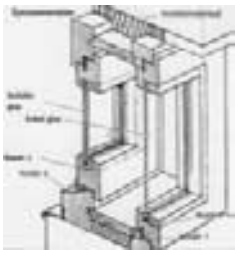
WINDOWS with INSULATING GLASS





U-value of windows depends on

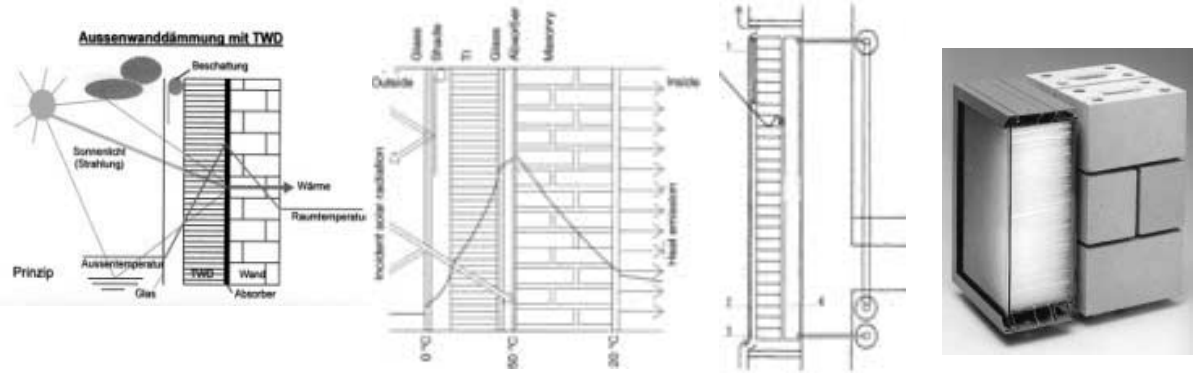
* type of glass
* type of frame (0.72/0.64)



$$U_w = \frac{A_g}{A_t} U_g + \frac{A_f}{A_t} U_f + \frac{A_f}{A_t}$$

Henry van de Velde,
Higher Institute of Architectural Sciences
Antwerp, Belgium

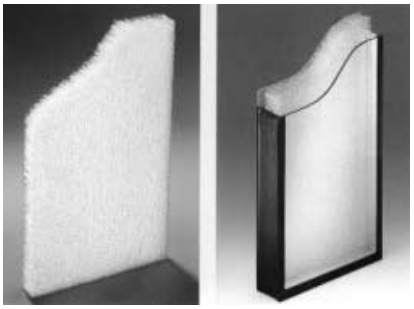
T I M



Composition of the Transparent Insulating Wall:
glass, store, t.i.m., absorber, brick (density < 1400 kg/m^3)

U = 0.5 - 0.3 W/m^{2}K (south)
Problem : time of heat requirement ≠ heat gain

With water circulation : energy available to other façades.

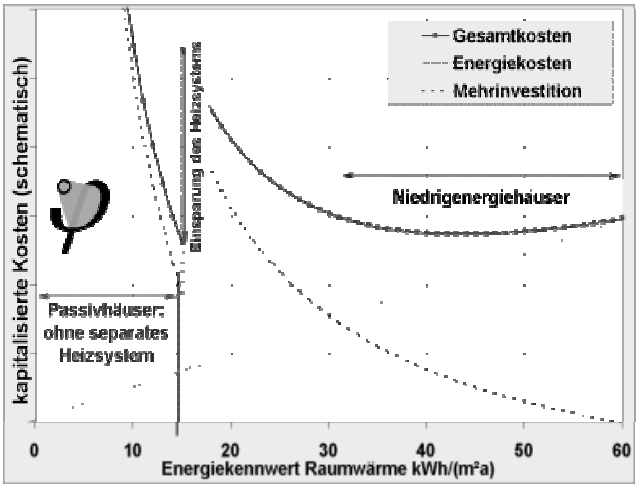


LOW-ENERGY and PASSIVE HOUSE

One should reduce the annual energy consumption for heating and the overall annual energy consumption.

The maxima are :

(kWh/m^2)	Low-E	Passive
H.En.C.	45	15
O.En.C.	72	42



* Insulation = extremely thick (30cm wall, 40cm roof, 20cm floor).
* Super windows
  with $U_g \leq 0.75$ and $U_f \leq 0.80$
* PSE
* Airclosure ' 0.6 at n50
* Ventilation with heat exchange (performance < 80 %)

Thanks to PSE the house doesn't need a heating installation. The 25 % energy for a.o. hot water comes from renewable sources (e.g. thermic collectors).

Department of Architecture, Sint-Lucas Brussels-Gent, Belgium

Marcel HEISTERCAMP

Building Techniques Structure, Construction, Infrastructure

Architecture is a comprehensive discipline. Many, seemingly irreconcilable demands are brought together in one cohesive whole. Next to design and architectural sciences, building techniques constitute the third important pillar of our curriculum. The elements dealt with in this group make sure that, in design, the student meets all the demands of the comfort in use and life in a technical and scientific way.

The rapid evolution and the on-going specialisation within the different fields make it impossible to deal with all themes in extenso. The group of Building Techniques, comprising Structure, Construction and Infrastructure, offers a selection of topics that should allow the designer to become aware of the implications of his designs on society, the environment and vice versa. The student is stimulated to consider the problem to the largest possible extent and to understand and/or foresee evolutions, all with the intention of working in an inspiring way.

The different fields of the training are treated in such a way that they can be easily used in design. Within Structure, Construction and Infrastructure the students learn which thinking models are generally accepted and investigate possible new combinations and ways of thinking. This means that formulas, procedures and typical details are offered, but also the backgrounds, the underlying theory and experiences in order to bring them to a better insight.

The knowledge the designer has gathered during his training should have enough depth in order to enable him, in co-operation with specialised consultants, to make intelligent choices. This will enhance the understanding and cohesion of his design. This cohesion will always be different, dependent upon the circumstances. Making links between different approaches, even those of technical- scientific nature, is an elementary part of the curriculum.

C | c+ Construction Approach

Construction teaches a thinking pattern in a methodological way, a pattern necessary for design and constructive shaping. Starting from four research themes, notably building stability, building physics, building technology and building method, and based on qualitative criteria (creation, constructive logic, and structural efficiency) one thinks and designs in a problem solving constructive way.

Educational Structure

The theoretical classes deal with form and physics, study of materials, techniques for construction and design, geology, technology, building physics, specific techniques, ... In the course of the different years, exercises are offered in order to allow the student, through different graphic and analytical representations, to assimilate the intrinsic possibilities of the course.

Goals

The realisation of insight and method with regard to contemporary and future oriented constructive means to realise an architectonic programme.

**S | s+
Structure Approach**

Structure is the cohesive whole of elements that provide the strength, stability and durability of a construction.

In addition to the theoretical study of these aspects, the application in design is necessary to obtain a profound insight and to understand the cohesion with the architectural concept.

A working method in which structure is added to the design afterwards leads to architectonically incoherent results.

The cyclical use of theoretical study and structural design is very fruitful and stimulates moreover the insight in the coherence between different themes dealt with in the study.

Educational Structure

To learn how to make structural choices requires successive years of study. In the first cycle, in addition to general structural principles we also study the basic themes of the science of strength and stability. In the second cycle, we focus specifically on the various materials that can be used in a structural way.

Goals

To teach the designer the necessary knowledge and insight that will allow him to integrate structure into his designs in a meaningful and correct way. A good design unites all the choices made by the designer in one single concept.

**TE | te+
Technical Equipments
Approach**

Within Building Techniques, in addition to Structure and Construction special attention is given to Technical equipments. In this part of the training, we need to offer the necessary insights and knowledge in order to allow the designer to integrate a vision concerning technical equipments in his design. This vision is to be grounded on a conscious use of energetic and environmental aspects and envisages human comfort and safety.

Educational Structure

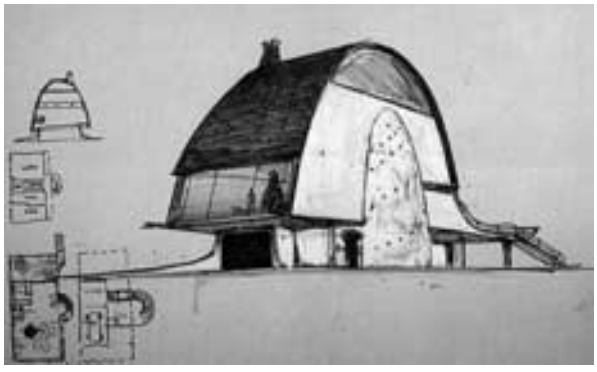
In the first cycle the scientific basic knowledge is offered, in the later years, attention shifts towards the technical realisation.

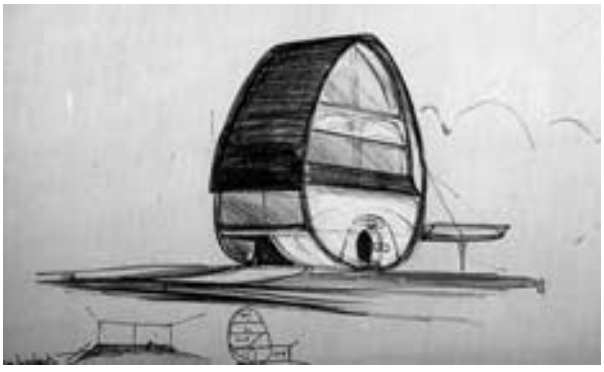
Theoretical classes are linked to a designing use of certain themes in the global context of design.

Le Corbusier

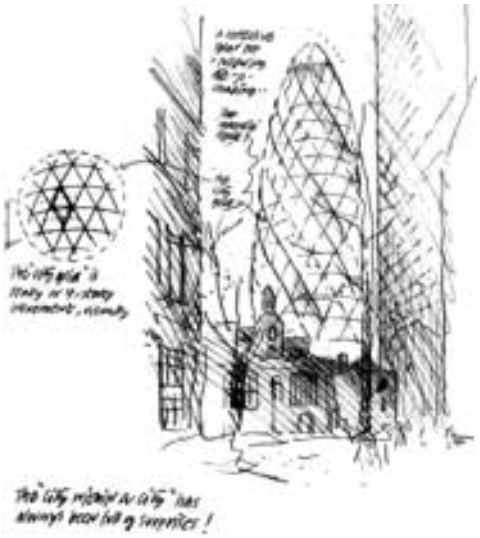
'Construction is to persist, architecture is to move. If the building you brings in agreement with a universe of which the laws we undergo and admire, we talk about architectural emotion.'

It is my opinion that architecture is the symbiosis between dream and reality. To attain that goal, hereafter I give you our working method and some objections of the teaching staff of the subdivision of training construction.





Van Humbeeck house, Buggenhout, Belgium, 1967-70, arch. Renaat Braem.

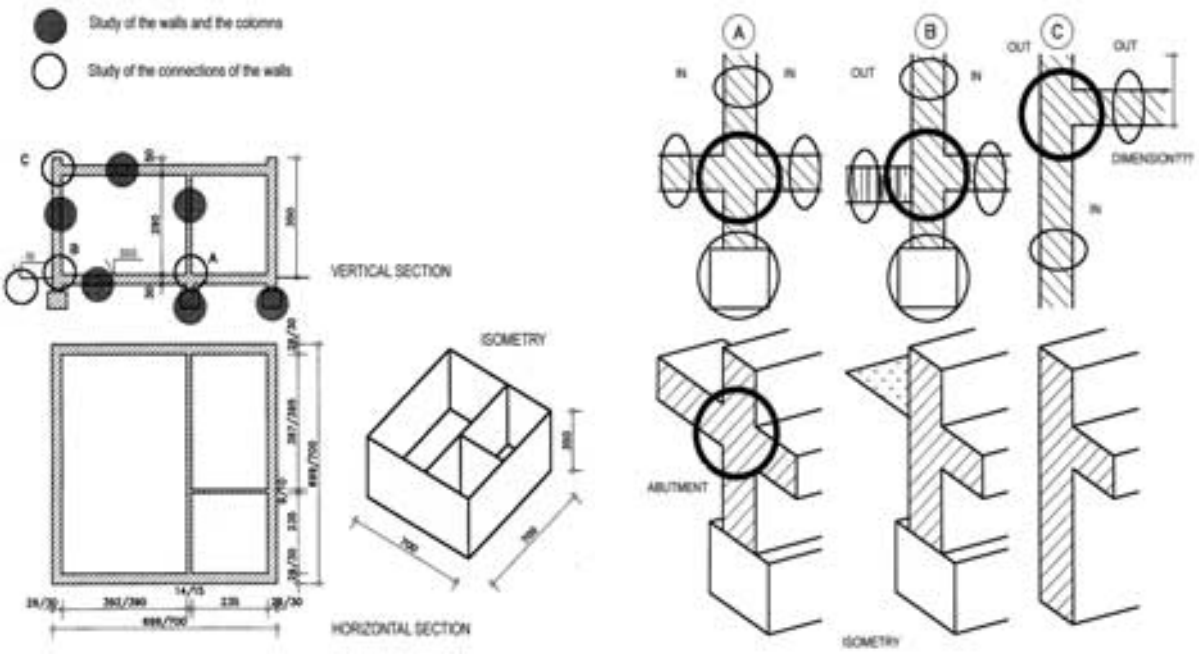


Swiss-Re tower, London, England, 1997-2004, arch. Foster&Partners.

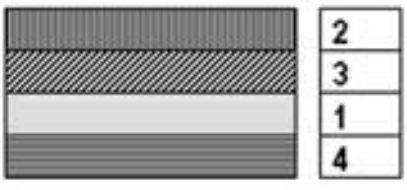
 # 0 –

Working Method

During the first year of the bachelor we offer the students a working method to solve an architectural problem. Before the architectural problem to solve, we go firstly visualise the problems in horizontal-, vertical section and in isometry.



THINK METHOD
APPLICATION : vertical wall / horizontal wall / slope / convex



Dimension ?

Dependent of the choise of the architect.

We must develop the 'think method' to stipulate the dimension, the structure of the walls.

1. Load-bearing wall: has to do with the structural concept of the building.
   | RESEARCH THEMES: BUILDING STABILITY – BUILDING METHOD |
2. Finishing: as aim to which must serve finishing (E.g.: plat roof: impermeable layers; floor: parquet, moquette ...).
   | RESEARCH THEME: BUILDING TECHNOLOGY |
3. Space for: (E.g.: piping: electricity, TV, tel., heating...; thermal and sound insulation; chape).
   | RESEARCH THEME: BUILDING PHYSICS |
4. Finishing: (E.g.: plastering; paint; false ceiling; electric cables...).
   | RESEARCH THEME: BUILDING TECHNOLOGY – SPECIFIC TECHNIQUES|

BM = BUILDING METHOD
BS = BUILDING STABILITY
BT = BUILDING TECHNOLOGY
BP = BUILDING PHYSICS

 # 1 –

We had earlier developed a comparative method concerning the analysis of Structural Efficiency. It was a logical step to try and apply the same method to our study of Construction, instead of approaching it as an isolated entity. The main reason for this being that in an ever changing reality there can hardly be such a thing as an absolutely correct solution to a constructional problem, nor an absolute degree of efficiency. Both are by nature relative. *However, this approach requires, and this is true for both Structure and Construction, a deep knowledge and understanding of the basics of both.* These basics are thoroughly studied during the bachelor years.

 # 2 –

Our point of departure has always been the **Constructional situation,** as opposed to the isolated detail. At every level of the study the approach is **integral,** meaning the synergy between Structure, Construction and Technical Equipments at the one hand, and the most efficient use of available materials and half finished products at the other.

 # 3 –

From #2 follows our preference for analysis of significant **cases,** whereby one always starts from a realised configuration and ends up analysing its parts and materials, analysing the method of **connection** on the way. This means more than a mere principle: it means a constant **updating** on behalf of the teacher, who has to analyse any upcoming new building of relevance.

 # 4 –

From #3 follows that the relative importance of any component of Construction is subject to change. The permanent **evolution** (itself the result of an integrated approach of Construction) is painstakingly

scrutinized and reflected in the courses ; e.g. double facades and skins, new glazing technology, increasing use of composite materials etc). This means in effect that our Construction courses will be different from one year to the next.

 # 5 –

In practical terms over the last 10 years 3 distinct paths have been followed in analysing Construction : Materials technology (reinforced concrete, steel and alloys, wood and derivatives, glass, stressed skins and composites), a Typological approach (starting from a specific design situation e.g. airports, sports accommodations, high rise etc), and finally a choice of carefully selected case studies.

 # 6 –

Obviously, traditional methods of graphic representation and reproduction are no longer suited to these aims. Therefore our choice has always been for three-dimensional analysis, using purposeful colour keying (as opposed to the surprisingly still current two-dimensional black and white technique) and for reproduction by means of an accessible and user friendly support, **CD-Rom,** in order to offer our students a maximum of information without any loss of quality. Up to this day, about 20 CD-Rom's have been realised, all of which remain available. This enables the student, in his Master years to make his own selection concerning the specific information he might require to develop his design.

Some Objections

 # 1 –

In Belgium we are with 11.000 architects. An architect is not a commission agent! The 'order of architects' says: **'an architect is a man, woman of art and technique with sense of creation (art) and practice, witch combines aesthetic pursuit with technical needs and material options. He is a professional who is able to protect all design phases of a construction project and the different implementing phases what he had to lead and check.'.** As a humanist, technician, expressive artist and administrator, he combines technical and artistic knowledge, imagination, know-how and experience to complete successfully the evolution process of architecture.

 # 2 –

The university W&K appropriate entirely the definition of 'the architect' described by the 'order of architects'.

Perhaps this remarkable combination, that for us is obvious, illustrates how architecture details and beauty go frequently together.

We have the remarkable pedagogical situation that the construction lessons and exercises are offered by architects (designers) who function also in the design studios. In the courses we contain 4 aspects : architecture – **history,** architecture – **actuality,** architecture – **building techniques,** architecture – **composition.**

 # 3 –

Subject to exceptions of the 'happy few' (e.g. Solvay – art nouveau by Horta) that concerns much **private** money, we have our remarkable study items in **public** architecture, financed by: regular alms (churches, temples...) or by secular taxpayers (cultural centre, town halls, airports...).

In this firmly built architecture frequently design and construction go (readably or invisible) together. Readably in aqua ducts, pantheon, crystal palace, centre Pompidou... Invisible in baroque plastering, renaissance palaces, Guggenheim museum...

In education no pleading is kept for **or** other one, but for **and** other one.

SO CONSTRUCTION CAN BE BEAUTIFUL AND THEREFORE NOT SUBORDINATE BUT INHERENT TO ARCHITECTURE

 # 4 –

I believe that constructively device to contemporary architecture demands a number of skills that must be developed at the same time:

- **observation and analysis of existing meaningful cases, especially by means of signs and sketches.**
- **study of traditional architectural constructions and the evolution of it.**
- **improve knowledge of sufficient physics to understand and use different materials.**

Physical factors in building design must be scientific well-founded.

 # 5 –

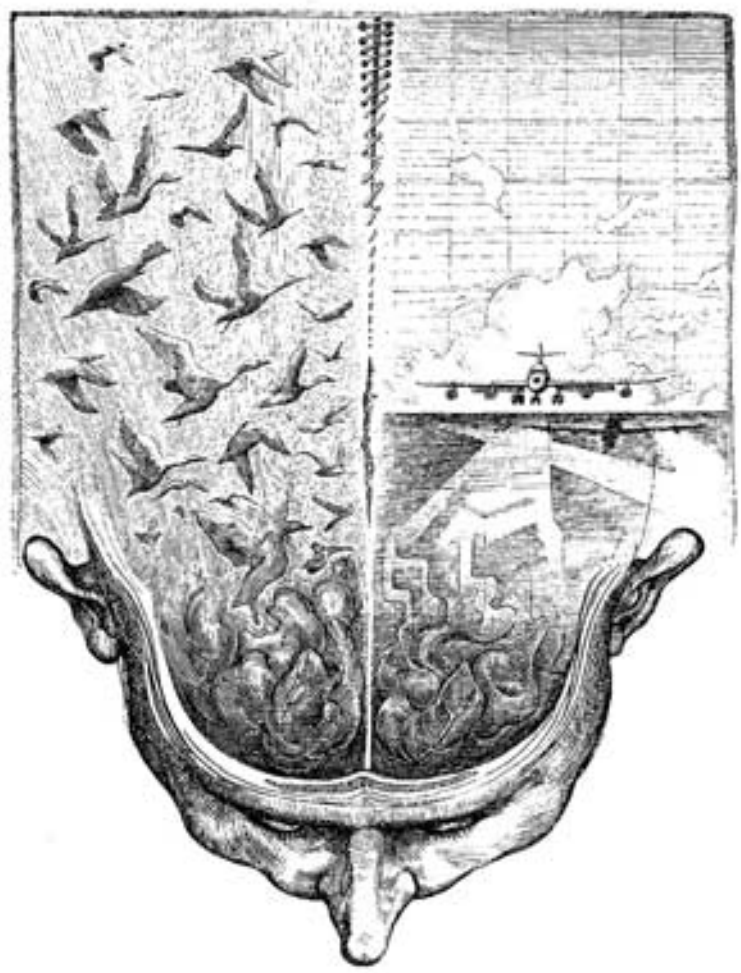
I don't find that the head emphasis must be laid on purely contemporary material and techniques. Moreover: what's contemporary? Frequently it are old techniques and material which are used in a renewed, creative situation. In the construction sector there are not so many 'inventions'.

Nevertheless education must be linked by scientific research in association with universities and third parties.

 # 6 –

Students must be informed about 'durable building' and 'sustainability'. These things will extremely determine the construction event in the close future. For this I refer to aspects dictated by the Brundtlandcommittee (1987 – United Nations). On federal level these aspects becomes translated in next objectives: diminish of energy usage, reducing the pollution of air-ground-water, reducing waste ... To realise these objectives we have obligatorily European directives like EPD (Energy Performance Directive), in Flanders already translated in the energy performance legislation (EPR) coming into effect from 1 January 2006. It is clear that our students must be prepared on all this, that have a great impact on the constructions. Never forget that firstly the basic principles and basic techniques must be learn in a training. I like the French proverb: 'pas à pas, on va loin'.

To realise these objectives it is perhaps necessary to build several compulsory teaching practices during the training.



Part of the Teaching Staff:
Marcel Heistercamp
Patrick Lints
Jules Mellemans
Johan Rutgeerts
Bernard Vandermarcke

Department of Architecture, KU Leuven, Faculty of Engineering Leuven, Belgium

Herman NEUCKERMANS

Keys to the Future

Change is and has always been part of life. Our being in the world, our perception of the world is changing more than ever. Almost two centuries ago Durand wrote in his treaty on architecture[1]: "the world is becoming so complex that we, architects shaping the world, definitely need a new approach." Today we repeat, and tomorrow we will repeat: we need a new approach.

Today we are still facing an ever-growing and changing complexity and thus education has to cope with this reality and educate people to be able to confront it.

In the context of this presentation we would like to highlight two ways to approaches the future: fundamentals and precedents.

Fundamentals

Solutions change, principles stay

Therefore education has to focus on principles.

Pertaining construction, pertaining the technicality of the building's materiality, **students in architecture should learn primarily the fundamentals of construction, i.e. the underlying principles, rather than their technological translation. Only the knowledge of the fundamentals can allow graduates lifelong achievement through lifelong learning and professional updating.**

This brings us to the issue of what these fundamentals are: principles that are studied in depth, in great variety, on a high qualitative level: knowing neither little about everything, nor everything about little as goes the saying about architects and engineers. Fundamentals pertain to contents and principles.

Fundamentals pertain to deep understanding, not encyclopaedic knowledge. If you know the fundamentals about vapour diffusion, you can deduce where to put or not to put the vapour barrier and when it is not needed in any new constellation of materials in a building element. If you know the principle of two-step sealings, you will be able to judge and use a new sealing solution when it comes up. If you know what is the relative humidity of the air and the humidity of wood then you can reason about the moisture stability of wood. The same is true for structural mechanics and the building's stability, as well as for energy, light and sustainability.

Most programmes of architecture show the full list of topics related to construction: materials, technology, and structures. The question therefore

becomes: **what** about materials, **what** about technology, **what** about structures? In other words: what are the students' achievements?

It is clear that graduates from different schools are not at all comparable as to the understanding of structure and materials, to take one example. In the context of the EHEA (European Higher Education Area) this variety may even be good, thus underlining the specificity of a school and the need for schools to advertise themselves with their specific colours. Nevertheless we believe that all schools of architecture should teach construction extensively and in depth, because architecture has a materiality which has to be inhabited and it is not just a work of art: it has to face weather and climate, weight... Some schools do not put too much emphasis on construction or exhibit another profile: they speculate the advent of specialised construction-oriented offices elaborating the technicality of a building by means of staff with a technical profile. Such a scenario still implies constructive knowledge 'at hand', i.e. at least within the design team. Technical feasibility and solutions are at stake even in the early stages of design: the design iterates between different scales and levels of detail. It is not easy to design while depending on somebody else's competence. In order to be able to design the architect needs to be autonomous up to a feasible and reasonable level. Take as an example the conception of a structure with bars and hinges. To a certain extent the understanding of how such a structure will behave is clear, but as soon as trusses are not in a vertical plane, it becomes impossible to intuit at what point wind starts to prevail over dead weight.

When you are designing furniture and are using glass for the shelves, knowledge of the differences in behaviour and characteristics of plain glass, thermally or chemically hardened glass and layered glass can be very helpful. If the designer cannot decide there and then, his 'designerly' reasoning will slow down if not become impossible.

This is where the perpetual struggle between conceptual thinking and computational thinking pops up. Both can be fundamental, but both are different and are not each other's substitutes. The more the architect masters both, the more he feels free to design.

Fundamentals are the key. On a European level this should be subject of debate: what are, in terms of achievements, the fundamentals that an architect should master? Choosing the low road ultimately results in a loss of control or even unemployment. Quality and level of discourse prove to be very difficult issues.

A comparison of different books on materials, for example, shows the huge differences (in depth of study). Vittone's book on construction, *Bâtir,* has an (introductory) chapter on materials, presenting the history of building materials and describing all types and products[2]. The explanatory content however is inexistent. *Materials and design – The art and science of materials selection in product design* by Ashby and Johnson is a very interesting book, partly because it presents the shaping of profiles and of course Ashby's famous comparative analysis of materials[3]. Careful reading shows for each material its major mechanical characteristics, without further explanation. Those who need/like to understand these have to read Ashby's books on Materials. Illston's and Domone's book

entitled *Construction materials* shows an entirely different picture: real materials science, very fundamental, but nothing about selection criteria[4].

The latter is more directed to material developers, Ashby's is on the right track, Vittone's is elementary.

The future debates within the thematic subnet of construction, could/should focus on a precise and detailed description and presentation of teaching practices, not in general terms, but in terms of how we as teachers explain specific topics in construction. For example, how does one explain 'lateral thrust'? Let us learn from each other's secret tricks, wisdom and erudition.

Ultimately it is all a question of competences. What competences are 'standard' within the architect's profile, which ones are not, which ones are optional? To list but a few:

Understanding and choosing materials, their behaviour related to their structures.

Understanding and conceiving details.

Understanding and conceiving structures.

Creative interpretations.

Capability to understand and judge propositions.

The future will see the emergence of centres of competence (in writing about architecture, in virtual un-built architecture, in building with wood, with steel, with glass...).

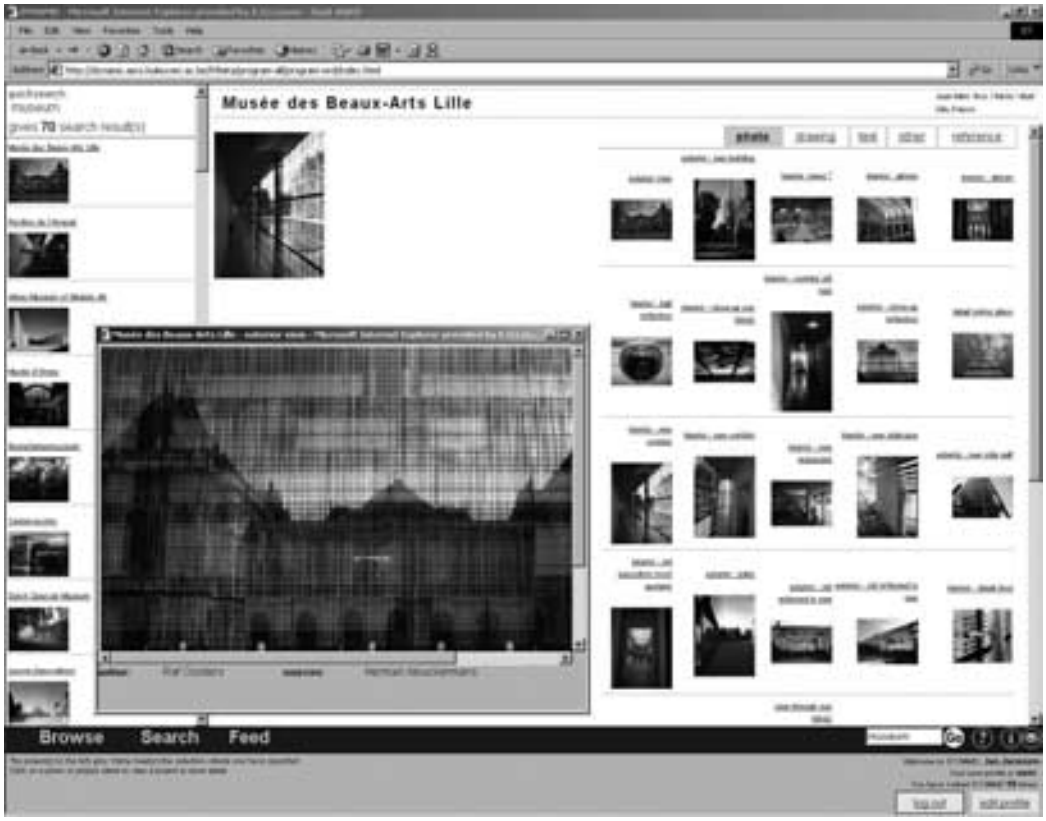
Precedents

Understanding the past is the second key to the future

Learning from others' experience is the major bootstrap to design. Others' experience lies concealed in cases or precedents. **Cases or precedents are crucial in (learning to) design.** Several speakers at this conference have presented their efforts in creating case bases of exemplars relevant to their teaching. We can only assume that the benefits of cases are beyond discussion.

However, there is still a long way to go and therefore two remarks about cases should be made:

1. It would be much more profitable to anyone in education, if teachers would sit together and agree upon subjects and contents, upon what kind of cases we all need and in what format they should be presented. Separate initiatives are bound to die or fade away, because of a lack of continuous effort and/or because of incompleteness. At the basis (or as a starting point) education in architecture needs a very limited set of paradigmatic buildings, which are discussed in virtually every school in the world. This is true for courses on theory and history as well as for construction. Together, schools of Europe can develop the digital material that all schools need.
2. At K.U.Leuven we have developed a case base for design, called DYNAMO[5] (dynamic memory on-line). This interactive multimedia platform is a database containing cases. It represents more than seven years



of work and contains over 500 projects, illustrated by more than 5200 files.

Everyone can access this database via:
http://dynamo.asro.kuleuven.ac.be

Access of Dynamo is free, but requires registration in light of copyright issues.

The interface allows for 3 windows on the data: theory, design and history. Within each window data can be accessed through 'indices and values of these indices' as shown hereafter for the ID and the DESIGN view.

Users can not only consult Dynamo, but also contribute actively by adding cases, linking them or adding new indices. Each case receives a label after check and fiat by the Dynamo administrator Ann Heylighen.

Our proposal is to start collaboration on the theme of cases between those schools in Europe willing to work together and to develop something that all need but no one can build alone. A lot of preparatory work has to be done as to the format of the meta-data, the content of information, the standards to make the cases comparable etc.


Advanced search: id
project :
period :
location :
country :
city or town :
architect :
last name :
first name :
submit
reset
The following values are available
Browse
Search
Feed
Check
log out
edit profile


Advanced search: design
form :
spatial configuration :
illumination :
function :
building programme :
building type :
construction :
materials :
structure type :
technology :
context :
climate :
The following values are available
Browse
Search
Feed
Check
log out
edit profile

Department of Architecture, KU Leuven,
Faculty of Engineering
Leuven, Belgium

In concluding my proposals at the end of the conference, I'll ask you to think about some of the ideas put forward during the debates:

- the cultural lifetime of materials: archaic, classic and baroque period. Materials first appear and are used in a quite traditional way; they move into a mature and well-known classic phase, and end their life in a period of 'decline' or exaggerated use. 'New materials' should be seen through this perspective.
- the meaning of materials is different between architects and engineers.
- low technology co-exists with advanced technology.
- teaching can benefit from experimentation and discovery by the students.
- concepts are important and belong to the world of the architect / designer.

Bibliography

[1] Durand, J.N.L.
Précis des leçons d'architecture
Paris, 1802

[2] Vittone, R.
Bâtir – Manuel de construction
PPUR, Lausane, 1996, (2004²)

[3] Ashby, M,. Johnson, K.
Materials and design – The art and science of materials selection in product design
Butterword-Heinemann, Oxford, 2002

[4] Illston, J.M., Domone, P.L.J.
Construction materials – Their nature and behaviour
Spon Press, London, 2001

[5] Heylighen, A., Neuckermans, H.
DYNAMO: Dynamic Architectural Memory On-line
Educational Technology and Society, Vol.3, No.2, April 2000 (ISSN 1436-4522), pp. 86-95

Faculté Polytechnique de Mons
Service d' Architecture
Mons, Belgium

Alain SABBE

De l'Intelligence des Gestes à Celle de la Conception Architecturale et Vice Versa

L'architecture a toujours entretenu des rapports privilégiés avec la technicité, notamment au niveau des savoirs et procédés techniques qui interviennent directement dans la conception et la réalisation des bâtiments.

L'évolution de ces procédés s'est développée à travers un long processus d'expérimentation laissant une place importante aux erreurs. À travers l'histoire, de nombreuses techniques se sont développées favorisant divers types de relations avec l'architecture.

En fait, le choix des matériaux et de leur technique de mise en œuvre pour répondre à un problème spécifique a évolué. À l'origine, il était défini par une série de spécifications descriptives qui constituaient des solutions types. Depuis la seconde guerre mondiale, la multiplicité des matériaux et des techniques de mise en œuvre a conduit à la définition de critères de performance. Sur base d'un ensemble de caractéristiques, on vérifie plutôt l'aptitude d'un bâtiment à remplir ses diverses fonctions dans un contexte donné.

L'aspect culturel intervient également de manière fondamentale dans les choix architecturaux. À ce titre, il est fondamental que les divers éléments du projet participent pleinement à la philosophie du concept architectural.

L'acte architectural n'est donc pas une somme d'éléments de réflexion superposés les uns aux autres. Ainsi, même si chacun d'eux est parfaitement réfléchi par rapport à sa propre logique, le programme, le contexte, l'expression, les matériaux et produits, la structure, les techniques, la sécurité, les détails, le prix, ... ne peuvent être abordés de manière autonome.

Pour atteindre l'œuvre architecturale, Il faut une démarche transdisciplinaire où chaque élément se nourrit de la réflexion des autres, tout en alimentant la réflexion d'ensemble vers le but ultime. On est donc davantage face à un processus itératif similaire à une grande spirale où chaque nouvelle réflexion tient compte des démarches précédentes (figure 1). C'est beaucoup plus riche.

En Belgique, la formation d'ingénieur civil architecte tend à favoriser l'intégration transdiciplinaire de tous ces principes. Elle permet donc une conception intégrée du projet.

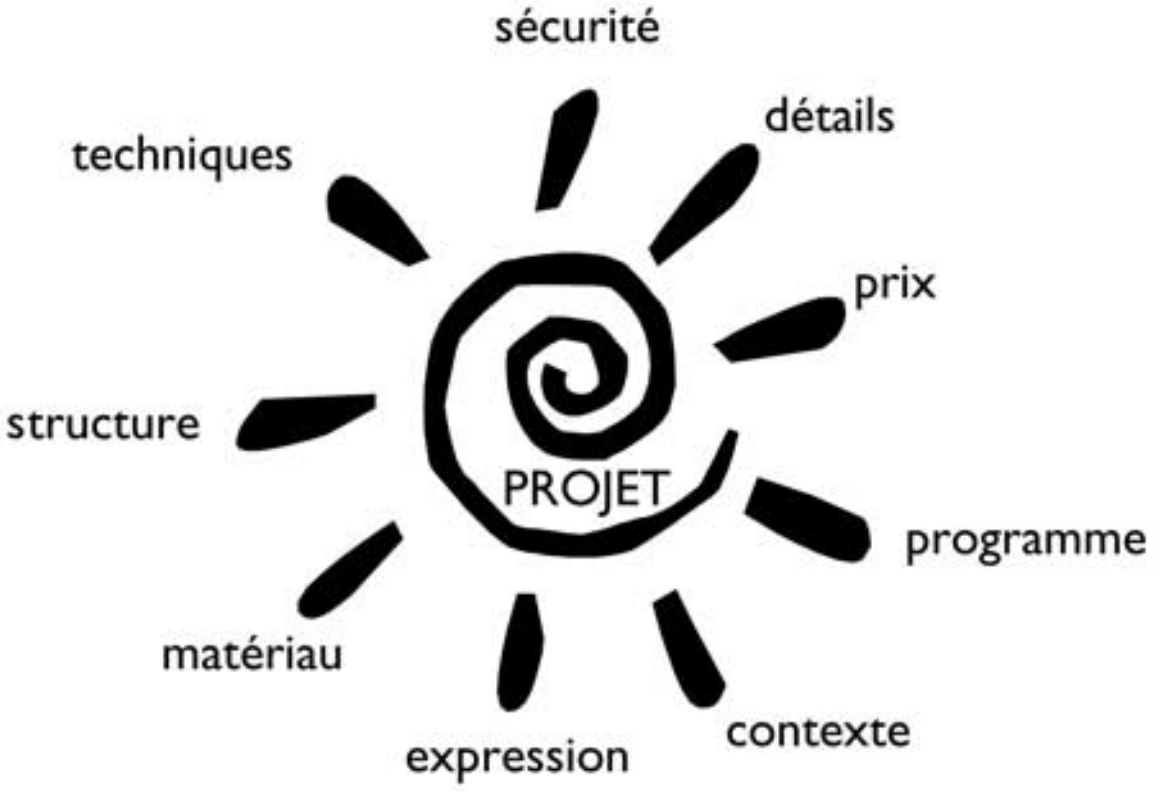


Figure 1

L'architectonique, qui regroupe l'ensemble des techniques de l'architecture, aussi bien les procédés de construction que les détails techniques, procède de ce principe de transdisciplinarité.

Pour des étudiants en architecture, comme pour les architectes débutants, il est très difficile d'appréhender les procédés de l'architectonique sans avoir pratiqué ni contrôlé des chantiers. On est donc souvent confronté, au niveau de l'apprentissage, à une totale incompréhension des détails architecturaux, leur représentation graphique ne représentant en général que des traits pour ces néophytes. On en arrive ainsi trop souvent à des solutions de «copier-coller», les solutions adoptées n'étant presque jamais adéquates à la philosophie du projet.

En ce sens, un cours ex-cathedra est très mal adapté à l'apprentissage des techniques constructives. On ne peut ni en comprendre, ni en retenir les divers éléments pour les appliquer aux techniques de projets actuels.

Des pédagogies favorisant des visites de chantier permettent de comprendre davantage les problèmes. J'ai eu l'occasion de l'expérimenter lors des visites que j'organise régulièrement avec mes étudiants. Cependant, il est difficile de trouver un chantier intéressant dans un environnement relativement proche et dans un état d'avancement tel

qu'il puisse répondre aux problématiques à aborder à cet instant des cours.

C'est pourquoi je fais souvent appel à des photos de détail de chantiers intéressants pour illustrer certaines techniques constructives ou certains détails techniques. Cependant, si ces visites ou photos permettent de comprendre davantage les problèmes, elles ne permettent que rarement d'ancrer les concepts dans la mémoire de nos étudiants. J'en ai souvent fait l'expérience au cours des discussions autour de leurs projets d'architecture.

La notion de détails est donc souvent abstraite et perdue : soit qu'ils sont inefficaces ou carrément impossibles à réaliser, soit encore qu'ils ne procèdent d'aucune technicité. Nos étudiants éprouvent couramment des difficultés à ancrer leur formation dans le concret, à comprendre les contraintes et les soucis des constructeurs, à participer, de manière active, à la mise au point de la réalisation, ...

D'autre part, les professionnels qui exécutent ces détails sur chantier connaissent ces technicités, mais rencontrent régulièrement d'autres obstacles: compréhension des demandes par les prescripteurs, compréhension des besoins et des soucis des concepteurs, participation active à la mise au point de la réalisation, ...

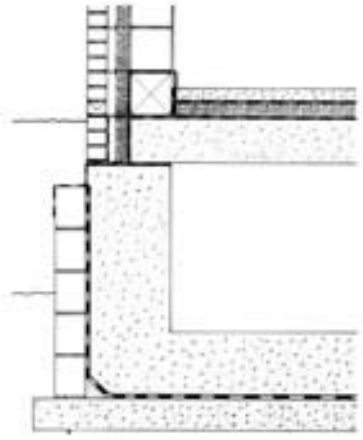


Figure 2

Au cours du temps, ces difficultés ont creusé un fossé entre les concepteurs et les constructeurs. On constate souvent une méconnaissance, des préjugés et parfois même du mépris de l'autre pôle d'acteurs. Aussi, nous a-t-il semblé intéressant d'organiser des rencontres entre ces partenaires, afin de permettre un véritable dialogue.

Nous avons donc réuni les étudiants de 4ème année en maçonnerie d'une école technique de construction (le Lycée technique Richard Stiévenart de Hornu, près de Mons) et nos étudiants de 3ème année d'ingénieur civil architecte (Faculté Polytechnique de Mons) autour d'un travail en commun. Les objectifs de l'exercice étaient multiples.

Il s'agissait premièrement de concevoir, ensemble, des détails spécifiques et de les mener, toujours ensemble, jusqu'à leur réalisation. Les rencontres se tenaient hebdomadairement, chaque groupe discutant de certains points de conception, de technique, d'architecture, d'esthétique, de réalisation, ...

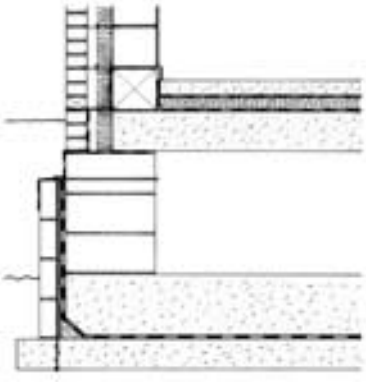


Figure 3

Des détails initialement élaborés de manière unilatérale se sont-ils transformés au cours des discussions constructives. Ces modifications vont dans le sens tant de l'aisance de la mise en œuvre que de l'efficacité.

Ainsi, le radier avec cuvelage, prévu initialement de manière théorique (figure 2) suivant les prescriptions du Centre Scientifique et Technique de la Construction (CSTC) et très légèrement modifié pour le passage du fil de terre (figure 3), subit-il des transformations pour réduire la mise en oeuvre tout en suivant d'assez près les principes de base (figures 4 à 6).

De même, pour le détail des fondations avec drain, la réalisation a permis d'apporter certaines améliorations au détail théorique initialement imaginé. (figures 7 à 9)

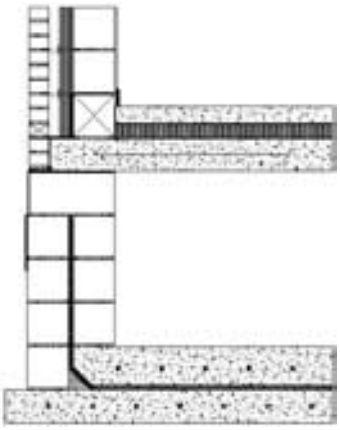


Figure 4

Figure 5

Figure 6

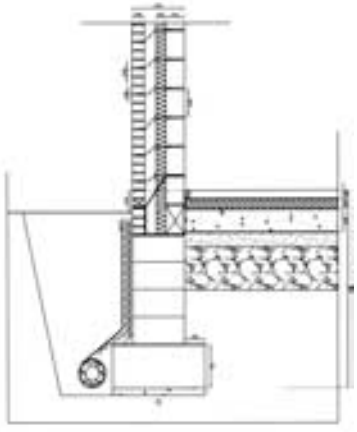


Figure 7

Figure 8

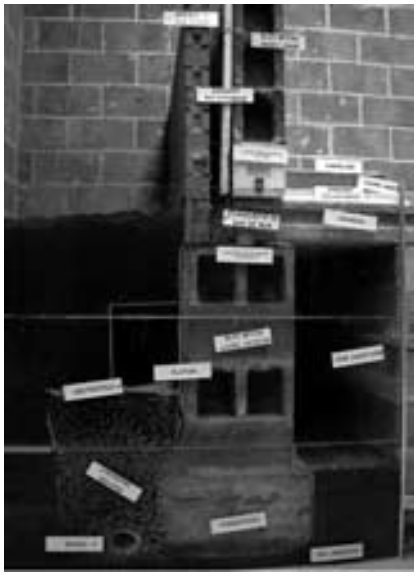


Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

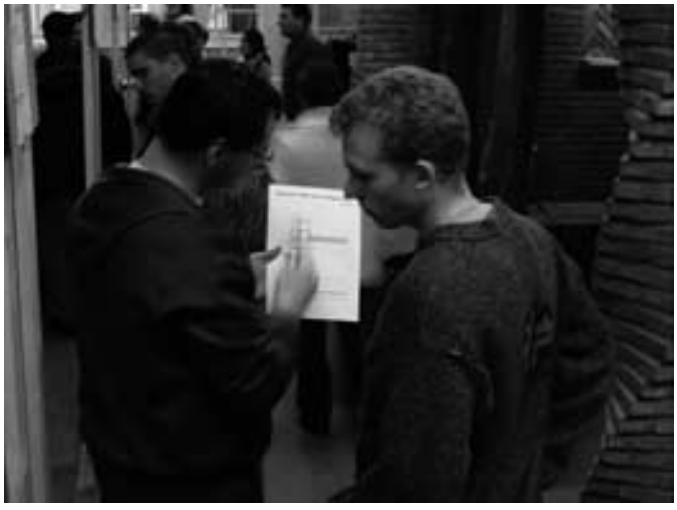


Figure 14

D'autres détails ont été abordés, comme la toiture plate avec acrotère (figure 10), les seuils et linteaux des baies de portes (figure 11) et de fenêtres (figure 12) dans des murs creux.

Cet exercice a été mené jusqu'à la réalisation à laquelle participaient de manière active nos étudiants ingénieurs civils architectes. Outre le fait que certains d'entre eux construisaient les éléments qu'ils avaient conçus (figure 13), ils apportaient des remarques constructives pour améliorer la qualité du travail et en augmenter la rapidité d'exécution pour assurer une exécution dans les temps qui étaient impartis (figure 14).

Dans tous les cas, ce travail leur a permis d'approcher le monde concret de la réalisation en architecture. D'eux-mêmes, les étudiants ont reconnu l'intérêt de cet exercice qui leur a permis d'appréhender une partie des difficultés du chantier: le contact entre les concepteurs et les exécutants, la gestion de l'avancement du travail dans le temps, la gestion des imprévus comme le retard en ce qui concerne l'approvisionnement des matériaux de construction, l'adaptation de certains éléments en cours d'élaboration, ...

À travers ces aller et retour entre des approches différentes, des dialogues et des considérations réciproques se sont développés entre les étudiants. Ainsi, dans l'exposé qu'ils ont fait de leur travail, nos étudiants ont-ils mis l'accent sur cet aspect de l'exercice.

En fait c'est l'un des objectifs essentiels de ce projet: apprendre à reconnaître l'autre dans ses richesses.

L'objectif principal n'était certainement pas la réalisation d'un détail type, ex nihilo, même si, d'un point de vue didactique et pédagogique, l'expérience de chaque groupe a permis d'enrichir les connaissances techniques de chaque étudiant de ce travail.

Bien plus, il s'agissait de leur apporter le désir de trouver une solution technique répondant à certains critères et, surtout, de leur donner des réflexes concrets, leur permettant de réagir face à de nouvelles situations.

Bien entendu, les détails proposés restaient académiques. Mais, forts de cette expérience, ces étudiants sont aujourd'hui aptes à transposer ces principes réflexifs à des problèmes beaucoup plus technologiques, dans une démarche holistique du projet d'architecture.

Ainsi, l'expérience est-elle la meilleure alliée à la connaissance. Si on comprend ce qu'on voit, on retient ce qu'on fait.

Bibliographie

PICON Antoine, 2000. Architecture, sciences et technique In Encyclopædia Universalis

RAPOPORT Amos, 1972. Pour une anthropologie de la maison. Dunod, Paris (FR)

VITTONE René, 1996. Bâtir - Manuel de la construction. Presses Polytechniques et Universitaires Romandes, Lausanne (CH)

Constructions Department, Faculty of Architecture, University of Architecture, Civil Enginnering and Geodesy, Sofia, Bulgaria

Mariana TSVETCOVA

The University of Architecture, Civil engineering and Geodesy in Sofia incorporates five Faculties – Architecture, Structural Engineering, Hydrotechnics, Geodesy and Transportation Engineering with thirty three departments.

UASG is not the only one civil institution in the country offering higher education for architects and engineers, but it is the traditional one.

The duration of Architecture study, including the time of preparing diploma thesis is eleven semesters. The number of students is approximately 720 – about 120 each academic year.

The department "Constructions" has specialized teachers in education of contemporary building technologies, materials and structures.

The number of students in the Department "Constructions" is 36 in the10th semester and the same number prepare their diploma in this department in the 11th semester.

The Teaching of Construction and the New Materials and Techniques

The main tendency in the Education of Constructions is: to provoke students to make maximum realistic projects, closely connected with the reality – from the situation to the details by using new materials and techniques. In these projects the construction is not only structural bearing system, but also a form creative factor. It is closely connected with the characteristics of new materials and the specific methods of their application. This tendency was imposed from the rapid development of Contemporary Architecture, New Technologies and New Materials.

The Education program has two very important sites, which give the specific image and quality of the Department - excellent educational methods and teachers team - the most famous practicions - architects with a great number of realized projects. Only in this way can be guaranteed the quality of education in Construction and also can be successfully prepared students for their future practical work. Students want to have teachers who are famous and well known architects.

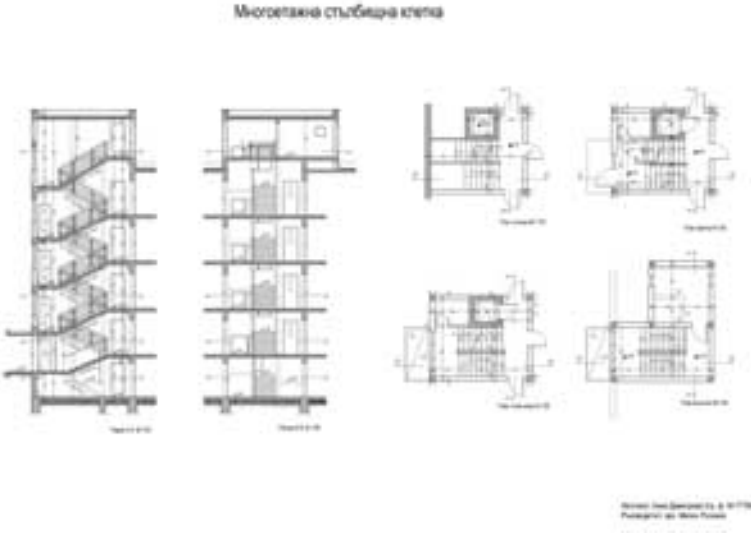
**Constructions Department, Faculty of Architecture,
University of Architecture, Civil Enginnering and Geodesy,
Sofia, Bulgaria**

The education in the Department "Constructions" is divided in to three main parts – **Housing Construction (part I), Architectural structures (part II), Special architectural structures, materials and techniques (part III).** Each of them is a kind of level in the education program. The direction in the education is - to establish a strong fundamental knowledge about old and traditional structures and then to present new materials and techniques in comparison with the first ones. Only in this way is possible for students to understand the positive characteristics of the innovations in Architecture and building methods.

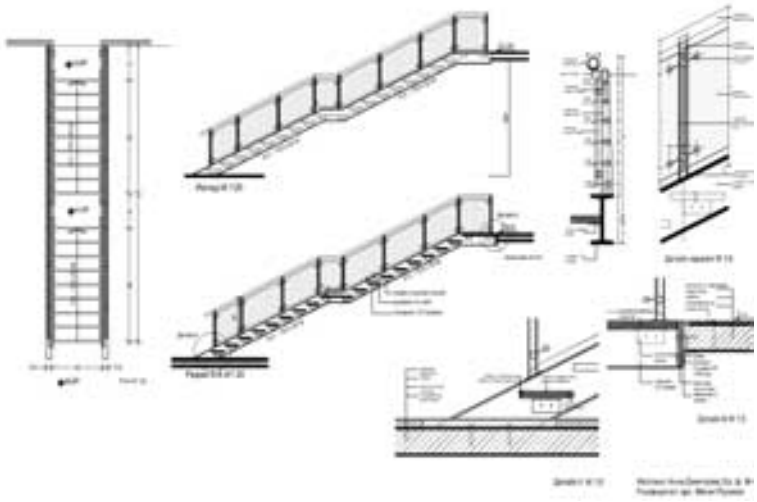
I part
Housing Construction

Housing Construction includes second, third and fourth semesters. It is divided in lectures and two architectural projects. It marks the beginning of the education in Constructions.

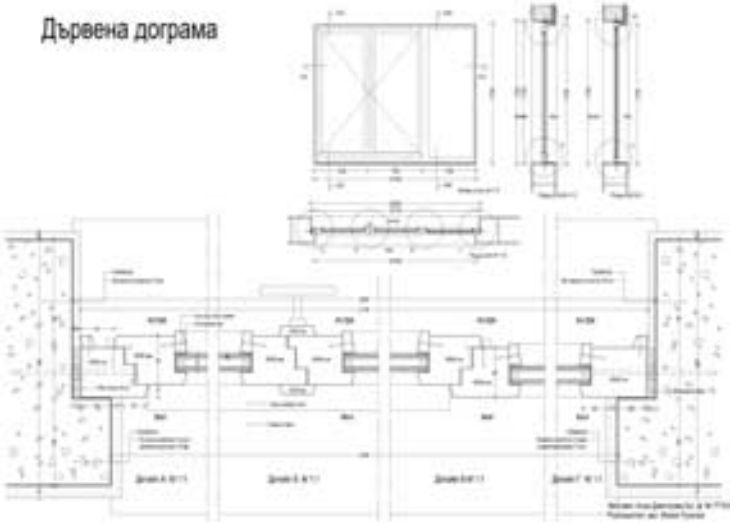
- **Lectures** are fundamental for the constructions. They give the most important knowledge which is as a base for the accepting new materials and building methods. There are some historical pats for old building methods.
- **Project 1** includes three projects - three variants of a little two-storey building with different bearing structures (monolithic skeleton reinforced concrete structure, bearing walls, timber or steel skeleton). The aim is to admit construction as a form creative factor and to make the connection between the main bearing structure and the other elements like walls, floors, roofs and their specifics. In this part students make models of the structures of each of the variant.
  In these projects students use for the first time new materials for walls, roofs, isolations.
- **Project 2** includes four projects of details- staircases, wood roofs, windows and doors. The aim is to obtain a specific knowledge about architectural structures and designing architectural details.
- **Engineering disciplines** also are included here. These are **Structural mechanics** (part I, II); **Physics; Building materials.**



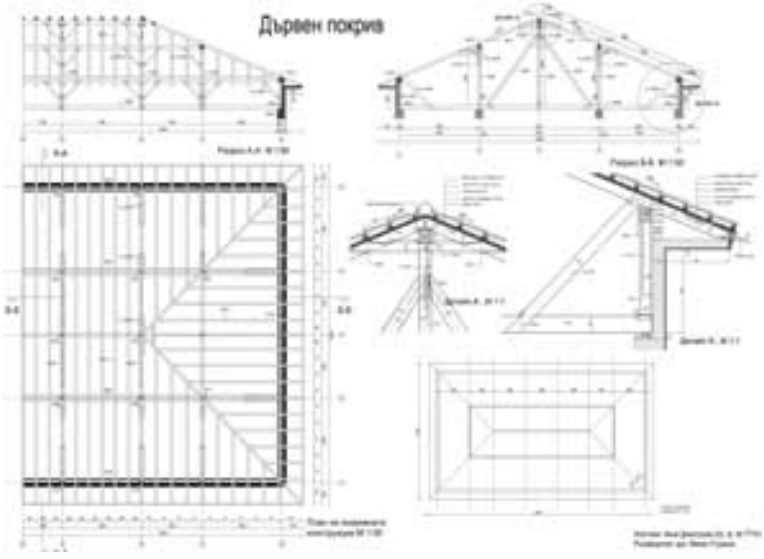
Интериорна стълба



Дървена дограма



Дървен покрив

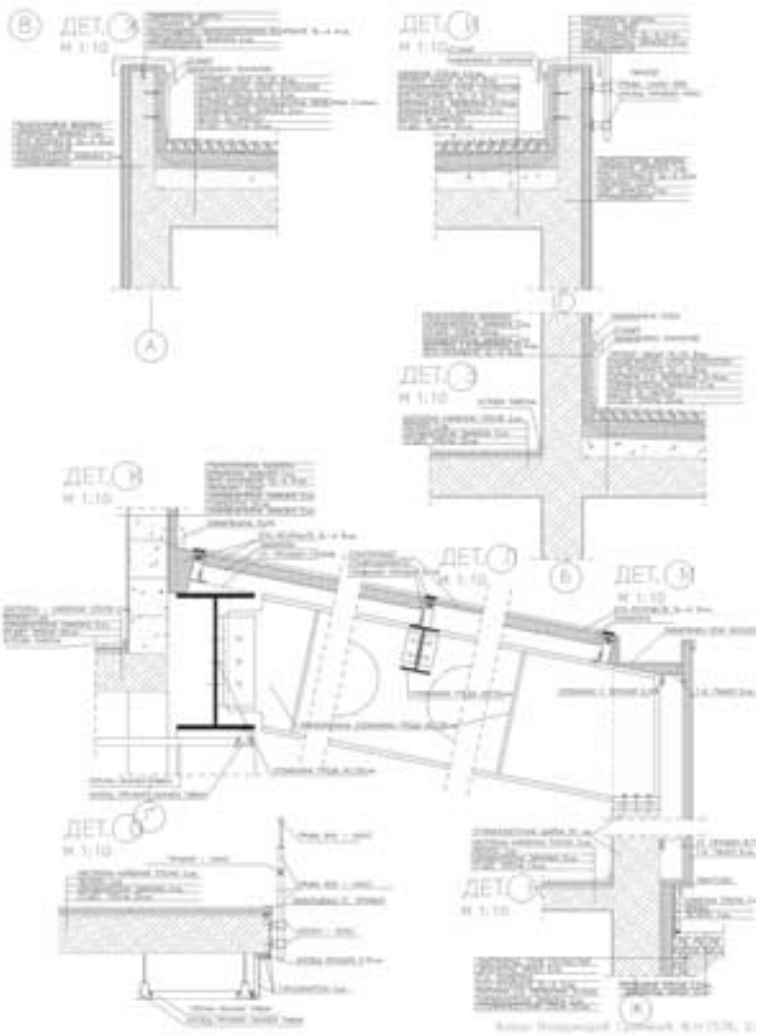


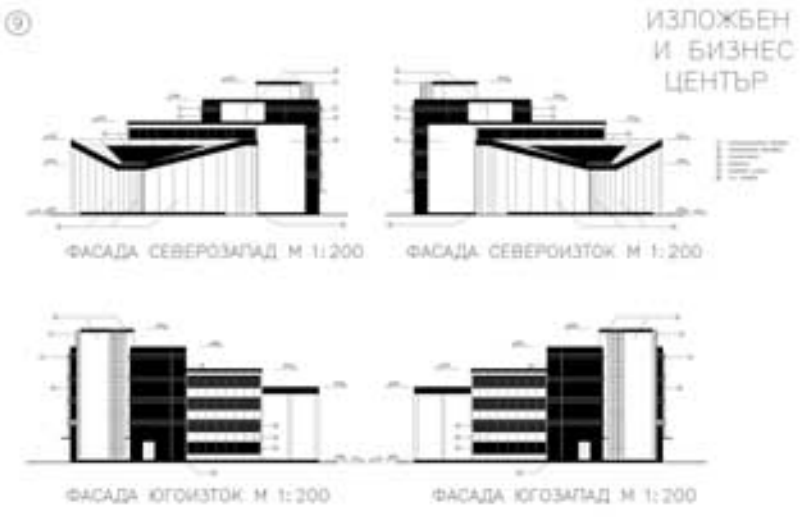
II part
Architectural Structures

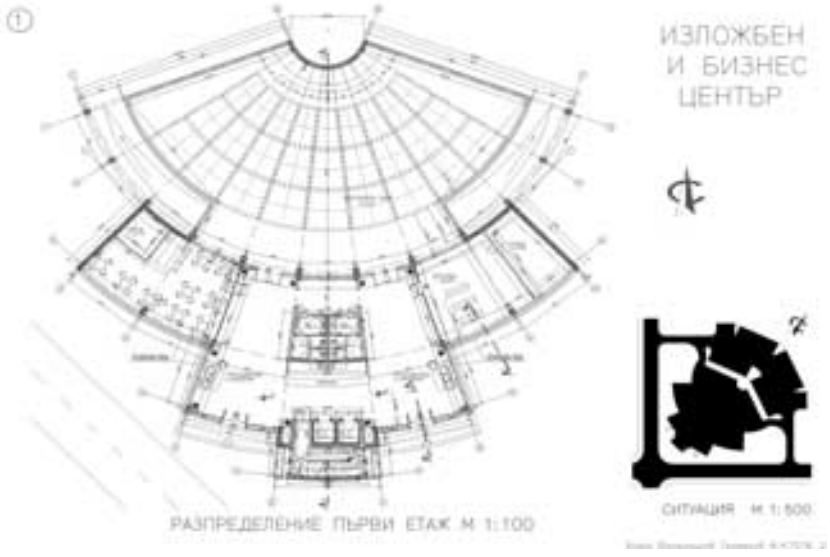
Architectural structures is in fifth and sixth semesters and includes lectures and projects.

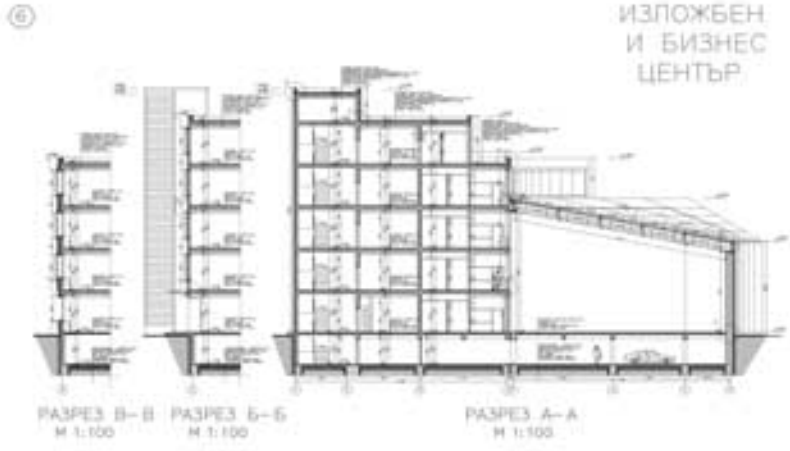
- The **lectures** in this part are fundamental for the main structural systems and constructions for the high multi-storey buildings and halls. Mainly the examples are given from the Contemporary Architecture in Bulgaria and in the World.
- **Two projects** are prepared in this part. The aim is to make a complex of competences and skills for making a real working project with details.
- **Engineering disciplines** also are included here. These are **Reinforce concrete structure, Steel** and **timber structures.**

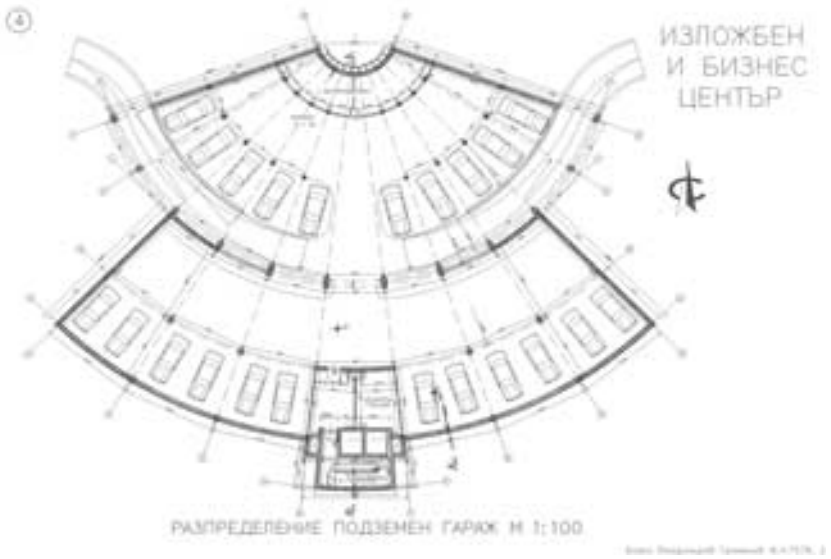
In this part is given more information about new materials and techniques. The projects are bigger than in the first part and at this level students are teached how to use industrial details and other firm products - how to adapt these new products to a building and how it will reflect to the image of the building. Students make specific parts of the buildings with details. This gives them practical skills and possibilities to reflect very fast in the real situation in their future architectural practice.




⑨
ИЗЛОЖБЕН
И БИЗНЕС
ЦЕНТЪР
ФАСАДА СЕВЕРОЗАПАД М 1:200
ФАСАДА СЕВЕРОИЗТОК М 1:200
ФАСАДА ЮГОИЗТОК М 1:200
ФАСАДА ЮГОЗАПАД М 1:200


①
ИЗЛОЖБЕН
И БИЗНЕС
ЦЕНТЪР
РАЗПРЕДЕЛЕНИЕ ПЪРВИ ЕТАЖ М 1:100
СИТУАЦИЯ М 1:500


⑥
ИЗЛОЖБЕН
И БИЗНЕС
ЦЕНТЪР
РАЗРЕЗ В–В
М 1:100
РАЗРЕЗ Б–Б
М 1:100
РАЗРЕЗ А–А
М 1:100



III part
Special Architectural Structures, Materials and Techniques

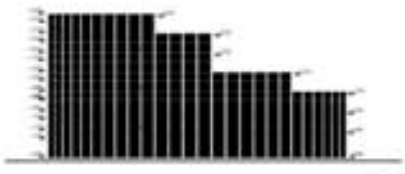
Special Architectural structures, materials and techniques includes the education in the ninth and tenth semesters. There are some specialized disciplines in lectures and three pre diploma projects.

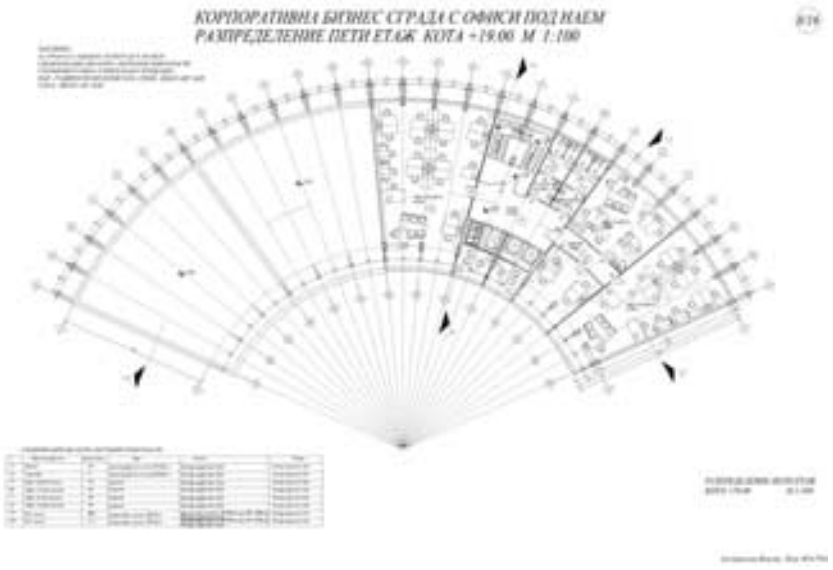
- **Special course in reconstruction** makes a connection between traditional construction in Bulgaria and the new building materials and techniques. Some questions are put here about how to use new materials without loosing the originality of the old buildings, how to adapt the building to the new conditions an other questions.
- **Special course in new technologies** is taking place here. This is the culmination point in presenting new materials, building methods and techniques. We invite foreign tutors for different lectures. They are representatives of some of the well known building companies as: "Shöko", "Ytong", "Knauf", "Allumil" and s.o.

  This last part of the education makes the connection between all the topics mentioned on the conference: Construction and Contemporary Architecture, Construction and new materials and techniques, Construction and the regional building traditions, Constructions and environment.
- **Three projects** are made trough this period. The firs two are in the phase – idea projects, but the last is technical working project with details. These projects are very interesting for the students because they treat the connection between new technologies, materials and bearing structure and are realistically made.

Innovations in the work of the Department are:

- **New information centre** collects all the information for the student's projects – catalogues, models, previous student's projects, CD information and details of industrial products, guide books for preparing student's projects.





- **Professional magazine "Detail"** is edited by our teachers and there is a lot of information about new materials and techniques.
- **Film projections from "Discovery channel"** are taking place in the Department in order to describe some important structural decisions in Contemporary Architecture.
- **Practical knowledge is obtained during the student's trip** every summer where students visit the latest interesting and famous buildings in Bulgaria and meet the architects and engineers who made these projects.

Results of our Education

- A great number of students study for their diploma in the Department
- All of the students who graduate our Department work as practicioners in Bulgaria or in great number of foreign countries
- A lot of students give international and national prizes in modern and contemporary architecture

Aarhus School of Architecture,
Department of Building Technology,
Aarhus, Denmark

Karl CHRISTIANSEN

Anticipating a Possible Future Architecture

The most radical new feature in the architectural language of form of the future will be the yielding inclination to – yes, perhaps even absent argument for – the use of standards and thereby implementation of mass-produced repetition.

In contrast to that the advanced and still spreading information technology has cleared the way for a language of form, that permits satisfaction of a long nourished desire for individual, unique forms. A desire that will not only fill and improve the qualities within the pragmatic field, but which will also be able to contribute to a clarification of works within the aesthetic, artistic area, from which primary meanings will in a hitherto unseen naked manner be able to stream.

A Historical Equation

The thesis of the project is that the future language of form will depart decisively with the prevailing. Such breaks have been seen before in history. An analysis of the past one hundred years can show this, illustrated by the following equations, which ends up pointing forwards:

1. Until about one third into the twentieth century the various crafts within the building industry lived as a matter of course up to their name. It was real workmanship; everything was done on site, by hand and to individual measurements. In this way the builders could satisfy their own individual wishes – could get uniqueness.

This period can be characterised by the following equation:

WORKMANSHIIP + INDIVIDUALITY

2. The first machine age which from the end of the nineteenth century had lurked behind the scenes struck through from around 1920-30.

The displacement of workmanship by the upcoming industry becomes still more visible.

Where the materials earlier followed a more direct way from nature to its purpose and destination, an industrial link is now inserted which under "orderly conditions" prepare these as standard goods that are not meant for a specific purpose but are stocked and offered from there as "building bricks" for, in reality, anything.

The industrially manufactured standard goods bring about the repetitive, strict, light and unsentimental elegant form which as such comes out radically differently than the earlier form. With regard for nuances this is still the situation of today, and the equation now looks like this:

INDUSTRY + STANDARDISATION

3. But how will the world look once information technology strikes through?

Well, industry has come to stay; the old workmanship cannot compete here. On the contrary, the view of the project is that standardisation with the resulting repetitive expression must give way in favour of the reappearance of the individual, and thus the equation of the future looks like this:

INDUSTRY + INDIVIDUALITY

The Vital Information Technology

In two places in the project the information technology tools is decisively used.

- One is during planning
- The other in production

The response of the project is that there must be not only similarity but also identity between the architectural form and the message that this form communicate - or to be quite precise – is.

At first the project focuses on the structure. This is the message and thus, as mentioned, also the form.

In architecture everything has to be bound up with all the rest, and it is precisely in architecture that this is quite a lot. Therefore, you should not be able to get the knife in between – in our example – the form and the structure. These two have to mutually create each other.

And so it is – when architecture, understood as a creative art form, is on the agenda – with all the conditions we place opposite each other. In short, precision is in this respect the key word.

The load-bearing structure must, cf. the above, be precise. I.e. there can in the form be no deficiency in relation to static conditions. This is obvious, however, because otherwise all the structures would be undersized and would in reality collapse.

But likewise there cannot be a surplus in the form. True, one would with such an over-dimensioning have made sure that the structure would last, but the structure would not be the message. It would not be precise, i.e. identical with its form. On the contrary, the form has to be optimal, i.e. exactly identical with, or more precise, be the statics – i.e. the load-bearing structure. It is here, *during the planning* that the potential of information technology strikes for the first time.

New Design in the Project Phase

So far it has not been possible to satisfy the demand for a precision as distinct as described above. The difference is, to put it very simply, a question of the number of calculations (statics). So far these calculations have been made by (mainly) engineers on slide rules and later calculators, and this method does, of course, have its limitations in respect to the number of calculations. This means that the optimizations have so far purely been a tendency, but not - well, optimal. This has not, however, been as disincentive as, which we will see soon, a more optimal form under all circumstances not been within reach as far as the question of practical production is concerned, and thereby the demand for such a distinct precision been purely theoretically founded.

The new forms are born as follows:

The architect sketches a structure with a specific form, which is imagined in a specific material.

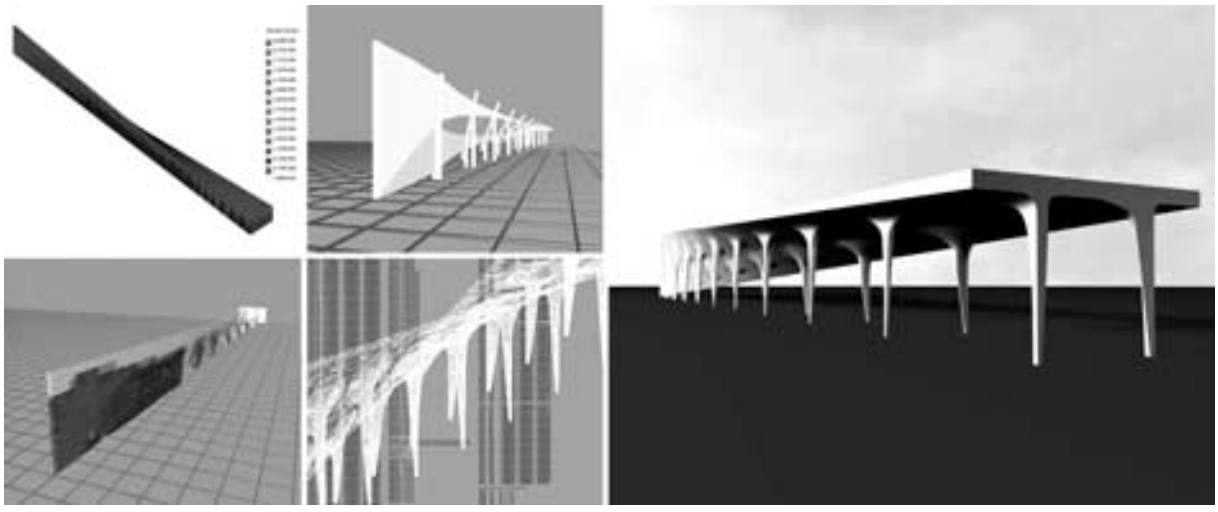
Already during this sketching the structure is optimized in its form, but only a tendency.

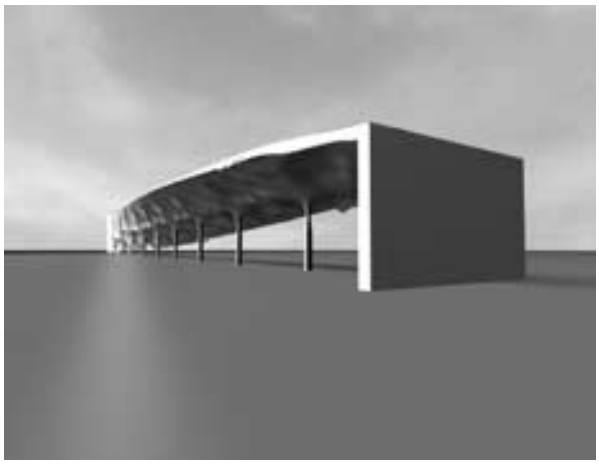
The architect uses his rather simple general knowledge and experience of basic static principles to create form. Where the tensions of a given structure is the biggest the form becomes the strongest and vice versa. But the form is still a tendency. For instance, offset loads which will undoubtedly change the form when it is later optimized have not been taken into account.

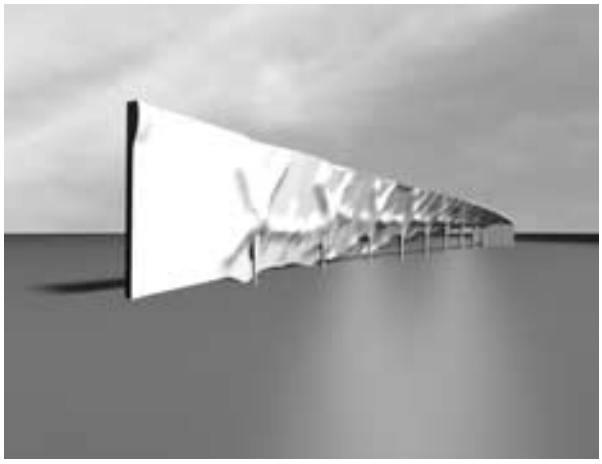
The architect sends the project to the engineer who supplies his computer with the relevant data, after which the structure is calculated in a special form optimizing programme. A programme that delivers a real (contrary to a tendency) picture of where the largest forces occur, where the smallest occur and for that matter how the forces are distributed in the structure, ungraduated between these two extremities.

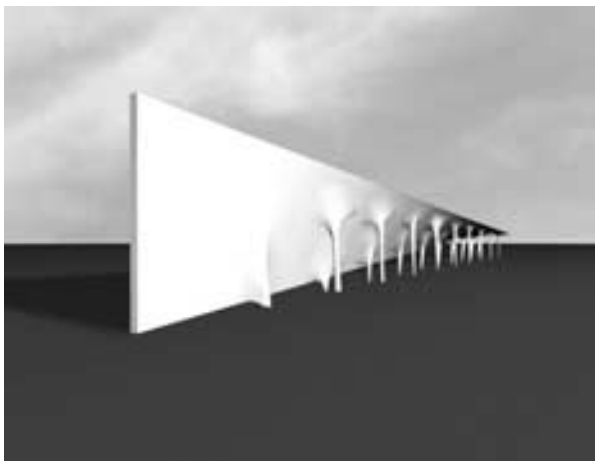
This operation brings about a new form as the optimizing points very precisely to the places where the form must be strong and where it must be fragile. The new form is returned to the architect.

Building forms in concrete, generated by form optimization









The architect assesses the form based on which he makes further sketches. Not as "free" design but based on the "rules of the game" that he himself, the engineer and not least the optimizing programme define. For instance, variations in the distance between the columns will have consequences for the height of a beam, which the columns were intended to possibly carry.

The project is sent back to the engineer who re-optimizes resulting in a changed form. Back to the architect who ..... etc., etc.

In this way the ping-pong goes back and forth until a satisfactory form has been obtained: A form which partially (but only partially) is created by the computer. A requirement is the very creativity of the architect. At the same time the form is only partially created by the architect who for one is dependent upon the IT-tool.

Such a practice gives "unruly" shapes. Ungraduated shifts between the tortuous shapes of all sorts, where no building part has the same cross section in two places, is the result of these new "rules" and – which is of the biggest interest – potential.

Similar unruly shapes have, of course, been launched before in modern architecture but have rarely been realized as these kinds of projects have on the whole always been rejected as being, in every way, unrealistic.

That is history now – and here, in the production phase, the IT-potential strikes for the second time.

New Form in Production

The production apparatus has in quite a few areas been changed into being digitally managed. This means that the work is done by robots that are programmed for specific operations that can be extremely advanced and often "intelligence based". Operations that the robots perform at high speed and distinct precision. The motor industry, the electronics industry, the furniture industry, just to mention a few examples are typical exponents of this new technology.

The building industry, however, uses these highly technological options only to a small extent, and when it does happen it is often in a "superficial", unimaginative and not very far-sighted way. In most current cases the robots are producing the same product that was earlier made by hand. A sort of pastiche of past technology. Probably able to compete for time and price. But what is the new?

New technology and new production forms must, which is also shown in retrospect, be expressed in the products and thereby change and develop our world of form,

But where do the robots in that way differentiate conclusively from the past technology?

Robots are not dependent on standards. This is what is really new, for it is precisely the standard merchandise, not least within the building industry, that has characterised the past century.

The robots have no favourites among forms, for instance as straight lines, right angles and pure circles; robots do "what they are told".

Therefore, the reservations are eliminated about the "unruly forms" we saw before, the forms that came into existence as the result of the form optimizing work of the architect and the engineer.

And with this the way is prepared for brand new architectural openings; namely the possibilities to realize architecture with a high degree of individuality, and great freedom of form.

Aarhus School of Architecture, Department of Building Technology, Aarhus, Denmark

Anders Nielsen GAMMELGAARD

If we Know where we are Going, there is No Need to Go.

First I will tell three short stories that reflect present and future demands for innovation:

Story One

Exercise II
If we know where we are going there is no need to go

Some years ago I attended a lecture given by the Danish philosopher Casper Nefer Olsen. The lecture reflected the differences between law and architecture. The main argument of the lecture was that where law in its fundament is based on match, architecture is based on the absences of match. Casper Nefer Olsen presented his argument with the example of a criminal who has become a criminal through the act of a crime. In order to punish the criminal, he (or nowadays it might be a she) is prosecuted. Through the procedure of the court case it is the work of the prosecutor to find a specific paragraph in the law that matches the criminal act. The point is that when a match is found the criminal can be sentenced and the work of the court is done; law works on the principle of match between the criminal act and the law text. Architecture, on the other hand, works on the opposite principle; the principle of no mach. If there is a match, there is no new architecture. Ever since the *Ten books on architecture* by Vitruvius, the field of architecture has constantly expanded due to this principle. Every true renewer has in the beginning stepped outside what was at the given time considered as the limit of architecture. Only after a long time and often with terrible struggles, what was at the beginning not considered to be architecture is slowly accepted and assimilated within the new boundaries of architecture.

In other words, story one emphasizes the importance of innovation in the field of architecture.

Story Two

Recently I overheard a conversation between some members of the Danish National Patent and Trademark Office. Through their conversation it became evident that the office currently receives a large number of applications for new patents. Among these applications a large majority (more than 95%) fell under the category of further development to already existing patents. Only a minor part of the applications fell into the category of *true* inventions or *never before seen* inventions. This shows in clear numbers the difficulties involved in creating something that from the beginning does not belong to a certain typology nor have an already known image; thinking the unthinkable, - or crossing the bounds of our

own imagination - is a difficult task to undertake. It does, however, make it more important than ever.

More and more industries have understood the writing on the wall. Research and development have become today's mantra in the struggle for survival in a forever more competitive world. Without innovation the days may be numbered for any modern industry; this applies to industries in general, and to the building industry in particular.

Seen from a distance this might seem as old news taking into consideration that the industrial revolution as well as today's information technology society have been carried on the wings of development and innovation. To be ahead of your competitors by means of new inventions has always been the trademark of success. The new news of today are, however, the speed with whitch the development of new inventions is done. This has to an almost extreme degree pushed forward a demand for people with an innovative way of thinking.

Story Three

At the last EAAE-ENHSA Workshop of Construction in Lyon we discussed various teaching methods as well as their possibilities and limitations. One of these methods being the "classical" study of the great masters caused as series of comments and reflections. On one hand it was evident that this method had numerous qualities. Not only did the students learn the secrets and tricks of the old masters in a very quick way, but the whole idea of learning by copying seemed efficient in itself. On the other hand the method seemed to carry its own limitations that became obvious by posing the question, "Where did the masters go to learn?" Or in other words; the method left the students at the doorstep of the masters without giving them the tools to pass beyond the masters. Therefore it became obvious that copying as a teaching method has its own limitations, and to pass beyond these limitations a method of a more innovative character has to be employed.

Mastering an Innovative Process,
- a Future Competence of the Candidate.

With the three stories at the back of our minds, it needs no further explanation that the ability to master an innovative process is one of the most needed and acquired competences in the profile of the future architect. This applies for the profile in general as well as for the competence in the field of construction in particular.

Naturally a series of other competences are essential to fulfil the profile of the future architect. Among these is the ability to identify, analyze and persistently pursue the architectonical problem of the greatest importance. Especially in the situation of today where the architectonical agenda changes rapidly. The young architect must be able to manoeuvre safely under these circumstances. This calls for the competence of being able to change architectonical strategy rapidly as the architectonical problem alters.

Yet another competence that needs to be mentioned is the ability to work in teams. With the increasing complexity of the building process, it becomes more and more evident that the traditional architect with the overall view is being replaced by a team of decision-makers. This calls for the

competence of being able to work in teams, and in this relation the ability to identify personal resources and competences, and to bring these into play in teamworks.

**Innovate
Don't Imitate**

The next question is how? How do we meet the above-mentioned needs for specific competences in the profile of the future architect after graduation, and which educational methods and pedagogic strategies does this require? The simple answer to these questions is of course that the students in their architectural training must *work in teams, using a process oriented method to solve architectural problems in an innovative way.* Put in other words; *if we know where we are going there is no need to go.* This answer, however short it may be, I think is right. At the same time it is a simplification of a reality that is far more complex than the answer signifies. The point here is of course that there are no infinite or normative answers to the question. The answer must always be addressed relatively because the question of "how?" will always vary according to the existing architectural realities. This is in my opinion one of the worst "traps" that must be avoided when trying to give a simple and ultimate answer to a complex question.

Again Sisyfos' stone rolls back in the pit and leaves us with the question of "how to teach construction" and "what pedagogic method to use".

I believe the best answer derives from empiric experiences in teaching; from demonstrating and sharing our pedagogic methods and aims; their possibilities and limits, successes and failures. Openness as well as self-criticism and criticism from others are in this process the only efficient tools that can improve the teaching methods in construction. The process is long and never-ending, only one thing is for sure; it is process oriented and innovative.

Go Shopping

The second EAAE-EHNSA Workshop of Construction Teachers' Sub-network in Lyon facilitated the above-mentioned possibilities. The different schools and universities of architecture presented examples of their own teaching methods. This gave a fantastic opportunity to share experiences and to "go shopping" among the presented work. Karl Christiansen and I from the Aarhus School of Architecture, Denmark, certainly took this opportunity to "go shopping" and be inspired by the presented work. As a result we tested some of the demonstrated methods and exercises when we came home. This has been the point of departure for testing and developing new ideas for exercises. As an act of gratitude we would like to present an example of some of our recent teaching exercises. This work emphasizes teamwork, innovation and the ability to work process-oriented.

One Example

At the Aarhus School of Architecture a workshop was held in 2003 with the aim of examining the architectural potentials of concrete as building material. The point of departure was teamwork between the school of architecture and a number of enterprises and companies within the Danish concrete industry. In the following text the experiences from this workshop are being resumed and evaluated: first of all the experiences

accumulated from the pedagogic aim of stimulating the students' innovative competences; secondly, the experiences from a teamwork between a state institution and private enterprises, - sweet music to the ears of the present government's education policies.

It has been said repeatedly to the schools of architecture in Denmark that the architectural education has become too academic. That the education focuses on theoretic and historic matters and gives less attention to the actual practice of architecture. It has also been said that the education is out of touch with the demands on the future architect as well as on the development of society in general.

The criticism has been raised from several sides simultaneously; from the private sector in general and the building industry and the political establishment in particular.

This is not an attempt to dismiss the criticism as this has unfortunately often proved to be right. On the contrary; the wish is to point out that attention is given to the criticism and based on this initiatives are being taken with the purpose of breaking down the barriers between education and practice.

Cooperation and teamwork between a state institution of education and private enterprises are not a new constellation in itself; and certainly not where a school of architecture is involved. In fact this constellation has often proved to be the rule more than the exception; with the cooperation between the Bauhaus school and the German steel industry as a splendid example. In that respect there is nothing new under the sun when the Aarhus School of Architecture cooperates with a number of private enterprises. The interesting thing is to evaluate today's state of teamwork and to ask the question how it is possible to establish a teamwork that benefits both parts.

The main participants in the workshop were forty architecture students, five teachers and four enterprises.

The workshop was divided into two phases corresponding to different casting techniques in concrete.

Exercise I

In the first phase the task for the students was to develop and plan a method for casting concrete in an elastic form. The students were in groups of four given two rubber tubes, with the dimensions 200 x 1200mm, which were to be filled with white concrete.

From a starting point this was an impossible task to perform as the rubber will only expand according to the quantity of concrete being poured into the tube, exactly like a balloon filled with water will expand due to the pressure inside. However, this paradox was one of the pedagogic aims of the exercise; to give the students an intuitive understanding of concrete as phenomenon. Or in simple words; through their own practise to let them see how concrete transforms from a heavy liquid to a heavy solid and in this process changes its pressure on the sides of the form. These are experiences that in a professional perspective exist as common sense and therefore may seem like trivialities, but for the students these are essential in order to be able to exploit the full potential of the material.

*Exercise I,
Casting Concrete
Objects*

*Exercise I,
Unwrapping Concrete
Object*

*Exercise I,
Tectonic Integrity*

*Exercise I,
Tectonic Integrity, detail*

The most important pedagogic aim of the exercise was, however, to stimulate an innovative working process. An aim that could be resumed in the question of how to cross the limits for one's own imagination and be able to create without a predefined image or goal? Not an easy task to undertake as architecture students are in general trained to find solutions to architectural problems by using their imagination. We wanted them to do the opposite; to find solutions without using their imagination but through a predefined working method. It was therefore a standing 'modus operandi' that *if they knew where they were going we would ask them not to go.*

The pedagogic strategy was emphasized by the way of casting concrete. In the traditional way of casting concrete a stable and non-elastic form is used. This has as a consequence that the result of the casting process is known on beforehand. Or in other words; through the design of the form the design of the concrete object is known. The consequence of this is that no sudden surprises occur during the casting process (unless something goes wrong) that could be a point of departure for new investigations of the potential of concrete. In other words, you get what you expect, no more and no less. When concrete is cast in an elastic form, the opposite situation exists. Suddenly a diversity of possibilities occurs as nothing is predefined from the beginning. This gives rise to a tremendous (endless) amount of developing potentials. For the students this way of working with concrete was both very inspiring and frustrating. Frustrating because the images that they unconsciously and by habit created were of no use, as only the process carried the result. Inspiring because they discovered new potentials in concrete that were beyond their imagination. In other words, they were tricked through the exercise to cross the limits of their own imagination. This was a truly challenging moment.

Finally it was a pedagogic aim of the exercise to emphasize how the process of casting concrete leaves its own and unique footprints in the cast object. In this way it becomes one of the aesthetic qualities of concrete to tell the story of how it was conceived through its own process. The finished concrete object tells its own story. This pedagogic aim was actualised through the exercise in the way that the student, in order to withhold the pressure of the concrete in the elastic form, constantly had to use different tools and items to keep the form in place. To maintain the column of liquid concrete through this dynamic process, they used strings, metal bands, heavy rocks, various pieces of wood, etc.; all were the kinds of materials that in their specific way left marks and traces in the concrete and in this way told the story of how the concrete objects were formed.

Exercise II

In the second phase of the workshop the task for the students was to design a larger column/beam construction that was to be placed in the context of the main entrance of the school. The construction was to be cast as a traditional pre-fabricated construction using plywood as the form material.

The pedagogic aim of this exercise was primarily to focus on the complexity involved in the solution of an architectonical problem of today. This expressed explicit in teamwork and cooperation that is necessary between

different groups of professionals. As so, the exercise represented a simulation close to reality.

The students were in groups of five asked to design a separate part of the construction (column, beam, foundation block). This had to be done in consideration of the overall design of the construction. Already at this stage an immediate urge for communication between the different groups emerged as even small changes in the design of one component resulted in the necessity of negotiations with the "neighbouring groups". As a direct consequence this necessitated an open and dynamic design process.

In addition to the need for communication the design process was strongly influenced by static and constructive demands made by the engineers. At the same time the designs had to be adjusted in accordance with the production techniques, and for that reason had to be discussed with the involved companies.

Exercise II
Design Process

Exercise II
Making the Mold

Exercise II
Making the Mold, detail

Exercise II
Making the Mold, detail

Exercise II
Preparing the Steel Reinforcement

Exercise II
Casting the Molds

Exercise II
Unwrapping the Objects

Exercise II
Montage

As if this was not enough, yet another set of design parameters were introduced emerging from the fact that the students had to design, construct and build the necessary forms on their own. Finally, it was a design parameter that the separate parts of the construction had to be adjusted in accordance with the facilities for transportation and assemblage. All this had to be done with a timeframe of altogether 19 days.

They succeeded, but only just, within the set time limit. The success was a result of a tremendous tour de force, an excellent teamwork and not forgeting the extended use of IT-tools which enabled the students to embrace the whole design process. In the initiating design process Form-Z was used as the design tool whereas AutoCad was used in the final stages of the process. Without these design tools it would have been impossible to carry out the exercise within the set timetable.

Exercise II
The Structure

Exercise II
The Structure, detail

Conclusion

Let it be said from the beginning and without any secrets; it was very difficult to catch the attention of the students to the theme of the workshop - concrete. Perhaps we should have foreseen this lack of interest, as the prejudice against the material obviously exists as widespread among architecture students as within the general population. The result was that the workshop started uphill from the beginning. It also gave us the first signs that in order to make the workshop a success we had to approach the subject in an unusual and unconventional way. This led to the decision to study and examine concrete in a very direct and intuitive manner. As a consequence the students were in the first phase of the workshop asked to cast concrete in elastic rubber tubes. This gave them an intuitive understanding of the specific limits and potentials of the material as it gave them a broader knowledge of the material as phenomenon.

With the experience from the first phase of the workshop it was the pedagogic aim of the second phase to focus on the complexity of teamwork in the professional world of today; this was done through the design of a larger construction in prefabricated concrete. In addition to this aim the wish was to give the students the experience of going through a full architectonical process from beginning to end; from the primarily freehand sketches, through the adjustments of the design due to the various design parameters, to the real making of the forms, and finally to the inauguration of the construction. An experience that is only rarely possible to give the students because of economical and practical reasons. This is unfortunate, one may say, because it is the only kind of experience that can fully open the eyes of the students to an understanding of the integrity of the architectonical process.

As a conclusion to this phase of the workshop it must be said that the students were fully confronted with the complexity of today's teamwork. The large number of design parameters that were brought into play forced the students to keep the design process open and dynamic. In the beginning this brought about a number of discussions and negotiations between the groups as well as within the individual groups; discussions that in many ways paralysed the design process. As a result the designs were constantly redesigned, and with a deadline that was rapidly approaching these disagreements became a valuable source for finding architectonical solutions. This was perhaps one of the most valuable experiences of the workshop as the students discovered the possibilities in a problem that from the beginning seemed impossible to solve.

Stop making sense

The big and open question of the workshop was of course how cooperation between a state institution and a number of private enterprises would work out. We on our side had our doubts, especially concerning the question of whether or not we would have free hands in the planning and definition of the aim of the exercises involved in the workshop. We were totally mistaken and our doubts were put to shame. Not on any occasions did we have our hands tied or feel any restraints. Of course this does not imply that the involved companies had no intentions or hidden agendas; of course they did. We were fully aware that when a company places their expertise at our disposal together with a larger sum of money, this does not take place for the sake of our blue eyes or without any payoff. Naturally the agenda for the companies was to introduce concrete as a building material and demonstrate its potentials to future architects. Of course, you can say, it has to be like that. The positive side was, however, and that is the point, that at no point in time was the agenda of the companies hidden, - or at least we did not find out. We were at no point in doubt about what they wanted and they were in no doubt about what we wanted. We needed professional expertise and the possibility of producing objects of a larger scale, and last but not least; we needed a financial sponsorship. They on their side wanted to demonstrate their expertise and products, and at the same time advertise for them-selves. Finally both parties had an interest in cooperation out of shear nosiness; this was in fact the real secret of the success of the workshop.

The Royal Danish Academy of Fine Arts, School of Architecture, Institute of Building Science, Structural Department, Copenhagen, Denmark

Ole VANGGAARD
Ola WEDEBRUNN

Concept of Architectural Structure

The authors of this paper are teaching structures and material at the department of Building Science at the School of Architecture of the Royal Danish Academy of Fine Arts in Copenhagen. The aim of this teaching is to stimulate and sustain the interest in **Concept of Architectural Structure.** This is sought to be accomplished by the integration of technology and building science in the concept of architecture through different programs of teaching such as: lectures for 1st and 2nd year students in a series of the history of architecture, seminars in the history of architectural structures and science and analysis of contemporary structures, and studio consultations.

The idea is to give the opportunity to discus the relation between the architectural understanding of the structures and the development of the architectural structures. Obviously the technological development in itself plays an important role, but the basic is, that it only is in relation with the architectural need – or wish, that innovations develops to general architectural technology. The development of reinforced concrete is independent of architectural concepts, - but it was the very strong architectural concept of the modernism, witch opened for a new architectural concept based upon the technical development – that formed concrete into **architectural structures.**

The gab between the architects (and the students) use of the powerful 3-D computer tool, and the technological reality may be seen as immense today, but seen in the view of the historical development, it is natural and necessary.

Before going to the discussion of how to deal with this gab, let us examine some of the characteristics of it.

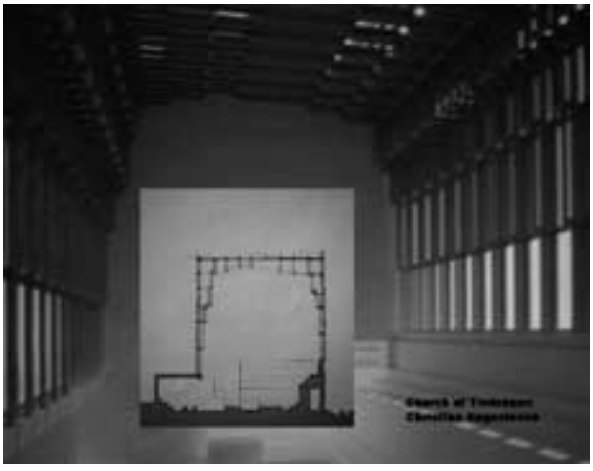
Architectural students have many new possibilities to define shapes and spaces through the computer. They can "manage" a very complex spatial situation, although, they sometimes only understand few dimensions of it. The architects do the same, although they to a certain extent are limited by practical and financial constrains. This gives a gap between the architectural presentation and the real content of the drawings. In that case it may be difficult and less inspiring for the student to have her project pulled apart, and squeezed into well known technological and architectural solutions.
The engineering world has changed at least just as much by the development of the computers as the architect's world. The engineer in theory has a tool enabling him to analyse and understand structures,

which earlier has been left to feelings and very rough check. Calculations of complex membranes, and of structures with large deformations are examples.

The manufacture – the contractor also has a strong tool for product planning and a possibility to deal with non-standardised components by parametric design and manufacturing.

The citizens of the future world also need new environmental surroundings to identify themselves in the contemporary world.

The student of architecture lives with these facts, and tries to find a response within their limits. Their statement must be matched with technological solutions of our time, as been seen in the relation between the eminent engineer Peter Rice, and some very great architects, concerning structures unknown at the time. (Centre Pompidou or the structural glass wall). Neither we, nor our students may be of that calibre, but wee must find methods to deal with the conflicts in a way witch enables a new technological



architecture to develop. One of our experiences from the historical studies is that architectural technology only develops when it is based upon architectural wishes and dreams, and only when these are using techniques of the technological forefront.

So, as technicians wee have to pull upon the latest developments within our field, and to do it in a creative, but responsible way. We need a language between provocative students schemes and the reality. The language seems to be to formulate structural or technological concept. Concepts, which have to match architectural concepts and thereby give guidance in the way the combined architectural and technological development must go.
The need for the use of structural concepts, and conceptual structural design has since some five years, been acknowledge among engineers. At least three international conferences have been held on this topic, and more are planned. It is characteristic, that very few of the papers from these conferences touch the problem, and the subject seem to be better to attract conference fees, than to develop a tool.

It is not our aim to overcome this problem with this paper, but by addressing the network of ENHSA at the meeting here in Athens we wish to present and discuss, the results of the daily work with our students.

The gab between an architectural image and the technological (and functional) problems is on the other hand not only a question of formulations. We believe that there is a need to activate knowledge of how to develop architecture integrated with structures that uses the "hidden recourses of the building" as OV uses to express it. It may be by the use of plate actions of the walls, or by membrane actions in curves surfaces. New spatial concept's seems to call for structural concepts of membrane, or semi-membrane structures designed in a parametric sense suitable for both the architectural computerised control, and the manufacturers use. In this space the engineer's advice of how to handle geometry, supports and curvature need to develop more knowledge, than the common engineering textbooks offers. This is where the impossible demand for some of us to be a "Peter Rice/Ove Arup" raises. Of course this is unsolvable, but the discussion about structural concepts may uncover areas to develop and communicate in a teachers professional forum. At the Architecture School in Copenhagen we try to develop and understand actions and possibility of freely shaped spatial structures. This is a research work, where the focus has changes from minimalize to possibilities of supports and curvature.

Apart from the formulation of architectural, technical concepts, their historical examples, and a development of actual structural systems, it seems very useful to discuss these problems based upon newly build structures with great architectural content. One of our college in Copenhagen a structural engineer Finn Bach scan technological and architectural publications, so that he can give sufficient facts to discuss the new architectural structures and their different concepts with the aim to give the student a more realistic picture of the glossy picture in the magazines.

**The Royal Danish Academy of Fine Arts,
School of Architecture, Institute of Building Science,
Structural Department, Copenhagen, Denmark**

Finally wee will like to point out a close collaboration between the specialist teachers, and the generalists. Between the architect and the engineer in some cases. The two authors of this paper are architect Ola and engineer Ole. We often give lectures and courses together, as we do by sharing this paper, in the benefit to reduce the gab of engineering architecture and the gift of provocation and dialogue that links studies, research and practice.

Ecole d'Architecture, Grenoble, France

Olivier BALAY
Grégoire CHELKOF
Jean-Jacques DELETRE
Philippe LIVENEAU
Nicolas REMY
Nicolas TIXIER

Building atmospheres

Introduction

Research at the CRESSON laboratory (CNRS mixed research unit 1563) focuses on the perceptible environment and architectural and urban atmospheres. Cresson advocates a qualitative approach capable of helping and possibly guiding the strategies and processes of architectural design. Initially focused on the sound space the laboratory broadened the scope of its investigations to the many dimensions that are perceptible *in situ.* Research addresses the phenomena of light, heat, smell, touch and movement. It is based on original pluridisciplinary methods at the crossroads between human and social sciences, between architecture and engineering science.

Drawing on this culture, each member of the laboratory and teacher at the school sets out to develop in his or her classes a pedagogical approach that teaches students to make allowance for atmosphere at every level of design: how to qualify a site in terms of atmosphere? how to draw up a perceptive programme for an architectural project? how to conceptualize the atmospheres of a project? how can work conceptualizing atmosphere initiate a particular process for producing a space? how to achieve the sought after atmospheres in terms of actual building? how do reference projects contribute to the design of tomorrow's atmospheres? how do atmospheres enable us to revisit classical categories of architecture?

Atmosphere as a transdisciplinary object

Whether addressed in design or construction exercises atmospheres enable a rich dialogue between disciplines. Asking students to do design work on atmospheres, build atmospheres, or experiment and make expert appraisals *in situ* are all ways of articulating design work and the learning of classical building techniques.

Atmospheres are a meeting place between the various trades that surround architecture. Atmosphere provides a starting point for dialogue between designers and builders, as it is a transdisciplinary idea that is meaningful for everyone involved.

Our experience of teaching shows that building in the classical sense is developed by the exercise of design at various moments and in various modes: sometimes building elements generate an architectural project, sometimes they only appear at the end of the process once the project, stripped of its material contingencies, at last exists in a conceptual form and it is time to focus on its material realization. We have all been confronted with a situation of this sort. We believe there are neither good nor bad approaches. What strikes us as fundamental, on the other hand, is the ability of students to organize their intentions, be they conceptual

or construction-oriented. As such the notion of atmosphere seems to offer a new means of overcoming this dichotomy by proposing different attitudes – intervening as a designer, or builder, but above all as a designer aware of the building choices that his or her intentions involve.

This article sets out to show what a theory of atmosphere has contributed to teaching of building and design in all the modules at Grenoble's school of architecture.

More precisely this paper will present the following exercises (to facilitate understanding the years indicated correspond to the new European organization of study (Bachelor, Master, Doctorate) regardless of how the new system will actually be applied in our school for the 2004-2005 academic year:

Studying Atmosphere

Inhabiting – Dwelling: design gestures, architectural and urban atmospheres

Philippe Liveneau - Bachelor, 2nd year

This exercise is organized around three pedagogical modes: analysis, experimentation and design. They enable students to understand and conceive the quality of the dwelling starting from the issue of architectural atmospheres. Each phase of the exercise centres on a morphogenetic operator, in other words a design gesture that enables the student to conceptualize and achieve articulation of the physical, perceptive and usage dimensions of the project: bending, cleaving, deploying and "imprinting". This prompts students to:

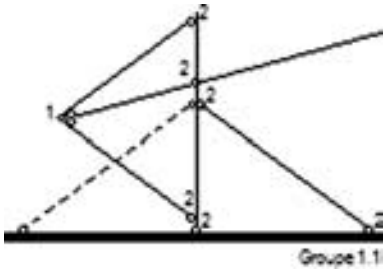
- analyse housing projects from two points of view, namely the perceptive quality of the resulting atmospheres and the design gestures involved;
- experiment with and test the quality of the atmospheres each design gesture produces. Through the production of a small wooden dwelling accommodating two to three people in a sitting position, students can test at the scale of the human body in movement the quality of the spaces obtained depending on the gestures previously analysed;
- design a student flat on the university campus comprising two main areas with distinct atmospheric qualities, one turned in on itself, the other opening onto the surrounding landscape.

Students are required to report on their approach, capitalizing on their analysis and experimentation. They design their project starting from a design gesture which offers a means of controlling the atmospheric qualities of the dwelling being designed.

2.5m x 2.5m: Structures and forces

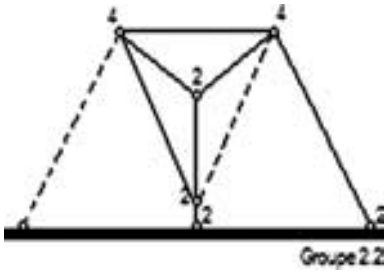
Nicolas Tixier, Nicolas Remy – Bachelor, 2nd year.

This exercise is the second learning phase started in class. The bases of statics are presented to students who very quickly are asked to analyse from a particular point of view the theories of static equilibrium underpinning reference buildings and constructions to be seen in Grenoble. This phase links a classical pedagogical approach based on class teaching with in situ observations in which the atmospheric qualities of a building are related to its structure and building materials.



The exercise presented here seeks to make students experiment their understanding of the structure and resistance of materials (does it work? can it withstand that stress? how can we build it? etc.). Students are asked to produce a lightweight structure subject to the following constraints: woodframe structure (posts and beams) with metal tensors. It must be anchored to the ground using existing inserts that form a 2.5 x 2.5m square. Triple ties are forbidden and the structure must be isostatic in all three dimensions. A person must be able to enter the structure and stand up inside.

This exercise measures students' theoretical understanding and their observations of other buildings against their ability to undertake a simple programme.



The greatness of the very small

Olivier Balaÿ - Bachelor, 3rd year

This exercise starts from a reconversion project on an existing building. Students are asked to find out how potentially identifiable, often tiny local roots might form the basis of a new project.

Architectural work starts with individual applied research focusing on the selected site. It continues with confrontation of project players and the disciplines capable of asking pertinent questions (opening up to interdisciplinarity). The method of work situates the project process as part of the search for a theme (expressed as three notions or concepts) permitting analytical observation of the territory, putting the project into shape and strategic action. Techniques for dealing with environmental and landscape issues (atmosphere analysis) and the ones for guiding the design of interior spaces are particularly sought. Students are prompted to concern themselves with producing a building in the service of humankind.

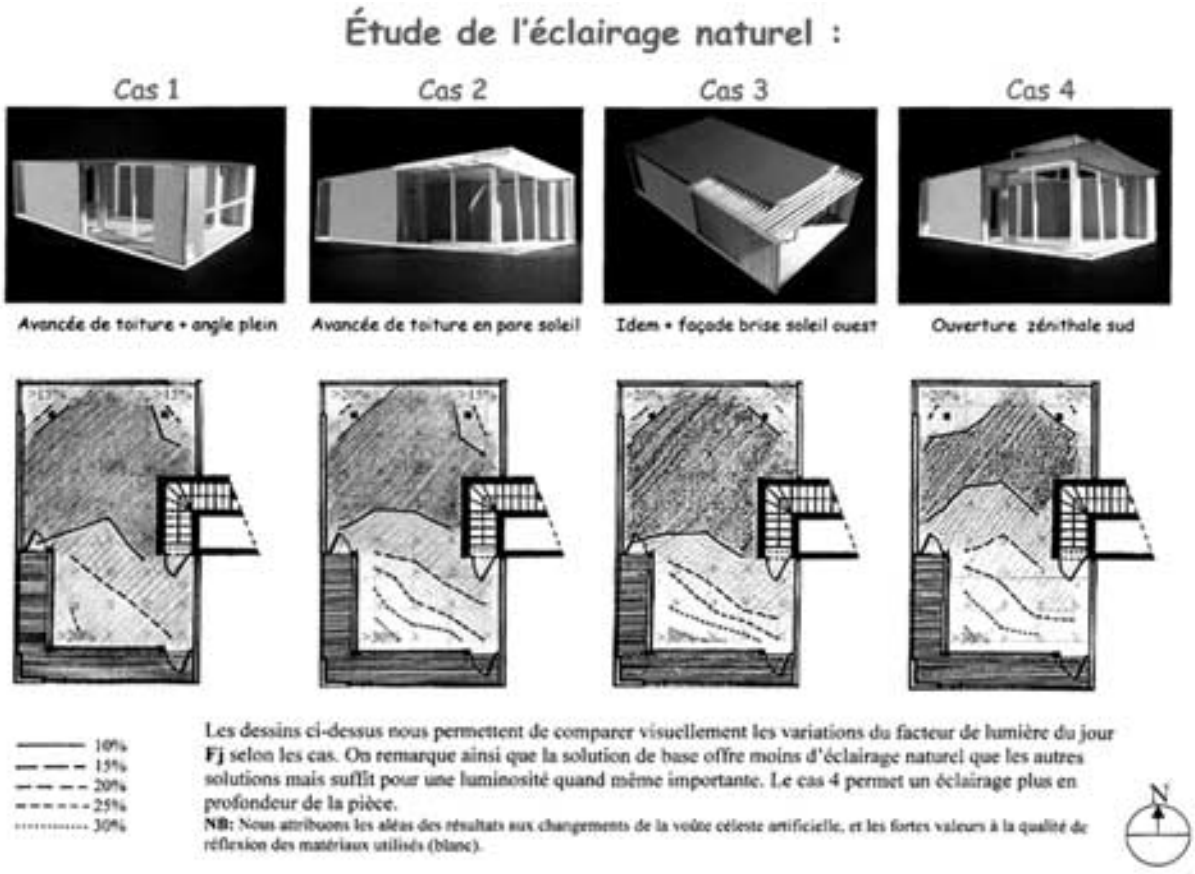
In terms of methodology the exercise incites students to seek out the qualities of the location and building under study, to describe them and imagine the people who would take pleasure in identifying with them. This in turn provides the incentive for a proposal (how to start a project? or the art of perceptive description). Analysis may serve as a strategic tool for rethinking the links between existing buildings, their location and the new project. This approach requires a two-way exchange between description and design.

Mastering atmosphere: achieving comfort with sounds, heat and light

Jean-Jacques Deletré, Nicolas Tixier and Nicolas Remy – Bachelor, 3rd year and Master, 1st year.

The overall objectives of these exercises are to:

- give tomorrow's architects ways of mastering atmosphere and a grasp of how it fits into the design and construction of our built-up environment;
- acquire basic tools and a way of working enabling them to integrate the sound, light and heat environment in project design;
- understand the simple physical phenomena linking sound, heat and light parameters to our daily environment, and acquire the necessary notions to keep track of changes in concepts and tools;
- show how such data is closely connected to our historical, social and cultural environment.



Bachelor exercise, 3rd year: starting from a design exercise done in the construction class, focusing on work on mass and framing, the aim here is to simulate on an analog mockup the natural lighting and exposure to sunlight of a room, deciding its allocation and which part would get the most light. In particular the aim is to test the solutions considered at the outset and to compare them, after obtaining initial results, to a range of other solutions.

In preparation for this work students receive teaching in class and do a supervised assignment involving the relevant techniques. The school has purchased luxmeters and specific software for natural lighting and heating. Next year it plans to build an artificial sky and a new heliodon.

Master exercise, 1st year: This work involves making allowance for sound atmosphere factors in an architectural project. The basic project may be underway or already complete (in the architecture studio). The aim is to study a collective building with several floors (dwellings or public-sector building) as a whole and how it relates to its surroundings.

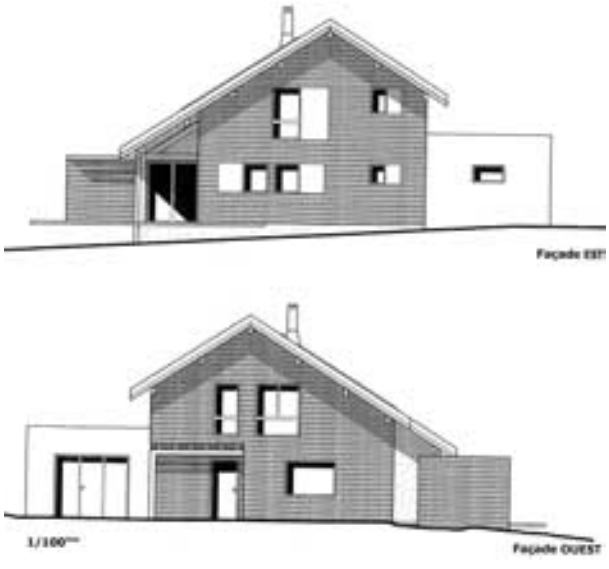
Students are asked to present a critical commentary on integration of sound elements, highlighting the positive sound features of their project, then ranking sound problems noting their position and possible ways of solving them (illustrated by sketches).

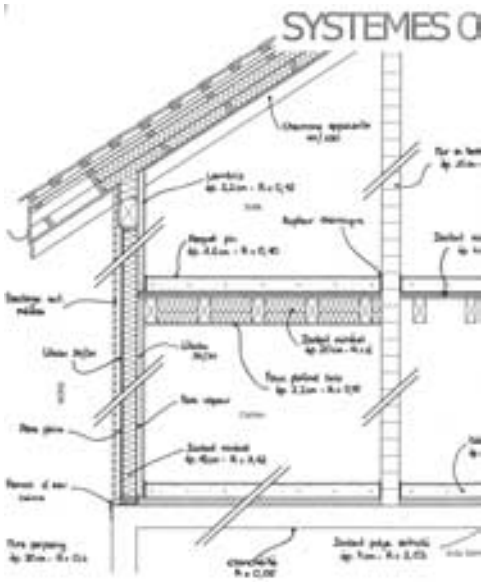
Possible solutions must be presented giving priority to architectural (rather than technical) solutions and assessing which are the most relevant (in

terms of results, cost, durability, etc.). Technical solutions may be proposed, with the appropriate calculations in an annex, depending on the complexity of the design. In preparation for this work students receive teaching in class, with supervision by two people during their critical analysis.

A second exercise aims to design a private house exclusively on the basis of thermal criteria. Students are asked to design a space occupying 150 sq m, detailing:

- context and dwelling rationale: geographical position of site (which way it faces, slope, prevailing winds, screens near and far, climate characteristics, exposure to sun and energy contribution on vertical walls at the two solstices, and finally occupation plans);
- the project itself with a ground plan (1:200), a plan for each floor, facades and a relevant cross-section to understand thermal issues;
- a presentation pitch, with short texts and diagrams describing rationales for warmth (winter comfort) and coolness (summer comfort);
- building systems used, details of the various elements making up the project;
- calculation of the building's conductance.





Experimenting with atmospheres – designing, building and using architectural objects

Grégoire Chelkoff, Philippe Liveneau – Master, 2nd year.

The pedagogical objective here is to integrate atmospheres involving several senses at the root of the design concept. We see this as a valuable means of prompting a dialogue between material and construction-oriented issues and the sensory characteristics of the aesthetic experience and the usage values of the design. But one of the main problems is that second-year masters students have difficulty grasping how a design is

perceived in terms of light, sound and movement. We consequently seized the opportunity of making mockups on a scale corresponding to bodies in movement the better to grasp these factors which are hard to represent and conceptualize when building. Starting from the idea that these qualities are poorly identified and do not weigh heavily in decisions in conventional architectural representation and design, dependent on drawing or digital simulation methods, the experiments we undertake aim to encourage atmosphere-oriented architectural design. In other words we set out to modify the cognitive attitude of the design process and favour the emergence of criteria specific to atmosphere-oriented thinking.

Since 1999 this exercise has experimented with full-scale atmospheric objects that we call "multimodal ambient devices" (DAM). After starting at Grenoble's school of architecture we continued the experiment at Grands Ateliers de l'Isle d'Abeau.

Conclusion

We hope that this overview of the exercises used for the teaching of atmospheres shows one way of overcoming the rather outdated opposition between studio and construction-oriented teaching. This type of approach also provides a possible response to contemporary changes in architectural practice, notably regarding sustainable growth, but also more generally from the point of view of the environment, architectural quality and user comfort.

In conclusion we may say that our pedagogical experiment also shows that thinking in terms of atmospheres offers students a way confronting their ideas with the perspectives of architects, engineers and sociologists. It thus represents a way of anchoring their work in a solid methodology essential to cope with their constantly changing trade.

Acknowledgements

We would like to thank Vincent Michel, the head of the Grenoble School of Architecture for agreeing to fund the missions of Nicolas Tixier, Philippe Liveneau and Nicolas Remy for the various EAAE meetings in Thessalonica (2002) and Athens (2004). We would also like to thank Jean-Paul Thibaud, head of Cresson, for paying for translation expenses. Lastly our thanks to Harry Forster for his enlightened English translation and to Grands Ateliers de l'Isle d'Abeau for the welcome they gave to our experiments with building atmospheres.

Ecole d'Architecture de Normandie EAN, France

Nicolas NOGUE

Innovation and Constructive Culture

There is a strong need today to develop a teaching unifying the construction culture with a historical approach in order to stimulate the creative capacities of students in the field of technical innovation. Such a teaching aims at :

- Focusing on innovation with different examples of the past to approach and finally better analyse the **new processes of contemporary innovation.**
- Analysing the process of innovation **through the role of the different partners of the project:** client, architect, engineer, industrials, contractors,... and replace this process in its historical context in order to show that constructive innovation has strong links with the other fields of intellectual and social activity: art, science, economy, politics...

A project has already been developed in this direction at the EAN for the exhibition "The *pan de bois* in Normandy, architecture and identity" (study of traditional wooden framed buildings in Normandie). We analysed the architectural "objects" but also:

- studied the technical evolution through ages
- tried to understand how this building technique became a strong image of the identity of the region. So that today we can find, for example, building walls in concrete covered with paintings imitating the traditional wooden frame, which has nothing to do with the reality of the structure. On the other hand, the strength of the link between Norman identity and wooden frame has damageable consequences for heritage: public authorities tend to foster the destruction of old buildings made with other materials, like brick, which is wrong, in a historical point of view, since in the nineteenth century - and particularly for industrial buildings - brick was then one of the main materials used in construction.

The proposed teaching develops this approach as a workshop with 4th year students. As said, the understanding of the process of innovation relies on the following points:

- the relations between the different partners of the projects (architect / engineer – architect / industrial...);
- the issue of technology transfer;
- the cultural context (from art to science)

These lessons lead to:

- better know the world of engineers;
- show that innovation is the product of a culture, of a historic period, just like art for example (indeed, we realized that students don't have this awareness)

Examples

1. The work of Gustave Eiffel can be used to show the links between the innovation in science (theory of the strength of materials for example) and industry (evolution of the production of metal), the role of the private railway Companies, their relations with modern finance (bankers).
2. The new shells in steel made in the thirties emphasize the connexion between:
   - the new high resistance steel sheets produced then by the industry;
   - the new techniques of welding on the site, outdoors
   - the use of a new kind of scientific design method
   - the demand for bigger buildings (aeronautics)
   - Transfers of technology: from aeronautics to building techniques
   - The aesthetics of purity
3. The industrialization of social dwellings in the 60's can be studied by analysing :
   - previous experiments in industrialization and standardization (XIXth century)
   - the role of the State through regulation
   - the new relations between engineers, contractors, architects and clients
   - the aesthetics of repetition and modularity
   - ....

Conclusion

Through this teaching, we would like to emphasize and then study different innovation processes without putting to the fore one or another.

- On this basis, we would like to help students be aware of contemporary processes for innovation and then help them find their own places/roles in this process as architects
- The aim of these lessons is also to make the students realize that architects don't have much power on the material production of a society so that they have to think in terms of strategy if they want to keep the control of their work.

Ecole d'Architecture de Versailles, Paris, France

Nadia HOYET

The Teaching Construction and the New Materials and Techniques

What should be the necessary competences end skills acquired through construction education that allow architecture graduates to be capable of following the rapid development of the building industry in producing new materials ans new construction methods respectively ?

What sould be the necessary educational methods and strategies to ensure these competences and skills ?

I will answer the question, in the field of materials and components for architecture. I teach this subject at two stages of the curriculum. For the bachelor's degree and the master's degree.

I will conclude with some ideas about the Ph.D. ; to complete the european LMD.

In general, we never know what type of new material will come to market in the future. We can note 2 major trends in the production of building materials, which influence future evolutions :

- scientific progress elaborates new materials, every day, especially with composites, polymers, and mixed materials.
- Due to diminishing mineral and fossil resources, it is necessary to find feasible substitute materials for the future.

One didactic strategy to teach « unknown knowledge » is to allow open reflection.

I try to apply this principle in my two courses.

During the bachelor's degree, students may be able to analyse and understand how and what materials are made of and to identify technical and architectural characteristics of the materials.

To reach this aim, I organize the courses about principal materials in 2 parts.

Principal materials are :

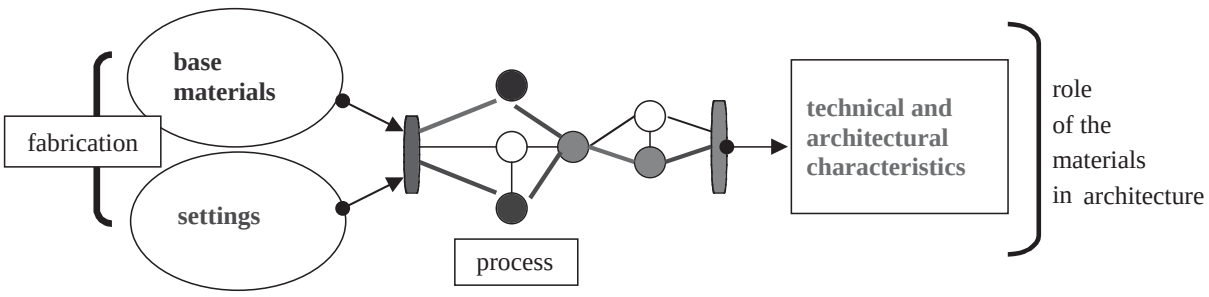
- mass materials such as clay, brick, stone, concrete
- structure materials such as wood and steel
- enveloppe materials such as glass, polymers and also plaster.

In the first part of the lesson, I show that the transformation of base materials belongs to a systemic process, with interchangeable elements and settings, composed in different manners to obtain technical and special specifications.

Mass, structure and envelope materials.
Examples of Peter Zumtor's architecture:
Thermal Baths. Vals. Switzerland
San Barnabe Chapel. Switzerland
Kunsthaus. Bregenz. Austria

In the second part of the lesson, I show the material's role in an architectural design, with case studies from contemporary architecture, or from vernacular and traditional architecture.

The understandind of this systemic process, makes the students conscious of phenomena which appear in the fabrication of any material and thus any architecture, without binding them within a limited knowledge of present day techniques.



Base materials of concrete:
Each new material depends on type of base materials

To summarize, the 2 major trends mentioned above, are integrated in the manner of teaching :

- first, in the future, students will be able to ask appropriate questions to discover any new materials and so, will be able to understand their composition and fabrication, related to architecture.
- second , sustainable development requires knowledge about materials and energy. It begins with the analysis of the process to identify renewable or recyclable materials and low energy settings.

The second course that I teach, is offered during the master's degree.

A this stage, I think that students (only interested students) must be able to design components for building, using the possibilities of tomorrow's technologies.

This idea is founded on several trends of evolution.

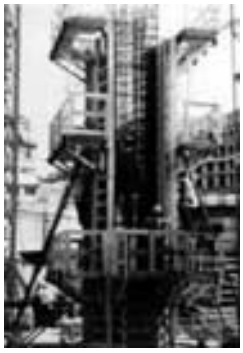
First trend

The first trend that I have identified concerns the reality of the building site.

The « value added » of the materials moves from the building site to factories. Trades of building are changing in a deep way. Labor intensive work is disapearing from the building site. Construction workers become people who assemble complex components which are produced in factories. These complex components require design. Architects are able to design these products with engineers, but are not specifically trained to do this.

Second trend

Base material notions are enhanced through the association between different materials. For example, the use of polymers transformed traditional materials :



The value added of the materials moves from building site to factories.

- laminated glass would not exist without butyral film
- new high perfomances concrete would not exist without admixtures (adjuvants)
- laminated wood or OSB panels would not exist without glue.

and so on...

This infinite variety of products requires the definition of expected performances for the building construction. We must know the specific functions of a material in a building before fabricating it. It is like the definition of a program for architecture. It is an integral step of the design.

Definition of the materials for architecture.
The concrete of Pont de Normandie (France) is not the same that Roland Simounet used for the Musée de Nemours.

Third trend

Computers allow the management of more and more parameters in the process. So limited fabrication to the scale of one building is possible today. But architects must be able to specify and order this kind of production.

Fourth trend

New trends in architectural design are created with surface materials. For exemple, the skin of a building becomes a major element of the architectural composition. New software modelling programs have liberated the boundaries of forms to various non standard conceptions. Architectural concept design is focused on materials and textures in a more sensitive manner. For example, acoustic qualities of a material are

considered with as much attention as the visual design quality of these materials.

In addition, the study of the envelope is focused on the dialogue of the building with its surrounding environment. And this is a very important aspect of contemporary building.

So, presently, architectural design works a lot with materials 'specifications.

Fifth and last trend

In certain cases, the client, or the contacting authority, makes decisions about material choices, their lifecycle and their upkeep. They may even elaborate technical systems which determine these requirements at the first stages of concept development of a building.

These five points of evolution, observed from factory to building site, show the necessity of materials design. It has become a foundation element of architectural design. It is an integral part of the design process if architects want to control the realisation of their building.

The teaching method elaborated to respond to this development is composed of theoritical courses on materials, meetings with members of the building materials industry, visits of factories and special building sites.

In addition, the project design is divided into two parts :

1. definition of the role and the functions of materials, in other words, specifications writing.
2. materials design.

These 2 steps are studied simultanously and in conjunction with each other.

The problem formulated by the project, to be appropriate to the evolution, is the choice of the subjects. To be sure that students will be interested, I let them choose by themselves the project they will study. Clearly, their motivations and ideas belong to the culture of the future. They will be the actors of the future, more than their professors will be. With this didactic strategy, this year, for example, they have studied components for renewable energy related to architecture and urban design.

Finally, I would like to formulate wishes for a future Ph.D. The concepts that I have exposed above, may be continued in a Ph.D. degree with experimental research on materials for architecture.

Such as methods used by scientific researchers, we should build research protocols and their validation, which include the complexity of architectural criteria, where artistic creation, which is related with the meaning, is as important as rigorous scientific criteria.

If we succeed in achieving this kind of research, maybe european research related to the Grands Ateliers, we could pretend to produce alternative technical knowledge in opposition to engineers rules which supervise the construction today –as CSTB in France- , it will be a chance to provide the necessary technical evolution in architecture, including its own quality criteria.

School of Architecture, National Technical University of Athens, Greece

Miltiadis TZITZAS

The teaching of Construction and the rare and traditional knowledge

The Aim of the Course

The evolution of the developed countries, went through dramatic stages that left their scars on the environment, both natural and built, imposing on the future generations the responsibility and task to find the ways and means to improve it.

Therefore, it is crucial, for the architecture graduates, to understand that as they practice Architecture, struggling with demanding design and economic problems, they should not undervalue or ignore, parameters such as the quality of the natural and built environment.

In order to gradually achieve this aim, during the undergraduate studies, we offer an elective course, on the subject of conservation and rehabilitation of old buildings, aiming at the supply of basic learning for the students to understand and approach, the incredible amount and extremely useful instruction that exist in old buildings.

Through this knowledge they comprehend that issues like environmental awareness or an economical use of materials, were known and respected. Also, they understand that the existing Architectural quality, in those simply but functional and built to last structures, is a result of a way of construction methodology, that contains the experience of hundreds of years and has been tested successfully, through the influence of natural phenomenon.

As they gathered experience, they feel more confident in designing new buildings, since they realize that so many Architectural and construction issues, are not new but, in fact, quite old and timeless.

The Course Curriculum

The structure of the course, does not aim to train young students into experts on conservation, it strives rather into giving enough information on the methods, the approach and the difficulties involved.

The course covers one semester and contains both theoretical and practical training, as conservation is one of the subjects that requires a lot of fieldwork.

The selection of the old buildings that will be surveyed is a very important factor for the success of the course. Although Greece is a country with a wealth in historical monuments of many periods, Classical, Hellenistic, Byzantine, we focus our research and analysis of old buildings, on vernacular architecture of the 19th century.

The reason for this selection is for instructional purposes. The simple, but not without Architectural and constructional interest building, is easily approached by the students and simultaneously it has a more comprehensible construction system.

Fortunately small villages with interesting regional Architecture, exists all over Greece, thus making the selection of buildings with intriguing construction systems, for instance, not difficult. The reason for this selection is the very interesting fact, that a construction constrain caused by the same effect, for instance, earthquakes, is regarded differently, in a mountainous village or in a coastal one.

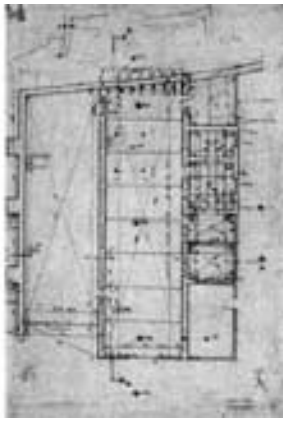
Last but not least, the selected buildings have to be, not in prime conditions, in order to register the influence, that time and natural phenomenon, had implement into the structural system, their external envelope and interior space.

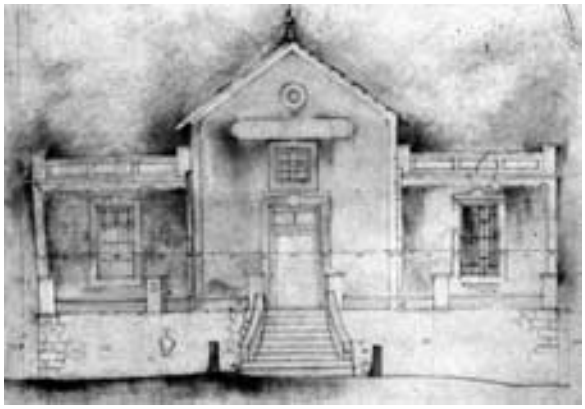
At the beginning of the course, a series of lectures supply them with, as much information is possible, on the approach, the recognition of the architectural styles and methods of construction. The vocabulary of the vernacular architecture is pointed out, identifying the variations according to the locality and the environmental parameters, without ignoring the social factors.

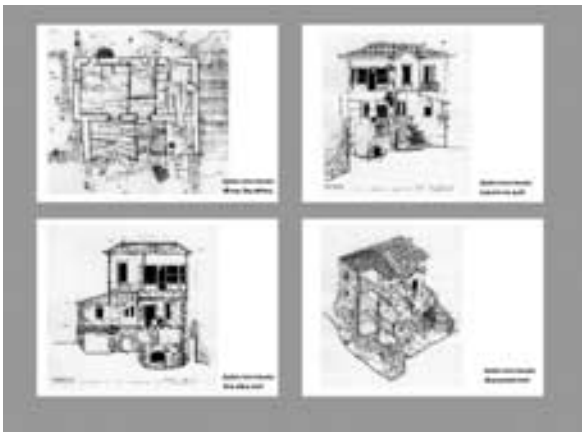
The theoretical material is complemented with examples of different methods of construction quite extensively, as they differ according to local conditions related to the climate, the ground relief and quality and most important, the seismic conditions, an element that has affected the development of many areas in this country.

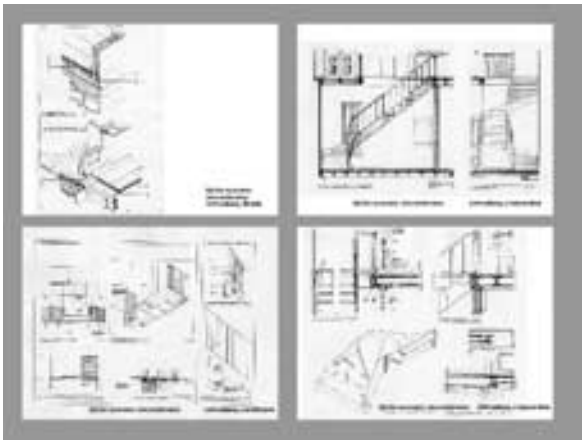
Theoretical knowledge and information is always desirable, but cannot substitute practical experience. In that respect, a field trip is organized, where students, with the assistance of the teaching staff members, are asked to apply the information they have attained during the lectures.

When on site, the sixty to seventy students that follow the course, are broken down into smaller groups up to maximum ten persons. Each group has a member of the teaching staff responsible for it and all groups go to their designated building. The work begins with the analytical perception of the building and its elements. It continues with the sketching and measuring of the building, including every observation they can make on the morphology and the construction with the cracks and damages.









They analyse the construction method used and identify the interventions made due to natural phenomenon or other causes.

The aim is for each group to produce measure drawings of the assigned building. Furthermore, in situ and with the continuous tutoring from their professors, they familiarise themselves with the environment. They recognise forms that derive from construction necessities and produce an Architectural vocabulary based on real functional needs.

It is also essential, the understanding of the relation between different materials, how they perform individually and collectively, in order to form an active construction model which finally will produce a building consistent to the original desirable functions.

Once the field trip is over, the students transfer their sketches into proper drawings to scale, containing all the details the damages and remarks from their observations on site. Their drawings are as analytical as possible so as to assist the next phase with the introduction of the new uses and the construction improvements.

They have to implement the acquired knowledge in designing a proposal for the rehabilitation of the case study building. The designation of the use of the building, either the original one or a new one, is top priority. The work is completed in the studio with the use of the measured drawings and it contains all the necessary working drawings for the realization of the project. At the same time, the lectures are continued conveying knowledge on the conservation methods, the construction, the details and the materials in use.

The use of new materials, the reuse of existing ones, the relation of the new with the old one, the form that results, the distinctive acknowledge of the rehabilitation or the downgrade of it, are some of the various important issues related to their proposal.

Finally they have to submit a complete project that contains two parts, the measured drawings with the analysis of the construction methods used and the rehabilitation proposal with the construction drawings.

The Final Results

This is an elective course that has been continuously active in our school since 1976, almost for thirty years. We have been in some villages more than two times and that has been very helpful, since we were able to acknowledge the transformation that occurred in most of them and the experience was passed to our students.

The in situ study of the buildings, has an direct impact to the students, since they measure, touch the materials with their own hands and they involve themselves with the methodology how to research, analyse, understand the construction, in order to implement a rehabilitation proposal that will not affect the stability of the structure and will not distort or affect beyond repair, the Architecture of the building itself.

Some Thoughts

The architecture graduates, that have participate in this elective course, fit to the profile of the student that has a special interest to explore and

study construction methodology, to understand why buildings stand and how that need affects, if it does, their design.

On the other hand, there are students that believe that there is a clear distinction between design and construction.

An attempt to explain this interpretation, could be that today, specialisation characterizes science, thus the impression that there exists many different architects, specialised in various domains, which is not totally untruth.

Nevertheless, as a result of such an impression is the production of buildings architecturally totally indifferent, with poorly designed details, unfriendly to users, more expensive that they need to be, for their construction and their maintenance, with an unconcerned attitude towards the environment and natural resources.

On the other hand, it is a absolute fact that contemporary Architecture that produces quality and distinguishes herself, is created by architects that care about construction methodologies and appropriate materials, designing details that emancipates quality and comfort in the composed spaces.

Finally we, as teachers, should insist on this direction, in order to inspire our graduates to produce solid and sensitive Architecture, which is lacking so badly to day.

Aristotle University of Thessaloniki,
School of Architecture,
Thessaloniki, Greece

Nikos PANAGIOTOPOULOS

New Realities and Emerging New Tasks in Building Construction Teaching

The New Realities within the Environment of Construction Teaching

Teaching construction is subject to constant change. The main reasons are

- Changing practices in building construction with a shift towards the implementation of manufactured products
- The rapid developments in Informatics, providing new means of planning, design and communication
- The European environment we all live and work in and the common European perspectives we all share
- Global factors, mainly the globalization of production, economy and labour.

Developments in Building Construction Technology

The percentage of industrial products within the building process is steadily increasing, supplanting manual construction. This fact is evident even in the less industrialized regions of Europe. Prefabrication, meanwhile, comprises not only elements and components, but also entire structural systems (Pictures 1-4: Structures, 5-8: components).

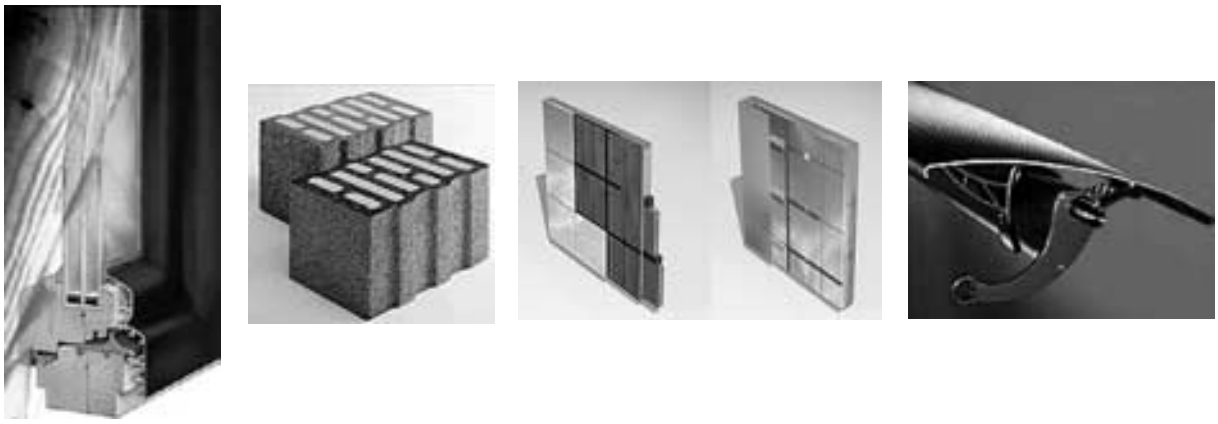
The transition from labour to product oriented construction effects dramatic changes in building practice. The main arguments for this product dominated building construction are:

1. The planner is able to acquire sufficient information about the product, so as to conclude on its adequacy, its applicability and its performance.
2. The quality and efficiency of a product can easily be tested and certified on the production site.
3. The efficiency of the product is known beforehand.
4. Constructive perfection guarantees more accuracy in the mounting process

Thus, the design of components and buildings becomes a process following two distinct directions:

a. Industry affects building design and building practices: This is, to a lesser or greater extent the main tendency in building practices today.
b. Construction design shapes a (new) product. This is the less trodden path, yet the most desirable target to aspire to in architectural education.

Pictures 1 – 4: Examples of ready –made structures provided by private firms



Pictures 5 – 8: Various high-performance building components

New Media and Aids for the Architect's Education

New aids are offered to designers, planners, teachers and students by computer technology. Media provided by computer technology and the development of networks are radically transforming planning processes. The advantages of these aids are obvious:

1. Co-operation between engineers via local or global networks.
2. Availability of architectural construction and mounting details, based on specific products.
3. The feasibility of many successive adjustments at a low time or material expenditure, due to Computer Aided Design.
4. New presentation methods allow for easier understanding and accurate briefing among designers, contractors and clients.
5. Several types of software assist optimization of the building process

A Common European Perspective

A common European perspective imposes upon new architects a common level of skills, to meet the needs of a common European market. The E.U.'s policies emanate from economic - political considerations, as well as from various factors inherent to the profession of the architect.

The economic - political considerations deal with the optimization of the cost to need relationship, the use of human capital, public health and also questions of energy consumption. This latter parameter is seen at the moment within a geo- political context, i.e. dependence on fuel imports implies economic as well as political dependence. To this end, the European Union issues a series of guidelines with regard to quality control, product performance, mounting, controlling various environmental parameters. In certain middle-European countries, governments subsidise energy-efficient building design (passive houses).

A Global Perspective

This emerges from the globalization of economy, competition and the opening of markets.

In this context, moral issues are brought to the foreground, dealing with the commitment of the architects as an independent and conscientious profession to future generations, inspired by and in accordance with the U.I.A. Declaration of 1993 and the Kyoto Protocol of 1997.

The Emerging Tasks for Construction Teachers in Architectural Education

With regard to points

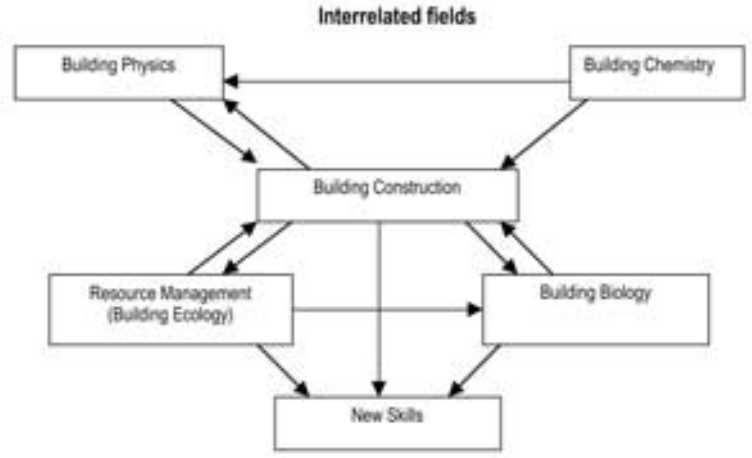
Construction Using Products

- Increasing product -oriented construction imposes a new role on the architect, namely that of a composer and a manager of processes.
- A new architect has to be informed not only about the existence of a product, but mainly about its applicability and features.
- An architect ought to know what to expect of the building in its entirety.
- In addition, the architect is in charge for the proper mounting and the appropriate combination of building compounds. Industry does not always accept responsibility on the building's total performance.

Universities should control information coming from industry and not the other way around. It is the task of the instructor/ teacher to raise the students' awareness on the fact that each building constitutes a specific case and hence there is no such thing as a global applicability of all products in any building.

The above premise leads us to introduce new contents in architectural education. As knowledge in statics and building physics has already established itself as a sine qua non in the architect's education, one should gradually allow other relevant fields of knowledge to enter our curricula, such as building biology and resource management.

The graph following below depicts the interrelation of the various relevant bodies of knowledge with architectural construction:



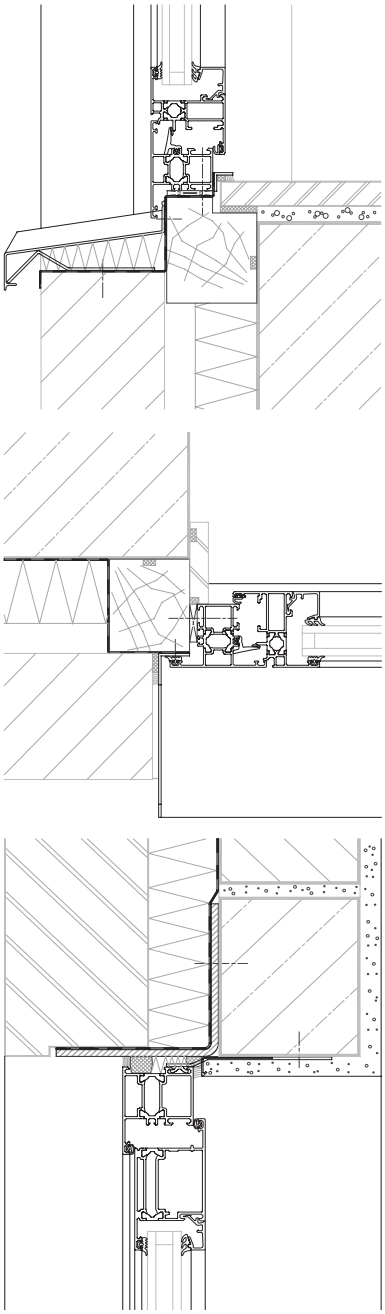
In addition, apart from integrated planning, which gradually and inevitably establishes itself in architectural practice, there are numerous of skills, opening the way to new professions, within and around the architect's profession, such as:

- Marketing
- Facility management
- Consulting
- Soft skills

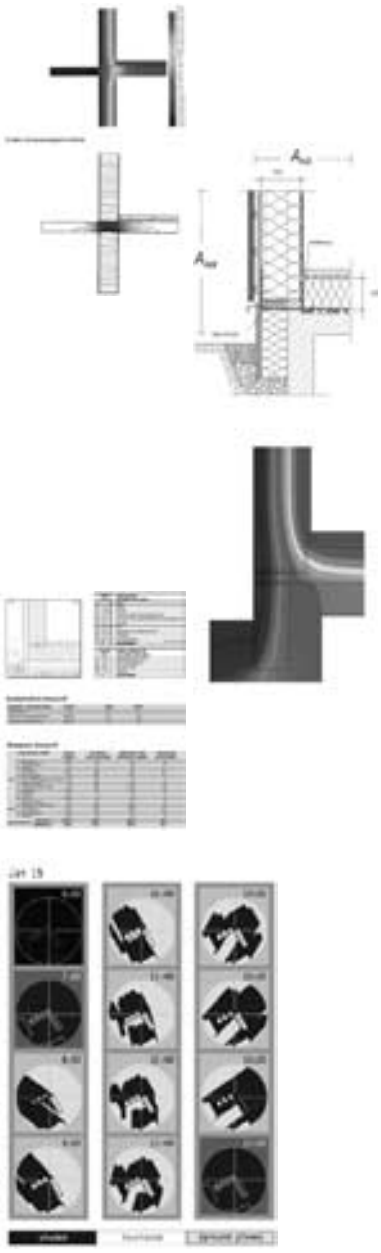
Architectural schools have to keep up to date, regarding these new perspectives and impart knowledge and information to their students.

New Aids to Construction Design

- As aforementioned, networks facilitate interactive communication between planners and designers. This is a valuable help for a multi-faceted planning process. Instructors should take advantage of these means to inspire and underscore the notion of integrated planning, which is today an absolute precondition for a project's frictionless materialization, performance and image.
- Private firms issue web pages, some with extensive information, in order to promote their projects. Our schools should also attempt to create their own CAD libraries with components, construction details and guidelines, addressing students as well as contractors and professional planners. Innovative design should be promoted in our schools, if we wish to preempt industry infiltration (Pictures 9 -11).
- There are several non-profit organizations and independent institutes active on sectors related to energy management, indoor climate and sustainable building design. Schools of Architecture have the chance to cooperate with such institutions, in order to supply students with



Pictures 9 -11: CAD – Details provided by private web sites



Pictures 12 -15: Software and catalogues for energy management and sustainable building

planning aids, e.g. on building analysis, statics and construction, building physics, environmental design and resource management, as an incentive for research and developing design skills (Pictures 12 – 15).

A Common European Perspective

Recent developments in today's building construction should not be left to industry initiative alone. The European Commission intervenes with guidelines, standards and codes of practice to control the performance and applicability of a multitude of existing and daily emerging products. Our schools should contribute in this effort. Today the European Union covers several latitudes, and hence schools of each country have to elaborate on particularities in climate, economic and social parameters, in order to expand the applicability of codes and guidelines.

Another point is that European Guidelines are dictated by economic – political rather than moral considerations. We think it is a task for the instructors to supplement directives with other considerations of a rather moral nature, such as sustainability and architectural ethos.

The Global Perspective

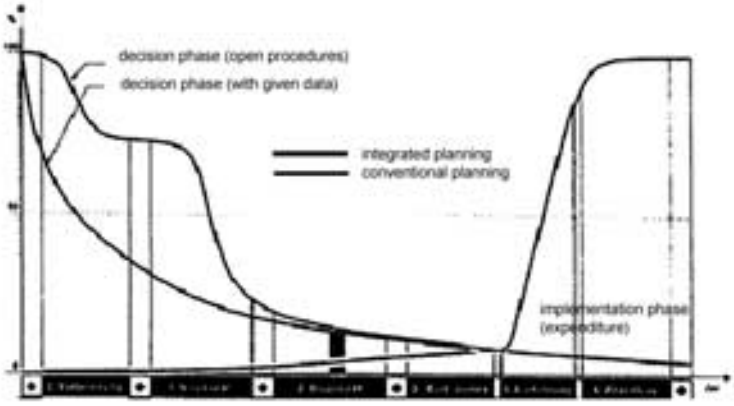
To the question, whether the objectives of the Kyoto Protocol are relevant to the architect's work, one should definitely answer: yes. The issue is space, living space in a global sense. The changes in the global climate, the protection of drinkable water deposits, the careful use of ground and materials with respect to the generations to come, should enter the scope of architectural education.

Picture 16: A much appraised and awarded project, which could serve as an example of typical modern architectural ego: Perrault's building, apart from the massive use of tropical wood, also fails to take its own purpose into consideration by endangering books through vast areas of glass.

Picture 17: Piano's Cultural Centre in Nouvelle Calédonie stands out as a remarkable feat of environmental and structural design

Conclusions on Future Teaching Approaches

The general notion underlying everything aforesaid is that of integrated planning. This as a premise for dealing with all future challenges in social, political and technological developments. Integrated planning may necessitate more time for planning and decisions, but it secures a much smoother implementation process and, what is equally important, it guarantees a better image for the project.



Picture 18: This graph draws a comparison of the expenditure required for a project's implementation in two cases:
1. *The project follows the conventional planning procedures*
2. *The project follows the tenets of integrated planning*

One can see, that expenditure is larger at the decision phase in the case of integrated planning, yet much lower at the implementation phase, whereas for conventional planning, the curve follows a reversed course

Evidently, integrated planning requires proper schooling during architectural education. Taking this into consideration, we should offer integrated studies, that is, we should organize multi-disciplinary training projects, integrating several subject fields. A single person or a group of persons covering a specific field would not suffice anymore to deal with future challenges. Cooperation among different disciplines, within a common framework is gradually becoming an imperative. This effort should start at an early stage of the students' education, to allow for optimal results. It is needless to underline, that university teachers should be steadily updating their level of knowledge. How this re-thinking and re-structuring of our curricula would be feasible, is a concern all our schools should share.

University College Dublin
School of Architecture,
Dublin, Ireland

Elizabeth SHOTTON

Fig. 1. Francis Matthews, Depth Of Field And Motion, Generic Office Space In Urban Infill Site, final model

Technical Intuition
Experimenting with the Role of Reason and Intuition in the Design Process

"Intuition and concepts constitute, therefore, the elements of all our knowledge, so that neither concepts without an intuition in some way corresponding to them, nor intuition without concepts, can yield knowledge... thoughts without content are empty, intuitions without concepts are blind"

Kant, Critique of Pure Reason

A Discussion of Principles: Comments on the Conference

There was some discussion, formal and otherwise, at the recent EAAE conference regarding the relationship between the teaching of technology and the traditional design studio. Some very positive experiences were related but there was some hesitation voiced regarding the influence and role of design studios in developing a student's attitude toward technology as well. Now it is an interesting thing to hear this hesitation voiced *from the other side* as it were. Speaking from the vantage point of the design studio, there is often a similar hesitation on the part of design instructors as to the role that technology should or does play within the territory of design. Yet design instructors are not opposed to material and technological sophistication being exhibited in their students work. Quite the contrary. Despite the reputation we may have among technology staff the vast majority of us desire the fullest realization of a design project possible. So how is it that such a mutual distrust has arisen?

There is no simple way to trace the origins of these misgivings and misunderstandings. But what seems clear from contemporary experience is that many design instructors fear that technological imperatives may have a limiting affect on students' imaginations. That all design work will be reduced to the known solution and experimentation will cease to exist. Yet experimentation is an important part of the role of design studio projects...to encourage the questioning of convention in an effort to better understand the potential of architecture. What is being expressed is not a dismissal of the importance of technological imperatives but a refusal to accept limitations by its hand. But are limitations in creativity really necessary if technological imperatives are addressed in design? Given some of the more insightful lectures at the conference this seems a false worry. Indeed

the range and depth of experimentation and invention exhibited across the conference is reassuring to at least this design instructor and begins to suggest that the problem we encounter together is an illusion of our own making. We all, for the most part, desire the same end and could, if we chose, be mutually supportive of one another to the ultimate benefit of our students.

Naturally the answer to this false schism lies within the domain of both the design studio and the technology course. And this paper presents a version of a more integrated and supportive format from the design studio perspective. But prior to launching into a discussion of this proposal it seems useful to comment on a version of a solution from the other side, the side of technical instruction, which seems potentially supportive in a similar manner.

As a conference intentionally focused on the issue of new materials and technologies the question of how to teach an ever expanding field of knowledge was grappled with continuously. Yet in truth there have always been new materials and new technologies arriving at our doorstep, certainly since the industrial revolution, which architects and engineers have been compelled to address and exploit in their design work. The only substantive difference is in the exponential growth in the types of materials and technologies on offer. Which is no small issue to address. Yet the principles remain the same; the fundamental principles of architecture as social and environmental mediator, albeit with significant changes in scale; and likewise building science, structures and construction technologies, though perhaps increasingly quantified and more readily analyzed, continue to operate on the basis of material properties, the means of assembly, the environmental context and of course scale. Is it truly necessary to address each possible material and technology in a course given that the underlying principles remain constant? Is it even possible? And perhaps most critical to the discussion at hand, is it even advisable?

At the heart of the discord between design studio and technology, from the studio perspective, is the conventional detail. It is this convention that creates such unease among design studio staff. And it seems the natural output of a technology course intent on teaching as many materials and systems as possible in the time given. And why should conventions inspire such misgiving? Because students, without a more fundamental knowledge of building science or structures on the *level of principles,* will default back into the detailing taught to them in technology courses, conventional or otherwise, if required to develop their design studio projects to this level. Without a more sophisticated understanding of the underlying principles which have governed the development of these standards the students have no means of evolving these details to suit a different design project, much less an experimental design project. Thus the potential of experimentation across all scales of the design project is reduced to accepted conventions, is reduced to the level of their competence in technology and their facility in rethinking these details based on a their understanding of the underlying principles involved. If we are to educate our students in a manner which encourages continual development as our material and technological choices increase then surely the key is to ground their learning in principles rather than specific solutions in an effort

to liberate their imaginations and creative freedom. This strategy has not only immediate benefit within the studio but a longer-range influence on practices as they attempt to accommodate ever-changing technologies and an increasing array of material choices.

Likewise for the design studio. While the depth of exploration in design studio can be fundamentally compromised by a lack of understanding of the basic principles underlying building science and structures, confidence and fluidity in these areas of knowledge can only be positive to any design process, particularly one intent on serious research driven exploration. But it is equally critical to reformulate the manner in which these material imperatives are introduced into the design process, how they are understood to relate to the design concept. All too often these issues are, if not abandoned entirely, addressed subsequent to the fleshing out of the design as a form, as a type of end-game tactic. A strategy which inevitably leads to mutations and compromises in form, conceptual intent and material resolve during the final stages of design whether in school or in practice.

The counterpoint position postulated by this paper is an approach which would recognize these material imperatives as inspiration in conceptual thinking, thus positioning these imperatives as early as possible in the design process, in fact prior to a schematic design phase. This approach enables students to use these issues as *strategic initiatives* in formulating a more precise definition of the polemic, which they are to test in a project. Implied in this model is an idea regarding design as research, or perhaps *research by design.* For while research is traditionally undertaken prior to a design project in studio in the form of theoretical readings, contextual studies or precedent studies, rarely are technological issues given the same pre-weighting in the development of the initial design conception. This is perhaps due to a misgiving regarding the limitation of choices far too early in the design process. Yet it could engender an opening out of possibilities if understood as preliminary research through design studies, the results of which inform the design process on the same level as other forms of preparatory research. This does not imply a lack of detail exploration in design at later stages but rather an awareness of their relevance from the outset.

UCD Thesis Program

The proposal is actually a model of the role which our rational and intuitive facilities play in the design process; developing the rational side of design as preliminary research where issues are confronted, be they theoretical, social, material or contextual, and carefully analyzed as to content and relevance which then liberates the design process itself to be intuitive, responding to a latent or unconscious understanding of these related issues with its success being wholly dependent on the depth of prior analysis. This model of investigative research and intuitive design was formulated and tested as part of the redesign of the fifth year thesis program at University College Dublin. The current structure of the final year is a slight recalibration of the previous model, adding additional layers which specifically address the ideas of research, the individual polemic and *the thorough investigation and translation of the polemic to material form.* The objective was to make explicit the material imperatives of architecture and its impact on the conceptual formation of the design.

Competencies and Skills

Though *competencies and skills* were not specifically addressed in our internal discussions these were implicit and are useful to extract for discussion. Our principle objective, to mature the students intuitive design skill, is a goal seemingly unrelated to technical competencies and skills. And intuition, as any design instructor knows, is a dangerous driver of design unless it has the capacity to draw on a wealth of information. Thus the means to enable the fluidity of this form of creative endeavour was to redress the lack of knowledge and skill which informs it, including those of a technical nature. This began by amending the form of research undertaken which would underpin the later design phase.

What often passes as research in architectural design studios would be more accurately described as superficial survey work which lacks both rigorous analysis and any critical conclusions which could translate to other design work. To achieve either one must first establish clarity regarding the questions being asked. In a thesis this takes the form of positioning one self within the broader architectural discourse and to establish this clearly enough to underpin critical research studies which would follow. Thus the first skill would be intellectual clarity which can be made explicit through verbal, textual or graphic medium, but must be underpinned by a depth of knowledge gleaned from literature searches, precedent analysis and, most critically, summarized into a conclusive argument.

From this one can establish a series of research studies which would test this position against the multiple imperatives which face any architectural project. This testing not only further clarifies the position but also establishes the relevance of each imperative and the possible means by which its astute manipulation can forward the design. This is perhaps the moment where the connection to technology teaching becomes clear. For the imperatives established in our program went beyond the traditional context, site and brief, the general cultural issues typically addressed in studio, and demanded a testing of technological imperatives such as environmental mediation, material use, structure and even economics, this being implicit within each of the previous three. Required to undertake these studies, in addition to clarity regarding the research hypothesis, are competencies with a variety of investigative tools as well as an ability to critically analyze the results in order to transform these studies into design principles.

Competencies with a variety of investigative tools are critical, with the emphasis on variety. The studies in our program were undertaken as design, thus used the fairly conventional investigative tools of models and drawings in the first instance. But equally important was recourse to other means of investigation which could inform this work such as photographic and video analysis of environments, computer modeling tools which could simulate thermal, sound or light environments, or full scale studies to achieve similar simulations. Without these tools for simulation the impact of design studies could not be successfully or fully interpreted. But neither could these simulations be valuable without recourse to the traditional tools for exploration to evolve the studies. Thus the greater range of tools we introduce our students to expands their facility to investigate more fully and creatively.

Finally the work requires analysis and transformation into design principles which can then be applied to a variety of conditions, in the same manner

perhaps that facility with the principles of building science or structures can be used more creatively in design then preordained solutions. Analysis of this kind is not a traditional strength among architectural students, perhaps due to a lack of experience in research, and can perhaps best be developed by demanding more rigorous research at an earlier stage in their design studies.

The results of such a structure have a direct bearing on the students' attitudes towards technical issues not simply in their studio work but in their future role as practitioners. Rather than teach specifics regarding technological knowledge we have invested the students with a critical attitude toward their relevance in the creative design process which has the capacity to provoke a continual pattern of research and experimentation and to encourage a form of *technical intuition* in their design process. And it is this perhaps most of all which is necessary to engender in our students if they are to address ever-changing technological realities, an attitude of curiosity and exploration which is supported by competencies in underlying principles, research tools and skill in critical analysis.

Educational Strategies and Methodologies

The 5th year program developed was based on a sequence of research workshops loosely described as; *thesis; precedent study; environment and economy; material and structure; context and brief* carried out in the first term of a three term thesis. These workshops were used as instigation for students to research these imperatives relative to their thesis intention through both reading and small design studies with the intention to both deepen and broaden the polemic and to equip students with strategic design skills which could be brought forward to their primary design study in the following terms.

The first week of the term was reconstructed as a *thesis* workshop as a encouragement to the development of research skills, and involved both year staff, invited lecturers and graduates of the program in a discussion of both the meaning of an architectural polemic and the nature of architectural research. This was followed by 4 weeks of intensive research in which students explored the territory of their stated intention through readings, precedent research and small design studies. The work culminated in a more precise statement of polemic, grounded in the context of existing research and theory on the topic, which was then tested against a noteworthy building as a form of direct precedent investigation.

The workshops which followed were structured on a two week cycle where 3 lectures on the particular issue were given and followed by seminar discussions on the thematic as well as the students own research work. The intention behind having a trio of lectures was to encourage a diversity of opinion and outlook, to broaden the discourse as much as possible, rather than establishing a preordained position which could mitigate against individual research. This was followed by a focussed two week design exploration, which was reviewed collectively with students, staff and, significantly, a critic representing the particular thematic in question. Thus the workshop on environment and economy was given by an economist, an architectural educator and a practicing architect with

sympathetic leanings while the review was attended by an environmental specialist.

The design research undertaken during this period involved the use of small scale briefs and sites identified by students as temporary vehicles for studying the relationship of certain imperatives which could enlarge their polemic stance and equip them with design strategies for the main thesis project to follow. Models were the typical medium for exploration and were used at two different scales, building massing and detail, in an effort to discover the appropriate scale at which the thesis could be tested. Thus the studies pictured here identified environmental factors as the principle issue which could inform the thesis proposition. The thesis premise, described as *depth of field and motion,* as tensions which inform the perception of space, explored the environmental issues of light and view as a design tactic to direct the exploration. [fig 2 & 3] Likewise, the studies on material | structure were used in a similar manner by the same student to extend his understanding on the strategies for manipulation of light through the development of a structural form on a narrow urban infill site which could support and enhance the diversity of light qualities within the deep recesses of the building. [fig 4-5]

Though not specifically 'technological' in their manifestation, as neither study was investigated at the level of construction detailing, these early research studies did firmly imbed into the student's thesis framework a preoccupation with controlling light in a building as well as an awareness as to the role that issues of an environmental or structural nature may play in the exploration and development of the design. This project was particularly interesting as the student, having been provoked to think in terms of different models of research and research tools, used a wide range of media to investigate his premise as well as to develop the project itself. Starting from an investigation of physiological, cultural and art theory texts on perception, as well as his own painting studies on depth perception, he moved fluidily across different traditional media to finally learning an advanced computer modeling system called Ecotech. This system, in combination with traditional models, enabled a more comprehensive study of the light conditions of a generic office space in an urban infill site, allowing a continuous evolution, evaluation and remodelling from early schematics to final proposition. Both issues of light quality and structural imperatives remained present throughout the work, being refined and clarified relative to each other to achieve the final form of the building. [fig 1]

In a thematically similar project, another student equally interested in light studies but with a focus on the ramifications of the material qualities of space, used a similar programmatic vehicle and site condition to achieve a significantly different interpretation of light as form giver. Rather than focusing on the scale and orientation of space to manipulate light conditions the intentions of the project were deeply rooted in the investigation of light quality through the manipulation of material assemblies. This was undertaken using a wide range of modeling techniques simultaneously, from Ecotech for accurate measurements to scale models and large scale wall/floor/ceiling sectional drawings to explore techniques of assembly to model light. [fig 6 & 7]

Fig. 2-3. Francis Matthews, Depth Of Field And Motion, Generic Office Space In Urban Infill Site, research model light

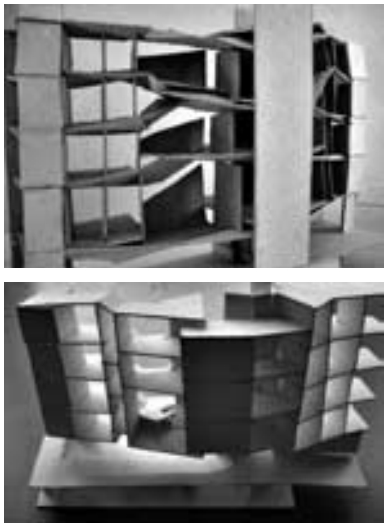


Fig. 4-5. Francis Matthews, Depth Of Field And Motion, Generic Office Space In Urban Infill Site, research model structure

Fig 6-7. Fiona Hughes, Light as Form Giver, Generic Office Space In Urban Infill Site, research model light and material

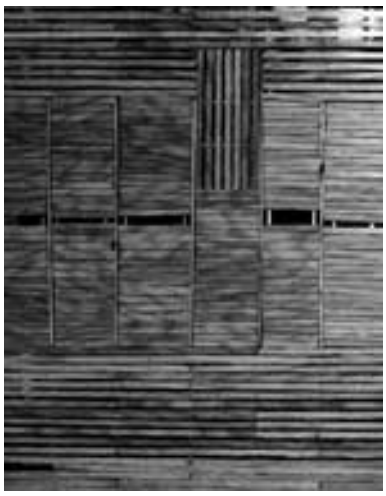


Fig 8-9. Shane Meehan, Time Cycles, Booterstown Marsh Dart Station, development model material

Fig. 10. Paula Kelleher, Making Place, Speculative Warehousing, research model material

Light was not the only aspect of the environment which became central to thesis work as a result of these studies. A thesis with aspirations regarding the evocation of the spiritual in architecture developed into a study of time cycles of degradation and wear in building materials as a result of a sequence of small design studies which attempted to elucidate the emphemeral relative to our series of technical imperatives. The final project, a boardwalk cum parking lot which housed both a train station and a hostel in an estuary condition was carefully specified and detailed to wear out relative to patterns of use, a study which involved the exploration in scale models of typical materials used in unconventional ways throughout the building. [fig8 & 9]

More conceptually based projects bore similar results. As a function of testing Heideggerian philosophies of place-making against the imperatives of environment, economy, material and structure through a sequence of design studies another student's polemic was successfully broadened to encompass the critical realities of economics and environmental issues in measuring a landscape through architectural form. Though the early studies leaned towards the improbably romantic, the final project took on the difficult program of speculative warehousing in rural landscapes, successfully developing an alternative model which embraced all the economic constraints but altered the modeling of the form through judicious use of site characteristics and sustainable strategies. [fig 10 & 11]

Perhaps the most striking success of the program was the 1:1 scale modeling of a wall section undertaken by a student interested in Freudian theories of disconnection. From initial research in theory, filming technique and precedent studies in collective housing this student found, on testing the polemic against material imperatives, that the modeling of spatial adjacencies could be achieved most successfully through articulate modeling of wall assemblies to inform visual, textural and thermal qualities. Though the project began with very aesthetic notions of form-making the final excercises revealed technological sophistication as the critical issue in achieving her thesis ambition. [fig 12]

Of course the structure of the year had its flaws, as every course does. The workshops were neither long enough nor sufficiently focussed to achieve serious work across the entire class. These are now being restructured into 3 week cycles which will incorporate a sequence of group research projects to initiate individual studies. Nevertheless the work from this preceeding year was suggestive of the manner in which technical imperatives can be researched in small design studies in an effort to test the meaning and

Fig. 11. Paula Kelleher, Making Place, Speculative Warehousing, final project image

clarity of the polemic, to extend the students range of thinking on their chosen topics, and to imbed a sense of material thinking in the theoretical premise which can be successfully extended forward through a more liberated and mature intuitive design process. It is worth noting that most of the students did not bring the specifics of their research studies to bear on their final project development but rather an awareness as to the relative significance of particular technological issues to their thesis which encouraged further experimentation to unfold during the final design stage.

The lessons gleaned from this thesis structure are now being folded into the 4th year curriculum for the coming year. In an effort to collapse the misleading boundaries between both studio and technology as well as between the specialist technologies themselves, the fourth year courses of building technology and structures have been aligned into a single course on integrated design practice which will also encompass environmental science issues. The project work from this course will be directly limked to studio design projects and structured as a series of research studies on particular technical thematics.

Fig. 12. Mary O'Niell, Disconnections - the Space Between, Gymnasium, research model texture, view and thermal calibrations

Attitudes and Conclusions

In addition to the discussion of skills and methods which were the theme of the conference there is another fundamentally important component to the enablement of a student's learning and continuing development as a professional which is about latent attitudes. Though not specifically a skill which can be taught nor related to any particular methodology of teaching, they are critical to how one engages in the design process. An attitude of open-mindedness, confidence and curiosity are the forerunners to sincere and critically minded experimentation and it is within our power, as educators, to encourage these attitudes among our students by the degree of respect we show them as individuals and the latitude we allow them in developing their own peculiar talents and often more peculiar interests. This is a critical a factor in teaching both design and technology in a fashion which sustains continued exploration, whether at school or in the profession. For while respect and latitude breeds confidence to experiment, to debate and to challenge conventions with authority, a lack of both closes down conversations, inhibits experimentation, renders research invalid by preordaining acceptable results and forces a level of conformance on individuals which breeds similar attitudes within the profession. Perhaps the most important thing we can bring to our teaching is this attitude of creative latitude, both within our courses and across the boundaries between courses, to encourage a more fluid, interactive and integrated approach to design in our students.

Faculty of Architecture, Genova, Italy

Fausto NOVI

Some Points about the Teaching of Constuction and the "Charming Power" of Contemporary Architecture

This contribution tries to follow exactly what was suggested by the organising conference and gives an answer to the two questions at the basis of discussion:

1. What competence and skills graduates are supposed to have in the knowledge of technology for architecture
2. What educational methods and strategies are to be adopted

I should like to begin by saying what kind of difficulty are coped today in our school, and in my opinion, in other Italian schools, in teaching technology and construction theory.

The reasons are basically five and are mainly related to the general cultural context in which students find themselves; they are only partially concerned with architecture and the building science.

1. The Power of Images

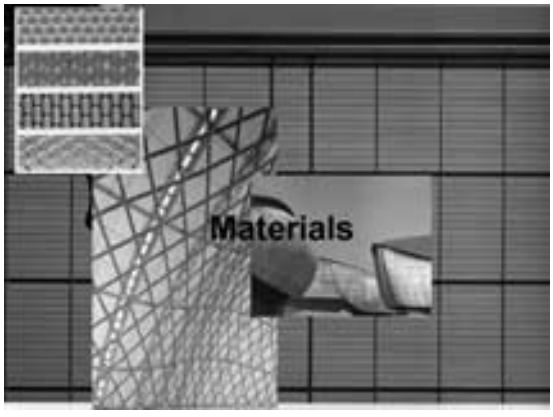
The images of contemporary architecture (above all the most eccentric and surprising) are more often than not taken as the ideal background to luxury products adverts and they are implicitly recognised by students (who are able to "read" not only the object itself, but also the background) as a finishing goal, as much as the possession of the product itself . Students are continually bombarded and overwhelmed by a huge quantity of architectural images, available in books and magazines, whose only concern is regarding architecture as an IMAGE. They seldom go to the details of the structural elements and hardly ever they tell the reasons beyond a project.

The process which has generated architecture (and its image) is not revealed. The image of architecture seems only to be the result of the architect's will and never the fruit of specific situations which may have inspired (or forced) the architect. As teachers lack data, they find it difficult or impossible to reconstruct the various architecture's routes and to explain the role played by construction theory and technology in the creation of the architectural product.

Two territories are still unexplored or undocumented in architecture journals: the first area is the space between the project sketches and the photographs of the results, whereas the second area is the space between what has just been completed and what happens in the course of time. Apart from very rare cases, however, we don't know anything about buildings lifecycle.

2. The Infinite Number of Materials

Architecture is the only human activity in which materials and techniques from different sources and ages are used without distinction. In architecture we use either the same materials which were used 2000 years ago or the new materials which come from other production sectors (e.g. the car industry, aeronautics, electronics, etc.). Teaching technology is difficult because of these reasons as well: every available material which has increased for 2000 years, each with its own features; the quantity of materials which are blended together in many ways, never in the same place, never for the same customer, never in the same building process; the amount of materials which are "imported" according to the individual designers' choice, without an industrial strategy of development pushing towards definite directions. Architects' creative choices, which are not only realised in forms, but also through the identification of the architecture's essence, increase inexhaustibly the building possibilities, which cannot be taught quickly and easily in a natural architect's vocational training.



Traditional materials as well are constantly rediscovered and reinterpreted to the highest degree: the use of brick covers adopted in Berlin by Renzo Piano is almost obsessive, and his extensive application in brise soleil and in the balconies parapets is a clear evidence.

So how can we give young architects the basic information on how to operate, if technology is out of control?

3. The Multiplicity of Languages

All students, and particularly Italian students, are used to living in situations brought about by the overlapping architectural languages which have emerged since 2000 years ago. The skilful ability to overlap and reinterpret architectural languages has been gradually decreasing and the charm of contemporary images might reduce the architect's caution (mainly in the first years' course) needed when their design is realised in a city. Too many times they just want to do something visible ending up in glass and stainless steel projects, devoid of any perpendicular lines, completely unsuitable for the context in which they should be inserted.

Christian Schittich said: "Leafing through international magazines, one gains the impression that no building material, no form of application is too abstruse for facades". This was published in Detail, a German journal concerned with all kinds of innovations in technology and form relating to architecture and not only in Germany.

Nearly mimetic net envelopes, with suggestive night effects, subtle plastic slabs in pastel colour, repeated writings, signs imprinted on a huge variety of materials, metal cages filled with stones, iron sheets, recycled waste, iridescent glass and else. This pluralist, media-oriented and computerised society is revealed through surprise, in the amazing use of "foreign" materials (at least so far) to construction or peculiar to other kinds of construction. The most important examples may be the cages used by Herzog. and De Meuron. for the Napa Valley's cellar in California or the coloured poly-carbonate for the Laban Centre. They have developed a fashion, they are "trendy" (again in the words of Schittich) and have been adopted some months or years later, virtually metabolised , in projects published on the pages of the same magazines which had published the "original" ones. On the other hand we live in a period in which the senses are constantly bombarded with increasingly stronger stimuli and designers are urged towards sensationalism in order to attract people's attention, to compensate their clients' investments with stronger images.

Finally transparency is often confused with lightness, and sought as much obsessively even at latitudes where it must be controlled, regulated, reduced by serigraphs, curtains, bulges, gratings and so on. It seems mostly a useless expensive formal performance (now usual and tired), rather than a real technical-functional need of the buildings.

The borders between formal and technical search and the effect surprise search, the innovative covering at all costs, the smart "packaging" is increasingly subtle and fragile.

4. The Influence of Computers

We have user-friendly and intuitive equipment, compatible with students' knowledge, who aren't afraid of computers at all. Computers grant an extraordinary freedom to conceive any form without restraints, by virtually manipulating it so realistically as to deceive the careless eye. Arata Isozaki, in a recent lecture at the School of Architecture in Genoa, has discussed the relationship between architecture and the computer, between "analogical" and "digital" architects. He described as "Photoshop architecture" that kind of architecture where the skin is like a veil pulled tight on a mysterious and obscure structure, which is scarcely understandable and even less feasible, so that specialised engineers must perform acrobats. So architects empower the computer to create and manipulate forms without awareness, maybe at random, by exploring the infinite number of possibilities offered by the software, as it was a video game. So lecturers find it difficult to single out realistic renderings and to understand how complete and responsible are the projects involved.

5. Fashion

Finally fashion in architecture plays a leading role in moulding and directing students towards unaware choices from a technological-structural point of view. When "high tech" and "post modern" go out of fashion, new tendencies will come out. The search for an environmentally friendly approach (a pretext sometimes used to justify eccentric choices in technology and form), and the search for building solutions which can limit the energy consumption by using all the resources offered by nature on the spot, are often inevitably a matter of fashion where the protagonist is a well-explained difficult mechanism with red and blue arrows and yellow sunrays.

It seems well-founded now that double building envelopes can be considered sustainable, at least as far as energy is concerned. At first they developed in northern climates (mainly in Germany) but some experiments and achievements have shown their good performance even in hot climates. The results of an experiment issued in the proceedings of 2003

Glass Processing Days Suitability of Dual Skin Glass in Hot Climates, GPD Conference Proceedings, Tampere, Finland, 2003) show the possibility to expand some buildings glass surface, e.g. offices, in Kuwait (where the trend of glass-made buildings is the same tested elsewhere) by respecting the limits imposed by local regulations about electrical consumption for conditioning. Nothing is told about the inside brightness whose degree may be intolerable and which is likely to require venetian blinds, curtains, gratings, brise soleil and the like, with an energy final balance to be worked out. It reminds us of SOM's skyscraper in Jeddah, little known but genial, built in the 80ies, a clear proof of how a foreign designer can think of a solution which fits the place (with reference to climate) compared to a native designer's attempt of conforming to global fashion.

Double building envelopes seem the right solution, at least where they are developing, to the contradiction aroused by skyscrapers, which are not environmentally friendly but which keep on existing in the customers' idea of self-representation (corporate buildings). Foster, Rogers, Piano, Ingenhoven, Murphy and Jahn, among the others, in their effort to reduce energy costs follow this direction, even though they are not formally asked for by their customers. As Ingenhoven said during a lecture held at the School of Architecture in Genoa, their attitude is simply one of etiquette (a "bon ton design"), typical of those who join the same competition, for the same clients and who often share the same consultants. The search for the most effective system of wind pick up and for the exploitation of the atmospheric pressure differentials have turned some building into textbook examples, celebrated in architecture magazines (Foster's "pinecone" in London and the Commerzbank in Frankfurt, Sauerbruch and Hutton's coloured GSW in Berlin, etc.). They seem to show that such costs as heating, cooling and ventilation may be notably reduced with the help of users who will not have the usual climatic excesses (i.e. too hot in winter and too cold in summer). All this is constantly monitored (at least as far as we know through literature); it would be interesting to assess the situation within a few years, assuming that we can remember.

What competence and skills graduates are supposed to have in the knowledge of technology for architecture

The most important requisite graduates must show is AWARENESS. They must be taught somehow to be responsible of the building choices they will

make once they are architects. Being aware is also realizing that the design process is an activity oriented to problem-solving and not a simple and uncontrolled game of imagination. Creativity in architecture is like in all human activities; the architect's imagination can't help coming to terms with the concrete feasibility of the project.

Being aware is also a balance between what science and technique can give an architect so that he can master all the information he's got and the risk of being overwhelmed by it.

Young architects must know there are countless design spaces among the initial idea of a project, the executive project; in addition the building process and these spaces cannot be left to technologists, experts and specialists. For instance, what do "design specialists" (façade consultants and glass specialists) do and how do they mutually interact? This aspect in the design process (which is more and more taking shape as a complex mechanism similar to a brain-teaser without a solution) deserves careful analysis because it gives architects new chances and indicates a new relationship between the designer who creates the project and the specialist-designer who affects the form through his technical and constructive learning, who looks after details and how it works, and assures the result. These consultants claim their right to be involved in the project since its initial phase of design in order to make the most of their knowledge. It is not easy to define how the design process changes, how the chain of ideas takes form, how the constant revision of solutions occurs, whether they depend or not on external consultancy which stands for basic scientific and technical knowledge for deciding the initial line of design (with reference to the problem of natural ventilation, solar exposure, shading, natural lighting, etc.)

We often hear that consultants are not a threat to designers' independence, that they do not manipulate their solutions, or rather that they are creative consultants who are to cooperate on the process of technical development of design. But they often turn out to be those who find precise solutions (they are closely connected to production), and not simple applications to technologies or imitations of standard products from one project to another. They look like specialists of "variations on a theme" and in fact by comparing a few projects it's easy to understand that many variations exist on the theme of the spider, the kneecap, and else which can be typologically brought back to the first solutions by Peter Rice. Rich customers who want great glass facades ask for "haute couture" solutions and not catalogue stuff.

What educational methods and strategies are to be adopted

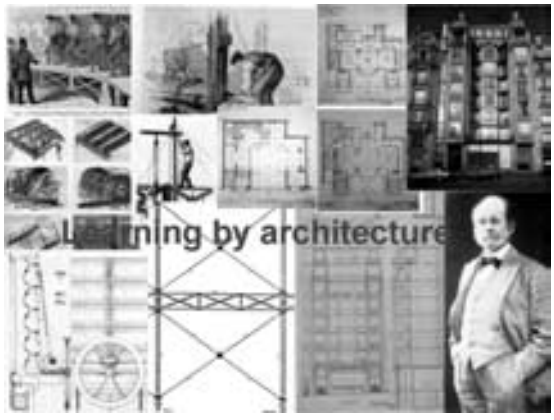
What students are taught first is that there isn't a chronological order between the initial idea of architecture and the form it takes through technology. The project, since its first phase, must have a potential for constructive development. The initial idea, even the most sketchy and superficial, must include the image of its concrete aspect. This clashes openly with design teaching methods in Italian schools of architecture because of three reasons:

- There is exaggerated theoretical knowledge, above all in the first years, which is not learned by students because too far from reality. The deductive method supremacy and a virtually absent inductive approach takes away theory from practice.
- There is poor integration of knowledge and subjects, which are taught as separate worlds and don't regard the project as the time of cognitive synthesis (this seldom happens only in the last years of the students' education, or when they prepare their university career final project).
- There is a strong tradition, at least in Italy, to teach architectural design mainly from an aesthetic point of view, leaving out the building culture.

In the first years of their university career students have to take courses aimed at highlighting the role played by construction, technology and the building site in architectural design and they are asked to understand that the building culture and technique are the essentials to the project, whose absence may turn technique into a system of obligations, ties or obstacles forcing its way into a project conceived in the abstract.

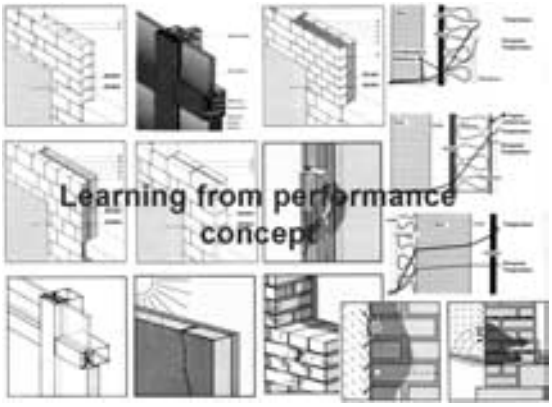
To reach this purpose technology and construction teaching are organised in three ways:

- by exploring architecture in order to discover the role played by construction in the design process. This activity takes place by "dismantling" some famous architects' buildings of different historical periods, from the Romans to contemporary architecture, assuming that the building process can be entirely documented. An example which is often dealt with in class is the house by A.Perret in Rue Franklin 25, one of the first reinforced concrete buildings in the history of architecture.



- Through the teaching of the idea of performance concept applied to architecture. It is perhaps an outdated approach which recalls the research into building industrialisation in the 60ies and 70ies which have been abandoned, but it seems to be the only one, as I see it, which can give students scientific elements to make a choice without having encyclopaedic knowledge of the building materials used in a project. The more material and formal possibilities increase, the more

teaching possibilities decrease. We have to replace notional teaching with "behavioural" teaching, that is education to architecture.



- Through experiments based on "learning by doing" in design workshops. They are organised as a sequence of multiple short meetings (at present they are four and they last from 3 to 7 days) whose goals are progressive and contents gradually difficult. Simple subjects make it easier for students to get information besides enabling the teaching staff to follow up the students' progress in their projects, which can be explained and discussed naturally. Meetings start with the explanation of materials properties in order to make a simple object (a prism made of cardboard, poly-carbonate or perspex slabs with simple joints) go on with the teaching of structural properties (a thin vertical structure or a small metal or wooden footbridge), then with the perceptive properties and in the end with a real construction or a substantial part of it (the roofing of an archaeological site, a new facade of an old building, the outside of a restaurant, etc.).

Renzo Piano, who is much loved by our students, has recently declared at the opening of his Genoa's exhibition that architecture is the longing to disobey, to rebel, to go beyond the known but with great competence and cleverness.

Faculty of Architecture, Genova, Italy

Rossana RAITERI

How Research into Technological Disciplines Influences Design Teaching: the Italian Case

Why does technology and construction research interfere so little with the teaching methodology of Architecture classes in Italian schools of architecture? It's not easy to answer. Do other countries have such a situation?

Within our Faculty a sense of duty in those subject-areas has often made us stand out from others. This is conveyed by offering, programming and inventing teaching programs related as far as possible to its general context; this may remarkably reduce the scientific level of a discipline (although it is itself difficult to estimate).

On the other hand, technological subject-areas teaching staff have always proved to have an ability to anticipate (events), or at least, a special attention to strategic architectural issues such as the environment, legislation, reclamation, maintenance, quality, the evolution of the building process and techniques, etc. Whereas in the fields of architectural design and composition seem to be strictly anchored to a traditional idea of architecture, in which either conventional techniques are taken for granted, or more updated views are suggested, but without a real technological and constructive culture to make them feasible.

Before the 1993 European reform, university research had poured into teaching thanks to a hermetic division of disciplines into compartments: everybody acted on his/her own and students could choose what they liked within a chaotic and disordered offer in teaching programs. Most subjects, above all in the last years of the course, were going to be characterised by complex matters, by proceeding nearly in parallel with investigation in progress, but incoherently from the whole context, with no educational purposes in multi-disciplinary integration.

The reform has compelled university to think over the possible links and aims among subjects, and to make an attempt to redefine the educational purposes which should have put all subject-areas in the difficult position of a common effort, by introducing laboratorial teaching for all design-based subjects (urban science, restoration, architecture, technology, construction science).

On the contrary technologists may have been the only ones who have posed themselves this problem seriously.

The teaching of architecture design has been given a major role in the vocational training, with at least a workshop a year, besides theoretical courses, and in most cases it hasn't developed into a consistent project

and in a teaching gradual sequence, taking advantage from the privilege of being ineffable and uncontrollable, of being devoid of any connections with the world of architecture and with its deep changes (in organisation, in processes, in production and legislation). Indeed students are not planning: they are simply doing architectural composition exercises (which is completely different) and, what's more, once in a year (a typical Italian fault).

Construction-related problems (that is a minimum level in the technology of architecture) are totally absent – as well as the simple idea of space organisation. Finally students are not even taught the basic elements of a "generalist" architect, on which planning their future specialization.

As regards self-referentiality in the construction theory and technique things are not better: engineers teach by using scientific and technical equipment without distinction, whatever public they speak to, in the same strict deductive manner. Architects are sometimes granted some simplifications compared to engineers which may as well result in harmful overall observations, which should be aimed at the receiver instead.

So in our schools of architecture technical-scientific education goes on through a strictly deductive method: you start from Mathematics to get firstly to Statics, and then to Construction theory; you finish your educational training with Construction Technique.

So the student's design experience is nearly devoid of those aspects related to construction practice. Most of his study is confined to pure noble theory. So the aspiring architect is prevented from integrating his diverse knowledge in order to develop design themes. His plans are regarded as forms and volumes without a frame or bone structure and with no technological devices, so devoid of any material substance and neutral towards it.

The same could be said with regard to all other subjects involved in the project. However I don't want the reader to think I'm in favour of empirical and vague teaching, only aimed to give instrumental knowledge, and meanly submitted to immediate reasons of application; scientific understanding of an architect's professional disciplines cannot be left out or neglected.

On the contrary I think that understanding scientific principles is essential to build a structure where progressive knowledge and continual learning are encouraged, even though with the passing of time those principles are forgotten. They are extremely useful in a rapidly changing and technically evolving world. The difference between a technician's knowledge and a more culturally qualified person is not only what you do, but the way you do it (cultural awareness and the ability to choose the right technical devices in the broadest sense: for instance the understanding of the primary and revolutionary role played by information technology applied to design and not only an instrumental use of photo-shop and autocad). What seems serious and intolerable is a snobbish indifference towards technical application of scientific and artistic knowledge. It's not a matter of choosing between science and technique, but giving each proper space and time.

In the chaotic teaching situation which characterises our schools of architecture, technological-oriented disciplines are making an effort to approach the basic project themes (and it seems to me the starting point

for mastering architecture and the growing changes in scenery) by trying to fill big gaps, to supply students with the basic elements of awareness in the meaning of architecture, which is to be regarded as a social, economic, collective, productive, material, environmental, constructive thing, something to live in, to maintain, to renew, to demolish, to look after people's safety, besides having the right formal standards.

So we are compelled to favour methodology; we give the basic elements to make students identify and formulate a design problem in every aspect. Students are encouraged to regard technological and building culture as the fundamental nourishment of correct design creativity, and to develop a critical design ability, as for a prearranged programme. We can hope to get to explain the nature of needs and performances as a method to look for solutions, the only bulwark of a contemporary designer vocational training.

Our recent introduction of the so-called 3+2 model, which has split up the five-year course into a three-year introductory but professionally-oriented course (in my view, an educational system which contains an irremediable contradiction) and a two-year course ("specialist degree") hasn't improved the situation: in each faculty it was interpreted differently. Sometimes it simply cuts up the five-year course (nearly swindling the student and the working world, since the first level degree doesn't correspond to any technical skill but it only gives a basic knowledge which can't be exploited without specialising). It might only serve statistics about the time needed to really reach the degree.

In some cases more technical-oriented three-year courses were born. Some of them are well-structured and culturally adequate but they won't easily allow students to become generalist architects by simply adding two further years without taking supplementary exams. But we leave this on other occasion.

Let's go back to technology and construction: the new research themes are various but not completely new. They have been dealt with for a long time and are at an advanced stage.

The connection between human settlements and the environment is one of them. This topic embraces many others, if we consider the whole lifecycle of the building product: the manufacturing of raw materials, goods production, the building process, maintenance and the perspective of possible demolition.

As you know, the consequences of aware environmental design are several and they aren't just a matter of energy saving and bio-architecture. These are major aspects but at present they cannot be taught because of the students' lack of time and of the teachers' shortage (except for post-graduate studies: masters or doctoral research).by the way it is essential to try and awaken students to the consequences on the territorial balance produced by their decisions. For this reason, in basic teaching we strive to supply the fundamental criteria and devices (see Adriano Magliocco's contribution) and we hope there will be a future autonomous germination.

Another major theme at the moment is the control of life of architectural work. This is a very complex theme, because it is connected with the

variability the obsolescence of architecture, both in functional and social aspects, and in the physical. The multiplicity of building techniques and materials, and the great number of possibilities of juxtaposition of design choices, make it difficult to foresee and programme the durability of an architectural product. This concerns as well some problems such as quality evaluation systems and contracts of guarantee, in addition to a large area including planned maintenance and the redevelopment of current buildings, even recently constructed.

Another fascinating theme is about the form of collaboration and co-design with manufacturing industry. New handmade products and components have been developed in the last few years in areas which are not traditionally involved in construction, but they are extremely interesting for both this boundary-operating designer and for those architects who are in charge of linking design and production.

And the list could be longer.

All this is a part of the research areas developed by our Faculty's lecturers and researchers in technology. It goes without saying that it is impossible to introduce these themes in the ordinary teaching programmes of architecture courses only through technology classes. But it is also evident that there may certainly be some indirect consequences on the way of teaching Construction, which represents somehow one of the last elements of the whole building process in design. So how can we cope with the problem of little time and few teachers?

This restlessness springs from the conviction that the nature of design problems is bound to change, since lots of changes are taking place within and around it. However, there are some methodological aspects which are not upset by changes. Some of them are, to some extent, free from any considerations within the ideational and heuristic process of architectural design and its cyclical advancement by approximation and verification. But we can't underestimate the importance of the relationship between information and decision. Secondly the idea of construction cannot be regarded as the final process of many other processes which are not directly called into question. Just one example could be the Crystal Palace, whose building process cannot be imagined independently from the whole idea of the project (and from its transience), from the connection it has with industry, from the economical and social conditions in which Paxton made his work.

So how can we bring technological and construction research themes back to an architect's vocational training, in order to mend the deep tear, or the dichotomy between architecture and its feasibility? Of course I haven't found any special solutions which can be put into practice quickly and easily.

I would like to finish these notes, by mentioning a students rep who pleaded movingly at our final meeting in Athens with regard to technical or artistic conception of architecture. "Please, don't make us choice" – she exclaimed.

These periodical meetings might be a lasting forum where to discuss ideas and experiences among participants, and favouring the creation of a cultural pressure group towards our Faculties of Architecture, making those lonely and unheeded voice more authoritative and European.

Faculty of Architecture, Genova, Italy

Adriano MAGLIOCCO
Andrea GIACHETTA

The Teaching of Construction and The Environment in the Faculty of Architecture in Genova, Italy

Technology and the environment

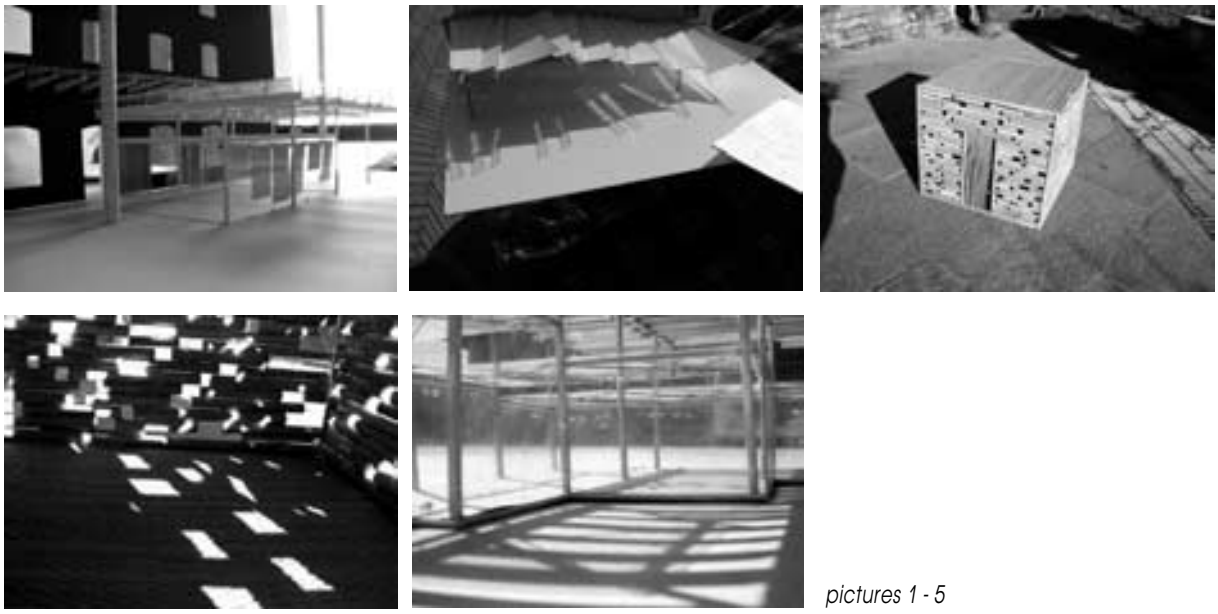
(Adriano Magliocco)

One of the aspects of architectural planning which is mostly linked to construction is certainly the connection with the environment, according to various aspects. The complexity of architecture requires the subordination of constructive aspects to the principles of reduction in energy consumption and to an awareness in the exploitation of exhaustible material resources at the various stages of the process: production, usage, maintenance and casting off. As a result the new architects must get basic knowledge relating to the impact which the building industry can have on the environment. They must be able to set up a plan correctly – from the point of view of ecology, in the broadest sense of the word - through simple and immediate instruments and ask suitable consultants the right questions, if necessary.

The teaching activity, about the inquiry on the link between architecture and the environment in the Faculty of Architecture in Genova, takes place at different stages of the students' curriculum. The subject is mainly dealt with by those lecturers who teach Architecture Technology [1]. I wish to point out that teaching hours in the five-year course are 360 and that many subjects are concerned with technology. During the first year, in the few hours which are dedicated to this matter, we explain the concept of sustainable development regarding the activities linked to the building industry. It is important to let the students notice that each sign on the paper made by an architect corresponds to a transforming flow of resources, materials and energy, from raw materials to final products, and this inevitably implies the production of polluting substances, and more often the materials may not be available any longer, if they are not renewable. The sustainable approach to planning can be carried out at different levels. Often you may not be involved in urban planning, an important aspect to identify the use of resources. It is possible, however, to set up the project and fix technological choices capable of reducing at best the use of renewable resources in accordance with the available technologies in a particular socio-economical situation. Finally we attempt to explain the meaning of the terminology used in this field, sometimes so "fashionable", and to outline the differences in meaning (bioclimatic architecture, bioarchitecture, biobuilding, eco-friendly building, etc.), when they really exist...

In the second year a first approach to the problem of the environment is discussed in the "Laboratorio di Costruzioni 1", thanks to the planning of small buildings with simple functions, paying particular attention to the

passive control of building climatic conditions. Students are given simple instruments to control sun radiation and airstreams. For instance, we show how to survey precise building orientation by using an anglemeter equipped with a compass; we show how to survey the horizon line from a point of observation by vertical angles (solar height) and horizontal angles (azimuth) and, by drawing it on a solar chart, we identify the periods of the year and of the day when that point is not directly lit by the sun, in order to assume the adoption of active or passive solar technologies. It's very important that the future professionals can understand the environmental implications of their projects even when they deal with secondary work. We can't expect the architects to refer to first-rate research laboratories for their environmental analysis and as a result I think we must show them this can be done through user-friendly and low cost equipment, by supplementing environmental analysis with the design procedure. In pictures 1-5 you can see some students' projects.



pictures 1 - 5

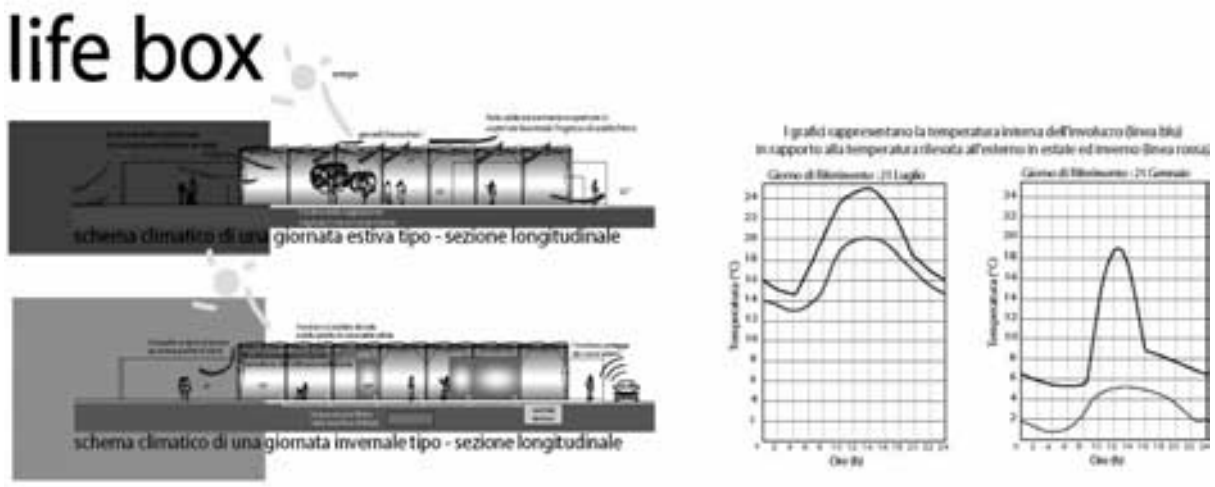
Some courses like Architectural Planning, which are usually focused on aesthetics, work with lecturers who teach Architecture Technology to associate their teaching support and deal with planning themes with a view to reducing energy use and increase the exploitation of low ecological impact materials. This is meant to make the design phase more aware and less abstract through the knowledge of materials and technological devices. To do that we often show particular projects, where the designer's attention is focused on low-impact materials but with a high power of formal fascination (bamboo, raw earth, cardboard, etc.).

In the fifth year a course in bioclimatic planning is given (see next paragraph) and it is split into two modules: environmental sustainability and bio-climatic technologies. Besides attending the lecturers' courses and the experts' seminars, students are supposed to do a simple exercise relating to open space and little buildings planning. Some easy instruments

are suggested for a preliminary check of the project as well as some software for the quantitative settlement of the buildings energy use in order to analyse the efficiency of the systems adopted.

In addition, a lot of degree theses deal with environmental planning, and they are often provided assistance by lecturers of other subjects such as Building Physics and Mechanics, for a better quantitative settlement of the solutions effectiveness. In this case it's a matter of project in which the environmental aspects connected to the building process are outlined, without neglecting the other aspects. In fact we are not interested in making "monsters", machine-buildings where the problem of energy conservation or production is exaggerated. We must try and get rid of mere experimentation and enable the environmental issue to become a part of the planning activity if we want architects to care about the environment not only on the day of their degree and solely for normative purposes. Images refer to some recent theses where some topics are dealt with. Picture 6 portrays a working wind tunnel, a 1:9 scale model, created at the Politecnico di Milano; the design of a large greenhouse in order to reclaim three subsidized building blocks required the positioning of air locks according to the resulting external flows due to the action of the buildings morphology on the direction of winds in summer and winter. Picture 7

picture 6



picture 7

represents the diagram of temperature fluctuations in a house made up of a greenhouse intended to protect single mono-functional volumes. It's possible to see that temperatures rise a good deal in winter and they remain acceptable in summer (about 25°). Picture n°8 shows a school scale model where there are underground ducts for prior treatment of ventilation air for heating or cooling. Pictures 9 and 10 show some scale model experimentation for analysing the lighting conditions in classrooms characterised by dazzling.

Our Department, thanks to some lecturers including myself, support ABITA, a university centre for bio-ecological architecture and technological innovation for the environment. It was established to do research activity

picture 8

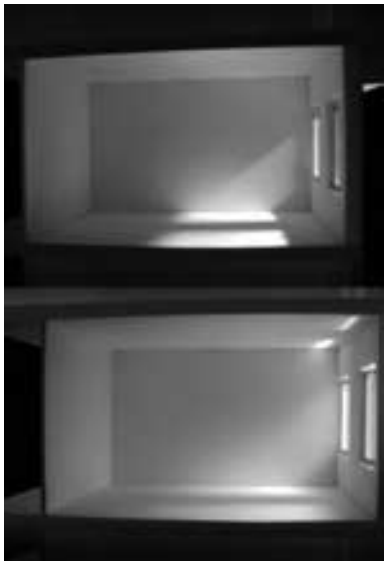
as a consortium into the building industry sustainability, but also to go through post-academic teaching with a Master in Sustainable Design. So new architects may continue their studies in order to get the right qualifications to cope exhaustively with the elements of a project which are mostly connected with respect of the environment.

How the principles and the devices of sustainable architecture are taught in the course of Bio-climatic Design.
(Andrea Giachetta)

One of the most important tasks for a Faculty of Architecture nowadays is to make students approach design from the point of view of the environment and focus on the search for technological sustainable solutions aimed to fit the project into the climatic context involved, to control airstreams, ventilation, heat and sunlight, and with a view to saving energy and water, and reducing the traditional sources of pollution brought about by the present plants. The future planners are bound to cope with these themes because of the growing interest in the environment and its resources in contemporary society. As a consequence of that there's an evolution of regulations at the base of the building industry and the urban and regional development based on the principles of the environmental sustainability. But teaching these principles and devices is at present very difficult because:

- It must be connected with an environmental ethics of design, to be learnt by students, but it cannot be taken for granted in Italy
- It doesn't have outstanding historical references from a teaching point of view, as the interest in sustainability is relatively young, as far as the basic vocational training in architecture is concerned (this subject has been taught so far only in doctoral and post-graduates studies).
- It hasn't got a point of reference in the present subject areas and even though in Italy it can naturally refer to those subjects relating to technology, it's also relevant to urban planning and landscape architecture.
- New teaching devices and facilities, now missing, should be employed. It must be possibly directed to the project's diverse actors, times and phases at the same time, because this is the only way to train people who not only can work on the environment but for it, and decide what interactions are necessary to the project: among designers, innovative building materials manufacturers, and all sorts of specialists who have a say in the matter; the interactions among the project organisation, the building site impact and the building lifecycle: between the local effects of the building activity and those on the surrounding territory, since a single building may either have an impact on a large area or vice versa. In fact design undergoes the obligations of regional planning with regard to the environment,
- It deals with a branch of design in which there are steady changes and so it must also be proposed as a design methodology, flexible enough compared to the predictable changes in design strategies, in the market, in the available technologies and in legislation.

picture 9



picture 10

The Faculty of Architecture of Genova, which had so far reserved some time to the sustainable approach mainly within such subjects as Construction Technology, is going to start a course of bio-climatic design from next year, which is split into two six-month modules (environmental sustainability and bio-climatic technologies) both intended for students in architecture (five-year degree) and students in landscape architecture and urban planning (three-year course). The aim is to involve the diverse fields of study, dealing with specific themes.

After analysing the cultural context in which the new interest in the environmental sustainability has been growing recently, and the reasons why architects can take the eco-friendly approach into consideration, the course will supply the students with a picture of the bio-climatic strategies which may be used for design of open spaces (1st module) and limited spaces (2nd module), through careful study of the diverse methods of analysis (survey and environmental modelling equipment), on natural elements (1st module) and the building components (2nd module), the building elements employed (windbreaks, sunbreaks, greenhouses, solar panels, etc.), on the possibilities offered by the innovative market of building products, on the way to organise an ecological building site and the diverse lifecycle of building products, on monitoring techniques, on environmental and urban regulations(1st module) and building regulations (2nd module), on national and E.C. policies supporting sustainable planning.

The course will provide some experts' contributions in such areas as environmental science and innovative building materials' manufacturing, as well as architects, engineers and planners who have already experienced environmental planning in their careers. During lessons students will have to do practical classes in order to be able to manage the diverse aspects of sustainable planning, with regard to analytical and calculation problems (even if their monitoring system is simple and made through friendly-user software because of the current shortage of proper equipment and lack of time). They must get experience in order to make aware design choices with regard to the environment, its resources and conservation.

These are the matters dealt with at the bio-climatic planning course: the general meaning of an ecological approach to built-up environment design (ethical, social and economic reasons); the historical evolution of ecological design; energy saving policies; procedures of environmental impact evaluation (VIA) and environmental strategy evaluation (VAS); sustainable planning on territorial scale (with references to the regional urbanistic regulations in force); sustainable tourism; interrelationships between environmental-bioclimatic analysis of a site and sustainable planning; environmental analysis (ecosystems, pollution, waste material, etc.); bio-climatic analysis (climate, air temperature, site locations, solar radiation, pluviometry, humidity; etc.); passive cooling; the use of water in the natural climatic control; strategies of water recycling and phitodepuration; the use of natural elements in the monitoring of the natural climatic control of a site; the basic principles of passive solar heating; passive solar systems; natural lighting (principles and elements); use of glass (main features of innovative products for solar radiation control); bioclimatic functioning special doors; sun protections; "intelligent buildings"; the users' role in how

to use this equipment; thermical insulation; supplementary plant design and installation to the solar passive systems; photovoltaic panel; sustainability of existing building requalification; simplified calculation systems and software; the final energy balance of sustainable design management; green building site management; principles of bio-architecture; eco-friendly use of wood; an outline of the use of bamboo; recycled material. Some seminars will be given by experts about: environmental analysis and sustainable design. They will discuss reclamation plans, experimentation in environmental wind tunnel, the natural climatic control through the choice of vegetal species; innovative technological elements and solutions suggested by manufacturers, research, theses and projects. Practical classes will deal with these themes: environmental-bioclimatic practical analysis and design solutions with case studies on real building sites; bio-climatic project of a building (with the calculations on the productivity of the passive solar systems).

Notes

1. In Italian university Architecture Technology and Construction Theory are two distinct subject areas. Even if the whole teaching staff are involved in construction matters, each of them has distinct knowledge.
2. At the first-year course Technology is taught as an integrated course, split into two modules and with two lecturers, even though belonging to the same subject-area; the first module is about building materials and components, the second one is about the role played by technology during the design process and construction.

Eastern Mediterranean University
Faculty of Architecture
Famagusta, Northern Cyprus

Cemil ATAKARA
Yonca HÜROL

The Idea of Festival in Construction Education in Architecture

Introduction

Problems of contemporary education in general are the:

1. Lack of concentration in students, because of the continuous stimulation of the senses by advertisements, computer games etc.,
2. Continuous development of new materials, systems and methods in all fields and professions,
3. Continuous developments in education technology,
4. Multicultural classes,
5. Increase in the multiplicity of the world views of the students. (Willis, 2003)

Types of construction courses in EMU, Faculty of Architecture, Department of Architecture -

1. Construction theory, in other terms "introduction to structural systems,"
2. Construction studios, containing education about the elements (or components) of construction, and advanced construction studios.

The subject of this paper covers:

Type of Construction Course – Construction theory, "introduction to structural systems" for the first year, second academic term students. (ARCH142)

The Normal Format of the Course

1. The first three hours of the four hours (per week) course are used to teach the theory of construction, description of structural systems in architecture, and the ways in which they are constructed. An authority figure makes all the necessary explanations in front of the blackboard, and by using the necessary educational technology.
2. The last hour is used to help and support the students to prepare a research project on construction. This contains a poster, a model, and a research paper about a selected topic in construction. The topics are selected by the students. The teacher starts learning from the students, and a reciprocal type of education goes hand in hand with the self - education of students and peer group learning amongst the students.

Educational Problems of the Course

1. Lack of concentration of students, (or, the ability of students to concentrate on more than one subject), because of continuous stimulation of the senses. The result is continuous noise in the class.
2. The continuous development of new materials, systems and methods in all fields. This results in the loss of respect of the students for the course.
3. Multiplicity of the world views of people. The result is a demand to be open to subjective attitudes about construction.

Another local problem in relation to construction education is related to the environment, which is experienced by our students. Since most of the buildings are designed as reinforced concrete skeletal systems with brick partition walls, and since there is no variety in the types of construction materials, our students cannot learn through their experiences within their environment.

Description of the Problem – The Spring term of 2002 – 2003 started with a crowded class for the course ARCH142. We were two teachers and they were around sixty. There were quite a lot of hyperactive, and very noisy students in the class. The usual methods of authority did not work and the relation between the students and us was damaged. We refused to send some, or all of the students to the discipline committee. It was not possible to follow the normal curriculum of three hours per week of theory sessions.

Known Solutions to Similar Problems

1. Two recent solutions to the low concentration problem, have been to advertise the course in order to increase the respect and interest of students, and to get help, advice and support from the psychologists.
2. The problem caused by the continuous developments in construction is usually solved by teaching how to do research, rather than teaching "the whole" knowledge about construction.
3. Advertising the course by considering the differing world views of students, is accepted as a solution to the problem of multiple world views of students. A "student based education" is usually supported. (Willis, 2003)

Point of View

About Teacher and Student Relationship

1. The problem between the teacher and students should be solved by the powers of people who are experiencing the problems, and not by the tactics given by the psychologists. (The concept of understanding in H. G. Gadamer, 1981)
2. Advertising the course, is a way of using the source of the problem as a solution for it. Thus, it increases the severity of the problem in the long term. In other words, this method will cause further decrease in the level of concentration of students. (Baudrillard, 1993; Horrocks, 2000)

3. Using external advice and tactics, and professional advertisements for the course, destroys the honest relation between the teacher and the students. (for the concept of authenticity in M. Heidegger see Mulhall, 1998)

About Learning

1. The self - education of students should be considered for the sake of good quality learning. (Chomsky, 2003)
2. The quality of education increases with the pleasure it gives. (Nietzsche, 1996; 1967)
3. Education should follow the interest areas of students, rather than beginning with the easier and elementary items and working towards gaining advanced knowledge. (Nietzsche, 1996; 1967)
4. Students learn more from their friends and peers than their teachers, (Pirsig, 1989)
5. Teachers should be open to learn from their students in order to enjoy their work. (Althusser, 1996; Balibar, 1991; Hürol, -)

Criticism of the Existing Solutions

According to the above world view, a research based education is highly acceptable because of the learning characteristics it can provide. However, advertising the course and getting psychologists' advice in order to deal with the students (to moderate them) is viewed as artificial, harmful and unnecessary in terms of types of approaches and actions.

The Proposed Pattern of the Course

1. The continuous development of new materials, systems and methods of construction requires the students to be taught how to carry out research, as well as the theory of construction.
2. The increase in the multiplicity of students' world views forces teachers to consider these world views while teaching the theory of construction. The meaning of the concept of "student based education" should be discussed. This means that consideration should be given to the subjective attitudes, as well as the objective ones. One of the best ways of obtaining subjective attitudes towards construction is to ask for research projects from the students.
3. The noise in the class reduces the performance of the teacher and the quality of the content of the course. It forces the teacher to use his/her authority, which means the end of all acceptable relations between the teacher and the students. The best way of increasing the concentration of the students, or eliminating the negative effects of the noise in the class, is to increase the stimulants in the class, and to use them for educative purposes. Thus, the proposed pattern of the course consists of an increase in research education, depending on the situation in the class, and to demonstrate this research in the form of a festival, to the whole class or to the whole school.

The idea of festival has already been used throughout the faculty during the design evaluation. This was the idea of our Vice Chair Dr. Guita Farivarsadri.

The basis of the idea of festival, carnival or similar ideas are considered by many thinkers. For example, M. Russo (1997) gives reference to Bahtin, while relating the carnival idea to contemporary feminism. Similarly H. Lefevbre (1998) relates festival and carnival ideas to a feminist concept of urban design. O. Paz (1999) uses the tradition of carnivals and festivals in his poetic texts.

Description of the Solution

At the end of each week we were giving one to one critiques to our students and they were also helping each other. One to one relations were always more positive than the relations between the class and the authority figure. They were asked to make submissions and presentations twice each term and simultaneously with their friends.

Description of the Research Work

Students select research subjects which are interesting according to them, with the guidance of the teacher. They are asked to submit:

1. A poster and a model in relation to their subjects,
2. A report on their research.

The visual and verbal expressions in the whole research work were expected to be very simple and easy to understand.

Figures 1 and 2 show the general atmosphere of the course during one of the submissions.

Figures 1-2. The central hall during the festival.

The central hall of the Faculty building was used for the exhibition of the group projects in the form of a festival area. All students were teaching and learning simultaneously.

The largest hall of the Faculty was used for Power Point and some other types of presentations by the students. They were using the most recent technologies, as well as playing electronic music and visual effects in the dark. The hall was full of lab-top screens, which were ready for presentation.

There were five main groups of research subjects.

Examples

1. Structural systems,
2. Secondary structural systems,
3. Some structural problems,
4. Structural systems of some specific buildings,
5. The relationship between architectural styles and structural systems.

The following expressions correspond to some parts of the students' research projects which correspond to these groups.

a. Research about Geodesic Domes

Name of the student: *Maryam Gandji*

This research contains:

1. Structural behavior of geodesic domes,
2. The method of construction of geodesic domes,
3. Examples of geodesic domes,
4. A model.

Figure 3 outlines the experiment of a structural model of a geodesic dome.

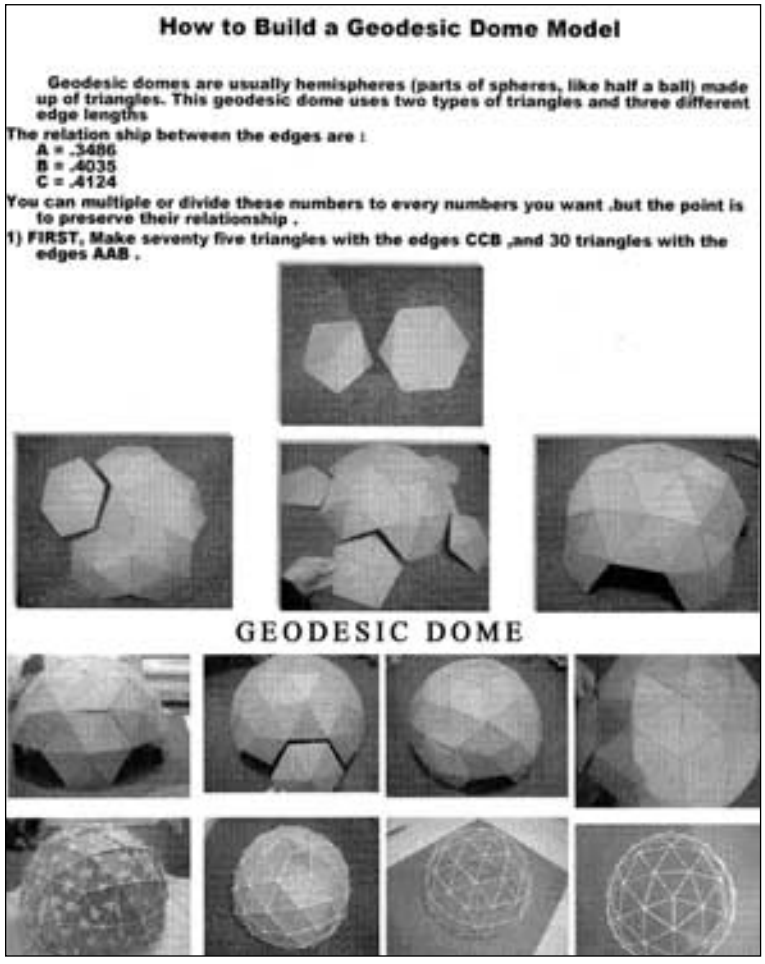


Figure 3.
"The way I made the model."

It became possible for her to explain her ideas with very simple statements and photographs. Thus, it was easy for the others to understand.

b. Research about Suspended Glass Systems

Names of the students: *Yasaman Aryanpour,*
Samaneh Ghaforian,
Yasaman Rezaee.

This research contained:

1. The different ways of relating suspended glass systems to the main building structure,
2. The structural behavior of cable trusses,
3. Examples of suspended glass systems,
4. A model,
5. Other methods of using glass.

Figure 4 outlines the experimental structural model of a suspended glass system.

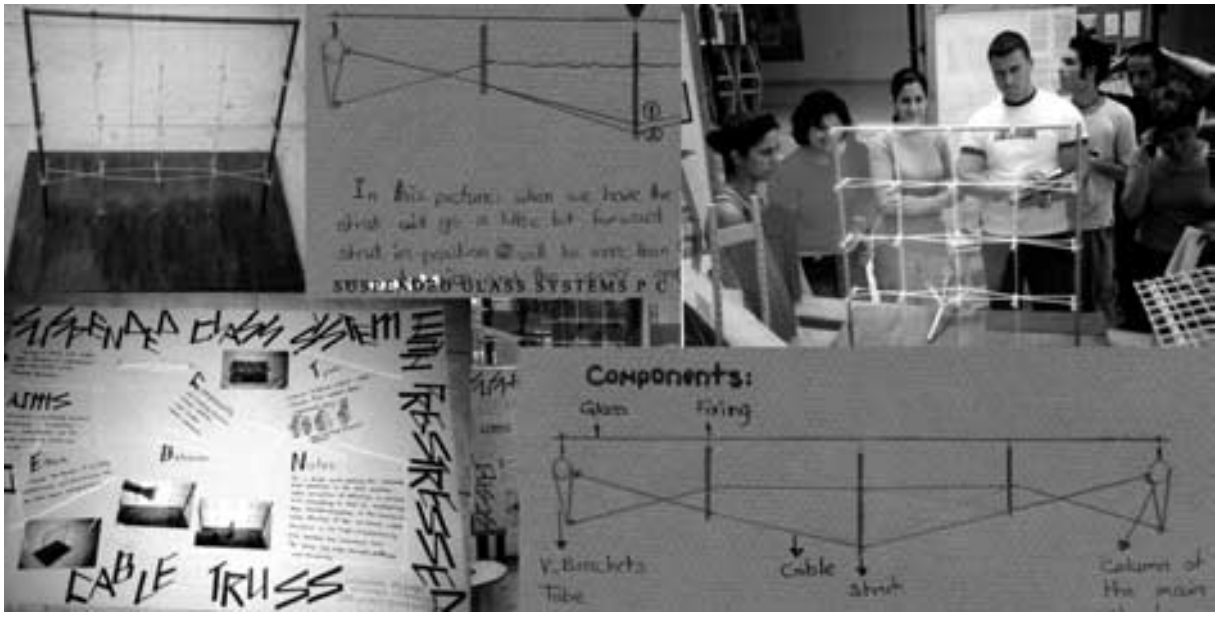


Figure 4.
A structural model of a suspended glass system.

Not only the students in the same class, but the students of the whole Faculty, and even some 'outsiders,' were interested in this project. Since the system was totally new and not well known, the students involved were honored because of their courageous attempts to understand and realize it; these systems will, therefore, no longer be foreign to the students of this class any more.

c. Research about the Problems of Short Column and Soft Storey during Earthquakes

Names of the students: *Can Gönül,*
Kübra Aktepe,
Bihter Taşpınar.

These students wished to understand some architectural problems in relation to earthquakes. We directed them towards the problems created by the wrong use of partition walls within reinforced concrete skeletal systems. They concentrated on soft storey and short column issues, which causes problems in all their countries when earthquakes occur.

Figure 5 outlines the experiment of abstract model making in respect of the subject. There were three types of models in this experiment. These were:

1. Model of a skeletal system without rigid partition walls,
2. Model of a skeletal system with rigid partition walls which form soft storey,
3. Model of a skeletal system with rigid partition walls which form short columns.

Students selected materials carefully in order to be able to compare the behavior of different skeletal systems.

Figure 5.
Abstract models, which represent the formation of soft storey and short column problems, and the students' poster.

Since the models themselves were abstract models, which were designed to experience the problem, students developed a sense of the research model during this study. Their work attracted the attention and questions of many of the students throughout the Faculty, because of the different character of the model.

d. Research about a Building with a Membrane Structure - Carlos Moseley Music Pavilion

Name of the student: *Roya Doostdar.*

This student selected a structure, which is a composition of membranes and space trusses. The construction process was quite different from any other similar buildings. She collected information about:

1. Structural behavior of membranes,
2. Structural behavior of trusses and space trusses,
3. Examples of these structures,
4. Information about the architecture of the selected building,
5. The construction process of the building,
6. A model.

Figure 6 outlines the experimental stage of the structural model of the selected building.

Figure 6.
The method of making a model of Carlos Moseley Music Pavilion.

We are still exhibiting this model as a good example of a structural model.

e. Research about Deconstruction and Structural Systems

Names of the students: *Pooya M. Malek,*
Kamyar L. Tehrani.

Two students wished to create a striking piece of work and chose the subject of the use of structures in Deconstruction. They were interested in the philosophy and technology of building structures.

Their research contained information about:

1. The general meaning of the term Deconstruction, including J. Derrida's thoughts on the subject,
2. The use of structures in Deconstruction was discussed in relation to architectural examples,
3. Some architects and their specific considerations about structures tried to be interpreted depending on their typical works,

4. Some slogans, which describe structural design in Deconstruction, are produced.
5. A Power Point show was added to the research.

Some examples of deconstructive architecture were collected, some books and articles about the subject were read, and some slogans describing the deconstructive attitude in structural system design, were developed. Some of these slogans are as follows:

1. "In structure they deny every standard and doctrines."
2. "Even the person with the least responsibility, should be the best in his/her profession."
3. "Engineering processes are challenged."

Figure 7 shows some examples collected during this research. This research also created interesting discussion in the class.

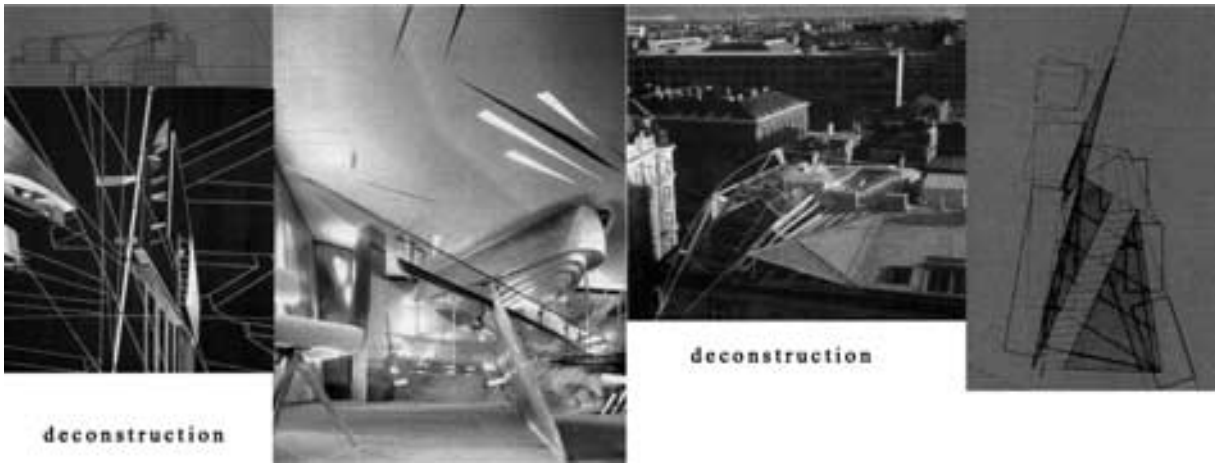


Figure 7.
Examples showing the use of structures in the buildings, which were designed within the style of Deconstruction.

These students developed the ability to have discussions with their friends, and to prepare good presentations of their research work, as well as a good understanding of a specialised type of the philosophy of technology.

Conclusion

The educational experiment described above, which was unavoidable and not well planned, shows that the increased time devoted to research education, and the reduction in time given to the theory of construction, result in an improvement in the quality of the knowledge gained, if there is a concentration problem among the students, and if the students have differing points of view about architecture. Insisting on classical methods in this situation is totally unproductive in such cases.

The exam results also show that students were following each other's work, and they learned a lot about construction and research during this process.

It can also be stated that the increase in time given to research might increase the quality of education even if there are no problems in relation to the attitudes of the students, because of the:

1. The possibility of self education,
2. The birth of questions, highlighting areas of interest, and learning whilst also enjoying the educative process,
3. The elimination of standardized and hierarchical learning,
4. Learning from other students,
5. Reciprocal learning between teachers and students.

However, verification of the last paragraph requires further research. By making small differences in the process, the method can slowly be developed. The needs of each class and each group of students in the class should also be considered whilst designing the details of this type of study or education. Action research can be proposed for the generalized development of the method.

References

Althusser, L., Gelecek Uzun Sürer (L'avenir dure longtemps), Istanbul:Can Yayınları, 1996.

Balibar, E., Althusser Için Yazılar (Ecrits pour Althusser), Istanbul:Iletişim Yayınları, 1991.

Baudrillard, J., "Hyperreal America." Economy and Society. Routledge. Vol 22. No 2. May 1993.

Chomsky, N., On Democracy and Education. (Ed- C. P. Otero) Routledge Falmer. New York and London. 2003.

Gadamer, H. G., Reason in the Age of Science, Cambridge:MIT Press, 1981.

Horrocks, C., Baudrillard ve Milenyum. (Trans: K. H. Ökten) Everest Yayınları. Istanbul. 2000.

Hürol, Y., "Intellectual Friendship in Architectural Education." Journal of Aesthetic Education. Accepted for Publication.

Lefevbre, H., Modern Dünyada Gündelik Hayat. (La Vie Quotidienne dans le monde Moderne) (Trans: I. Gürbüz) Metis Yayınları. Istanbul. 1998.

Mulhall, S., Heidegger ve Varlık ve Zaman. (Heidegger and Being and Time) (Trans: K. Öktem) Sarmal Yayınevi. Istanbul. 1998.

Nietzsche, F., Tarih Üzerine (On History). (Trans: N. Bozkurt) Say Yayınları. 3rd Edition. Istanbul. 1996.

Nietzsche,F. On the Geneology of Morals and Ecce Homo. Trans:W.Kaufman. Vintage Books. NY. 1967.

Paz, O., Yalnızlık Dolambacı. (El Labirento de la Soledad) (Trans: B. Güvenç) Can Yayınları. Istanbul. 1999.

Pirsig, R. M., Zen and the Art of Motorcycle Maintenance. Vintage. Sydney. 1989.

Russo, M., Female Grotesques, Carnival and Theory. Writing on the Body, Female Embodiment, and Feminist Theory. (Ed: K. Conboy, N. Medina, S. Stanbury) Columbia University Press. New York. 1997.

Willis, J., (Ed.) Society for Higher Education Innovation. International Conference on Higher Education Innovation. Published by Nizhyn State Pedagogical University. Kiev. 16 – 19 May 2003.

Warsaw University of Technology, Faculty of Architecture, Warsaw, Poland

Jerzy GORSKI

The two parallel and complementary topics proposed for the third workshop of the Construction Teachers' Sub-network are perfectly chosen from point of view of teachers of my and other Polish architectural schools. Constant changes of political, economical, social matters causing also great modifications in building industry and investment process were our experience during last two decades. They were connected with the degradation of communism system in 80's, with transformation to capitalism after 1989 and now with joining the European Union.

The first topic concerns the expected profile of young architects after graduation which will allow them to confront the world of architectural practice in a changing society where common demands tend to be on constant reformulation. The competence and skills or essential requirements provided through construction teaching should lead to effective work in the real and changing world.

The second topic concerns the educational methods which will ensure the acquisition of these competences and skills – teaching methodology as well as structure of courses in which the competences and skills of a graduate can be ensured

The problems connected with these topics were somehow actual in the changes we already experienced. The changes in didactic programme and teaching methods reflected changes in actual organisation of investing and building processes

The main difference in the architectural practices between the past and present in Poland occurs in the organization of designing work and legal responsibility. In the old system the architect worked in the large scale state owned designing offices where he was a part of the team of several specialists groups – structure engineers, M&E engineers, quantity surveyors etc. He was responsible mostly for a development of an architectural form and functional layouts.

Somebody else, from higher management group, represented the office to the investor (in most cases also the state owned company) and decided about formal and financial matters. In such situation the young architect could have steadily and safely developed the skill under supervision of experienced designer. Also the limited number of building materials and technologies and the clearly defined standards made the designing simpler. In such situation the teaching of Construction could have been limited to basic information and general training knowing that further and deeper education can be achieved safely during the practice in the office.

The transformation to the capitalist system allowed the creation of private architectural practices of different size, from one man business to bigger ones organized accordingly to scale of the project. That changed the liability of an architect within the whole designing process. In most cases an architect

signs the main contract with the investor and then chooses independent consultants (structures, services etc.) who work for him as the subcontractors. Thus an architect is responsible for all legal and financial matters. Previously all of these had been included in the large state-owned offices organization.

Now the building materials and technologies, existing worldwide, are easily accessible. They are offered with aggressive, commercial advertisements. Because of that an architect must have ability of rational choice based on necessary knowledge and experience. In view of this the student must be adequately prepared for such duties especially in case when young architects start their private practices soon after graduation.

At the second workshop we learned about various methods of teaching of these problems, but the scope of basic theoretical knowledge possible to teach in usually limited time and it's relation to present and future technological reality is still a difficult and open matter.

Specialized firms connected with production of building materials, assembling components into technological elements, erecting prefabricated buildings are presenting to clients and architects information in technically elaborate way using computer programs, calculations, visualizations with possibility of variations of architectural form and adaptation to local climate. These particulars are prepared in such way that they may be used by clients without architect's help. This may weaken the position of an architect in designing and construction process unless local building law prevents it.

The Teaching of Construction and Contemporary Architecture

Students willingly observe achievements of contemporary architecture in nature or in professional magazines and books. In their designs they repeat, sometimes consciously and in many cases unconsciously, forms of existing buildings. Mainly they are interested in external view of famous buildings and imitate their fashionable elements. Lately popular among students were deconstructive forms, large glazing areas and double skin glazing – in cases of glazed surfaces usually without thinking about the climatic consequences of such decisions. Analysis of functional layouts of existing buildings and their relations to form are very rare. The knowledge of structural elements and construction systems are even more limited unless they are visual parts of an architectural forms for example expressed long span beams or space trusses.

The influence of contemporary architecture is visible especially at students' design studio works. Architectural design studio is considered by students as the most important and leading subject. In such situation the attitude of design teachers towards the whole architectural education process is very important. Ours, as Construction teachers, achievements also depend on their attitude - whether they stress importance of technical aspects or not. If they do so, the students would not treat the technical subjects as something completely alien to "architecture" and they acquire the knowledge we try to pass to them.

The architectural designs prepared by students has a form of concept stage design where the main objectives are functional layouts, spatial arrangements and visual effect. This stage appears in all design processes in real practices. The difference is that the experienced designer while

preparing a concept design or even doing primary sketches thinks or subconsciously feels the constructional aspects of the building knowing that it will be eventually realized. For students it is not natural, intuitive process. They have to be made aware that all aspects of design are important, even though at the beginning formal aspects prevail.

The role of studio teachers is crucial and difficult . They should not limit students' imagination but on the other hand should show also rational aspects of architectural design (function, stability, local physical aspects, lighting, choosing real materials to achieve visual effect). These rational decisions have to be obviously adapted to the scope of concept design. Too detailed technical particulars at the primary stage may limit visual imagination, but on the other hand rationalization strengthen the quality of architectural concept.

Students are very skillful in using computer techniques for graphics and visualizations. Looking from point of view of building materials choice this has a positive aspect. At least they have to decide what colour should be used on elevations and 3D visualisations that should represent real materials. It is one step forward in comparison to black and white elevations and monochromatic models. Nevertheless some students designs are, as Fausto Novi from Genova stated, the "Photoshop Architecture".

Assumption, that students are aware of importance of technical aspects in architecture and want to know more about it, place the special obligations on Construction teachers. The basic information necessary for understanding of construction process should be supplemented (in appropriate proportions) with the examples of the newest technologies applied in existing buildings. Thus students would feel that they are close to contemporary architecture and that it is a starting point for changing the professional reality by them in future.

The Teaching of Construction and the New materials and Techniques

Fast developments of technological possibilities, a large variety of modified and totally new construction materials and techniques offered in the building market have also influenced teaching methods. Teaching in traditional academic, encyclopaedic way is not sufficient. The lectures and school handbooks no more can be the only source of information about materials and technologies. The time given in curriculum is usually too short to cover all actual information. Constant changes cause also that some information given at the beginning of study period are already out of date at the end of it. Nowadays the students commonly use internet where they can find all current technical information, libraries of details in CAD, etc. They have to be taught how to seek information also in technical literature and professional catalogues and how to reach producers and distributors of construction materials. Such skill would be very useful in their future work as a constant seeking for current information about technological possibilities is an everyday practice of real designing work. But on the other hand the large amount of information commercially presented by competing firms causes the necessity of the rational choice. To do it sufficiently students have to be specifically aware what is the task of their search and how to evaluate acquired information. During the Construction course they should gain an ability to comprehend the basic problems connected with developing an

architectural concept to the building design stage. Knowing these problems they should be able to use their technical knowledge and all information sources to prepare technical drawings and specifications necessary for construction of the designed building. They should understand the relation between an architectural form, materials and structural principles in order to use the knowledge of Construction as the means for expression to serve their imaginations.

The Teaching of Construction and the Environment

Environmental view of architecture may be considered in two scales: global and local. Global view concern sustainability connected with the foreseen limits in the exploitation of exhaustible energy sources. The awareness of such problem grows from seventies and has impact on all life areas, also at building industry. One can observe many ways of solution to this problem. The simplest is connected with thicker thermal insulation in order to decrease production of energy, which in turn save the sources and abate pollution. The thermal insulation requirements are usually set in local building codes. It is comparatively easily comprehensible by students that external partitions' (walls, roofs) construction should fulfil "U" value requirements and thermal bridges have to be reduced to a minimum. They may implemented it to their designs with no special problems. But "regulations does not mean comfort". Designer has to take into account other elements like ventilation, natural light etc. Also from sustainability point of view the production and transportation of building materials, also those used for thermal insulation may have negative impact on environment. More advanced view on sustainability refer to several forms of low ecological impact buildings – using bio-climatic technologies and non-conventional sources of energy (solar, passive and active, wind, heat-pump) considering shape of building, its orientation. This matters in basic forms are taught in our school at Construction and Building Physics courses and supplemented at some optional seminars and design studios. The progress in comprehension of wide matter of sustainability by students is visible but it has to be constantly intensified (also among adult architects).

In local scale all global problems are present but should be implemented individually. Architectural forms, technologies and materials should not be imported mechanically. Climatic particulars, construction traditions, existing neighbourhood, life habits have to be taken into consideration. Long time experience and common sense of our ancestors are worth to be followed.

The Teaching of Construction and the Rare and Traditional Knowledge

Traditional constructing methods are presented to the students in the process of teaching of the various subjects - history of architecture, construction, structures with adequate attitude to the matter. This refers to use of traditional materials such as wood, stone, ceramics, their individual characteristics and methods of application.

Historical view connect the use of certain materials with the architectural form and style. Course of structures presents the mechanical properties and structural possibilities of various elements of traditional constructions. Constructional attitude extend it into other properties important for building process. It helps to examine the nature of things – to understand the basic and invariable principles and on the other hand the causes and effects of

Digging for the earth below the humus layer

Loading earth to marked sacks

Documentation of the depth of layers

Sieving of earth to exclude too big pieces

technological progress. That in combination with views from other fields should cause students' awareness of historical evolution of technologies and understanding of their internal substance.. This substance derives from long time experience of logical use of materials connected with their natural properties, local climate and functional needs. From that originated the architectural forms typical for certain geographic areas.

For example the traditional carpentry of timber framework, when no metal fixing were used is an excellent model for understanding of structural matters. Following the modifications connected with the technological progress one comes to used nowadays light timber frame work, to structural elements of laminated timber and other forms of modified wood like plywood, Kerto, Thermowood etc.

Similar occurrence one can find in other traditional materials (stone, ceramics, iron, and other metals) .They can maintain their natural features and beauty and then due to technological progress they can be used in more efficient way and widen the architectural effects.

According to the curriculum of our school all students of the eighth semester take part in the design studio dedicated to modernization of existing historical buildings. For this task the knowledge of both, traditional and modern technologies known from Construction courses in previous years is necessary.

Matters presented above are included in compulsory part of curriculum. Apart from that the teachers have opportunity to offer optional lectures and seminars to widen the basic knowledge. They are connected with various subjects of which one example will be mentioned here. Dr hab. Teresa Kelm from Contemporary Architecture Dept. in co-operation with Construction Dept. offered lectures and seminars concerning non-conventional building technologies especially earthen architecture: adobe bricks, rammed earth, compressed earth blocks, straw-bale, wattle and daub etc. She maintains contacts with CraTERRE in Grenoble and centers in Germany, USA, and other countries.

Earthen construction are sensitive to moisture, which appear in various forms in our climate. The historical building though from different areas in Poland and other similar climatically places (Grenoble area etc.) show that earthen technologies have been used successfully if they were protected from water. For example close to Warsaw there is a palace from XVIII century with walls constructed in rammed earth.

Our school received from Belgium hand operated press for making compressed earth blocks. It was used by students at the workshops to produce blocks using earth from different sites (also from school courtyard) as the one of the values of this technology is a possibility of using real "local material" from somebody's own site in order to reduce transport costs. (Photos show consecutive stages of described workshop). As the continuation of this action the small experimental building for University was planned to be built but it was postponed due to legal and financial matters. Meanwhile in order to observe a climatic influence to earthen elements students built some small walls. Some of them were covered with metal roof, other uncovered. Two are shown on the pictures. The uncovered one is steadily dilapidating, while the covered one is still in good condition (photos shows the situation after three years from erecting time).

Preparing of mixture adjusting proportions of components (sand, clay)

Compressing blocks in hand operated press

The block taken out of the press

Blocks put aside for drying

Not protected wall after three years of exposure to external weather conditions

Protected wall

Within the same cycle of optional workshop the students visited the factory where the straw and clay blocks are produced in rather traditional way. These blocks are mostly used as an infill of timber framework. Practically the whole production goes to Germany and France as in our country the ecological attitude is still very rare among the investors who prefer industrial products. The exercises of this type may increase students' comprehension of ecological attitude (microclimate, recycling etc.) but at the moment are still rather incidental.

Dynamics and Tendencies

Teaching in most of architectural schools is fragmented to separate subjects as the necessity from organizational point of view. But this does not conform to the situation existing in the real designing process. Al aspects – formal, technical, environmental are considered here simultaneously from concept stage through whole design process to realization stage.

Even if there are separate subjects in school curriculum the task of architectural education is to educate the graduates in such way that they will be able to cope with all problems awaiting them in the professional life.

In previous parts of this text I have tried to show that interesting us problems are taught not only in Construction and other technical subjects but also are very often considered in design studio works. On the other hand teachers of technical subjects, especially if they are not architects, should remember that the main task of their teaching is preparing the graduate to work as an architect who will collaborate with structure and service engineers but will not do their jobs. In such situation the cooperation and exchange of experiences between several school departments, design studio including, is necessary. We have to build the **together** the identity of our architectural schools.

University of Architecture and Urban Planning 'Ion Mincu', Bucharest, Romania

Rodica CRISAN

The Teaching of Construction and Contemporary Architecture

The spirit of the diversity seems to be a characteristic of the contemporary's architecture; a diversity which rose from the very different ways in which architects are approaching a time of unprecedented freedom in their profession.

The contemporary architecture expresses itself by a large range of forms. The creative freedom has expanded proportionally to the technical progress. Computer-aided design makes it increasingly easy to create unique and sophisticated buildings. Materials too have taken on flexibility unheard of just a few years ago.

The profound change of our civilization is suggesting the need for high level of contextual awareness, questioning, and flexible adaptability.

THINKING ABOUT FUTURE is essential, especially for our students who will carry on their lives and professions in that future.

As a designer, the architect always deals with the future. The anticipatory nature of design seems to be itself a good antidote to any type of future shock. If this has been true in the past, it seems now that the magnitude and depth of change underway makes this argument doubtful.

We use to think of the future as an extrapolation of the past. From this perspective, teaching means to hand down the existing knowledge to the next generation. But the contemporary world and particularly the forecast future do not offer any guaranty for the validity of this logic. In fact, the fast and non-linear leaps we are already experiencing make evident the possibility that the future surpass the most daring extrapolation of the present.

Paying attention to the future means at least two kinds of attitudes within the architectural education.

The first one - not very common - introduces the discussion about the future into actual education. This kind of approach means to bring the future of the architectural practice within the curriculum.

The technological area of the architectural education curriculum, dealing with seemingly cutting-edge subjects - as 'intelligent façades' or 'solar houses' - appears at first sight more conductive to future thinking. But just like other disciplinary areas (including design studio),

it is usually based on past experiences, even if very recent ones. Courses rarely involve any true study of the future and most frequently concentrate in developing applicable skills for the job market of today.

As the role of anticipation becomes increasingly vital for responding to our fast changing civilization, the 'futuring'[1] - based on more or less sophisticated forecasting tools - needs to be formally included within architectural education.

Bringing the future, as a subject of inquiry, within the architectural curriculum does not necessarily means less focus or time for other subject matter. The exploration of the future could be included within existing courses content; the necessary pedagogic ability is to select problems and issues that have within them the seed for engaging the future. This can be done in design studio or in interactive lecture classes. For instance, a class of 'history of techniques' could include an examination of the way the future has been constructed in the past, so that students could understand how the architect needs to address it for facing the challenges of tomorrow.

Perhaps the most important gain in a curriculum that considers the future is the possibility to make students and teachers alike change their mind about the present. Looking at the present with the eyes of tomorrow, its perception of can be significantly modified: what is a problem now, may become an opportunity later; what is an asset today may be a heavy burden tomorrow.

Including a 'futuring' component in the curriculum may also have other pedagogical objectives. For example, it may help students to understand the nature of change, identify the most probable futures on forecasting scenario basis and clarify their implication; it may prepare the students for what is to come while helping them to develop a vision of their personal and professional futures.

'Futuring' also offers a great opportunity to improve traditionally weak areas of architectural education such as externality, integrative activities, interdisciplinary inquiry, alternative practices, etc

From an administrative point of view, bringing the future into architectural education does not imply a revolutionary, but rather an evolutionary movement that directs the objectives, curricula, methods, research and academic services towards the arising new realities. We need to emphasize ways of thinking; making that transcends the norms of today's practice - the limitation of current technologies, methodologies, customs, etc - and focuses on how architectural ideas, representations, building processes, etc, are influenced by the arising new materials and technologies, cultures, practices, etc. This means TO TEACH HOW TO THINK, HOW TO LEARN, HOW TO DEAL WITH PROCESSES AND NOT SO MUCH WITH CONTENTS, because contents are transitory, both in present and in future world. *'Including this type of flexible thinking and learning within a future sensitive pedagogy is definitely not part of ordinary architectural education'*[2] and probably there are few (construction) teachers that

explore this territory within their classes. *'Although their actions do not result in widespread curricular changes, they provide valuable work.'* [3]

The second possible pedagogic attitude means to look at the future of the profession identifying possible changes in the educational structure, in order to 'produce' a particular profile of the future architect. This approach doesn't include any action aiming to incorporate future thinking into the architectural education. It is constructed as a response to the pressing needs of the present and generally refers to the competences and skills that would make the graduated able to practice the architect profession. From this point of view, the simplest example of curriculum 'adjustment' is the incorporation of the computing. Today is almost impossible to obtain a job without at least basic knowledge of computers. Students are being prepared for some of these requirements during their studies by goal-oriented CAAD courses; however, this relatively flexible reaction arms students and graduates with fast design tools, enables them to visualize and model their architectural concepts, and to better communicate with their beneficiaries. But it is not enough to survive in a fast changing world.

The INFORMATION SOCIETY is strongly affecting present labor market, education and professional training, but also family life, habits, culture and leisure, health and politics, hence nearly all fields of our daily lives. Such transformations in society bring about changes in professional practice, new demands upon competences and skills, and, last but not least, change in the way of thinking.

The significance of the information society for individuals - including practicing architects, teachers and students in architecture - does not consist (only) in the use of industrial facilities (digital phones, computers and Internet). It also means a specific swiftness and quality of attitude towards information sources, the ability to select information and to apply it strategically, to analyze it and to know its value. Understanding the significance and the power of information and appreciation of information industry are essential elements for changes in the way of thinking. These changes are tied with the labor organization, but also with the assimilation of new elements into the structure and methodology of the educational process.

Today's students and teachers have many new drawing and modeling tools, new information resources and new teaching supports at their disposal. Students want more from their educators. And teachers themselves are experimenting with new ways of delivering information.

Instead of passive learning, active learning comes to the fore. Students may search for data and programs from electronic databases. With the development of multimedia, educational supports readable from CD-ROM are appearing in addition to the traditional textbooks.

The educational methods based on information technology effectively promote the development of creativity. In contrast to passive receptive learning, these methods are more effective in the study of the theory

of structure, as in the study of the building's physique. The student can better understand the structural design requirements and integrate them into his/her architectural concept, using informational tools for visualizing the state of tension under load. Furthermore, the available informational tools can facilitate the knowledge of the building as a complex environmental control system, which has to respond both to individual's needs for comfort as to the society's requirement for a rational use of energetic resources. (In our Department we have done some small steps in this direction, not only by making demonstrations into classes, but also by using simple software into design studio work.).

The expanding and shifting information (about new materials, products, systems, firms, regulations, etc) that an architect has to manage is a major challenge for his/her professional practice and so it is for the educational process. A solution could be a solid INFORMATION CULTURE formed within the architectural education, with special relevance in construction teaching – may be the educational component most affected by fast changes of the present society.

In the educational process of today the memorizing of knowledge is of decreasing importance and methods of seeking information are gaining ground.

In a world dominated by information, the communication and computing technology enables 'table research' and is fully valorized when used for obtainment, compilation and analysis of strategic information for architectural design (as for other specific activities). This is probably the place where lies the most demanding part of the transition: the increase of information culture using the services of information industries and the consecutive changes in organization of the labor – in the professional activity of the architect, but also in architectural education.

The educational process has to adapt its goals (introducing new competences and skills of the future architect), but also the teacher profile (the teacher is not anymore the person who knows everything, but he has to be an exponent of the new information culture), the teaching methods and the evaluation criteria.

An educational process focused on information culture means understanding of the key role of information sources. Working with them and habitually using information services (websites, specialized databases) should become an important part of agenda of the future architect and has to be a component of the educational process, especially in construction teaching.

(Few years ago our Technical Sciences Department has initiated a project for an information centre in construction, architecture and urbanism – BICAU - financially supported by the National Council for Research in Higher Education – CNCSIS - and the World Bank. The goal was to organize in a complex database system all the available information in the mentioned areas - services, products, systems and

materials, dealers, publications – and to make them accessible to professionals by an informational platform consisting in a portable catalogue and a vertical portal hosted by the site www.bicau.ro. In 2003 BICAU became fully functional. As they are going to do it in their future professional practice, the students can easily accede to the information they need for a certain class or a specific studio design work)

Adaptability to perpetual changes can be achieved by cultivating research aptitudes, as continuous learning instrument. Architectural education, and in particular construction teaching, has to facilitate student directed inquiry, encouraging individual exploration based on well-defined objectives and standards of evaluation, using both traditional methods and modern information instruments. Cross-disciplinary extension is to be promoted defining particular areas of emphasis in accordance with 'hot' social requirements, such as energy optimization, rational use of resources, building rehabilitation, etc

The technological progress inevitably leads to an increasing specialization. More and more sophisticated materials and technologies claim specialized professionals and for the architect this fact means to cooperate with (and coordinate) an increasing number of possible 'specialties' beyond the 'traditional' engineers. That's why the exercise of trans-disciplinary approach, as well as the practice of working in multidisciplinary team is and will be an important component of the architectural education.

The separation between 'design' and 'construction' can be considered the worst dysfunction of the present architectural practice that progressively has hit the teaching, the profession and the society as a whole. It is commonly accepted that in the architectural process there are two phases: the first, creative, depending on the architect's 'fantasy'; the second, practical, depending on the engineer's 'realism'. During the second all-important decision are to be taken: financial, structural, type of materials, technical implants. On the other hand, the increasing complexity of the design is leading to a more and more accentuated fragmentation of the building process, which has to be controlled by the architect, able to integrate several specific requirements. In these conditions, the capacity of the architect to dialogue with and to coordinate other specialists is essential. The architectural education has to reckon with the 'traditional' separation between 'architecture' and other 'specialties'; even if for methodological reasons specific disciplines are separately studied, the school has to teach the student how to re-assemble all the sequential information in a global building concept. This means to privilege the construction not as a-posteriori task for one or several specialized persons, but as a unique moment part of design. (We have tried to re-establish the synergy between design and construction in the student's activity within a design-and-build optional studio coordinated by the Technical Sciences Department; unfortunately it is not a large-scale action, as for administrative reasons it can involve only 12 students)

The way to prepare for the future is not by denying and abandoning the inherited knowledge, but by critically revisiting it, following the two 'traditional' directions of the architectural education: one of them based on the formative role of knowledge, and the other based on the emphasis of the practical utility of knowledge.

The interest for the traditional construction knowledge is presently increasing in the architectural education; it is re-valorized not only as cultural reference, but also considering new aspects of its practical relevance.

First of all, it is the growing sensibility of the society for the cultural heritage preservation and the rational use of the built resources that generate a special interest for the local constructive tradition. The expanding market of building rehabilitation largely demands traditional construction knowledge. There are already signs that in the nearest future the major part of the architects will be involved not in designing new buildings, but in re-designing exiting buildings, considered as re-usable resources.

On the other hand, the present preoccupation for producing sane and 'sustainable' new buildings has broth in front natural traditional materials and traditional bioclimatic building concepts belonging to local cultures. Historic buildings have low energy consumption, climatic adaptability and long life, so the lesson learned from their study is relevant to modern architecture. *'There is no dichotomy between modern buildings and historic buildings – they both are used and abused, and have to stand up. However, it is still not realized how sophisticated traditional building techniques were. Since they have failed to understand buildings as a whole, designers using modern technology have now to relearn many lessons'.* [4]

Unlike traditional materials, some contemporary, experimental, attractive but untested industrial materials and systems may be not so adequate to local environmental conditions and internal comfort requirements; they could imply exaggerated investments and/or constant and expensive maintenance. As an alternative, the constructive tradition represents a rich heritage of knowledge tested in situ for a long period of time. The creative encapsulation and synthesis of the traditional knowledge could help the future graduate to face major requirements of rational use of resources and environmental protection.

As educational method, the exploration of a design concept already materialized into a historic building or the investigation of major technical events that in the past have generated important movements in the architectural expression, can facilitate the understanding of the architecture in a synergic relation with its constructive part and can stimulate the student to mentally repair the artificial fracture between 'architecture' and 'construction' deeply affecting present teaching system.

Furthermore, the survey of the physical decay symptoms of historic buildings, put in relation with the characteristics of traditional materials

and of the local environment, can facilitate the understanding of the building as a process and help creating the aptitude to control the physical decay phenomena in new construction.

New necessary competences and skills are requested for coping with new technical achievements (new materials, techniques, products, systems), new problems to be solved (as environmental protection and sustainable design concept) and shifting orientations of the professional market (between tradition and modernity, between existing building rehabilitation and new building design).

The observation that TEACHING HOW TO THINK IS MORE IMPORTANT THAN TEACHING WHAT TO THINK seems to be the necessary guiding idea of an educational system which intends to produce graduates capable of following the rapid changes of the present and especially of the future, unknown, world.

Under these circumstances, the architectural education and in particular the construction teaching should follow some general principles (suggested by an article[5] written in 1986) aiming to add some new competences and skills to the 'classical' profile of the architect. These principles are:

- To produce flexible professionals, adaptable to varying, uncertain categories of future tasks.
- To emphasize the use of general principles and theories as cognitive devices for organizing, understanding and dealing with changing knowledge; they allow adaptation under varying circumstances and help continuously learning.
- To teach not only 'general rules but also rules for the changing of rules. Teach how to design a theory and how to test it'. [6]
- To teach the 'knowledge necessary to obtain the knowledge needed for a particular project'. [7]
- To stimulate interdisciplinary work and thought into specific areas of design or research.
- To fully integrate in the educational process all the opportunities offer by the information technology.
- To encourage diversity (different individual personalities and opinions, different models and approaches of contents and methods; different cultures, contexts, and individuals), which expands the menu of choices available, but also extends the individual adaptability.

In order to respect these principles, the major changes of the educational process are to be looked for not in the curriculum, but in adapting to new goals the structure of the classes, the teaching methods and the evaluation criteria. The success also depends on the individual flexibility of the educators, their aptitude to accept the challenge, to up-to-date their own knowledge and to permanently look for innovative teaching solutions.

References

1 Term used by Bermundez, Julio, University of Utah, 87th ACSA ANNUAL MEETING PROCEEDINGS, Minneapolis, MN: ACSA Press, 1999.

2 Bermundez, Julio, University of Utah, 87th ACSA ANNUAL MEETING PROCEEDINGS, Minneapolis, MN: ACSA Press, 1999.

3 Ibidem.

4 FEILDEN, B.M., Conservation of Historic Buildings. Architectural Press, Oxford, 1996.

5 Rittel, Horst, Some Principles for the Design of an Educational System for Design. Design Methods and Theories, v.20, n.1, 1986.

6 Ibidem

7 Ibidem

University of Architecture and Urban Planning 'Ion Mincu', Bucharest, Romania

Rodica CRISAN

The Teaching of Construction and the Rare and Tradittional Knowledge

Competences

I. Competences in Conservation and Re-use of Historic Buildings

Case no.1
The architect facing common historic buildings (not 'listed')

The common historic buildings forming the 'minor architecture' of our historic towns represent symbols of our cultural continuity in a certain place; they are also considered 're-usable resources'.

Facing the 'minor architecture' the architect has to be able to rationally decide between demolition and conservation.

For taking wise decisions on the use value of an old building, he has to be able to evaluate its technological response to contemporary requirements; this response is based on local constructive tradition.

Building rehabilitation becomes more and more present in the professional life of the architect, requiring specific competences.

In rehabilitation, the architect needs specific competences for 're-designing' old buildings, increasing their use value without loosing existing qualities.

The maximum contemporary valorization of a historic building can be achieved by a minimum intervention only by first understanding the original concept of the building generated by traditional knowledge.

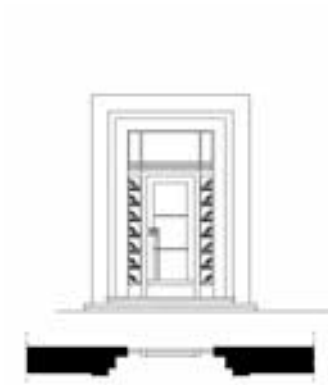
An effective rehabilitation requires technological compatibility between the contemporary treatment and the historic building as the product of a pre-modern technological civilization.

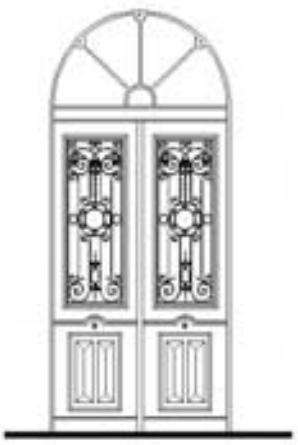
Case no.2:
The architect involved in the conservation of 'listed' historic buildings

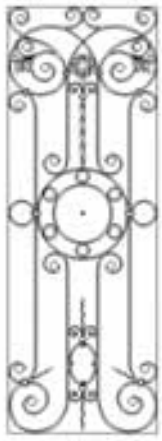
He needs more specific technical competences concerning the wise management of non-renewable resources.

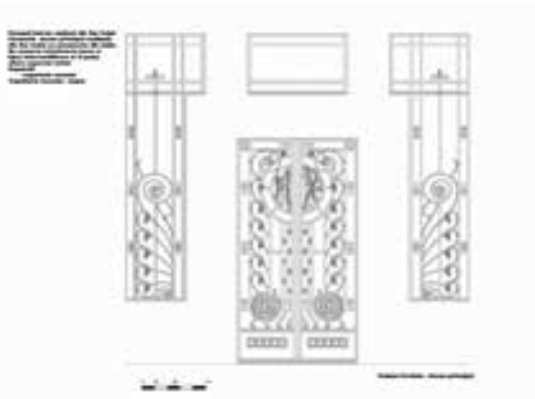
In this particular field, the conservation of material authenticity is an essential request: it refers to the original materials and workmanship, but also to the building's original technical concept.

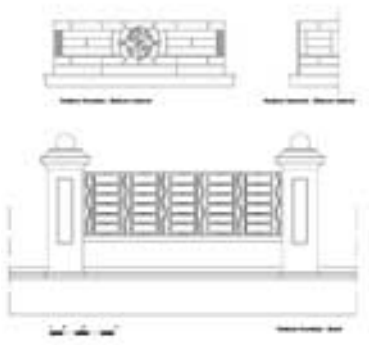
The professional has to have a sound judgment and a clear sense of proportion in deciding the restoration treatment, based on a good knowledge of the constructive tradition.

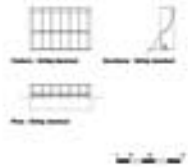












Generally speaking, the growing sensibility of the society for the cultural heritage preservation and the rational use of the built resources generates a special interest for the constructive tradition knowledge.

This knowledge has practical relevance for several reasons:

- The buildings' physical decay depends on the properties of the materials and techniques used.
- The constructive characteristics of the building determine its 'response' to use requirements
- The compatibility of the treatment technology can be ensured only by understanding the old building as the product of a specific technological civilization
- The study of constructive tradition is a source of compatible treatments
- The cultural resource's quality of being a historical document is essentially based on the authentic information supplied by the original materials and techniques.
- The architectural expressivity is supported by materials and techniques; they are an intrinsic part of the artistic expression.

II. Competences in New Construction Based on Traditional Constructive Knowledge

Constructive Tradition vs Modern Technologies

A reconsideration of traditional materials and techniques can be noticed all over the world during the last decades.

In building restoration the return to traditional materials and techniques has accompanied the growing reserves toward new techniques, largely experimented in the past due to great enthusiasm and unlimited confidence in the technological progress.

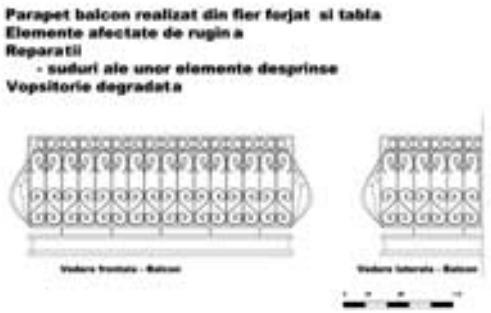
The abandon of pre-modern techniques represented an unjustified and serious loss of technical culture (not necessarily 'expired') in favor of new materials, insufficiently tested, often proved to be inefficient, even harmful and of doubtful durability.

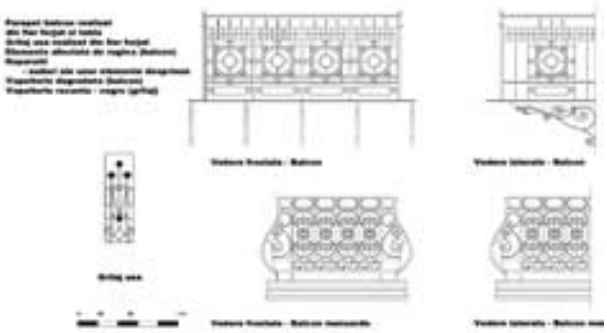
What happened in the restoration field demonstrates that an exaggerated enthusiasm in front of new achievements and the total abandon of the traditional, long-time verified knowledge, is a risky attitude.

The new construction is also facing new offers of new tempting materials.

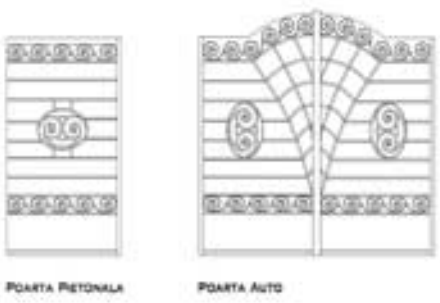
Unlike traditional materials, some contemporary, experimental, attractive but untested industrial materials and systems may be not so adequate to local environmental conditions and internal comfort requirements; they could imply exaggerated investments and/or constant and expensive maintenance.

Common architectural production is still strongly tied to tradition. Traditional materials and techniques are still largely used and useful. Their use has been and could still be perfected by the building industry





releveu
locuinte nr.11
studenti:
Diba Diana,
Sandu Theodor



and/or by applying new concepts in building design (such as rational energy use or building industrialization)

The competence in using traditional knowledge for new constructions is still in actuality.

The constructive tradition represents a rich heritage of knowledge, tested on site for a long period of time

The creative encapsulation and synthesis of the traditional knowledge could help the future graduate to face major requirements of rational use of energy and environmental protection.

' There is no dichotomy between modern buildings and historic buildings – they both are used and abused, and have to stand up. However, it is still not realized how sophisticated traditional building techniques were. Since they have failed to understand buildings as a whole, designers using modern technology have now to relearn many lessons.'

(FEILDEN, B.M., Conservation of Historic Buildings. Architectural Press, Oxford, 1996)

The Traditional Bio-Climatic Building Concept

The increasing interest in producing 'sane' and 'sustainable' buildings has brought in attention the traditional, natural materials; bio-climatic building concepts, belonging to an ancient tradition, almost forgotten, are now rediscovered.

Historic buildings have low energy consumption, climatic adaptability and long life, so the lesson learned from their study is relevant to modern architecture, which should aim at the same qualities.

The way to prepare for the future is not by denying and abandoning the inherited knowledge, but by critically revisiting it so that new and more appropriate methods, technologies, rules and practices may be developed.

Educational Strategies and Methods

The History of Techniques as Cultural Reference in Teaching Construction

A historical approach of the relation between formal expression and technological support can help the student understand the relation between 'architecture' and 'construction' and mentally repair an artificial fracture deeply affecting present society, professional practice and educational system.

The 'History of Building Techniques' (optional course for the 3rd year) tries to facilitate the understanding of architecture in a synergic relation with its constructive part.

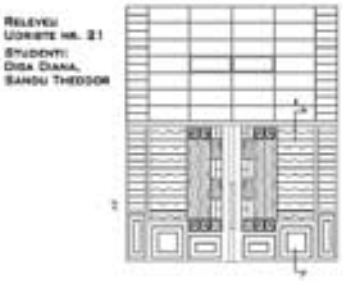
The practical exercises are inviting the student to explore a design concept already materialized into a historic building, or to investigate major technical events in the history, which have generated important movements in the architectural expression.

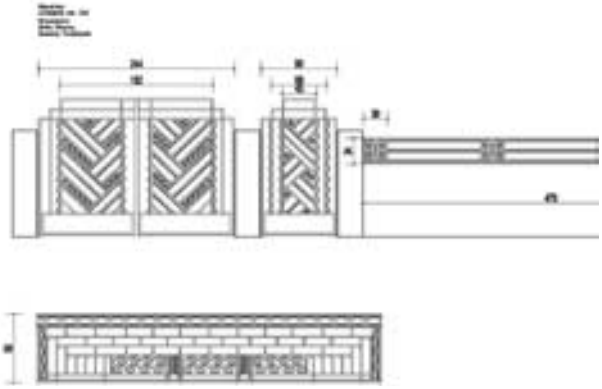
In the same idea, students are asked to make surveys of historic buildings and their components, relevant for the relation between traditional techniques and architectural quality.

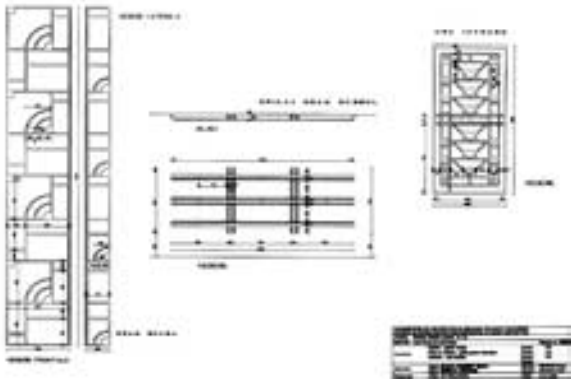
RELEVEU
UDRISTE NR.11
STUDENTI:
DIGA DIANA,
SANDU THEODOR COPERTINA

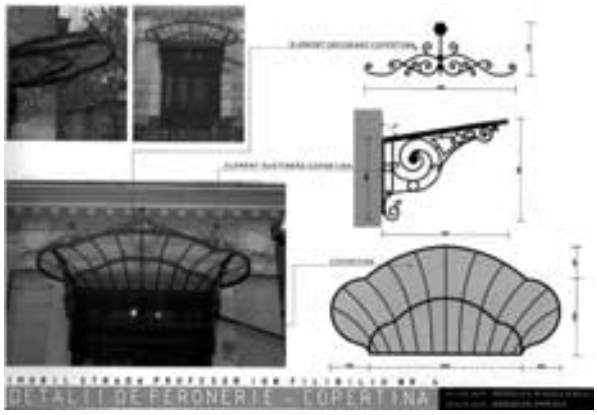
RELEVEU
UDRISTE NR.11
STUDENTI:
DIGA DIANA,
SANDU THEODOR DETALIU CONSOLA COPERTINA

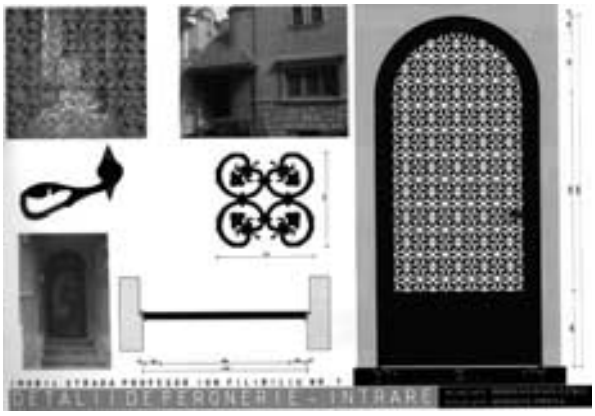
RELEVEU
UDRISTE NR. 21
STUDENTI:
DIGA DIANA,
SANDU THEODOR

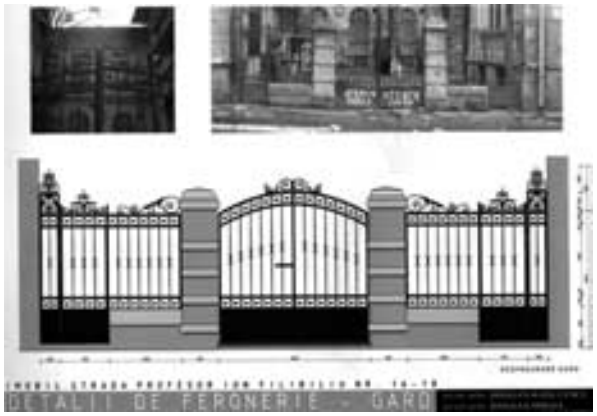


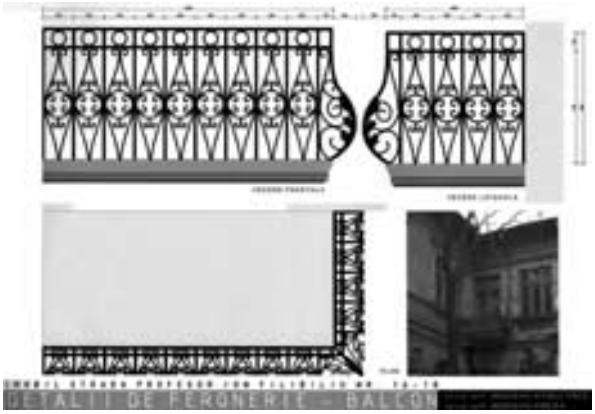





DETALII DE FERONERIE - COPERTINA


DETALII DE FERONERIE - INTRARE


DETALII DE FERONERIE - GARD


DETALII DE FERONERIE - BALCON

Historic references are also present in other technical classes, trying to help the student understand the relation between an architectural expression and its technological support.

The 'Static of Built Forms' (new compulsory course for the 1st year) is conceived as an introduction in the constructive logic of architecture; it is mainly based on the static analysis of famous buildings, from ancient times to nowadays.

The 'Building Systems' class (compulsory discipline for the 2nd year) introduces basic notions on different possible ways to build with wood, steel, masonry and reinforced concrete. The didactic approach is based on the exploration of historic and contemporary architecture.

The Constructive Tradition as 'Futuring' Instrument

As the role of anticipation becomes increasingly vital for responding to our fast changing civilization, the 'futuring' (i.e. the thinking about the future) needs to be formally included within architectural practice and education.

Certain technical classes include problems and issues that have within the seed for engaging the future thinking.

The 'History of Techniques' as well as the 'Building Systems' class propose an examination of the way the future has been constructed in the past, pointing out how the technical progress has generated new ways of building and new architectural expressions.

Teaching Traditional Knowledge for Historic Building Restoration and Rehabilitation

The traditional materials and techniques are studied in a specialized (optional) class: History of Building Techniques.

Some other (optional) disciplines dedicated to building restoration and rehabilitation (Technology of Building Rehabilitation, Restoration Techniques, Structural Restoration) also include the study of traditional materials and techniques.

Within these classes, the characteristics of traditional materials are put in relation with specific physical decay symptoms, the diagnosis and the choice of an adequate treatment.

This kind of approach can also help to understand the possibilities to prevent the physical decay phenomena in the case of new construction by correct use of materials and detail design.

The practical exercises associated to disciplines dedicated to the conservation of historic buildings generally consist in case-studies.

For example, the 'Technology of Building Rehabilitation' class requires the student to elaborate the diagnosis and treatment strategy for a historic house, in base of an architectural and technological preliminary evaluation.

Traditional techniques, as well as the relationship between historic buildings and modern treatment technologies, are practically experimented by the students in restoration sites.







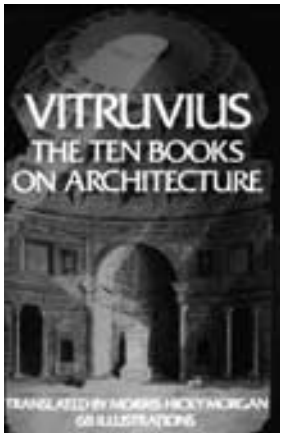
ETS Arquitectura del Vallès, Universitat Politècnica, Catalunya, Vallès, Spain

Ramon SASTRE

New Materials and Technologies for Old Problems

When we look at the shelves of our studio, full of catalogues or information leaflets about materials and components for construction, it seems impossible to be able to build without knowing all these products and using them.

And this feeling is often transmitted to our students. We complain we have no time to explain them conventional subjects as *Building Materials.* Some years ago (may be a few decades ago) the list of these materials was shorter and we had time to explain their history, the way we produced them, their diversity, their properties and so on. Now it is quite impossible and in some way it seems much better explain properties of building materials and elements and hope the students will learn to decide according to their needs.



Industry gives us the opportunity to choose. We don't have to use the *normal* materials and components that our ancestors have always used. Modernity means originality: not only design new forms but use new elements, but meanwhile forms can be invented (as we usually do) elements must exist in the building market. We are not prepared nor allowed to invent them.

On the other hand, if we go back to Marcus Vitruvius, and consider building requirements *firmitas, utilitas* and *venustas,* we conclude that things have not changed so much and, maybe, we don't need this enormous amount of possibilities to solve our projects. Of course we have changed names. *Firmitas* could be structure, stability, resistance, etc. *Utilitas* would probably be comfort, utility ... *Venustas* for aesthetics, fashion, beauty ... And what about sustainability, ecology, etc. But even with all these new requirements things are still similar.

**ETS Arquitectura del Vallès,
Universitat Politècnica, Catalunya,
Vallès, Spain**

Architecture, mainly from construction point of view, must solve, among others, those aspects that can disturb our comfort. Comfort which is felt throughout our senses, means a state of satisfaction about light, temperature, sound, touch, etc. And we know that this satisfaction is altered by external or internal aggressions: rain, wind, sun, noise, etc. Construction will be required to give the response to these demands. These are the *requirements* we must take into account in our designs.

Because this is so obvious it is often forgotten. We, teachers, take it for granted that students have it on mind as we have. But if we asked our students we'll realize that this is not true, at least not always.

And as requirements don't change everyday nor do materials and elements, a *way* to use them had been established by tradition. Vernacular construction or traditional construc-tion can be considered as a distillation or sediment of this knowledge, this *how to do.*

But obviously, traditional construction has its own errors. Sometimes it copied from other countries and other climates, mostly when it pretended to show class, power or distinction. And may be it noticed that things didn't work as they did before. This is quite common among our students. I even could say it is necessary, since they are learning. Copying from models is a normal way to learn. When we show them the works by the masters, we are not only illustrating them but attempting to imbue them with examples of something they should acquire and use.

Probably, in the old days, these errors would have led to a reconsideration of the design. This way, throughout an iterative process (*trial-error* process) we would try to get a design without errors. This process could be described as *design-check errors-redesign-check errors-redesign-...,* and so on.

Of course it was not done in a single building by a single man. *Design* was something completely different from how we understand it nowadays. The process of *checking errors* means two things: firstly a *capacity* of analysis o reflection about their lack of comfort and secondly an acknowledgement and *acceptance* that this as an *error.* And both are not easy to define. It is necessary to have a big dose of humility to recognise that we have failed instead of blaming the others.

Comfort is not an absolute term, it depends on many factors, and what could be uncomfortable for someone is perfectly comfortable for another one. On the other hand to accept or recognise that an uncomfortable building is an *error* is not even realised at the present time.

Students, probably, have suffered at their own home some uncomfortable experiences and they have assimilated them as normal. Why are they

going to be concerned with all these annoyances if they have lived together with them?

People blame architects if rain water leaks in a building. And not always! Some times they blame materials, workmen, building managers, etc. But most of the time they accept resigned noise from the streets, excess or lack of sunshine, problems with air renovation and so on.

In our days, both architects and students of architecture tend to design buildings following a process that can be described as *freedom-error-patch.* It means that while designing, there is no worry about requirements; trends, new shapes, fashion are often the main arguments to produce a result. This would be *freedom.*

After that, it's time to check errors. According to the capacity or ability to imagine how our design will work, we'll find more or less errors. And, of course, teachers must contribute in this stage since students are not used to criticise their works. This would be *error.*

Finally, we can redesign (this would be the trial-error method) or just try to mend the error by adding a new element that will correct the error. This would be *patch.*

If there is only one error we'll have a single patch, otherwise we'll have a *patchwork!* In fact sometimes this is my perception when I look over some works by our students. You notice that many of their design elements have been added just trying to correct malfunctions. And, perhaps, they even feel proud to show their ability in using so many components.

Are we, construction teachers, prepared to help our students in this situation? Now, as university professionals, we are supposed to have this ability of reflection. We can check our design with the help of many other experts. Offices and bureaus have changed a lot at the end of the XX century and, now, we use to work in complex teams. Sometimes even laws oblige us to do it this way. Therefore, once we have detected the errors, solving them is just a challenge to be won. It is the in some way the justification of the existence of the team. Our society is used to the concept that money solves all, and a *simple building problem* will no be different.

If we accept this *paradigm,* we might wonder why. It is, of course, not easy to answer it but probably we could look for a response in the first paragraph of this text. Technology allows us to do almost everything. We have got new materials, new components and new elements with the most unpredictable properties. They serve for everything.

The feeling of our students, encouraged sometimes by their professors, consists in not bothering about the problems of their designs. If they exist, what has to be done it is finding for something that will mend it.

If we wanted to express this way of designing in a few words we would say that we al-ways have to *add,* in other times we would have had to *change.* But is this sustainable? Of course not!

Adding means consuming and we know that most of us belong to a society of consum-ers. So, companies making these products for building nag us about using them. All are advantages, they say. But it is not always true.

They provide us with lots of information, software tools, examples, help ... They show themselves confident of their products and we can not ignore these advantages. We surrender easily to their overwhelming self-assurance.

But using more means paying more, being less sustainable and, what is the most im-portant, introducing new behaviours in our design. May be we could refer to transgenic food. Of course it is not the same, but consequences are similar.

And this is one of the main points in this theory. We are aware and used to the secon-dary effects of medicines, even to collateral damage of the wars. But we often think that solutions to building design errors by adding new elements have none of them.

I could report lots of examples but I'll mention one that we can come across quite often:

> *The old ceramic tiled flat roof or terrace is leaking. We don't know why although we imagine there is some crack somewhere.*
>
> *Setting a damp proof course is easier than looking which is the origin of the problem: expansion or contraction of the terrace floor, excessive flexion of the slab, etc.*
>
> *Probably this damp proof course is also a vapour barrier and when it is cold outside we have again water inside, this time condensation!*

But this is not the only one. If we have a look at the list of requirements that a building must cope with, probably we'll find examples of *misdesign* for each one. Cases, for in-stance, were sun radiation becomes a problem and the solution consists in adding blind-ers or air conditioning instead of re-orientating the windows. Or where a *new* way or pattern of laying bricks produces cracks and the solution consists in adding reinforcing bars, etc.

Well, that's the problem, but it's not so easy to find out the reason of it or the answer for it. Surely in part it is due to a lack of knowledge and an excess of vanity. Or may be it is also due to the superficiality we have when we design, not worrying about the prob-lems, because some one will solve them later. In any case, we must not forget that ar-chitects are immersed in our world, as everybody, and today values affect our behaviour in general and our way of designing in particular.

But mine is not a negative attitude. With a little reflection we can conclude that most of the troubles we face while designing architecture have not change along the years. And, although materials, technologies and knowledge have evolved positively, doubtless! some times we feel that the *common sense* has been abandoned because we consider it as not necessary any more. This is a tremendous error!

School of Architecture
Faculty of Duncan of Jordanstone
University of Dundee, Scotland
United Kingdom

Christopher LOWRY

on_making:
3 Dimensional Computer Modelled Case Studies applied in the teaching of Construction Technology

"A responsible architecture can only be created through a clear understanding of how it is made. Technology is inseparable from architecture as a whole, and the teaching of these subjects is central to the courses." [1]

Fig 1. Part timber structure study. Baumschlager + Eberle. Kern House. Lochau. Austria.

Pivotal to the student's ability to develop an architectural idea is their understanding of construction technology and reciprocally, how it is taught. The capacity to make informed evaluations of materials, structure, scale, form and assembly is inherent to the successful conclusion of a complete design and ultimately an appreciation of how buildings are made. In assisting our pursuit of this we have introduced a supplementary resource to our existing delivery of construction technology teaching in the form of computer modelled building case studies.

The case study method is motivated by an effort to promote student awareness of the position materiality and construction occupy within architectural design. To this end the method aims to avoid potential for a drift toward technology becoming either an idiosyncratic design approach or a residual afterthought when applied in the design studio. We have all experienced the student design project where the adoption of a single technological design strategy has progressed to the detriment or ignorance of the plan, context, scale etc... The opposite is also evident, interesting plan and section but little appreciation of how the building might be structured. These are extreme and happily seldom examples as our teaching aspires to a balance of consideration and inclusion of technology across the course syllabus best described through the school ethos of creative realism.

Advantages of the case study method come to light when considered in conjunction with existing lecture and seminar based teaching. Students can observe the direct correlation between specific knowledge and understanding we impart to them and how it has been applied in a realised piece of architecture. This is in contrast to many textbook approaches where construction principles and ground rules are conveyed through studies of autonomous building parts. Additionally, the case study offers an inclusive building description where the relationships between core technology subject areas of construction, structures, sustainability and environmental design may be observed collectively within the design process.

In principle the case study method is perceived as a positive addition to our customary teaching methodology. However, it should be stressed that this method's success relies fundamentally on the careful consideration of the buildings to be employed. Several factors contribute to the criteria for building choice, they include;

- the requirements of the technology course syllabus and broader course syllabus.
- potential as a vehicle to convey the intended learning outcomes of the syllabus.
- appropriateness of the building's complexity and scale with respect to studio programmes being explored by the student.
- visiting and accessibility opportunities for study visits or personal analysis.
- extent to which building has been reviewed and published in the architectural press offering potential for individual student research.
- potential for the case study contributing to the broader course syllabus, humanities, communications and professional practice.
- availability of detailed technical information to enable the production of the three dimensional computer model. See fig 1.

The availability of building information and details has the most significant influence on the generation of the case study once other factors have been addressed. A number of architectural publications provide sufficient general arrangement and detail information such as the 'The Architect's Journal' weekly technical study or 'Detail' magazine's more broad descriptions of building construction and specification. Ultimately the optimum source of the necessary information is the profession itself and encouragingly the profession has been generous in this provision given the application of the architect's work to an educational context.

One of the first practices we approached with the case study idea was David Chipperfield Architects, London. We were interested in The River and Rowing Museum at Henley (1996), a building conceived and executed by an architect whose attitude captured the spirit of what the case study method of teaching tries to achieve.

'Within our work I see no ideological righteousness in the development of a structural idea, in the materiality of the building, nor in the order of the plan, but rather that in general the architectural project must look for ideas that are engaged with the fundamental issues of making a building. While these concerns in themselves cannot generate an architecture, the dynamic relationship between abstract idea and the material and constructive method is central to the architectural project.' [2]

At Henley the development of an architectural idea which navigates context, programme, materials, structure and form toward a conclusion can be observed, from inception through to completion. Chipperfield's earliest design sketches for the project intimate an already present consideration of materiality, structure and form. (see fig 2.)

Equipped with general arrangement and specific detail drawings supplied by the practice (see fig. 3) we proceeded to build the detailed three

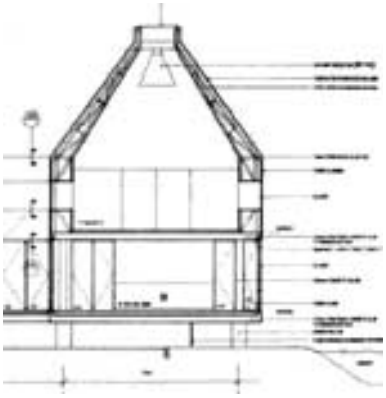


Fig 2. Part general arrangement section through ground and first floor exhibition galleries. Phase one. River and Rowing Museum. Henley. ©David Chipperfield Architects.

Fig 3. computer section model through ground and first floor exhibition galleries. Phase one. River and Rowing Museum. Henley.

Fig 4. computer section model indicating wind load transfer through primary structure. Phase one. River and Rowing Museum. Henley.

Fig 5. computer cut away study model indicating air conditioning system integration. Phase one. River and Rowing Museum. Henley.

dimensional computer model. In general the information required can be hard copies of dimensioned drawings or more convenient cad drawings which are then translated into a three dimensional wire frame model. Exported to a programme with rendering capability the final model is produced (see fig. 3) forming the common source for generating stills, animation and multi media resource material. The model may then be manipulated to reveal information particular to the user. (see figs. 4 and 7) This process utilises the same software our students encounter in the computing component their communications course. The case study to this end offers one of the core subject areas out with technology an opportunity to see the application of student acquired knowledge and skill.

To appreciate the full potential of the case study method we must consider how and where it is applied within the course delivery.

In the second year of our undergraduate course the students pursue an array of modules over two semesters building on their knowledge gained in year one. Technology, during semester one, concerns itself primarily with the delivery of lecture course based modules covering more complex essentials of construction, structures and environmental science. Construction is presented in a rational sequence of lectures covering foundations, floors, walls, openings, etc and culminating in the characteristics and performance of timber and steel. The module is assessed by formal examination or submitted coursework normally in the form of written papers.

We could describe semester one as the delivery of the subject area theory, however the desired application of this theory by certain students during the semester can expose the lecture course methods limitations. Although we are constantly promoting the application of knowledge acquired through lecture based teaching in simultaneously run studio design projects the duration of the lecture course can be at odds with the demands of a project early in the semester. In addition, studio submissions are not implemented formally in the assessment of the semester one lecture course. This may be a contributory factor in undermining the student's appreciation of the holistic nature of their architectural education. It is in semester two where the advantages of the case study method become apparent.

"Design Technology is concerned with the application of the formally taught knowledge within a contextual architectural design programme. Students are required to demonstrate their ability to design the whole building in detail, showing an understanding of appropriate and sustainable construction / structural systems and environmental control systems. This includes a general awareness of the appropriateness of the fabric design and material used contextually, and the impact these elements will have on the environment and the buildings, formal, functional spatial and aesthetic relationships." [2]

Design technology describes the studio module in semester two where students are required to formally[3] apply the theory in the development of their studio design project through to detail design. Emphasis on the modules intended learning outcomes is assisted in the control of the programme's complexity with respect to the scale of the project brief. A

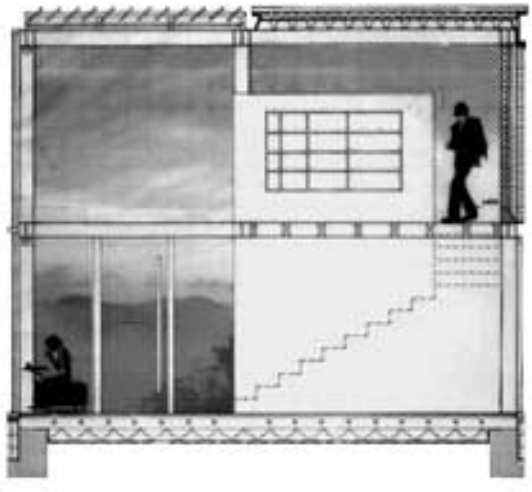
limited schedule of accommodation is presented where one component, such as a maximum building footprint, will suggest the use of a two storey design solution which in turn may suggest a structural frame solution. This control enables a more considered and extended phase of research and enquiry during the preliminary stages of the project. During this period the case study buildings are presented in a series of lectures and used as precedent in studio seminars.

The case study lectures present buildings from their inception through to completion. Although under the auspicious of the technology course all design considerations are presented. This is valuable in allowing the student to appreciate the architect's agenda which has informed their choice and development of materials, structure, scale and form. The first seminars are inclusive of construction, structures and environmental design where tutors from the three subject areas meet with groups of students to discuss project development. Emphasis here should be given to the inclusive nature of the seminar. See fig's 5 and 6.

This is deliberate teaching strategy as it introduces the student to the reality of the architectural practice with consultants debating and deliberating over proposed design strategies exhibited in the case study. As students witness debate amongst tutors they are forced to address issues within their project and find their position within the conversation.

Bringing their own research and project development to the discussion in the form of precedent studies, drawings and models we are able to raise considerations and steer their concentration toward achieving a successful conclusion. Large scale models are employed in investigating the components and assembly of their design. Section models at 1:20 through to 1:1 scale models of jointing details are used to explore how their building is made. Student work contributes more significantly to the seminars as the programme progresses as projects develop clarity in the relationships of materiality, construction, structures and environmental strategy. The final submission requirements of the *Design Technology* programme call for information which offers the student the opportunity to exhibit their knowledge and understanding gained during the course of the project. See fig 6.

Fig 6. Café project. 1:20 section model and section drawing. Paul Cumming. Student. Year 2 BSC. 2003.



In both the final drawings and models the student is required to exhibit substructure,superstructure, wall, floor, interior finishes and roof components with an accompanying text describing their sequence of assembly. Also, in as far as it is possible, students are encouraged to express the true materiality of the building. The advantage of this is clear in the large scale 1:20 section model which enables the student to experience more vividly the spatial qualities of their design.

The final crit of student work in effect brings the *Design Technology* programme full circle where having set out with the presentation of the building case studies the student in effect arrives back with a case study of their own.

A growing library of case study buildings is being added to each year which our students can access for their own personal research via the school server. We hope to expand this library with the inclusion of student *Design Technology* projects and student authored building studies observed during the construction phase allowing video recording of actual building processes and student on site experience.

To date feedback for the case study method is limited to student staff liaison meetings and end of year questionnaires. Feedback has been positive especially with respect to the inclusive nature of the lecture presentations and seminars. Future development will involve an analysis of the learning and teaching quality of the proposal with a case study presentation of Mount Stuart Visitors Centre, Isle of Bute, Scotland by Munkenbeck and Marshall Architects, London. This will be followed up by a field study visit by a cross section of the student cohort and completion of a subsequent questionnaire.

Reaching further abroad the 'on_making' research group is currently developing a website to promote and share building case studies. With combined professional, academic and student feedback it is hoped our research and development of teaching methods in construction technology will continue.

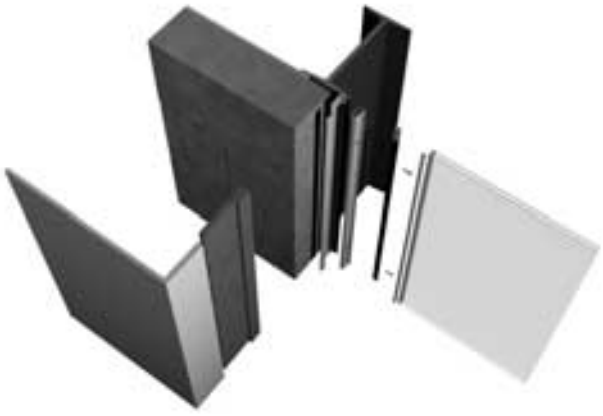


Fig 7. Detail study. Glazing jamb detail. Bramante Architects. Citizen Advice Bureau. Chessington. London.

Notes

1. Programme Review. School of Architecture. Faculty of Duncan of Jordanstone. University of Dundee. 2004.
2. Chipperfield, D. Tradition and Invention. Techtonic form/Making Space. 2G International Architecture Review. David Chipperfield – Recent Work. 1997. p. 140.
3. Burford, N. Design Technology. Course Handbook. Technology. September 2003. School of Architecture. Faculty of Duncan of Jordanstone. University of Dundee.
4. Author's note. Refers to the application of knowledge which will be formally assessed.

References

Waechter-Bohm, L. Baumschlager & Eberle: Bauten Und Projekte / Buildings and Projects, 1996-2002.

Shortis, M. Leahy, F. Ogleby, C. Kealy, A. and Ellis, F. The Use of Simulations and Visual Feedback in Learning Spatial Design

And Analysis Concepts. Department of Geomatics. University of Melbourne. 2002.

Larsen, H. Summer House with Studio in Vejby Simple Forms of Building. Detail. Volume 3. 2001. p. 420 – 425.

Silvia, F. Ef-Kern House. Lochau (Austria). Baumschlager and Eberle. Materia. 31. May-August 2000. pp. 56 – 65.

J. Finklestein. (1998) 4D Multimedia Datascapes: The SSV Program. Faculty of Architecture, Building and Planning. University of Melbourne.

C. Newton. (1998) Architecture as Alchemy. Changing documentation languages and their translation into built forms. Faculty of Architecture, Building and Planning. University of Melbourne.

Forster, W. Tradition and Innovation: timber as rainscreen cladding. Architect Research Quarterly. Volume 2. Summer 1997. pp 54 – 63.

Chipperfield, D. Museum in Henley-on-Thames, Oxfordshire. Pitched Roof Construction. Detail. Volume 5. 1999. p. 827.

Gustavo Gilli, G. 2G International Architecture Review. David Chipperfield – Recent Work. 1997.

Webster, A., Feiner, S., MacIntyre, B., Massie, W., and T. Krueger. Augmented reality in architectural construction, inspection and renovation. Proc. ASCE Third Congress on Computing in Civil Engineering, Anaheim, CA, June 17-19, 1996, 913-919.

Illustrations

Fig's 1 and 3 to 7. Render images from Rhino' computer model. Christopher Lowry.

Fig 2. © David Chipperfield Architects.

Fig 6. Paul Cumming.

The International Focus Project Brussels, Belgium

Pierre LORENT

International System of Reference for the Accrediatation of training and Certification of Security and Health Coordinators on Temporary or Mobile Building Sites

The FOCUS project
(European training and qualification in construction safety)

This is a project jointly financed by the European Commission within the framework of the Leonardo da Vinci 97 programme, the co-ordination of which is ensured by CAATB (the Association of draughtsmen and architects of Barcelona). Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, Portugal, Sweden and the United Kingdom took part in the project through the European Council of Building Professionals (ECBP).

The FOCUS project has given itself the following objectives:

- To define a referential and training programs on the subject of security in the construction sector that are adapted to the participants that are concerned.
- To define a system of accreditation for this training.
- To define a system of certification of professional prevention capacities of the participants in the sector and in particular of the coordinators on the subject of security and health.
- To create a European network in order to manage this system.
- To create a European glossary concerning security and health in the construction sector.

Introduction

The International and European framework of the project and the system of reference of the competencies of the security and health coordinators in the construction sector.

The system of reference of the competencies of the "security and health" coordinators defined by the International FOCUS Network has its origins starting from the recommendations of the BIT and the seminaries organised by the European social partners FIEC and FETBB of the construction industry with the support of the European Commission and the studies of the International Committees of the AISS of the Construction industry and for prevention Education and Training

Since 1989, a series of European Directives, together with a Convention 167 and Recommendation 175 of the International Labour Office in Geneva (ILO), have changed the outlook for working conditions in all SMEs in all industrial sectors, introducing: increased responsibility for employers, new obligations for workers, more involvement by all in the management of risks to health and safety at work.

The Directive on temporary or mobile[1] construction sites transposes the general provisions of the framework Directive for the construction sector. It makes the client and designers responsible for assessing the risks to safety and health and ensuring that the prevention of risks during the execution of the works or subsequent use of the structure are integrated into the architectural and organisational aspects of the project.

To this end, the role of coordinator has been created. The coordinators prepare for the execution of the works and future maintenance of the structure by means of a Safety and health plan and File appropriate to the characteristics of the project.

Overall, the Directive on temporary and mobile construction sites formulates a framework which assigns a specific and active role to all those involved in a construction project, although it is still necessary for them to apply the directive appropriately in practice within the framework laid down by this body of legislation.

The safety and health on a construction site concerns all actors in the construction sector from the planning stage until the execution of a project as well as during its renovation, maintenance and upkeep.

The purpose of this first part is as follows:

- to give a brief review of international and European laws and regulations relevant to health and safety activities;
- to give a rundown of the outcome of activities under the social dialogue so far in order to provide suggestions and tips for incorporating the prevention measures catalogued in this paper within a broader strategy on preventing accidents and organising health and safety protection in small and medium-sized firms;
- by describing the European network FOCUS, highlighting the key role of the Health and Safety Coordinators and the crucial importance of the work of architects.

The Reason Why

The International and European regulations in the field of safety and health.

1. Recommendation 175, Convention 167 and the Code of Practice of the ILO (Geneva).

Extracts from the ILO Code of Practice :

General duties of designers, engineers, architects

Those concerned with the design and planning of a construction project should receive training in safety and health and should integrate the safety and health of the construction workers into the design and planning process in accordance with national laws regulations and practices.

Care should be exercised by engineers, architects and other professional persons not to include anything in the design which would necessitate the use of dangerous structural or other procedures or materials hazardous to health or safety which could be avoided by design modifications or by substitute materials.

Those designing buildings, structures or other construction projects should take into account the safety problems associated with subsequent

maintenance and upkeep where maintenance and upkeep would involve special hazards.

Facilities should be included in the design for such work to be performed with the minimum risk.

General duties of clients

Clients should:

a) co-ordinate or nominate a competent person to co-ordinate all activities relating to safety and health on their construction projects;
b) inform all contractors on the project of special risks to health and safety of which the clients are or should be aware;
c) require those submitting tenders to make provision for the cost of safety and health measures during the construction process.

In estimating the periods for completion of work stages and overall completion of the project, clients should take account of safety and health requirements during the construction process.

2. The European Directives

2.1. Public works contracts in Europe[2]

It is interesting to note that Article 22a of the Council Directive of 18 July 1989 amending Directive 71/305/EEC concerning coordination of procedures for the award of public works contracts provides that:

- The contracting authority may state in the contract documents, or be obliged by a Member State so to do, the authority or authorities from which the tenderer may obtain the appropriate information on the obligations relating to the employment protection provisions and the working conditions which are in force in the Member State, region or locality in which the works are to be executed and which shall be applicable to the works carried out on site during the performance of the contract.
- The contracting authority which supplies the information referred to in paragraph 1 shall request the tenderers or those participating in the contract procedure to indicate that they have taken account, when drawing up their tender, of the obligations relating to employment protection provisions and the working conditions which are in force in the place where the work is to be carried out. This shall be without prejudice to the application of the provisions of Article 29(5) concerning the examination of abnormally low tenders."

2.2. The framework Directive[3] and the individual Directives on safety and health at work

The objective of Community policy is to establish a solid core of essential minimum requirements for the protection of safety and health at work through the adoption of Directives covering a maximum number of workers exposed to risks.

The general principles of the framework Directive

a) "The employer is responsible for the health and safety of his employees"

The employer must therefore take all practical measures necessary for the safety and health protection of workers.

b) Every worker must receive adequate safety and health training, appropriate to the nature of his workstation or job.

Training of this type will take place:

- On recruitment
- In the event of a transfer or a change of job
- In the event of a change in work equipment
- In the event of the introduction of any new technology.

c) Such training must also be provided for workers from outside undertakings engaged in work in the undertaking.

d) The rights and obligations of workers[4]

Every worker is required to comply with the employer's instructions, in accordance with the information and training provided, and to take care of his own safety and health and that of colleagues.

Workers are entitled to appeal to the competent authority, if they consider that the measures taken and means employed by the employer are inadequate for the purposes of ensuring safety and health at work. presents a serious and immediate danger to safety and health and of any shortcomings in the protection arrangements;

2.3. The construction site directive: Application of the General Prevention and Protection Principles in the European Construction Sector

At the Planning Stage of the Work

When architectural, technical and/or organisational choices are being made, and when deadlines are being estimated, the coordinator must ensure that the project supervisor or, where appropriate, the client adopts the following general principles of prevention :

1) Avoiding risks.
2) Assessing risks which cannot be avoided.
3) Combating risks at source.
4) Adapting the work to the man (ergonomics), by improving design, organisation and working and production methods.
5) Achieving these objectives while adapting to technological progress.
6) In general, replacing the dangerous by the non-dangerous or less-dangerous.
7) Developing a coherent overall prevention policy, which covers production, organisation, working conditions and social dialogue.
8) Giving collective protective measures priority over individual protective measures and using individual protective measures only where no other solution is possible.
9) Ensuring that all contractors and self-employed persons are fully informed and receive the necessary instructions to protect the safety and health of all those who will be involved in the execution of the works.

At the Execution Stage of the Work

On the site the co-ordinator coordinates implementation by the contractors and self-employed persons of the general principles of occupational risk prevention concerning:

1) Deadlines and organisation.
2) Good site housekeeping, circulation and storage on site.
3) The conditions for handling materials on site.
4) The site environment.
5) The safety and health plans.
6) File appropriate to the characteristics of the project (FAP).

Attention !

The Directive makes individual contractors and self-employed persons subject to the same obligations as employers and workers, where they refer to the professional activity itself: they must respect the safety rules, use appropriate equipment, give priority to collective protection, etc.

The Ways and Means

The Social Dialogue between EFBWW and FIEC

In 1992, when Directive 92/57/EEC on temporary or mobile construction sites had just appeared, the European Commission, FIEC, FETTB and the social partners in the construction industry, together with prevention experts in various industrial environments, agreed to coordinate their activities at European level. The working group thus established organised three seminars, the first on vocational training safety and on health, the second on the choice and application of the tools provided by the Directive on safety and health on temporary or mobile construction sites, and the third on risk assessment and the evaluation of pilot training and site schemes.

1. The lines of force of Pont Royal

1st European Seminar on Temporary and Mobile Costruction Sites in Pont Royal in France (22-23 November 1993)

Study on the needs for training on risk prevention and the making of a joint European Training programme

The first seminar was held at Pont Royal on 22 and 23 November 1993. It identified "five Pont Royal Guidelines" on basic education and training principles for clients, project supervisors, project and site coordinators, employers, the self-employed, employees and experts in on-site safety and health.

These "Five Guidelines" served as the basis for establishing a coordinator training policy among a number of Member States. Teaching objectives were jointly defined and European pilot training courses for "project and execution" coordinators were organised on a partnership basis (with exchange of trainers, courses and teaching methods) between the universities of Barcelona, Liege, Lisbon, Milan and France

Equivalence of diplomas and skills

Since October 1994, courses for health and safety coordinators of between 80 and 150 hours at temporary or mobile construction sites have been organised by a European partnership. The training and content of the courses are identical in Spain, Italy, the Grand Duchy of Luxembourg and Portugal and aim to achieve equivalence of diplomas and skills.

European certification in this area is being put in place. Coordinated by the Professional Association of Technical Architects in Barcelona, the European network FOCUS (see point 4), a European body for the accreditation of training and certification of professional aptitude in health and safety matters brings together the European bodies which, for a number of years, have formed a partnership of coordinators in the sector " temporary and mobile projects and construction sites".

2. The priorities of Bolzano

2nd European Seminar on Temporary and Mobile Costruction Sites in Bolzano, Italy (17-18 November 1994)

Choice and use of joint prevention tools

On 17 and 18 November 1994, a second European safety and health seminar was held in Bolzano. The European social partners in construction together with several training experts and training institutes established the "Bolzano priorities": a draft methodology for evaluating and preventing occupational hazards, based on "Safety and health plans" and "Files appropriate to the characteristics of the project".

3. Implementation of Lisbon

3rd European Seminar on Temporary and Mobile Costruction Sites in Estoril, Portugal (10-11 October 1996)

European strategy on training and methodology for the assessment of "site" and "use of project" risks.

On 10 and 11 October 1996 in Lisbon, there was a follow-up to the Pont Royal and Bolzano seminars focusing on the appraisal of various pilot schemes that were run in Belgium, Spain, Italy, Luxemburg and, more particularly, the pilot site at the Universal Exhibition in Lisbon. It came up with the "Lisboa applications", the strategies for safety and health training and risk assessment methodologies in the light of the requirements of Directive 92/57/EEC on health and safety on temporary or mobile sites.

Strategic Observations and Training Methods in Building Sector

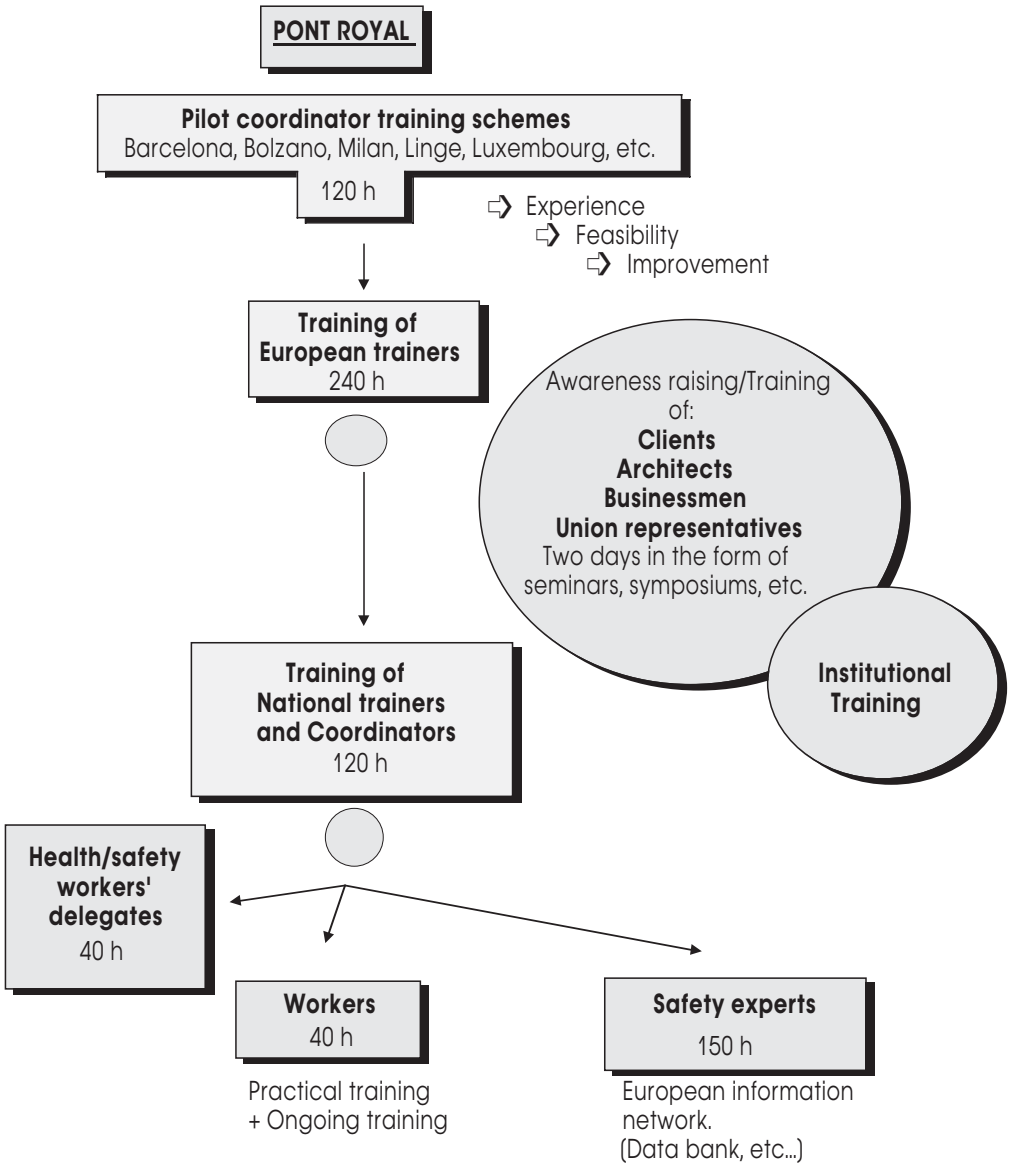
That information on health, hygiene and safety differs among the countries represented at the seminar:

- That different training systems lead to different educational approaches and training content.
- As regards integrating the prevention of occupational hazards into base-level training systems, its inclusion in education and training systems is non-existent in many EU countries.
- These principles must be accompanied by a concerted monitoring programme. Thus, current workers, project managers, designers and others involved in the buildingprocess show gaps in their skills, which have repercussions on the behaviour and decisions of the various people and bodies involved, as already noted at Pont Royal:
    1. Coordinators' training experience (France, Spain, Belgium, Italy, Luxembourg and Portugal), which has its strengths and weaknesses, forms a reference point for creating training structures both at Community and domestic level. The results of such projects should be assessed in greater depth.
    2. It would also be worthwhile evaluating the pilot schemes submitted to the seminar, with a view to expanding the range of training in the various EU countries.
    3. Similarly, different countries have regulations specifying the roles, skills and the status of coordinators, and a hierarchy should be considered. It may prove necessary for training to deal with the joint responsibility or joint liability of those involved, with the coordinator playing a decisive role in developing the ongoing dialogue between those involved in the sector.
    4. Concerted training of coordinators and trainers is deemed to be a priority.
    5. The establishment of a transnational working group is proposed, in cooperation with the International Social Security Association (both the Education and Training Committee and the Building Sector Committee), with the following aims:
        - To design joint training modules for the various players identified at Pont Royal, the aim being to develop a skill certification

process to enable the free circulation of workers and services

- To boost the role of training organizations, especially universities and university/business associations, without prejudicing Member-States' domestic practices.
- The establishment of "competence cards" in occupational health and safety in the building industry.

Proposal to standarize training based on experience gained through social dialogue



N.B.: A. Standardization should not only encompass the duration but also the level of content.

B. Countries should be free to set various levels of competence. The important point is to standardize basic training.

4. Standard profile of co-ordinators defined by a transnational working group in cooperation with the International Social Security Association (both the Education and Training Committee and the Building Sector Committee).

The competence of a project preparation or project execution co-ordinator is determined by theoretical knowledge of and adequate experience in carrying out the tasks entrusted.

The pedagogical objectives of the training of "temporary or mobile construction sites"' health and safety co-ordinators encompass three domains:

a) Knowledge

On completion of training, the trainee must have a knowledge of :

- The safety and health regulations.
- The safety and health aspects of the regulations governing public contracts.
- Planning methods used on site.
- The risks connected with the construction methods, site organisation, maintenance of the structure and other activities in progress on the construction site.

b) Know-how

On completion of training, the trainee must be capable of :

- Reading a plan.
- Understanding contract specifications and assessing the risks they entail.
- Understanding a tender and assessing the risks it entails.
- Assessing the risks connected with planning (simultaneous performance of activities, deadlines, etc...).
- Assessing the risks involved in the use and maintenance of the structure (wear, future works, etc...).
- Assessing the risks involved in the methods used and interaction with other activities within or in the vicinity of the construction site.
- Formulating proposals for avoiding, reducing or combating risks at source and adapting the work to the man.
- Establishing, on the basis of these evaluations and proposals, a "Safety and Health Plan" and a "File appropriate to the characteristics of the project" which are clear and comprehensible for all those involved (including workers).
- Organising the layout of a site (access to the site, access to workstations, storage areas, materials handling equipment, plant, etc...).
- Coordinating (and ensuring) implementation by contractors and self-employed persons of the prevention measures concerning:
    - coordination, simultaneous performance of activities, organisation, deadlines, development and monitoring of the works;

- cooperation and information exchange between contractors, self-employed persons and workers;
- the health protection and health surveillance of workers;
- good site housekeeping, storage, traffic, workstations, dangerous products;
- maintenance, checking, commissioning, use and handover of equipment and installations;
- the site environment and simultaneous activities;

- Adapting the Safety and Health Plan, the Specific Measures and the File Appropriate to the Characteristics of the Project to take account of the progress of the works and any changes made.

c) Communication and social skills

On completion of training, the trainee must be able to :

- Conduct information exchange meetings and encourage participants to express their views.
- Present the measures required to achieve optimum safety and health conditions in a positive manner.
- Negotiate with and convince others that these measures are well-founded.
- Choose the relevant information, express it clearly and disseminate it to all concerned.
- Take account of existing structures for participation and incorporate them into the information dissemination network.
- Persuade the client to impose the necessary measures where there is no consensus.

d) His independence

In the same way as with the architects and consultants, independence and expert knowledge are a factor in the quality of the studies carried out and the services provided.

This implies that the "project" Co-ordinator and the "execution" Co-ordinator have complete technical and intellectual independence when carrying out their duties, even if they are recruited under a service or employment contract with the contractor and/or project manager.

5. The international FOCUS project concerning the accreditation of training and the certification of the security and health coordinators.

Focus Survey

In the light of points 1 to 5 of the "Strategic reflections and methodology concerning education and training in the construction sector" which took place in Lisbon, The "Focus" partnership carried out the first stage of this opinion poll in Belgium, Italy and Spain.

Aims of the inquiry :

- To find out the training needs of all those involved in the building trade.
- To obtain information on the different training systems and means used in the construction sector in Europe.

The full findings of the focus survey are available on the Internet: **www.apabcn.es/focus/**

The experts meeting at the seminar of the AISS "Education and Training Committee" in Mainz (02/07/1999) proposed the following concerning the profile of coordinators :

- A minimum prerequisite : post-secondary training in building and public works plus occupational experience of at least two years.
- An assessment test concerning the motivation of applicants at the time of registration.
- Training lasting between 120 and 150 hours covering the 12 areas defined in the Focus survey.
- Verification of knowledge and execution of a coordination paper on completion of the studies.
- Periodic meetings to update knowledge, distinguishing between retraining and advanced training.

6. Guide of Best Practices on the Co-Ordination of Health and Safety in the Construction Sector (Directive 92/57/CEE)

A. The co-ordination of health and safety in the construction sector: an other manner to consider the man at work.

The project partners involved, the EFBWW[5], FIEC[6] and SEFMEP[7] and FOCUS[8] experts, have gladly availed themselves of the opportunity, in the context of the accident prevention programme in small and medium-sized enterprises, initiated by the Bilbao Agency, to compile and publish their experience regarding effective accident prevention, not least on account of the fact that work in the construction sector is still among the most dangerous.

The materials we have compiled focus attention in particular on the special conditions in small and medium-sized enterprises.

In drawing up accident prevention strategies and describing concrete prevention activities and examples of prevention, reference was repeatedly made to the legislation on occupational health and safety, and especially to the so-called Framework Directive[9] and the Construction Site Directive.[10]

Repeated emphasis is also placed in these materials on the importance of good coordination of the occupational health and safety activities and in addition suitable consideration is given to the role of the construction site coordinator.

B. This brochure comprises three specific parts:

1. Legal bases of accident prevention and results of the European Social Dialogue

   In the first part, the general conditions of the organisation of

occupational health and safety and protection against accidents are set out in condensed form and earlier results of the social dialogue in the European construction sector are presented, which still make an important and useful contribution today.

2. Guide of best practices on the co-ordination of health and safety in the construction sector

   The second part presents an integrated concept of coordination of protection against accidents during a construction project. In addition to coordination of the safety activities during the construction phase, elements such as the planning of building projects or safety questions in connection with maintenance and repairs are also dealt with.

   Concrete safety problems and attempted solutions are also theme of this part. Here great store was set on a simple, clear presentation of problems and possible solutions. The individual examples are essentially based on pictorial and graphic presentation.

3. Applications and site overview

   The third and final part of the brochure consists of a collection of examples of optimum use of safety equipment for different types of buildings and activities. This part of the document too is made easily comprehensible through the use of essentially pictorial and graphic presentations.

Notes

1 Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites

2 Council Directive of 18 July 1989 amending Directive 71/305/EEC concerning coordination of procedures for the award of public works contracts.

3 Council Directive 89/391EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

4 and their representatives, where there are any.

5 European Federation of Building and Woodworkers

6 European Construction Industry Federation

7 Société Européenne pour la Formation, le Management et L'expertise de Projets (European Society for Training, Management and Project Expertise, SEFMEP)

8 FOCUS project (European training and qualification in construction safety)

9 Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

10 Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites.

Les Grands Ateliers de l' Isle d' Abeau France

Denis GRÈZES

Les Grands Ateliers, proposed by researchers and professors of eleven higher education institutions and one center of research, and realised with the support of the Ministères de la Culture et de l'Equipement, and of the City Ville Nouvelle de l'Isle d'Abeau, and also from several important building materials companies, are in an extraordinary and unique position in Europe and maybe throughout the world to make progress both in training and research in construction and materials.

Their mission is to bring together artists, architects and engineers in order to conceive, elaborate and realise training modules, research projects and dissemination campaigns of their knowledge and skills within the domains of materials, construction as well as inhabited space quality.

This is an original place for training, not a new school but a common tool that is complementary to teaching and research centers.

It is an experimental space on materials and structures.

It is a dissemination space for constructive cultures

It is a space for innovation and invention.

Finally, it is a space to create meetings.

Meeting between thought and material :

We are in charge of conceiving and designing objects with the environment in mind.

Les Grands Ateliers allows students:

- to discover materials, manipulation and construction on scale 1.
- to understand, respect and know their amazing variety,
- to learn their life cycle, from resources to recycling.
- to manipulate, assemble and discover the importance of implementation and precision, and of the relation between drawings and the building site.

Meeting between disciplines, represented by people coming from different but complementary backgrounds and professions.

A good score for frequenting

After 2.5 years of activity, we will welcome
7500 days-students
(one student during one day)
for this academic year.

Acquiring working methods

- Learning how to dismantle and reassemble the construction (from project to parts and vice-versa),
- giving the envy to go deeper in the project, its details, choice of materials and assembling.

Les Grands Ateliers allows students:

To learn to work within groups and to discover collective intelligence,

To learn about other professions and to work together, to discover the advantages of interdisciplinarity, in respect of their respective competences.

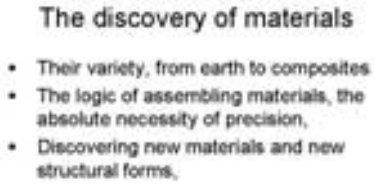
Meeting between professors, researchers, and practitioners around the act of building, industrials and firms.

The main representatives of building materials companies are partners of Les Grands Ateliers : for example the CNDB, CIM-Béton, ARCELOR et ID-Inox, Syndicat des Producteurs de Matières Plastiques, and we are now beginning collaborations with companies working in other raw materials such as glass products, plaster, baked clay.

More concretely les Grands Ateliers propose:

- A space for experimentation and realisation of prototypes allowing implementation of construction at scale 1 (a 500 m^2 work space, a façade for experimentation, 2 workshops, an exhibition hall)

- A place for welcoming students, researchers, professionals or artists to realize theirs experiments or prototypes.
- International contests opened to students of several disciplines, followed by summer workshops where laureates are invited to realise large scale models of their projets (Art Nomade, Mini Maousse. Building with wood...)



- Two thematic weeks each year on a material, with exhibition, conferences and workshops (earth, concrete, wood and vegetal fibers)
- Short information and training sessions for teachers and professionals (on materials, major risks, design for antiseismic buildings, sustainability, etc)
- Projects of continuing education and specialisation post Masters for several disciplines.

Introduction

Lots of you were present during the second workshop organised last year at the Grands Ateliers. For those who do not know the project, an activity catalogue is at your disposal as well as an internet site with a new improved webcam.

Some answers

1. A probably improved efficiency of this type of training
2. The discovery of the benefits of working in groups
3. The probably good efficiency of learning by doing, by intuition, by the body,
4. The discovery of matter and materials
5. Acquiring working methods.

What's new since last year

A good score for frequenting Grands Ateliers: after 2.5 years of activity, we will welcome about 7500 day-students (ie 1 student present during 1 day) for this academic year. And we have noticeably enlarged our panel of activities (original contests, international workshops). And we now have new projects for the future, dealing with post-Master curriculum.

Learning by doing

- Learning by building
- Learning by experimenting (trial error process)
- Learning by intuition
- Learning by the body (space, ambiances, ergonomy, kinaesthetic)

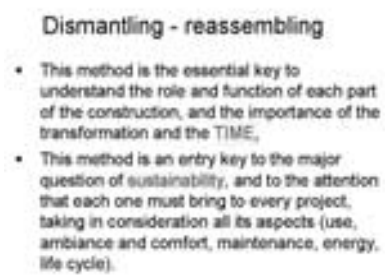
Today, the main question is: In what manner the training and the teaching methods of Grands Ateliers will improve the teaching of construction, regarding the objectives and questioning of this 3rd workshop ? We have 5 answer to propose:

1. potentially improved efficiency of this type of training (you should remember that GA are not a new school, by a common tool proposing short intensive sessions dedicated to one topic).
2. the discovery of the benefits of working in groups (as we had the pleasant surprise of reading this point through the evaluation sheets distributed to every student at the end of each session) and learning from the other disciplines.
3. the efficiency of learning by doing, learning by experimenting (trial/error process), learning by intuition, and learning by the body (understanding the space occupied by the body or by the dance, discovering ergonomics by producing full scale models, touching the materials, feeling the ambiances, discovering the principles of forces in structures by kinaesthesic exercises).






4. the discovery of matter and materials :
   - their variety, from earth to composites,
   - the logic of assembling materials, and understanding how to put them in form, and the absolute necessity of precision),
   - Discovering new materials and new structural forms, with the help of our industrial partners, and the cooperation of some research teams (high performance concrete, composites and tensegrity, light structures (Art Nomade, JM. Delarue),














5. acquiring working methods, by study sessions giving the desire to go deeper into the construction process :
   - learning how to analyse and dismantle then reassemble the construction, a mental then physical exercise for going from the project to its parts and vice versa,
   - This method is the essential key to understanding the role and function of each part of the construction, its own life and life cycle, and the importance of TIME. For example, it seems impossible today to design a building without anticipating its future transformations, in particular on energy questions.
   - This method of dismantling then reassembling is an entry key to the major questions of sustainability, and to the attention that each one must bring to every project, taking into consideration all its aspects of use, ambiance and comfort, maintenance, energy and life cycle.

What are we looking for the future

To improve the capitalisation of these innovating teaching experiences, often strongly tied to research, and innovative in their didactic approach: observation, memorization (pictures, video), description of the didactic process and writing of narratives.

To develop the activities of teaching for teachers, in order to enlarge the dissemination of these teaching experiences to a larger audience (on the example of Unesco teaching chair obtained by Craterre)

To develop research and experimentation : GA are an extraordinary tool for researchers, but we would like to go further. Our objectives today are:






To create a doctoral school on the theme of "construction culture", composed by the network of the various existing research laboratories ("architecture formes et structures", Craterre, Cresson, Laboratoire d'Analyse des Formes, Structures Légères et Architecture, etc)

To develop around GA new post-Masters training (DSA) more oriented towards continuing education or specialization, at the attention of professionals architects, engineers, artist or designers, and dealing with new or rare topics like:

- Major risks,
- Building with earth (or building with local resources)
- Sustainability : materials, energy, ambiances
- New materials
- New conception methods, shared between architects and engineers

As a first step, in order to get students prepared for these two curriculae, one more doctoral or research oriented, the other shorter and more oriented for specialists, we have the project to create a shared Master curriculum on "construction culture", including courses common to several schools (workshops, seminaries, boards), and tightly linked to Grands Ateliers. The participation of foreign schools in this project, or, in a following step, its inscription in a larger project such as Erasmus Mundus, would give more critical mass and credibility to this project.

Expectations

Opening and Welcome Address

Maria Voyatzaki: I wish to extend a warm welcome to all our guests and participants here, today. Welcome to Greece and particularly to Athens on this memorable year! As it is our opening day, many will be gradually arriving as we proceed with the workshop. To begin with, I'd like to welcome you on behalf of various organizations and institutions, starting from the European Association for Architectural Education (EAAE), the European Network of Heads of Schools of Architecture, the National Technical University of Athens and the Aristotle University of Thessaloniki, Greece. As you probably know from the correspondence we exchanged throughout the period of preparation for this meeting, this is the Third Workshop we have held for the third consecutive year, starting in 2001 – 2002 (Thessaloniki) while in 2002 – 2003 it took place in Lyon, Grands Ateliers de l'Isle d'Abeau and, this year, it's back in Greece for the year of the Olympics to welcome you home.

It seems appropriate to give you, at this point, some historical information regarding this initiative, which originated with the creation of Thematic Sub-Networks related to particular subject matters in the area of architectural education, all within the general framework of ENHSA, which is one of the two logos on the correspondence you have been receiving, funded by the European Commission. The principal idea behind this scheme was to create thematic sub-networks in an attempt to ameliorate or improve our educational methods in teaching a specific subject. Therefore, in this framework and through your school participation, as a full member, you have the potential to partake in all the activities related to the Sub-Networks, as is the case with us here representing the Construction Sub-Network.

When we began two years ago in Thessaloniki, our effort then was rather tentative and somewhat instinctive since we did not know each other sufficiently to establish a clear identity and scope, so, in that spirit, we followed some very general principles in order to set up a framework for our meeting. Nevertheless, for the sake of those who did not attend our first meeting and wish to be informed, we did manage to gather 45 members in that first year from the various European schools of Architecture. This figure augmented to 55 last year and increased to 65 members this year.

In terms of content, the first year was somewhat exploratory and the questions dealt with were related to what we teach (**content**), how we teach (**method**), who teaches (**profiles** and **qualifications** of construction teachers) and to what extent and when we teach what (**timing** and **prioritizing** material taught). Therefore, in the first year we mapped out the different aspects related to construction teaching and, by the end of that first meeting, it appeared that we wanted to explore further the how question. In other words, the participants requested that the next workshop continue along the lines of **methodology.** As a result, last year, with the kind offer of the Grands Ateliers de l'Isle d'Abeau and, more specifically, Denis Grèzes, who is among us today, helped us organize the Second Workshop that had as theme the how question, thus focusing on the **Exercises in the Teaching of Construction.** Basically, members of that workshop shared their thoughts on what they considered to be the key exercises in construction teaching as taught in their schools. In retrospect, although at times we felt that we were running out of steam and wouldn't get very far, the group was determined to move on and demanded a Third Workshop, which is actually the present one, to talk about **future outlook** since we had already talked about the current time in our first year and the general topics of construction teaching and methodology in the second, it seemed apropos to envisage the future. In fact, towards the end of our last workshop, while eliciting proposals from the various participants on what to do next, members such as Ramon Sastre from Vallés intervened by challenging us to consider whether the key exercises presented would still be valid in ten years' time.

Moreover, there were others such as Nadia Hoyet from France who suggested that nowadays we are going through a period of "mutation" where old buildings are starting to "move" and wondered whether we would continue to teach construction in the same way. Surely, there are other issues that come into this equation. Therefore, in response to your request, we are gathered here to discuss the future of construction education. Glancing at the program you have received, you will note that this Workshop has been divided into four sections, for obvious organizational purposes. However, besides the practical aspect, the four sections also correspond to the four reasons we should be rethinking or reassessing the ways we will be teaching construction in the future in light of the following:

1. Contemporary trends in architecture in reference

to the question of mutation, flexibility and, primarily, with the role of computers and digital technology in the generation of form in the architecture of today and tomorrow;

2. The appearance of new or innovative materials that demand new construction methods and, in turn, new ways of perceiving construction;
3. The urgent need to take the environment very seriously when teaching construction today;
4. What we do with what we have that is rare and traditional knowledge, because it's all very well to look ahead, but the question remains, how do we maintain and preserve the knowledge that relates to the past?

Looking through the program, you must have noticed that there is a set of two words relating to the skills and competences a student should gain from his/her education. Also, what are the educational methods and strategies that can ensure these **skills and competences?** We have invited five brilliant keynote speakers, hoping that they will relate each or more than one of them to each topic and discuss the different issues of the relationship between the skills and competences we cultivate in students that will enable them to respond to tomorrow's architecture. Furthermore, since we are all educators of architecture and construction, what are the methods, educational practices or pedagogies we should adopt to ensure these skills and competences? Finally, the Workshop is structured around the keynote speakers followed by brief fifteen-minute presentations of four representative cases expressing how it is felt they relate to each topic. Apart from that, as you all know, what those of you will produce by the end of June in the format of a 3,000 word paper will be published along with this year's proceedings as has been the case in previous years. Many of you are familiar and have already received such publications, but for the sake of those who haven't yet received the previous volumes, they will be up for sale and you can thumb through them.

Before passing the microphone to one of our co-organizers, Spyros Raftopoulos of the National Technical University of Athens, I wanted to say a few things about our future and I'm not referring strictly to this Workshop. As you can all recall, when we last met, we felt that this would be our third and last year, but I can now happily announce, with a reasonable degree of reservation that our contract may be renewed for an additional three years, so, this should not be seen as our last opportunity as there is more to be invested in this effort!

To sum up, I cordially welcome you again to Athens and wish you all a fruitful meeting and constructive working experience. At this point, I wish to call on Prof. Raftopoulos of the National Technical University of Athens to give his introductory remarks.

Spyros Raftopoulos: Thank you, Maria, for the introduction. It seems that all the essential points have already been mentioned, so on my behalf, I would like to welcome you as the Deputy Head of this School, the National Technical University of Athens, hoping that we will have, within the next few days, as successful a meeting as we have had in the past, both in Lyon and in Thessaloniki, as those who had the good fortune to attend will surely agree. I am also eagerly hoping, even if there is some inkling of doubt, as is usually the case with such matters, that these meetings will have continuity. Such meetings, where we exchange views as "construction educators", as we have been referred to earlier, provide a useful platform for sharing ideas and suitable grounds where we can see what and how things are happening in many countries from East to West, North and South. We can improve, reconsider and adapt our policies in relation to the material and the way we approach construction with our students.

In an effort to return to the down-to-earth particulars, I would like to give you some information about our University, our School and the building hosting us because there is an anti-climax between the space we're in and the deterioration of the exterior. Our school is a very old one, originally established in 1917 and the University itself was founded much earlier. It is the only school based in this campus since the remaining schools are situated in the North-bound campus. Architects, as you know, are somewhat different from the technocrats so we have decided to stay here, close to the happenings of the city. Nevertheless, I should mention that this event is the last one that will be hosted in this building for the next three consecutive years because the contractors are waiting as soon as possible to restore it, so, hopefully, should you visit Athens in three years' time, you will be able to see a shining, brand new building as it was in its original state when it was first built in 1875.

As far as the content of the Workshop, I will not go into any details since Maria has already provided a

considerably adequate description. Perhaps, on a personal note, I wish to add that being an educator from an older generation, having started teaching construction in this School in 1972 as a young architect, I must admit that there has not been much change except for the last few years, especially with the advent of computers and information access for both students and teachers which tend to make us all critically self-evaluate whether we can actually follow the rapid changes that are happening in the world. The reason for mentioning this is that when Maria proposed the title for this conference "Visions", I started considering whether we actually do in fact have visions and what kind of visions can those of us have who have been teaching in a certain way for so long, particularly when taking into account the way of construction, which has not undergone much change over the years. Nevertheless, what is hopeful is that in the audience, I can see quite a few young people of Maria's generation that will be able to provide us with more information about the relevant dramatic changes so that we will be able to convey this through our teaching in the years to come to the new generation of architects for the benefit of all those who wish to persevere in their teaching pursuits. I would like to conclude by once again welcoming you and thanking you for being in Athens. I wish you a successful meeting and also hope that you will find the time during your stay to tour Athens and visit some of our interesting sights.

Maria Voyatzaki: Thank-you, Spyros, and I wish to take this opportunity to thank you and Miltiadis Tzitzas for all your help in organizing this event.

Session 1:
The Teaching of Construction and Contemporary Architecture

Chaired by M. Voyatzaki

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be capable of following the contemporary attestations and changing trends of contemporary architecture, the architecture that charms the students of today?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of following the contemporary attestations and changing trends of contemporary architecture, the architecture that charms the students of today?*

The Schools presenting in this session were

Aarhus (Denmark) School of Architecture by Anders Gammelgaard,

School of Architecture, University College Dublin (Ireland) by Elisabeth Shotton,

Genova (Italy), Faculty of Architecture by Fausto Novi and

School of Architecture, DOJC College, Dundee (U.K.) by Christopher Lowry

Please find the respective interventions in the section of articulations.

Debate on presentations and theme

Chris Williams: I'd like to ask Christopher Lowry regarding the point about his bringing outside consultants – engineers such as structural or environmental – to help with the teaching of studio. Perhaps he could give us a few more details of that and particularly on how he finds that the practitioners are able to understand what is needed of them in the design studio.

Christopher Lowry: Well, I think it's fortunate that we bring in those who we have worked with professionally in the past, like I've personally done. There is a certain amount of learning in both directions since I need to teach the consultants that come in a little about what exactly we are aiming at. Part of this in the beginning is very much about allowing the students to keep control of the conversation and bring what they want to do with their project as opposed to the consultant coming in and dictating what should be done, which would certainly not be very effective with younger students in particular. I invite the consultants at the end of the year and show them what we're doing and what is involved. We keep them informed, communicate and exchange ideas about the pitch of the particular project as well as take their advice on the program we generate so as to allow the students to learn and enable them to understand the knowledge we want them to develop. So, really it's a two-way learning process.

Chris Williams: We do a similar thing at Bath and we also find that most of the architectural tutors now teaching in the design studio are practitioners, mainly because the full-time staff is by and large researchers, particularly in the case of Bath's History of Architecture. It's actually quite difficult for them to bring into the studio the practical techniques of construction which only practitioners obviously have. I'm just wondering if there are other schools of architecture that are increasingly bringing in not just practitioners in terms of engineers, but architects as well. Even our years are actually run now by outside practitioners largely on the architectural side.

Christopher Lowry: We're certainly not at that stage yet and each of the five years is run by a full-time staff member. However, the teaching teams each year consist of four other colleagues who are part-time, whether practitioners or working for a company. Within our school there is a resource issue as to whether to bring more practitioners in. It's nice to have the control and the freedom to run your year according to the way we want it to be and involve those we want, but there is a cut-off point when money runs out and we can't sustain them.

Chris Williams: We have the same problem, but what tends to happen is that if a full-time staff member retires, he/she is not replaced, but, instead, we bring in two or three part-time practitioners. Whether that will increase or not, I don't know, but it certainly means that the way the school is run has changed significantly over the last few years.

Maria Voyatzaki: I'll comment on what Chris has just said, which is, perhaps, relevant to your conversation on practitioners employed in studio work. I found a book that I'm holding at the moment, which although I wasn't sure I would actually come across any references on construction, I was proved wrong. In the first few lines of the book, Greg Lynn, who, as you know, is a hero among contemporary students, says that construction has made a "shift from the modernist mechanical kit of hearts design and construction technique to a more vital biological model of embryological design and construction." Regarding the point you made about who teaches in the studio, especially in advance studio work, materiality should be an issue as much as the historical and other architectonic issues that are taken very seriously. What I find is that it's the researchers that follow the contemporary trends and that are experimental when inventing new forms as opposed to practitioners, who of course experiment, but in safer ways. Therefore, I see a schism (gap) between the two tendencies and, **it's very difficult to have people who, although can convey to students their experience from practice, which is undoubtedly valuable, do so with limitations since in their effort to play it safe, they do not really transcend the limits of architecture and, effectively, of construction. What was apparent and a common factor that surfaced in the presentations and keynote speech is that architecture and technology should be interlinked in order for both of them to be advanced.** My remark, then, is that it is without question a big dilemma for us educators.

Elisabeth Shotton: I want to comment on question 2. The University College of Dublin has long been staffed by practitioners in the design studio exclusively, almost excluding full-time faculty who tend to be researchers, lecturers and, it's only now, actually, that they're starting to change this around, not by getting rid of the practitioners, but by assigning a full-time member of staff to every year because one of the problems that arises is that there is a lack of consistent ideology and building up of skill level from year to year since the practitioners who run the year are not talking to the other years. Also, they're not talking to the people involved in the rest of the program. Often they don't know these people and there is a schism between what they're teaching in lecture courses and bringing that knowledge into the studio. There is a real friction so they are trying to rebalance that partly through the work I'm doing, but also partly by bringing back the full-time member of staff. So, there can be more coordinated effort within each year, but also across the entire degree program. There are pros and cons to practitioners and I'm one of those.

Maria Voyatzaki: Elizabeth, I think there is a fear of the new and I'll explain what I mean with an example which is not off the record. One of Neil Leech's frustration teaching at Bath, which he has openly confessed to and this is why I can freely bring it up, being the fresh mind that he is, he was not allowed to run a proper studio in the Diploma part of the School. You all probably know Neil Leech, who is a theoretician, but likes calling himself an architect because he does not want to be left out of teaching design. There are tendencies in schools of architecture and very few of them allow pluralism of approaches when it comes to design. As a Bath graduate, I know that there is a neo-modernist approach to design and less of a digital one there, although I don't know if this has changed since I left. However, on visiting the School's website to see whether they have allowed avant-garde architecture to shine through, I realized that there is still some conservatism and traditionalism in design disguised in the form of neo-modernism. Therefore, it's very difficult to allow changes for fear of the new.

We will hopefully argue in the last session that there is a need to preserve the rare and traditional, but there is also a need for a school of architecture and an educational system to be advanced so as to allow the new to shine. Of course, the comment regarding Bath should not be taken amiss as it was not meant to be a criticism of the School itself in any way. After all, as I've already mentioned, I'm a graduate of Bath.

Christopher Lowry: I agree with what you're saying. Sometimes students are discouraged from practitioners limiting their imagination on the grounds that something cannot be built. On the contrary, students' imaginations should be encouraged. There is a fundamental level that exists regardless of the complexity of a project, whether it's the structure or how it's made, etc. and, that is that they understand where technology "sits" within that and what they have to employ so that there is actually a line before they actually enter the complexity of the program that is important for us to convey to students in order for them to get an understanding of where it actually stands in the scope of things.

Maria Voyatzaki: That's why I read the quote from Greg Lynn because it's very clear that we've made a shift in our approach from the modernist way of thinking about architecture and construction to a post- modern one and, by this, I don't mean the historically defined post-modern movement, but a contemporary way of thinking about architecture. Therefore, we cannot really follow (quoting Greg Lynn)[1] "from an assembly of independent parts, which is a heap-of-parts approach of the modernist movement to the desire for formal variation and uniqueness" that is something that cannot be really ordered in industry in the conventional way that every day architecture happens, either by going to an internet site or flick through a prospectus of the company to come up with kit parts and order what you need over the phone and it comes to the building site in an approach where computed parts can be e-mailed to the company and tailored to your needs. Somehow they have the same generic type and yet they're different in terms of form by being varied and unique.

Ola Wederbrunn: I think it's very important to stress that the educational period is getting shorter and shorter. Ten years ago, the minimal education of an architect was seven years, but, today, it has come down to five years. The situation has changed a lot and there is no time to study things very thoroughly. Some people say that when you come out of a school of architecture you enter reality, which is a difficult thing to hear if you're in a school system. Also, it's important to stress transparency between school and what is not school and see the transparency that things don't work only in one way, but both. As previously mentioned, we get inspirations from offices, etc. and this inspiration goes back to the school and places demands on it. But schools must also put demands on the other reality. Moreover, an architectural school needs to take the responsibility to develop a reality which works, not just within a school setting. This situation also involves transparency between student - teacher and a teaching studio. I believe that the case study for the Master's is good, but it also has to be critical of the other reality so that we can benefit both ways. Finally, it's also essential now that education is shorter that we get students back in school again.

1 From the book 'Architectural Laboratories', by Greg Lynn and Hani Rashid, Nai Publishers, Rotterdam 2002

Donal Hickey: I'd like to respond to one of Anders Gamelgard's statements about knowledge base which is getting wider all the time. I haven't been teaching technology for very long and my question is **how do we avoid just teaching students what we know?** I'll try and answer how I see that. I had seven days to prepare for my first lecture at the beginning of this year because somebody had retired and I was put in a dilemma as to *what* to teach and *how* to teach. I remembered seeing Leonardo da Vinci's notebooks and this may refer to some of the things Anders was talking about. Da Vinci was an artist, an architect and a very brilliant thinker. I decided to start my lecture with a quotation from Madrid 8 or it could have been 6 or 16 (I can't actually remember it now and I can't quote it). He talked about the world around him in terms of how he understood it, through mythology and of seeing and trying to understand the nature of things. I suspected that from that attitude came the information or legacy contained in his notebooks, which doesn't really describe technology, but a way of *thinking.* **My way around not affecting students by my own limitations is to try to think like that: to try and teach them to see the world around them simply because I can't teach them every detail or I can't get them to analyze every building, but maybe I can influence them in terms of the way I've learnt, which I hope is useful. I would like to hear about other strategies people use in coping with how to teach with our own limitations.**

Ed Melet: My question is a remark on Anders' presentation. You mentioned Zaha Hadid as an example, but Zaha Hadid, Daniel Libeskind and Koolhaas studied at the AA, where they didn't really bother with building construction. They concentrated on concepts, space and depth. They started designing without all the knowledge we are teaching. Mere building was considered to be banal. The question of course is: can our students design as freely and brilliantly as Hadid, while they have this enormous technical 'burden' we think they ought to know. Knowing all the technical preconditions one, perhaps, will not come up with completely new concepts (architecture, structure, construction) because one fears the technical consequences.

In our school we are trying to teach our students that everything is possible. For every architectural concept, how bizarre and unrealistic it may seem, there are technical solutions. You have to trigger the students to go beyond the known technical solutions,

because if otherwise the technique will be a limitation. We teach them that they should not fear technique, or consider technique to be a restriction to their architectural freedom. Instead, and you can see this clearly in the work of Liebeskind, Hadid and Koolhaas, the technique is a means to strengthen the architectural concepts. In Amsterdam we designed exercises in which students have to come up with completely unbuildable architectural concepts and they have to design a structure, installation and building details which are in compliance with this concept and which are technically sound, of course.

Anders Gammelgaard: Regarding the last question, I would like to present some tasks that demonstrate a way of working where the results are certainly unknown. If there is time, I could do that later on. But, in reference to the previous question about **how to teach beyond our limitations, the first step is to realize that the knowledge we have is extremely limited and the next step is how to go beyond that. The answer, basically, has to do with the role of research. We start by identifying the problem we want to address, we investigate to see if others have already addressed it and if it has, there is no point in going on, but if it hasn't, then we start by developing a method. The method is the key because it can lead us beyond our own imagination and limitations.**

When searching for a method to be used to answer the question we've posed, we don't know where this exploratory process will lead us. This same method can be applied to teach students construction. It's a way of going beyond our limitations. To a large extent **we try to organize the teaching of construction closely to our own research for a couple of reasons. Mainly, it trains the students to develop a method, which is essential for practical purposes since we use the students to do the research we would otherwise have to do ourselves. Therefore, the method is the vehicle which makes us surpass our limits, but the difficulty lies in our giving up existing images.**

Herman Neuckermans: I wanted to react to something Maria said, but due to the dynamics of the discussion, we've moved on to another topic. Nevertheless, I'd like to go back to the issue and reference to Neil Leech, i.e. the issue of the relationship between theory and practice. In my opinion, the education in schools of architecture has shifted from the view of education towards the profile of the architect and moving more towards education in architecture. As a result of this shift, we will have more and more research in schools of architecture and, due to the research we will have more and more full-time staff. Some of these will be called theoreticians in various areas: philosophy in architecture, rule of tendencies in architecture or construction in architecture. So, I think that in the school of the future, the theoretician has to be part of the studio as well as the practitioner. We need a model of the school where both interact in the studio. Several speakers have mentioned the split in boxes in education and I agree that boxes and walls should be torn down when it comes to education. There is, however, the possibility of having one of these walls where we invite a theoretician into the studio, but not as the sole person running the studio. As in the example of Neil Leach, who is a fantastic theoretician, knows a lot about digital architecture and wrote and edited several books on it, I remember attending one of the study conferences in Bath and from all the examples given there about digital architecture, I think there were two that, indeed, somewhere in time had a link with something that could be build(able): the Roller Coaster Terminal in Yokohama by Foreign Office architects and the bar structures by Mrs.Shea Theory is interesting, probably, because it's not necessarely (only) about what can be built. But, I know for sure that although ETH Zuerich_has a lot of means and personnel to teach CAAD, they have shifted from the education of graduates who are only skilled in digital architecture but who can't build, towards the education of architects who now again are capable of building real buildings. What you aim is linked to the profile of your school. So, in my opinion, theory and practice have to be linked in the studio. **The practitioner will bring the theoretician down to earth and the theoretician can allow those that are in practice -but who sometimes don't have the opportunity / time to keep up with the latest insights regarding architecture - to catch up with the state of the art in theory.**

Maria Voyatzaki: As far as I'm concerned, that which can be built should start from theory and should have a strong theoretical context and content, otherwise it won't produce good architecture. My approach is not an *either / or,* but a *both / and* approach. This, I think, is where we differ in the way we look at things. I don't see this issue as two separate things and this is why Neil Leech does not like calling himself or to be called a theorist –

he's an architect. We're all architects and this is our starting point. Whether our architecture which starts from a theoretical basis actually becomes architecture in the form of a building is a different issue. However, what you have suggested is, I think, another view that digital architecture is unbuildable. Last year, I went to the AA summer show and, despite the fact that the AA is easily, though debatably, considered the most avant-garde architectural school in the world, what was impressive about the work of the students was that the digital projects there had a very strong emphasis on the actual making of what appeared on digital form to actual building. In fact, I believe that with the digital approach, it's much easier to make something because you have the exact coordinates of every single point on a vector, on a surface and much easier than having a Euclidean approach to architecture. **Digital architecture does not divorce theory from architecture and practice in the form of building.**

Herman Neuckermans: Yes, theory and practice *should* go together, not separately. The second thing is that, in my opinion, there is a risk in theory which is not linked to practice since it starts floating from reality. Maybe it has a role in architecture – that's another story, but in terms of design, I don't know. Finally, I also mentioned that from what I had heard from Leach , only two examples could actually be linked to something that could indeed be architecture.

Maria Voyatzaki: Those were student work, I suppose.

Herman Neuckermans: No, it was a foreign office and the Roller Coaster Terminal in Hong Kong.

Chris Williams: You're talking about the Conference 'Digital Tectonics' held in Bath. I think that Neil Leach, David Temple and I spent a long time discussing who we should approach to talk at that Conference. Obviously, all the people we wanted to invite had strong views, some of which were not, perhaps, compatible with each other. It's probably true that it's so theoretical that it does not get involved in building. However, life is too short for all of us, in the sense that you have to go either one way or the other.

You either end up being overly practical or overly theoretical and few of us can bridge that gap. I guess we did our best, but what we also wanted to do, I think, is to aim the conference at people who were fairly practical. Therefore, the idea was that it should be relatively theoretical, particularly in trying to bring in threads from other areas which most practitioners wouldn't have come across. Certainly, I'm a rather practical person and I'm aware of what you're saying, but I think it's a perennial problem and probably always has been for the past 5,000 years or so.

René Hughes: There is frustration among all participants. We normally refer to construction, but in fact we're talking about architecture. Ole Vanggaard, said, for instance, that it's the architect or the architect practitioner that makes theories. I think that Elizabeth should be proud to have come to this discussion since she's an architect with an architectural studio and she's come down to talk about engineering and construction, not architecture. With all the examples shown on the screen, it seems that there is more of the teaching of architecture than the teaching of construction.

So, there is at least 3 "dangerous" people – Anders, there is another who hasn't spoken yet and Michel Paulin. We remember the exercise presented last year from the Arhus School of Architecture teachers with the ball in order to teach construction as opposed to practice having a ball stand in the air. We can also remember the exercise with the vegetables that people like myself and Michel Paulin and others use. Perhaps, that's the future! But for the basic construction teacher, it seems that it's not simply because materials, language, image and construction itself that's increasing more and more with computers justification for us to discard all that and start with an innocent view of construction. It's exactly the opposite. **We must put things in order and show all this basic material and its capacity and develop this competence and, on this basis, move ahead.** So, my question to Anders is, when your students pay their hourly quota 60 hrs per year, if you have spent all these hours on these exercises and they don't know what's concrete, steel, zinc, etc., when there is a gap in their concept of structure or stability, when they don't know or have any idea of what regulation is, what do you do at this zero point?

Fausto Novi: I have learnt what I do as a professor in the Faculty of Architecture and from friends in France, at Grenoble, Les Grands Ateliers with Denis Grèzes. I have also learnt from the Spaniards at Barcelona, Thomas Herzog and others. When I went for the first time at the Grands Ateliers, I was surprised to see all those people making things with concrete,

fabric, pyramidal structures, etc. At first, I didn't understand why those people were involved in all those exercises. However, I understood that clearly a year later -that visit was enlightening! **What I do know is that I may have doubts about how to teach architecture or how to teach someone to be an architect, but what is certain is that I must have knowledge of materials (concrete, old, etc) – that's part of my job!** I also know that I'm not alone in teaching architecture in a school and that there are five years or more of teaching in a course. **My job is to pass on to students the concept that technology and construction can be the beginning of design or that every line drafted on a sheet of paper can have a solution.** I don't know how this is successfully internalized or processed at the end of a course of studies because people's brains are complicated!

I conduct several experiments in my teaching from Architecture, starting with materials and small experiments like those carried out in Grenoble, not with concrete, but with cardboard_it's the same method of understanding materials.

I don't know how people like Zaha Hadid can come on the surface, however, in the thesis and final work of students, I see an awful lot of Zaha Hadid, Frank Gehry, Daniel Liebeskind, but I'm not sure they've understood what architecture is, how that architecture is made and we leave these people in the world acting in this manner; this frightens me! I don't know if all this answers your question.

Anders Gammelgaard: The problem we face is that the field of architecture is constantly growing, there is more and more knowledge that we need to pass on to students and, as Ola Wederbrunn mentioned before, in a shorter and shorter time. **That means that the discipline we have to teach is becoming more and more superficial. However, what we can give students should address the difference between skill and attitude.**

In other words we should give them an attitude of training them to think for themselves. This is universal and it has permanence. For example, in one of the studios, we had a teacher who placed a Morris Minor on the table and asked the students to dismantle and reassemble it using a method of their choice. The outcome was unimaginable! They didn't learn anything about design or construction, but by the end of the day they had learnt a way of thinking and in many architectural offices, today, you will find that it's the people who have acquired this mode of thinking that ultimately become directors. It seems that this is the right approach because we can't just focus on skills; besides, we can't teach all of them since they're constantly increasing.

René Hughes: You started off by saying that there is more and more architecture, but what about construction? Also, you mentioned Zaha Hadid, and Frank Gehry but they don't care much for construction. **Let's say that the idea and working concept is architecture and that afterwards there is the big construction team that tries to build and negotiate in the end, but the point is that this fragmentation is our concern and precisely what we don't want when dealing with construction in school.** It places us in the difficult position of having the architectural side do everything while we have to make *their* ideas stand. If we envisage the future, perhaps you're right in saying that there are dangers in the way things are being done. **After a five-year program, basic things should have been done,** but it seems that these are more on the architectural side and the role of construction is to provide the materials in order to realize the architecture. Fausto's perspective in terms of the sources through which students learn about architecture (materials, images, language, reviews, shapes) leads us to conclude that it's *construction* that provides the material for this concept. Finally, if we let this concept flow freely, then it's not for this construction group to deal with, but for a future group meeting.

Anders Gammelgaard: I think what creates confusion is making the distinction between architecture and construction and it's impossible for me to think of that as two separate entities.

Ed Melet: That's exactly what I wanted to say. There is no difference because **when you're creating architecture, then construction and structure should be integrated into the architectural concept. When doing the details, as an architect, one should be able to translate one's concept into something that ought to be built and can be built.**

We did an experiment during the second year according to the example of our colleague from Genova where we had students photocopy architecture they liked from magazines. We also thought we should introduce new fields so we included in the group of architects a mathematician, a florist, a fashion designer, etc. Their task was to choose a building that could be built by the end of

the day. The frightening outcome was that the architects came up with a fence-kind of form which they said they could not detail accordingly. Consequently, the form had to be adjusted so that it could be detailed. Therefore, when construction becomes limited in architecture, then construction is in danger. Our role, then, is to focus on how to teach construction that will allow our architects to make their ideas stand.

Andreodaki: I'm a Civil Engineer from the National Technical University of Athens, where I teach the course related to bearing structures. I'm very concerned about the question of "how" to teach architects because we make tremendous effort often to no avail. From my point of view, architecture is a three-dimensional art which, like sculpture, has to stand and follow the natural laws. It seems to me that you should not fear other experts or other scientific fields. In fact, all this gives you freedom in your designs and imaginations. The only problem is that architects must communicate with other scientists in a basic language through which they can transmit their ideas. As far as construction education is concerned, I think what should be learnt is the language of bearing structure in order for students to spot their design problems, identify and express them to the civil or mechanical engineers and ask for their technical assistance in an effort to resolve the problems. This can be done only if architects have a clear understanding of what the problem is and what their limits are in realizing or building what they design. So, structural education has to address these questions right from the start through the knowledge of basic sciences, such as Physics, Maths, etc. and afterwards deal with the question of how this knowledge can be used in the studio through certain examples. This, of course, is a very difficult process and our problem is to find the best possible means of delivering this to our students. I'm afraid what I've heard so far does not answer this question. Also, **if we say that architecture is a 3-D art, I would add that it's multi-dimensional. If we imagined a structure moving, there would be a parameter of time, such as in the case of an earthquake. Therefore, the more we know, the more we can imagine freely.** The problem is time, but to be an architect, one needs to be mature, so the educational period in architecture must be long, not as short as a 3-year course and, ideally, with few students.

Ola Wederbrunn: I agree that this education has to be long and without beginning nor end. Through our teaching we meet students, people in their workplace and we are uncertain about many things and it's very important to stay uncertain. When we meet students, we are uncertain about what they want; on the other hand, students are uncertain about what they can do, so, we have to mingle or merge. In Denmark we have a long tradition of working with projects. We start with a project on the first day of the semester and we continue working exclusively on this single project for the rest of the semester. We've been doing this for ages! Also, the courses, in the past, were taken when necessary not because they were compulsory. Now things have changed due to the shorter time we have to educate as well as the fact that we need to have the entire new ECTS (European Credit Transfer System) points, etc., which we didn't have then. Before, all we had to concentrate on was the project, so, we tried to develop all the knowledge related to it. Construction was, of course, very important in this struggle to complete a project. Just thinking about what the construction would be was an uncertainty in itself because you would rarely be faced with actually building the design project. At the end of the year, when students exhibit their designs, there are hundreds of them and it's a good exercise to go around the room and ask the students to consider whether each of the projects could actually be built. Surely, the students' ability to discern is ultimately essential and we should ensure that. Students, on completion, should be able to communicate with different kinds of people. But, what is the role of the architect? Are we just builders of houses, buildings, etc. or are we designers? In the past, architects used to make letters according to tradition, but, today, an architect might go into Nanotechnology – that would be quite a different kind of science for consultation! **Also, traditional housing construction might be something we may move away from and approach another construction reality on the computer, in which case we won't need Newton or 9.1 to worry about. So, there are different kinds of sciences and tools to be used.** As a result, we have a great responsibility at school to face and screen all the possibilities that are made available for constructing realities and mirror them both ways.

Ramon Sastre: I'm from the Vallés School of Architecture in Barcelona. I'd like to reflect on three points we've discussed during our first session today on construction and contemporary architecture. I think that **this afternoon we've looked at construction as a means of solving problems in**

architecture more than as a generator of architecture. So, if we see it from this point of view, even if not solely, we can understand that there is new, contemporary architecture. Consequently, as teachers of construction, we have to change because we must teach or give our students the means of creating or generating this new architecture and not to solve it. In our school, we have ten years of experience with studios being taught by professors of design studio in association with other professors from other departments. For example, in construction, we participate in the third, fifth and tenth studio. So, when we arrive at these studios (I'm using the idea from my colleague, here), rather than demanding from our students to demonstrate what they've learned, **we have to ensure or check whether we ourselves have given these students the means to propose an architectural design which takes construction into consideration or seen from the point of view of construction.** Therefore, if we find that sometimes their projects are not good, then, it might be our fault! In fact, design teachers are always to blame because in such cases, it means that they have not passed on to the students the way of thinking that can generate architecture through construction. The other point refers to the issue of practitioners. We talk about practitioners in general, as if they were all the same, but this is not true. We have practitioners in construction, studios, in the design studios, but they come from very different studios in the profession. They may work in small settings, in teams of two or in very big design offices. So, the term "practitioners" has wide connotations. We must narrow it down, otherwise, we're merely referring to full-time professors and practitioners, as if there were only two possibilities.

Lucien Denissen: I'm from Henry van de Velde, Antwerp. I would like to make three comments regarding the debate. The first is about what someone said earlier that an exercise should start at the beginning and go right up to the end. In general, among the themes in construction, it's impossible for every exercise to be carried out right to the end. It normally isn't. In fact, we can agree that many exercises stop at what is sketched and not at the construction phase. Of course, this is quite dangerous, but there is also the risk that in view of the curriculum some students will never reach the end. The second point is that in terms of how to teach, **the link between construction and design depends also on the kind of students we wish to deliver after five years. There are some who will go into practice, but others won't. The reality is that if everyone does, I'm afraid there won't be any work for them.** Some go into administration, others in theoretical orientation or whatever. Because we don't always know their future orientation, they should be exposed to the various possibilities and have some knowledge about what others are involved in, so that one going into practice will also know about theory, while one going into administration will be aware of the difficulties involved in practicing. I think we should cover both and link construction to design. Therefore, a minimum of construction should be made compulsory for everyone, even those in design. The third point concerns what Fausto Novi mentioned about the difficulties in design. Some reference was made to fashion and, I agree, that students should react to what they see around them. As an example, you mentioned sustainability and I will come back to this point tomorrow. However, in general terms, it's true that in good architecture and sustainability, if you follow the right principles, the outcome is really relevant. From what I've understood, I think what you meant was that the real danger lies in students thinking that they have to come up with something spectacular when it comes to architecture and sustainability. This overreaction is the real danger.

Donal Hickey: I've been thinking about what people have been saying, particularly the engineer who talked about the length of education and how it actually operates. There were also comments about methodology, and the fact that students have to know a certain amount before leaving college. Maybe, this stems from two things. I'll use an analogy about fishing to make things easier. **The old saying, give a man a fish and you'll feed him for a day, give him a bigger fish and you'll feed him for a bit longer, but teach him how to fish and he'll sustain himself. Perhaps in the beginning, we may have to give students fish, but we also have to teach them how to fish.** As a teacher, I'm very interested in other people, but I'm only interested in fishermen, not people who only carry fish. The engineer who spoke earlier, I'd love to speak to her; An artist, I'd like to speak to him too; A sculptor or the man who puts the nail on a piece of timber, I'd want to speak to them too. **If we can feed our students with fish at the beginning and teach them how to fish as well, then they can go out and find other people who know this skill.**

Anders Gammelgaard: And, in that way, they'll be

interested in going fishing on their own. I'd like to comment on what Ed Melet said previously. Often, on examining student projects, we're faced with the task of having to make these projects buildable. **I think that's the worse thing that can happen. It's a "killer" to ask students to design projects that must be buildable instead of asking them to produce architecture. We should ask them to deal with architectural problems and, in doing so, the solutions in matters of construction will come about.** This is a situation that we see very often where students come with projects that are almost finished and then we have to think construction into it, but it's far too late. This is so because in some departments they have been asked to make architecture which stops them from dealing with architectural problems that could develop the project also in terms of construction.

Vangelis Evangelinos: I'd like to introduce to our discussion some parameters that haven't been brought up yet. The number of students you have to teach construction to is of paramount importance. If you have as large a number as we have, and we are not as fortunate as some of you are to select students, it's obvious that you will have to oversimplify not only your teaching methods, but the experimental and theoretical work that you put forward to your students. I think this should be included in the discussion along with the thoughts of everybody, if we expect to find a solution that will apply to all schools of architecture in Europe.

Ed Melet: In reference to what Anders said, the buildable part is proof that our students could translate the concept into construction. So the buildable is not a limiting factor, but it shouldn't be only a form in the specific design. I agree with Herman Neuckermans that a lot of digital architecture is only about form and not about how to make it. We don't want this type of exercise. We want an exercise to make a new kind of form because we have new participants in the design studio, but these new forms have to be translated into new kinds of details. So, the translation between architectural concepts and details is a parallel session.

Spyros Raftopoulos: Can we go back to basics because I think we're going round in circles in our discussion about certain things? Perhaps we should start talking about what sort of architects we want to educate in our schools, not just as teachers of construction, but as schools. **What sort of mentality are we cultivating in our students? Is it that of the grand designers who, possibly, when in practice will use others of potentially inferior qualifications to draw up the details or to build? Or are we trying to cultivate the mentality of a comprehensive sort of image of the architect as the designer, but also as the person who constructs and details the building?** Although my reaction may sound provocative, in a way, I believe it's an issue that needs to be clarified within ourselves, because, even though we are construction teachers, we are, nevertheless, part of schools of architecture. We educate architects and not construction people. So, in that sense, I think the idea that's repeatedly come up, which is practiced in our school, is that of the studio comprised in a comprehensive way. The studio is comprised of people, what we would call designers, but also construction teachers as a group. This is so especially in the latter phase of their studies, always hoping that we are going to produce architects that look at architecture holistically and who will practise without trying to fragment or separate theory from practice. It seems to me that we have already been through this matter in some of our other workshops where we discovered that some schools (in Barcelona, Aarhus, etc.) adopt the same policy. The fear we may have relates to the kind of self criticism I referred to earlier, which is, that the availability of information the students have presently often puts us in a position where we cannot provide answers to certain matters. Students, also, very often look at the examples of the so-called famous architects, superficially, and come round with projects that, to a certain extent, are copied from the famous prima donnas of architecture and who, from their drawing boards, ask us to find solutions. It's quite understandable that very often we cannot give answers to these queries.

The danger in this exercise is that they don't design consciously, whether drawing on paper or designing digitally, which is actually the means of the future. I'm afraid that personally, like many of my generation, I don't know much about the latter. Nevertheless, we should not look upon it in a negative way since our students will have to live with that. This intervention was simply a matter of raising questions and if we can provide some answers, I would be very happy to hear them.

Ola Wederbrunn: Another fundamental thing that needs to be discussed is the issue of whether we are, in fact, *teaching* students and *what* are we

teaching at architectural schools. Moreover, what are we learning? What is the role of the architectural school? Is it to produce a certain amount of graduates every year? I know that this session is about how to develop skills and competencies for graduates, but who are the graduates? Graduates also entail teachers' sustained and renewed interest in what they're teaching and an ability to mitigate that to not just the school of architecture, but to professionals and non-professionals as well. The responsibility of the school is an extremely important element to discuss for the teaching of construction, in light of the fact that construction can be so many different things. For example, one of the aims of this discussion could revolve around the various tools we use, whether computers, bio-technology or construction language or building wooden houses or those made of stones piled one on top of another – what kind of construction are we talking about? The role of the school of architecture is to teach and learn to gather and assemble construction and to think about this not only in terms of tools, but through methodology. Gathering this information and mitigating it is extremely important. Therefore, it's not just a question of teaching so many students; let's say, for example, 200 this year, with results that can be shown to the government in an effort to request funding for more students (e.g. 220) the following year. This is a poor example of how to make a market economy, which could potentially destroy architectural thinking.

Christopher Lowry: I'd just like to pick up on the point regarding what type of architect we want to create. For myself, I'll have to bring it back to first principles because it's a question of showing students what to expect from an architectural education so that they can understand from the start what they're actually involved in. I find, more often than not, that students who wall paper and paste their projects with something they have seen from glossy magazines, but who don't really appreciate what they are involved with, are, perhaps, students that are after some qualification as opposed to an education. I think I like Donal's analogy about the fisherman because I believe that teaching is a two-way process since the answers or knowledge that we have is not exhaustive, but an on-going process of learning. In fact, I wouldn't be a bit surprised if, sometimes, while as a fisherman you teach someone how to fish, that person teaches you something as well. I find students, especially in the earlier years, have actually been unconta-minated, if I can use the term, by the "technology that won't work" or our warnings of "Maybe you should do it this way _ the technology won't work." Despite this, they have jams of ideas that I think we should encourage. **I believe it's dangerous to say "You can't do that because we aren't sure we have the technology to actually realize it."** Even if they don't get to the point of actualizing it, they still have to learn or understand that they learn from mistakes and that they are on an educational journey or path that is inexhaustible. Therefore, I think I'll be careful about saying "what kind of architect we actually want to produce". It seems that we all have to find our own place in deciding what it is that we want to equip our students with. I would agree with Anders **that one of the things to cultivate and equip them with is a searching mind – a mind that wants to investigate and discover – then, they'll eventually find their place if an education is what students are really after!** Of relevance, of course, is the question of student numbers and contact time, which is becoming more and more diluted, all of which have an impact. This is where a venue such as this is fantastic because it gives us the opportunity to collectively direct our attention to such factors as how to make that more efficient, how we can disseminate what we have more effectively so as to maximize student ability to manage time and learn from it.

Dimitris Papalexopoulos: This is a nice, quiet discussion, wouldn't you agree? I believe it's the quietness before the storm, at least I hope so. **When we talk about construction, we must bear in mind that construction means technology, and it's technology that has revolutionized our times. So, in this sense we can say that it's the quietness before the storm.**

Marianna Tsvetcova: Six years ago we conducted an experiment where we explored student opinion about construction education. We found that there was no interest in our area, on the part of students, so, we decided to research this further. From our findings, it was clear that what the Bulgarian students wanted was to receive "realistic" education and make "realistic" projects. Consequently, in view of these results, we changed our program and educate our students in more practical aspects, such as materials and new technology. Our students, now, make realistic projects from the situation at hand through the details. As a result, for the past few years, the number of students in our Construction Department has risen to 50% as compared to

students in other faculties. We stimulate our students in the third phase of our education with new lectures and these lectures change every year. These lectures are also given, not from teachers in the Department, but from guest firms that we invite to present their technologies and materials. These firms also arrange various contests for students to participate in. Perhaps, all these features have contributed to the increase in student interest in this education. I think that this was a very successful experiment, which is not based only on my opinion, but of my colleagues as well.

Erik Geens: Regarding Anders' presentation, I liked very much his point about setting limits about going further and further and would even stress this point. However, I have a problem with, or perhaps, I may not have clearly understood whether the knowledge referred to is based on research or prime knowledge. This type of knowledge can be obtained by asking students to learn on their own, but I'm afraid that this would be too time-consuming. Also, we have heard that there is a need for a common language or vocabulary. Even if we teach an architect-designer, he still has to communicate with the structural engineer and other consultants. So, I'm wondering, *where, when* and *how* can that basic, essential vocabulary knowledge be built up as a foundation so that it's not just talk, but a real research-based, critical approach to the problem? **When this methodological and basic knowledge is available, then we have nothing to fear and I don't think that a conversation between architect-designer and an architect practitioner is a problem.** On the other hand, I had a bit of a problem with Christopher's presentation where he mentioned that external consultants / engineers come in to consult and, as someone else added, to provide solutions to certain problems. But, I'm somewhat ambivalent about this, even if I were to understand your point better. If the student is expected to find a solution that goes beyond the limits and the consultant is there to provide or confirm an easy solution, then you defeat the purpose of the exercise.

Therefore, I think it's very important that a common vocabulary and common knowledge base is given within a limited teaching period, but on the other hand, it's tremendously important that, in a positive way, you try to postpone the "defeat" (failure) for the student. Whether it's a wooden, plastic or stone building, it really doesn't matter as long as the method and vocabulary is there.

Herman Neuckermans: In reference to different things that have been said here, I think that there is no single definition of what architecture is or a single definition of the role of construction in architecture and, thus, I think we can try to explain to ourselves why we take this or that position. In fact, I think that in Europe, schools will advertise their profiles, which can be determined by the teachers or a strong figure within a school or government, etc. This means that in some countries, the architects you deliver will be able to solve construction problems while in other countries their schools may have a different profile. However, those who will survive will be the ones that advertise a profile for which, I regret to say, there is a market! Thus, if, as Maria says, AA is an avant-garde school, then, yes, as long as it can stand, it will survive; the same applies for the Bartlett, which has such a profile. My school and probably many other schools, but others may have a different one. **I hope that this will emerge and become visible to students so that after the Bachelor, they can choose and say that they will go to a particular school because it fits the image they have of architecture.** I repeat that there isn't one truth about architecture: it's always value based. It has been value based and will continue to be, and the schools have to advertise the values they stand for.

Anders Gammelgaard: There are tendencies in the world that you can't struggle against. One example is that in our city, within the last two years, the School of Engineering has been interested in collaborating with the School of Architecture. The reason for this is surely not a sentimental one, but because they've realized that a great number of the engineering problems that have been solved have been dealt with in India and China. This means that **we can't compete with straightforward engineering problems, so, the only way they see for the future is to train their students to be innovative. This is their rationale for seeking cooperation. A fact we can't deny is that our world is changing in that direction. We cannot produce architectural candidates whose knowledge can be assured for the future, but we can train them into a way of thinking that will keep them "fishing".**

Session 2: The Teaching of Construction and the New Materials and Techniques

Chaired by Herman Neuckermans

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be capable of following the rapid development of the building industry in producing new materials and new construction methods respectively?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of following the rapid development of the building industry in producing new materials and new construction methods respectively?*

The Schools presenting in this session were

Versailles Paris (France) School of Architecture by Nadia Hoyet,

Royal Academy of Architecture, Copenhagen, (Denmark) by Ola Wedebrunn and Ole Vangaard

Aarhus (Denmark) School of Architecture by Karl Christiansen

Grands Ateliers de l'Isle d'Abeau, (France) by Denis Grèzes

Please find the respective interventions in the section of articulations.

Debate on presentations and theme

Herman Neuckermans: We will now proceed to the Question and Discussion Period related to the thematic presentations from Session 2, which you've just heard. For the sake of facilitating this discussion, I propose that we start by asking the more general questions addressed to the team first and then go on to the various individual questions or remarks you wish to make. So, are there any general questions related to the themes proposed?

Jerzy Gorski: This is not exactly a question to the panel, but some general comments.

I liked the idea of teaching construction in a conceptual way, which means that the general problems should be taught. I want to illustrate this idea through an example that also came up in yesterday's discussion. Students now have ample opportunity to get information easily via the Internet, contacts from firms and an additional two sources, the first being magazines of architecture, where students see the forms without, perhaps, analyzing the value of the architecture. This, of course, is one extreme. The other extreme is the libraries of details and technical information coming directly from the manufacturers. Normally, students ask for the names of manufacturers and their immediate response is "We'll find the information on the Internet." Also, in technical magazines, they are provided with CDs on all this information. Another area is regulations and norms and to get to this source all they have to do is click and obtain all the information they want. It seems that they can get around this field very easily, but they are lost in getting the "real" information, meaning that they go about it unconsciously. Consequently, **our role is to fill this gap between the architectural concept and the technical details through a conceptual way of teaching construction and the architectural studio as well.** This, in fact, means that we must somehow teach the basics so that they know why they're looking for technical information. When I think back of my earlier teaching days, the amount of materials, then, was limited and we were a source of technical information for students. **Nowadays, because of this enormous amount of new materials, details and information, there isn't sufficient time to cover everything.** Personally, as a way of dealing with this information overload and easy access, I found I had to reduce the amount of technical information and return to basics, i.e. understanding how a building works, understanding the connection between elements, etc. I have no easy answers, but our team is in the process of changing our way of teaching. I like the Danish attitude of teaching and believe that if students understand basics and are aware of what is important in their concepts, then they can look for details that are easily available. In fact, students have often handed in ready-made details which

they obtain from such libraries, but the problem is that they don't know what to do with the details.

Herman Neuckermans: Thank you. Is there anybody that would like to respond or react to the statement made?

Ola Wederbrunn: This attitude of changing the educational process is right, but regarding the bulk of information which is easily accessible, we must remember that one has to "digest" the information one gets and, before even getting it, one has to have schooling. The role of the school is not just to give information, as this can be obtained elsewhere, as we've already mentioned. **Therefore, our role is more to show students how to "digest" it and provide a forum for discussing the information, which can be done at various levels.** There is pedagogy in Denmark on how to teach young children so that they are no longer being taught as a whole class, but rather in small groups of different sizes. This idea can apply to architectural schools as well so that we can provide an open forum rather than a class where we teach and learn architecture. This kind of openness should exist in an architectural school. Today we face a lot of students who work on their own at home with their computers and stations, where they can go on line to schools and exchange information through chat lines. In our school the students are very fortunate to have each their own table and lamp, etc. However, you have to get them in different groups, seminar groups and smaller teaching groups and define these kinds of groups where discussions can be held, including a large project where many participate or the individual project at the end of the year as is done at the Academy in Copenhagen, where we have the intensive three months.

Marcel Heistercamp: I'm from the School of Architecture in Gent, Brussels. There seems to be a missing link in your discussion – the link of the relations between design and surrounding elements – the landscape. We only see the design of an object, but what about the other important factors or elements?

Cyrille Simonnet: I think there is a gap between what was said about the facility with which we obtain information (Internet, etc) and the technique. As a way of bridging this gap, there is something called a project, but a quality project, since a project is a "conduit d'anticipation" involving a kind of anticipatory response or means of expectation. Now, in schools of architecture, the main object of the project is the town, generic town, landscape, etc. Also, I foresee another gap coming, which can be observed in many schools, i.e. that in architectural studios and architectural workshops, the main interests revolve around the very important questions of town development, landscape, patrimony, etc. to the detriment of construction; so that the question of construction is being totally ignored by many architects and this neglect presents a real problem. Therefore, as far as I'm concerned, I foresee a further fragmentation coming.

Ole Vanggaard: The question related to landscape made me think that as a structural engineer, I have a different view. Structures, nowadays, are getting so large that you have these huge projects of transportation where the issue of structure and landscape emerge. So, I see a great need for a structural-landscape conception, something that is moving and changing and also related to what the computer could do. When I see these schemes round the world being done, then I feel that this concept needs a structural answer which has not been provided yet. But, I suppose the question asked was more environmental in nature, which I really didn't comment on.

Ola Wederbrunn: On the environmental aspect, Mies van der Rohe said that "God is in the detail." I don't know if we have to be religious about this, but surely you have to relate the environmental aspects to objects in a context. The contextualization of a project is very important. Therefore, it's essential to stress that culture and sustainability go together and, this aspect of teaching has to be developed as well as the technological aspect and, this needs to be seen in the details of construction and materials.

Marcel Heistercamp: In the teaching of design, we don't see this relationship_that's the problem! Models and drawings are never made in a context.

Ola Wederbrunn: I'd like to answer by saying that in the "sawing project", of course, we were not involved in the timber industry, but the students who took part in this project started with wood and wanted to make wood, so they thought about trees and how to cut down trees to make pieces of wood. Finally they had to think about how they could make tectonic out of the pieces of wood. So the student tries to follow the project by working manually and quite intensively right through to the construction phase. Therefore, from material to construction,

contextualization with the landscape (forest) was part of the aim. Of course, I'm simply referring to this particular project as an example, but there are many students in the Architectural Department and there are many ways in which this can be done. I very much agree with you that contextualization should be brought into the discussion and that material and technology have to do with a greater contextualization -- that of the environment.

Herman Neuckermans: Yes, I agree with Marcel Heistercamp's remark that as far as the relationship between objects and surroundings is concerned, it was not really visible or apparent in our presentations with respect to the objects we designed. So, he has a point; although I'm not sure if it was intended to be a constructive suggestion or simply a critique. Would you like to expand on this and share some ideas on how this could be done?

Marcel Heistercamp: I think we have to start with the environment. Study the conditions: the air, water, land, rocks, mountains, etc. and a discussion about these objects in their relation to the landscape is more important than merely making a drawing about the forces of an object.

Herman Neuckermans: Since we have another session coming up devoted to "Construction and the Environment" and your remarks would be highly relevant there, I would suggest we "stick" to the program at hand.

Donal Hickey: Where do new materials come from? Are they pure innovations corrupted by the time they make it to the construction industry? Do "smart" materials and systems divorce us from our senses?

Maria Voyatzaki: I'd answer that by asking "What materials?" Also, again, I wish to refer to the point I made yesterday from Greg Lynn's and Hani Rashid's book 'Architectural Laboratories' some notes on the book, which I started quoting to you yesterday. To adequately answer your questions, we would have to re-define "materials". For example, if I think back of the materials I learned as a student, the "Modernist Movement" at the time used and talked about metal, glass, concrete and such techniques as cutting, welding, joining, pouring concrete, etc. However, if you go through the contemporary, avant-garde books of architecture and the new paradigm that does talk about materials, you'll come across such terms as glass fiber, raising panels, vacuum formed PETG, plastic composites and techniques such as bolt hammered aluminum, high- pressure water jet cutting, multidensity fiberboards, fiber plastic rotor molding and, of course, the popular term "nanotechnology" even if we don't know what it means. A very recent book, which you probably already know, edited by Toshiko Mori from Harvard, based on experiments she did with her students entitled "immaterial/ultramaterial" talks about the new experiments that schools conduct in their experimentation for forum to change the genetic code of known materials or even computerize the characteristics they desire their forms to have when they are materialized through a material. Therefore, I think, we have to make a distinction since we live in a changing world. Ed van Hinte will tell us a bit more about this topic this evening. After all, we're amateurs in this particular aspect and he's probably laughing with what I'm saying. Nevertheless, we should be aware of the fact that when talking about materials other than the ones we're familiar with, which of course entail different techniques for producing and assembling parts, we will need to answer questions such as Donal's with the question, "What materials? since this is not the "palette" we've been familiar with for years.

Donal Hickey: There are "smart" materials. There are very "smart" materials. There are exceptionally "smart" materials. (Interruption by Ed van Hinte)

Ed van Hinte: Sorry, **I'd just like to specify that "smart" can also be defined in terms of how you apply a material. For example, sand can be extremely smart. So it's far more complicated than merely defining the material itself as being "smart". You cannot just talk about the material. I'm often asked "Can you tell us what material is sustainable?" to which I answer, "Styrofoam in the sea", or other, because that can be sustainable too.**

Donal Hickey: Let me finish clarifying what I meant. There are materials that are relatively transient in terms of their capacity to change, but there are materials that in terms of process, physical properties and qualities have medium-term longevity as far as usefulness is concerned. There are materials that are ultimately malleable in terms of the way their physical properties operate, the way we think about them and how useful they are. That's what I meant by the "smart" "very smart" and "exceptionally smart" materials.

Ola Wederbrunn: In reference to Maria's remark, we're not talking about such materials as stone, glass, wood. In fact, it's not even necessary to refer

to those. However, what is necessary is to talk about whether the material is hard or soft, so that experiencing the material is part and parcel of the material itself. In this way, we manage to change our perspective of things from the view of what they are to what they do by simply experiencing them. Therefore, we're not looking at numbers or quantity of material, i.e. we're not trying to say, for example, there are 155, 248 materials, but that there are different ways of experiencing them.

Ole Vanggaard: As an engineer, I think that when architects talk about "smart" materials, smart gimmicks, they might also be referring to the lovely machines. In a way, I think we're forgetting that all these things have undergone a certain kind of development, technical development. However, from history we know that this type of development lacks or does not go into architecture and, therefore, of any architectural value, unless the architect strives to derive or find an architectural concept from it in the form of material concept. It's precisely for this reason that we can use the example from the Modernists. Although it took a century for technology to develop, it wasn't until later when some architects formed the Modernist Movement that they actually managed to use the available technology in architecture. So, in this case, it seems we're also on a hitch of technology which is there and, I think, **what is far more interesting to see is what the architectural content of these "smart" materials is.** But, I guess, it's always funny to look at strange things! I have no answers and, presumably, no structural answer, but I believe we need a conceptual way of talking about this concept. So, what is the concept in "smart" material? How can we formulate concepts about them?

Maria Voyatzaki: I'd like to challenge the debate by making a distinction and I'm wondering whether you'll agree. It follows a kind of chronological order. To my mind, the so called traditional materials such as masonry, glass, concrete, wood or timber, steel, metal, etc. had certain properties, and knowing their properties, for example, whether they could undergo tension, compression etc. when we designed something, bearing in mind the potential of the materials in terms of loads, we would then choose a suitable material. Or, vice versa, knowing these properties, we would design something appropriate to the materials. The second step was, I think, a kind of modernist / logical or rational approach to materials. Then there was some experimentation in transcending these properties of material, an attempt to go beyond what they could actually offer, which resulted in structural glass, for example.

So we moved from the phase where glass was fragile and sensitive to the point where by laminating glass it could bear loads. Today, we can say that the paradigm has changed altogether and, with such new structures, it seems that we want to pre-define the properties of materials and then design according to the best material of our choice or needs. This is a very avant-garde paradigm, but, I think, this is the phase we're going through. In fact it's what Ed van Hinte describes in his introduction in a book he will present this evening, which is like reading "A Guide to the Galaxy" where you imagine what it's going to be like in 10 years' time. It's a kind of analogy similar to what the Internet was to us 20 years ago or even 10. It was unknown territory and no- one could imagine what we would be doing with the Internet! Along the same line, this could be true for materials as well. So, we basically prescribe what we want the properties to be, make new materials and come up with a new list. I must admit that I understand about 30% of the list of recent materials I read to you earlier. I don't think we know what these new materials are and this, I feel, is where there is food for thought and a broad field for research to be undertaken in the future, especially in education.

Michel Paulin: I'm from the School of Architecture in Lyon. I agree with what Maria has just said, but **I think the problem is not new or old materials, but rather the problem lies in the processing or mining of materials. If we look at the history of architecture or art, we can readily observe that each historical period began with an archaic one followed by the classical and Baroque. This cycle is the same each time and I believe we're going through the Baroque phase. The archaic period represents the setting up of principles, aesthetics, and means of building while in the classical one you try to expose as clearly as possible these principles.** Mies van der Rohe is the best example of the modern style. It's not so much the concept or principle which is essential, but the effect and perception together with the whole enjoyment of building – the game of building. When I consider this very room we're in right now it's typically Baroque. Look at this particular column, is it all of stone or brick covered with marble or is it just paint on imitation marble? All this is not important, but what is important is the result of the finished product in that particular period, which in the case of this building is the end of the 19th century. When

I said that this was a God blessed period I said so because we have a single "one-way" thinking mode. We showed last night the large historical survey where all the pictures were a reenactment of this kind of approach, the classical one where the main value was what the material choice was based on, but not the effect. Even in the extension of the British Museum there is a structural grid and the main value is the structural principle, not the form. This morning, we saw the sketches made by Frank O. Gehry for the Guggenheim Museum.

The approach was completely Baroque, only the effect was sought after by Gehry. He's not at all concerned with construction. He says that he wants a kind of shape; he doesn't know exactly which one, he'll try by modeling, sketching or whatever means and he wants the skin like that of a fish and if someone can give him the proper material, fine. In the end, it was covered with stainless steel, but it could have been any other material. **For those of us in charge of teaching construction, we need a change of attitude, a different approach because, as Nadia Hoyet said earlier, we have to teach on the basis of a performance check list, and this is a radical change from the way we originally designed. We have to learn to tell students how to establish this check list very firmly and how to assess the process. That's a radical change of ethics for us and very difficult, especially for me, who is close to retiring.** Moreover, it presents a problem to the younger staff members too. In the discussion, there is clearly a gap between the two approaches and it's clearly a gap of ethics or culture, not a technical one.

Herman Neuckermans: So, I'm sure we'll hear more about the performance-based approach, but for now, Miltiadis Tzitzas will take the floor.

Miltiadis Tzitzas: Thank you. Regarding the remark previously made about the fact that choice of materials is irrelevant or does not really matter, I wish to say that what I actually learned in this School as a student and what my colleagues and I try to convey to students is to learn to respect materials in terms of what they are and to show respect in the manner in which we use them. Whatever materials we use to form or materialize the architectural idea we have in mind, we must take into consideration that some materials are used for the structure, others for the purpose of creating the exterior envelope, etc. A distinction between how we use these materials and show our respect for them reflects good, quality architecture. I will give you an example to demonstrate what I mean. I've been to Copenhagen several times as it is a place I like very much. Apart from our Danish colleagues, I hope others have also been to Copenhagen, and, if you have, you will know that there is a complex of buildings that houses the royal family. You go through a huge portico, like this one here, for instance, with two magnificent columns, very much like the ones in this room, but on approaching them one notices that the material of the columns has deteriorated and that the material is not stone, but wood. This, of course, is understandable when one considers that, in Denmark, the land is flat and marble and stone are not available. However, the use of the material itself simulating a portico column was kind of shocking to me. I felt terribly disappointed with that and I should add that it was the only disappointment! Nevertheless, what struck me was their willingness to use a form familiar with the icon we have. This big column, here, is made of marble and is a supporting column, not a decorative one like the column you see at the corner, which is painted; that's different. Naturally, this doesn't mean that one doesn't use marble for other purposes. Another point I wish to make refers to the Café Georges at the Pompidou Center, which as mentioned this morning is made of new material that in fact is not so new, as commented earlier. Actually, when visiting the place, I went to the lavatory and I remember worrying about not being able to find my way around because of its peculiar shape. In fact, I started wondering what the toilets would be like, but, fortunately they were quite conventional. So, there you see new material used in a very conventional space.

Anders Gammelgaard: I'd like to go back to Maria's comment on the development of the Internet and new materials. As you said, nobody could have foreseen the development of the Internet, even Bill Gates was surprised at the rapid growth. He also said that in the future, already today, the development of materials would be the development of concept. We will simply define what we want the new material to do or how it should perform and then design it. However, this development will not be so rapid, in fact, because if we take a material like wood, for example, which is a very old-fashioned material that should have been taken out of production a long time ago, we realize that it's still being widely used. Why do we continue using it when, today, we have so many new materials that

perform much better than wood? I think, it has to do with the fact that it's so strongly related to our culture. We have stored in our memories all kinds of familiar associations and shapes related to the term "wood".

However, if we consider another material like plastic, developed around the '20s when we saw the first plastic products, it's not until today that we have become very familiar with this material. **Therefore, it takes an extremely long time before a material is adopted for architectural use. Then, we can go to one of the new materials such as polyamide carbonate and no images come to our minds because we have no conception of the material. So it seems that the human factor slows down the introduction or acceptance of new materials.** When we see modern buildings, today, where new materials are used, we feel like aliens walking in them and the first thing that we tend to do as architects is to try and find out what they're made of. It makes us terribly uneasy if we have difficulty figuring this out! So, this whole view of the future in terms of material development and implementation moving at a fast pace is a notion that I don't really believe. In 30 or 40 years, we'll probably still be using the old-fashioned material that I love so much-- wood.

Herman Neuckermans: Of course, there are traditional materials, but in teaching, I think we should make a distinction between our knowledge of materials and the direction where architecture is evolving, whether it's the whole avant-garde trend or whatever one may call it. Also, I think students should know what is still there. I can guarantee that most students in their fresher year don't know what some of these materials are, even the traditional ones such as wood. So, I think that this material knowledge should be part of the teaching, and in understanding such things, new problems can emerge from it because, let's take as an example a very traditional material, glass, and you've already mentioned the structure of glass a bit, but how many students should know the difference between hardened glass and laminated glass before even going into the actual use of these materials? I remember that I asked students of architecture at a conference some years ago, in the presence of Pierre von Meiss, what is glass made of ? Well, I was proven right, because they not only didn't know what glass was, but cement as well, despite the fact that they might have had courses on them. Therefore, it's not simply a question of making distinctions, but we must also not skip or overlook teaching the traditional materials, taking this information for granted as given, because for students these materials are yet to be discovered.

Maria Voyatzaki: I'd like to answer by repeating what I said yesterday that there is the fear of the new. When we talk about kevlar, we don't bring it up because we want to rule out of construction timber or concrete, etc. New and old in respect to everything we've discussed throughout the Workshop are not mutually exclusive. What, in fact, we're saying is that there is a new world out there and we have to look at it. We're certainly not suggesting that the old paradigm should be discarded and replaced by the new because there's no other way of building! We've learned about the Internet in the last ten years, but it was used over fifty years ago as a means of communication in military services, universities, etc. This story can be compared to the way kevlar is used in building, nowadays, to a minimal degree and, in much the same way, plastic was unknown when we were born, but now it's part of our everyday life as well as being widely used in buildings. So, we would have to dismiss the idea that this developmental process is lengthy because fifty years is not a long time. Kevlar will be commonly used, as far as I can foresee, by the time our grandchildren will be constructing buildings, and it doesn't have to be this particular product. It's merely an example.

Michalis Limenitakis: I'm from the Clermont Ferrand School of Architecture. I'd like to add that it's not just a matter or question of materials, but the main distinction is about architects and engineers. An architect designs space with materials that have meaning or that carry a message, whereas an engineer knows the materials without the awareness of the symbolic meaning. So, our question as producers of built space with meaning that is occupied and used by others is, how do you, engineers, give us the tools to manipulate and create new meaning through these new materials?

Herman Neuckermans: Thank you. I'd like to give the floor to those who have been patiently waiting for their turn for some time.

Nadia Hoyet: I'd like to continue with what Michel Paulin mentioned earlier. I think we have lived in an industrial era. We are now at the beginning of the era of communications and information so the main objects will not be industrial products or materials, but information. This fact influences our way of conceptualizing; we must be able to have all the

right choices and in huge quantities – that's the deal! But that's a problem because we have difficulty prioritizing and putting things in the right order in the hierarchy of products made available. We are in the process of searching for new ways, but we have yet to find them.

Ola Wederbrunn: The world is always changing and we have to cope with the changes. If we understood the myths, we could convey the message to others who don't. If we know how to read, then we can read a book, but there are people in the world who don't know this skill of reading. If one can read, then the book becomes the means of constructing one's reality. The poetry of the words make you think about construction. There is an architect in Dallas, Marcus Novak, who has been writing and, I think, is researching this. I think it's very important to stress that we have to maintain the relation between what we're navigating through, whether it's the poetry, the book we're reading or the text we understand, if we're lucky enough to be reading. So, what do we educate our students in? Do we educate our architects to build houses of wood, plastic, etc. or do we educate them to be able to set up a website for Amazon, for example, in order for them to construct things on the computer? Actually, it would be interesting to elaborate on how to make programs because, as we've heard yesterday and from Karl today, constructing programs is a way of constructing too. This will also include material properties and the properties will be the materials themselves. Therefore, this discussion can flow in this direction and it's apparent that we really need to deal with this computerized reality in terms of construction and materiality.

René Hughes: I wish to comment in reference to the notion of "concept" that stemmed from the presentation of Ole, the Engineer and Ola, the Architect. (By the way, the relationship between the last letter of your first names and your chosen profession respectively is an interesting coincidence. In fact, we can almost say that you were born to be Engineer and Architect and here you are sitting side by side with one another, just as engineers and architects should!) However, to get back to the point, I'd like to respond to our colleague from Warsaw about the Internet and the problem with information processing and materials, etc. I think that "concept" derives from architecture, but it can also be found in construction. A concept deals with something that doesn't exist – it's purely the term of an architect – the concept of a building, idea etc., it's an abstraction that leads a project right through to its realization, and it helps us in the field of construction to know that this notion exists. For example, in the area of material, we make various associations related to the details of the material itself and we need to keep these concepts in mind. If we take glass, for instance, we associate with it the concept behind the material. I believe that the best thing we can teach our students is precisely this type of conceptual knowledge. It's possible for us to adopt the manner in which the architects use the notion of concept in our construction field in order to produce a good line. We can talk about laminated material, but we can't associate this to wood, for example, because wood is mainly fiber and processing will turn it into small pieces or turn it into aluminum extruded or laminated with resin. Along the same vein, concrete can't be laminated either because concrete is a chemical reaction. Therefore, the concept of concrete is basic and self-explanatory. Also, I recognize the controversy that Paulin introduced with the Baroque reference, which arises when you transfer the concept of one material to another in an attempt to experiment. For example, with steel, which can, of course, be laminated, you can cast or pour the steel in the same way you do with concrete, but it's irrational and totally experimental! As a rule, we should use the same architectural tool, the conceptual notion, as a guide to our construction teaching.

Herman Neuckermans: I agree with your definition of concept, but I wouldn't say that it's the prerogative of the architect exclusively. Designers as well as people who are capable of perceiving also use this term. For example if you talk to a computer scientist, he / she will ask you to explain your conceptual framework if he / she is to develop something for you. The converse is also true, i.e. if we were to do something for the computer scientist, then we would readily see that his / her conceptual system is quite different from ours. So, we all function within a conceptual framework.

Michel Paulin: The question of information and communications is very important and we must be cautious not to confuse the two terms as they are two separate entities. Information about materials today is "hyper" or ultra developed. However, I wonder if the flow of information is really rooted in the personal culture of individuals - I have my doubts! **We have two problems to confront when teaching: to instill this personal culture in our students and to improve knowledge and**

information. Moreover, I believe that it may not be possible to efficiently and correctly utilize this bulk or large body of information without the presence of, at least, a minimal amount of personal culture. For example, with regards to new materials or plastics, we try even if minimally, at the Grands Ateliers to search for this personal culture. Of course, this is extremely difficult because we don't use this kind of knowledge daily; in fact, it's difficult enough just naming each plastic correctly, even if we are more or less specialized. We have developed a small training program called "From Objects to Molecule and Feedback from Molecule to Objects" The first is a blind test, just like that of a wine tester. We start by cutting into small pieces various kinds of plastics and the students are blindfolded and asked to identify the individual types by such strategies as tasting, touching, smelling, scratching, cutting, firing, etc. We have a series of tasks that are meant to improve step by step the kinds of properties and distinguish the kind of effects extracted or derived from the pieces as well as identify them. If the student manages to identify the kinds of plastics, then he/she can go on to the information provided on the Internet or CD ROMs to learn more about how these materials are made. In the subsequent program, we start with a pool of properties and ask them to design something using this pool.

Ole Vanggaard: I'd like to refer to the comments made on the "concept" issue. As mentioned, there are concepts at many different levels, but the notion of concept was brought up here mainly as a tool that can be used between the architectural idea and technological content. For example, a young student may say that she is not satisfied with the types of glass available and wish for an alternative solution. However, we must remember that the concept is about glass and so we start a discussion on the basis of what this concept is. Then, one can argue that the technology related to the particular glass is wrong because it's brittle and, as a result, we continue our discussion looking for ways of dealing with this particular feature. We may consider combining the material with something smooth in order to eliminate the roughness which could be potentially dangerous in a structure, etc. Reflecting on this, the student may decide that the idea is a good one and ask about how to proceed. The point is that we are all initiators and try our best in developing and creating things. We know that we shouldn't put all the force at the corners or triangulate, but make 3-inch corners to ensure that the plate action is in the object. This is how we begin developing something, but that's because you put forth the concept of what is desired (e.g. purely glass – it's impossible, so this sets up a forum for us to work in). Therefore, we should regard the **concept** as a **tool** which can help us in our teaching, particularly with older students, because it can be a worthwhile means for you to enter into a dialogue with them whose language can be developed, and once we develop this language, it can be very useful.

Maria Voyatzaki: I think we're again referring to existing knowledge in the example you gave advising a student about triangulation, etc. That's the case where you have the answer off the cuff based on existing knowledge. However, I'd like to make a reference to a recently published book by Cecil Belmont called "Informal". You probably already know the author, who is a Structural Engineer working for Ove Arup and Partners. This is a very interesting case as he also works with Liebeskind and Koolhaas among other very well-known architects. A running thread throughout Belmont's book is that invention and experimentation are hugely attributed to the duty and task of a structural engineer. In fact, what he actually mentions in his book is that he's the one who prompted Koolhaas in the Rotterdam Kunsthall to go beyond the grid, which is existing knowledge that we are all aware of. We have rules of thumb which we use to deal with the problems our students encounter. However, he suggests that experimentation either in material or structural systems has to go all the way. This is how we can innovate if we want to go beyond the existing body of knowledge in architecture. This is the reason he called his book "Informal" because he challenges the existing formal patterns or modes of thinking and of conceiving architecture, structure and materials.

Ed Melet: I'd like to comment on what Maria said as well as what was previously mentioned. Indeed Cecil Belmont proposed an offbeat kind of structure and Koolhaas accepted it because it was part of the concept of the building and it made the building stronger, so there is a relation or integration of structure and architecture. I think it's the same with materials and detailing. **Materials have meaning only when they are within the architectural concept, otherwise, they're not very important in terms of how smart or dumb they are.** They acquire meaning only when they are in a building or space, then they reflect the idea of an architect. Since this Session is on "new materials", including

new structures, etc, I was wondering whether new materials and structures imply a new way of teaching.

Maria Voyatzaki: I'd like to correct you on the remark you made about Belmont's structure. It wasn't the strength of the building; Cecil makes no reference to this in the book. He merely made the suggestion and Koolhaas agreed. It's a very strict and rigorous way of dividing space and if you have large pieces of artifacts in a grid it's as if you frame them with four columns, so, all he said was let's transcend and go beyond this old grid system of putting things evenly distanced and loosen up the space by arranging the vertical support in different directions. As a result, it has nothing to do with strength. However, as far as you're second point is concerned, I think you're right in saying that the discussion here is about educating people to come to terms with the fact that there is a new world of new materials, as well as traditional ones, and that these materials demand new methods and new ways of understanding architecture as a whole if we want to accept the point made in Session 1 that only by integrating the idea with its construction, we can have good architecture. Consequently, of course, as teachers of architecture and construction, this is what we're here to discuss.

Ola Wederbrunn: Just a short commercial presentation: Rasmussen's 'Experiencing Architecture' is a book written in the early '50s and it's about experiencing architecture for people that we'd like to talk with, i.e., those that are interested in being educated as architects. Rasmussen died in the 1980s at the age of 90. The book is in English, published by MIT Press.

Herman Neuckermans: We've come to the end of the session, but, in my opinion, I don't think we've answered the question of what we should really teach. As our colleague Professor Gorski from Warsaw emphasized at the beginning, there is a great deal of information, but where does it all fit in terms of what we consider essential to be taught so as to prepare students to adequately face the demands and requirements of the future? Surely it's not enough to simply teach new materials. We need to teach the basics first and then enter into a discussion on the rudimentary basics of materials, which I'm afraid was not dealt with in detail here.

Session 3: The Teaching of Construction and the Environment

Chaired by Emmanuel Tzekakis

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be responsive to the sensitivities and consciousness of our society towards the environment, sustainability and energy conscious design?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be responsive to the sensitivities and consciousness of our society towards the environment, sustainability and energy conscious design?*

The Schools presenting in this session were

Genova, (Italy), Faculty of Architecture by Adriano Magliocco

Thessaloniki, (Greece,) School of Architecture, by Nikos Panagiotopoulos

Antwerp, (Belgium) Institute of Architecture Henry van de Velde by Lucien Denissen

Please find the respective interventions in the section of articulations.

Debate on presentations and theme

Emmanuel Tzekakis: We will now begin our discussion on the presentations related to the theme of Session 3. As proposed by the former Chairperson, which I found to be a very good suggestion, we will proceed with questions on the general theme first and then move on to the more specific ones.

Nicolas Remy: I teach at the School of Architecture in Grenoble and wish to comment on the speech of Nikos Panagiotopoulos. Although I'm addressing the question to Nikos, this is also part of the general discussion. From what you have described on the role of the European Community, we can extract a few good points. For example, regarding the recent thermal regulations, as well as others related to acoustics that we have in France, all of which try to improve the comfort of inhabitants in buildings and reduce the consumption of energy; one of the overriding goals of such regulation is to enable us to engage in dialogue. In fact, I was very pleased to read in a leaflet that people in Belgium share the same criteria with us. However, does regulation really mean comfort? If we take the example of acoustics, I'm not sure that the maximum level authorized in Northern Europe has the same meaning or can even apply here in Greece or Italy or the South of France or Spain, countries where there is a different relationship with outdoor, public space. So, my question is what can we do with trying to improve the level of construction that aims at better and better care of the environment while trying to maintain the uniqueness or singularity specific to each country? Moreover, I think a school of architecture can play a major role in achieving these goals.

Emmanuel Tzekakis: Does anyone care to comment?

Nikos Panagiotopoulos: The point I made was precisely that -indeed that is our role! Also, we should bear in mind that to enforce a regulation takes at least ten years: you start in 1980 and by the time you finish in 1995 it's already outdated. Therefore, we should be more flexible.

Ola Wederbrunn: I think there are regulations, but they're difficult to handle. The European Community's regulations also relate to things other than economic ones. There is the Council Directive 85 / 347 amended in 97 / 11 and, again, amended last year that takes care of cultural heritage and architecture. It also deals with environmental impact assessment and strategic environmental assessment, both of which fall in the category of the environment regulated by the European Union. The question, however, is whether we should regulate down to every project. We need to have some flexibility in the system. I think you're right in saying that it's the schools that should be involved. After all, dealing with every type of project is much too detailed. Finally, it's important to stress that sustainability has to do with culture.

Lucien Denissen: I don't agree that there should be a great deal of flexibility; after all, regulations are there for a reason. A regulation should be flexible

enough to allow each country to make some exemptions or special amendments, but the overall goal should be to abide by the Kyoto Protocol. For existing buildings and matters concerning cultural heritage, certainly, exceptions can be made as far as isolation is concerned, but that's another case. However, for new buildings the matter of regulations is an issue that an architect has to deal with, and it is our duty to teach our students to take into account factors such as fire prevention, safety, sustainability, etc.

Emmanuel Tzekakis: Are there any further questions?

Ed Melet: I have a general comment. Sustainability is also a matter of attitude. **Of course, sustainability is adequately covered in the regulations, but for people like Piano, Foster, etc. it's an attitude of improving sustainability beyond regulations. There is also the attitude reflected in your own individual school methods through which sustainability is encouraged beyond regulations onto the design.**

Emmanuel Tzekakis: That's a good point. Does anyone wish to comment?

Vangelis Evangelinos: I believe that if you see sustainability as a series of criteria, then you can prioritize or set a hierarchy of criteria concerning architecture. If you put on the top of the scale the sustainability factor, then you could use it as main criteria for checking your work. In this sense, you could use local materials as being sustainable in creating the local picture in architecture, use material that is energy saving, etc. If we introduce these criteria in our class discussions, which we sometimes do, and put sustainability further on the line, then we can start a dialogue with our students regarding the specifics that could improve the picture of sustainability in local architecture.

Ole Vanggaard: There seems to be too much talk about used materials, but you must be aware of the fact that according to regulations, producers are not allowed to sell material that's not certified. Used material can't be certified. I was a member of a Danish Committee and was very surprised when I realized that used bricks couldn't be used again unless they were first tested.The question is, how can they be tested? Old bricks can't be certified although we know that they can be quite good. Seemingly, with these European stipulations, we're running into the problem of not being able to reuse materials, ultimately.

Lucien Denissen: I don't think you are required to test the material at all times; that applies to public buildings and so forth, but in the private sector that's not the case. Nevertheless, we should allow such experiments at the experimental phase. Of course, where there is a large production, there should be testing and certification, especially if safety is in question. However, if it's a matter of a used tile that's not easy to clean in the recycling process, then it can enter the experimental phase of reusable materials. If the person who plans to reuse the material decides that it's fine, then I really don't see why the person shouldn't be allowed to do so.

Ole Vanggaard: I'm sure that one's judgment is correct and that they could be used and if so, they should, in fact, be used. However, it basically boils down to the question of responsibility – who would assume responsibility for a house that may be fine, but not worth it because it was built with uncertified materials whose safety can't be guaranteed? Eventually, it would end up being illegal and the contractor, architect or engineer would be held responsible. Therefore, I doubt that anyone would take the risk of being sued in court for using uncertified material. In fact, it's a professional obligation to use certified material. However, I am also fully aware that this legislation creates a rather unpleasant situation for which I have no solution. I resisted accepting it for the longest time while I was on the Committee mentioned above. I could understand the difficulty so we circumvented it by trying various tests with bricks. For example, we thought that if by throwing them on the floor they would be intact, then they could be used even if for low-level or use. The same principle applied to timber; however, that's no solution for reusable materials.

Vangelis Evangelinos: I think that the way one can use an old building material depends on the imagination of the architect who makes the final, recycled building. I've been using recycled materials for quite a while. For instance, I've used load-bearing brick for paving; this is a very good solution because you needn't check its strength, but merely its wholeness. I've also used ceramic tiles for roof paneling. The tiles I used were 150 years old and they've lasted for 35 years with no ill effect. When I first used them I had to clean them and check each one to ensure that they weren't broken. There are simple things that you can do to recycle old materials; all it takes is a little imagination.

Ed Van Hinte: I'm wondering, sustainability is not

simply a matter of regulations and complying with rules, it's also an educational challenge. You can, for instance, ask your students to design a building where there is sufficient light for 24 hours without the use of electricity and they are to work out how this can be done. Such matters are very important in education. It's not just about knowing all the rules, but finding interesting solutions as well.

Ed Melet: Are there any other colleagues, here, who do similar kinds of exercises where students are challenged to think of sustainability beyond regulations?

Emmanuel Tzekakis: Do you mean that you would like others to share their experiences in this aspect?

Ed Melet: It seems to me that we're not discussing sustainability itself, but in the context of the teaching of sustainability. Undoubtedly, we all agree on the importance of sustainability in general; however, what I'm wondering about is whether there are any workshops, seminars or specific exercises that are being conducted on the subject of sustainability beyond an isolation of fifteen or twenty centimeters, so to speak, which is not really relevant, in any case.

Spyros Raftopoulos: In answer to your question, I think that we definitely differentiate between teaching sustainability as an exercise where students may produce something in one of their projects, just applying as much as possible the regulations pertaining to a certain country or particularly now in our country. What we also do is try to sensitize students to the subject of sustainability while they're working on their architectural projects. In this case, we cannot or even think it would be proper to try to insist on the application of regulations at a time when we want them to concentrate their efforts on having a free hand on the architectural design. Nevertheless, we do discuss sustainability and inform them of the importance of sustainability as a major issue in design confronting them during the entire course of their future practice. However, we're not very strict on the regulation issue since in many ways it could limit their intuition or imagination that is required in order for them to express themselves in architectural terms. Of course, I'm referring to the studio projects that our students do in the 4th year, in the 7th and 8th semester, scheduled just before the final design thesis, where again we ask them to take all these factors into consideration. To sum up, I would, personally, never ask my students to try to apply strict regulations or even the very limited criteria that they will eventually have to adhere to in their professional practice. I would be happy to hear your reactions to this matter.

Ramon Sastre: I'm thinking about my own experience of teaching sustainability to first year students who, on arrival, know nothing about construction. **What needs to be considered is that they have to learn about sustainability as another property of materials or elements or construction, in general.** So, when explaining to them a certain type of wall, you talk about properties such as weight, isolation, etc. Actually, you're talking about sustainability as a property that is not either sustainable or not, but more or less sustainable, simply because things are not black or white, they're grey and other colors, too. Therefore, this is a notion that should be taught in the beginning as another property of materials, elements or architecture. Another problem is defining sustainability because with such terms, it's often difficult to arrive at a common meaning due to their wide repertoire of meanings or associations. In the case of sustainability, many people think of energy, ecology, etc. As a result, a commonly accepted definition would certainly facilitate our communication. Finally, I think that the teaching of construction must always include sustainability as another property.

Vangelis Evangelinos: A few years ago, we had an elective for the "Self-built". In this particular course, we gave as a topic for a project to redesign a cement block that could be recycled with ease, i.e. students were not to use cement adhesives or mortars binding the blocks together. We got some interesting solutions. One of them was a block made from LEGO, where the pieces could be reused. So, a major theme of sustainability is recycling and using less. When the lifecycle of a material ends, recycle and re-use it in order to give it more life. A way of dealing with the problem is by giving the students the means to design something sustainable. Others may have other ideas or examples of such exercises.

Ola Wederbrunn: We can focus on sustainable materials, but we can also focus on the built mass of existing buildings because more and more of the work we will face as architects will be to build within the existing building mass. This could initiate discussion on how to work within the built mass and how to deal with these existing buildings in terms of sustainability. In Germany, there are a lot of housing blocks in need of renovation or turned into something new because they can't be used any longer in their present condition. The question is,

what can we do with them? Should they be torn down? Should an assessment be done on how to recycle the existing materials as built structure of the cities? I think that this is a very important area to be taught in architectural schools. There is, perhaps, a discrepancy between this and what we talked about previously, i.e. the rapid development of materials and architectural ideas or trends. However, I think that it's also the slow developments that should be encouraged in some ways as in the case of sustainability.

Donal Hickey: I'd like to make one more comment. What I've noticed in recent years is that there is preoccupation with the topic of sustainability. It may have something to do with our culture of consumption and, maybe, there is a shock value. When I see students dealing with this as an issue, they think of it as something they add on rather than something that is integral. I have direct experience with that in Ireland though it may be very different in other countries. When visiting the agencies that are meant to assist in terms of helping designers who want to engage in more sustainable means of developing, I found that they were only interested in funding something that would propagate industry and were less interested in more passive methods of sustainability in terms of form and the way we actually do things. I don't know if the circumstances are similar in other countries. You end up with the motor car that you have to peddle when you take the engine out. I find it kind of strange. It also seems to me that there is a culture of levers to stop the sunlight and they seem to be cropping up everywhere. I'm just wondering, are we actually teaching students in a way that they understand the fundamental principles as a starting point rather than tacking pieces on to make it better? Another thing that worries me is that when students are taught about sustainability, one of the first comments is that it's sustainability that should inform architecture rather than the form informing the architecture and this can sometimes turn students off.

Lucien Denissen: I agree with you. We should make architects with integrity. I can't imagine a good designer not taking the sustainability factor into consideration. It's a question of mentality and principles rather than calculations and the impact on social life and their position as architects later, which is important.

Nikos Panagiotopoulos: One more thing to consider off the record: A building itself is a major intrusion on the environment. The very fact that a builder builds is a major intrusion. However, if we insisted on this point, we wouldn't be here. The other thing is that we still don't know what exactly sustainability is and how it can be judged or determined. I've seen buildings in which the choice of materials is not entirely sustainable, but that, in the long run, have proved to be less detrimental to the environment than some that were strictly built with sustainable materials. Therefore, we are always on the look out, searching and experimenting. However, in an effort to return to the question of how to introduce such lessons, I would say that it's far more essential to me that students realize the importance of this matter; otherwise, to simply introduce a new item into the curriculum and burden students with more information to learn without being convinced of the necessity of it is something I wouldn't dare do. On the other hand, as the construction teacher from Barcelona said, **if the teacher believes in sustainable design, this will permeate his / her teaching of construction at all times. If the notion is internalized, then one can't avoid thinking about it.** For example, how do you mount a door? Do you use spray polyurethane or a mechanical fastening means? If you use polyurethane, you can mention in the process that it releases EFC and the student can decide. Anyway, one should be free to decide -sustainability is not the only thing we want to teach new architects.

Ramon Sastre: I also think that it's not just a matter regarding construction, but it has to be part of the general attitude of the student. In Barcelona, we talk about materials and get some insight into them. We also have a design studio in the 7th semester where students are specially trained on the impact of sustainability, but not as a "sexy" or sensational word; instead, we go deeper into the notion of sustainability to include different factors in forming space and structural scheme behind it, working towards flexibility, recycling and detailing materials and renovation.

Herman Neuckermans: I'd just like to add a layer to the discussion. **As far as I'm concerned, a sustainable building starts with a sustainable concept, which means that the idea behind the building should at least survive as long as the materials survive, which is not often the case.** Perhaps I'm generalizing, but in the beginning of the '80s all theoreticians were proclaiming the typology of Aldo Rossi. Consequently, in construction courses,

you had pitched roofs because pitched roofs were in the typology of many countries. Ten years later, as we moved into the Modernist paradigm, if you proposed a pitched roof in the studio, you would have been considered old-fashioned to say the least. So, what I'm saying, and I'm sure that this might not be a problem for the construction people, is first of all that it, perhaps, has to do with fashion trends in architecture where ideas change frequently, even quicker than the pace we are discussing sustainability. Possibly, in construction teaching, we don't have to shift from left to right, going from pitched roofs to no pitched roofs, just because there is a change of fashion.

Adriano Magliocco: It seems to me that the problem is not teaching sustainability in construction to our students – that's easy enough. However, the market does not ultimately consist of our students. There are many professionals who don't know much about sustainability. They work in our society and build our cities. Of course, we must teach the mentality or attitude to our students, but to our colleagues, the architects and engineers as well.

Emmanuel Tzekakis: Unless there are any questions we will close the Session. Thank you for your participation.

Discussion on Ed Van Hinte's keynote address

Maria Voyatzaki: Thank you very much, Ed. I'm sure we're all eagerly awaiting to read the written version of your lecture in the proceedings since it was quite dense and, undoubtedly, we're all looking forward to taking a closer look at the information you've presented today. Are there any questions?

Cyrille Simmonet: What exactly is the significance of "smart" in terms of your presentation? How would you define it?

Ed Van Hinte: The term has several meanings from (a) "looking smart", looking good when one wears clothes that suit them, for example, to (b) "being smart", being intelligent. In this case, what I mean is thinking about structures and using materials in an intelligent way and in terms of the combinations I referred to. For example, if you want to make light structures in composites, intelligent fibers, etc. Intelligence can help buildings work through simple feedback systems, so that if something moves, it can react, which can help buildings function better. Actually, it's not a very new principle. I met an architect from Israel who made a brewery in Cyprus, if I'm not mistaken, which I think is a very "smart" building because the ventilation system is automatically regulated so that it doesn't need air conditioning, which is sustainable. It has a very clever system of vaults for air to circulate in and which keeps the beer cool. So, basically this is what I mean by smart – trying to outwit nature.

Discussion on Bjorn Sandaker's keynote address

Maria Voyatzaki: Thank you very much, Bjorn! Are there any questions before proceeding to the next Session?

Chris Williams: I was very interested in your observation about Jean Prouv_, where you said that he had a relatively simple structural form for the Pavilion, and you then went on to describe his details. One of the things I find in teaching architectural students is that they very often start at the overall level and want to have an interesting and exciting structural form, which they sometimes achieve, but then they find that they can't deal with the details. So, **time and time again, I try to get students to have a very straightforward structural form in order for them to spend more time thinking about the details; so, I think that Prouv_'s example is very illuminating in that respect.**

Bjorn Sandaker: I think this is an experience that many of us share. We try to formulate exercises that allow students to go deeper or closer to actual execution or design detailing and, as you said, I think that Jean Paul Prouv_ is very good: he's subtle in that respect.

Herman Neuckermans: First of all, thank you for the lecture. I fully agree with what you have said. The influence of making on the conception is an idea which has come up in all the conferences we've had in this context since the Plymouth Conference because I remember when Mark Mimram was presenting his design for one of the bridges, he even designed the machines that would make the metal sheets in the form he wanted for the bridge. We have also seen, several times, schools presenting students working with materials and making details or structural elements. I would like to complement this with the idea of also going into the industries to see what they do because I have the impression that doing things according to what you have shown us, i.e. welding, folding, etc. and working in the traditional ways with materials, with the new developments, schools of architecture will never do that. Stereotography , in essence, has been around for 20 years. Some schools bought it; they may be happy with it, but, I think, they will soon be dissatisfied because the box is too small; the technology has changed, selective centering came and, meanwhile,

you have spark erosion – machines that you can never buy in a school. So, there is plenty of new technology that we need to be aware of. I agree with your argument that we need to look at what this technology consists of, how it operates and learn from it. However, as far as what can be done in the school, it's limited and, I think, is bound to lag behind new developments since new developments in machinery and technology take place outside of architecture. They occur in the airline industry, mechanics, electronics, etc.

Bjorn Sandaker: Yes, I agree with you. I think that what the school can contribute is the attitude of investigation. They should be curious and look into how things are actually made, starting by going into the industries. Even if the schools cannot compete with technology production, they can at least provide students with an attitude of developing interest in the area.

Ed Van Hinte: I have a relatively simple question. Suppose you have a very talented student who says that he / she doesn't want structure to play any role in the expression of a building. What would you say?

Bjorn Sandaker: I would say Okay and not spend much time on the particular student.

Session 4: The Teaching of Construction and the Rare and Traditional Knowledge

Chaired by Miltiadis Tzitzas

- *What should be the necessary competences and skills acquired through construction education that allow architecture graduates to be capable of encouraging the creative encapsulation and synthesis of particular knowledge deriving from the construction culture of a place to new construction logics and practices?*
- *What should be the necessary educational methods and strategies to ensure competences and skills acquired through construction education that allow architecture graduates to be capable of encouraging the creative encapsulation and synthesis of particular knowledge deriving from the construction culture of a place to new construction logics and practices?*

The Schools presenting in this session were

Vallés (Spain) School of Architecture by Ramon Sastre,

Ion Mincu School of Architecture, Bucharest, (Romania) by Rodica Crisan

Normandie (France) School of Architecture by Nicolas Nogue and Christine Simonim-Adam

Mons (Belgium) School of Architecture, by Alain Sabbe

Please find the respective interventions in the section of articulations.

Debate on presentations and theme

Miltiadis Tzitzas: The panel invites reactions and questions related to the theme presented.

Ed Melet: I have a question for our colleague from Romania. As I heard you say you send your students out to investigate historical buildings. I don't know if you've shown all their work, but there were some very good drawings. We have a similar kind of exercise where the students examine new construction: what is in between the outer and inner. We do this for a purpose. You mentioned that energy use in historical buildings is minimal today, but I don't think so. In the Netherlands, we've seen a change from the massive brick walls of the early 1900s to a cavity wall with isolation in it, etc. I think that this is common practice in the Northern countries. What we ask our students in the case, let's say, of an historical building, is that, once they have examined the structure and construction of it, to think about a way of altering the structure and construction in order for it to comply with the present day regulations. This exercise is becoming quite important, now, although we didn't perceive it as such at the time we started it. We simply saw it as an exercise to build awareness of the changes that have taken place during the last one hundred years in an effort to understand the reasons for this change. In the Netherlands, there is legislation which prohibits historical buildings (except for 10 or 20) from being tampered with due to their historic value. Even the listed monuments, if altered and are used, have to comply with current regulations. However, to return to your students' task, I'm wondering, are they asked to simply produce a good drawing or are they expected to examine the structure of the assigned buildings as well?

Rodica Crisan: Yes, we would have much to discuss here. I have presented only a few examples and I meant to present exercises which they had as a team to analyze historical techniques and materials as support for architectural form. For example, in the class of Technology of Building Rehabilitation, there are exercises, case studies aiming at realizing preliminary diagnosis of a building, considering the physical decay and relation between present requirements and performances of old buildings. As a treatment strategy in reference to contemporary regulations and old buildings, as far as I know, nowhere in the world is there the purpose of transforming an old building into a new one. Contemporary regulations are usually at the level of restoration, but not compulsory limit. Generally, we don't transform an old building into a new one. We cannot impose on an old building to respond or have the same values for several parameters.

Ed Melet: I agree with you that it's very difficult. We have a town hall in a small town in the Netherlands

built in about the 1400. It's a building on the waterfront which has to be extended with extra functions, but the historical part has to comply with today's regulations because it's a functional building.

Rodica Crisan: It seems to me it should comply in a more flexible way. Obviously, it has to comply with the new requirements in terms of rehabilitation, but an old building cannot be transformed into a new building. For instance, the same degree of insulation is normally not required. Especially in our case, as we're a seismic country, even in structural restoration, the same degree of safety is generally not required. A reduced level of safety based on traditional safety standards that can't be quantified by contemporary codes is permitted. This is perhaps the most interesting relationship between traditional and contemporary knowledge. We now live and produce architecture in a modern civilization based mainly on modern materials, beginning with reinforced concrete, but there are old buildings of several hundred years resisting and functioning xxx without complying with modern codes. I've included in my presentation a quote from Bernard Feilden who claims that perhaps the greatest danger for historic buildings comes from the engineers that doesn't understand old buildings and mechanically applie modern codes.

Miltiadis Tzitzas: If I may intervene a bit because I find this whole discussion very interesting, you mentioned earthquakes and, as you know, they are quite common in Greece. When we started rehabilitating old buildings, mainly those of stone, there was ample use of concrete inside the buildings to make a wall attached to the stone one that with the first small quake or tremor, there was failure on the structure of the building which hadn't occurred in 200 years. So, engineers mostly realized that they comply with regulations as far as concrete or the structural system of a building are concerned, but that they should be mindful of how a particular building has remained standing for so long without anything happening to it, except of course, for the deterioration caused by the fact that maintenance of old buildings has not been a priority. As far as regulations governing the use of buildings, such as safety, fire exits, etc., one can easily comply, taking into account that these should enter the architectural plans and design; however, the stability of the building is another issue.

Ed Melet: It focuses on comfort, so, thermal laws. I think it's a nice exercise for examining old construction and to try and alter it in such a way so that according to thermal laws and comfort you can create a nice building. In this way you can understand the new regulations affecting old construction. This involves transforming the old into the new without losing the characteristics of the old building. I think this is a good exercise.

Rodica Crisan: You claim that I said, in my presentation, that historic buildings are low-energy and you don't agree with. May be according to the modern codes. For example, our recent code concerning the energy consumption does not consider the solar control that exists in historic buildings. There is also the great thermal inertia of mass buildings to be considered. Also, regarding the relation between modern codes and old buildings, we can observe that old buildings of masonry always have small windows. But it doesn't mean that we have to modify the windows of a historic building in order to comply with modern standards for natural lighting. There is a limit to what can be done. In my opinion, it's very interesting to analyze historic buildings from the point of view of specific mechanisms complying with the general comfort requirements of human beings.

Karl Christiansen: If I may, at this point, I'd like to refer to a general comment made by Neuckermans earlier this morning. **Actually, it concerns an attitude that I personally have trouble with. I'm not sure if I completely understood what you meant, but it sounded as if what really counts goes on in practice or industry, production, etc. and that's where the ideas, technology and materials really come from – outside the school. However, technology is in fact material that came from the schools and universities.** To be a little idiosyncratic, the program I showed yesterday stemmed from the University – it would have never been developed in practice! It was actually the students who started it and it was further developed by Ph.D. students in that way. There are other programs, too, and that particular one is actually being used by industry. **What I'm trying to say is that as schools we should be the ones to build the "lighthouses" for the practical world to navigate towards. This calls for ambition – we simply can't keep repeating what's being done outside the school! After all, that's what the school or university is for, if not we would just send our students out directly into the practical world and, in that case, shut down the schools.**

Herman Neuckermans: So, if I've understood you correctly, you're objecting to the remark I made earlier. However, my point was that schools could never catch up to the latest developments in technology, i.e. in the realm of manufacturing. I was not at all suggesting that schools and universities should be on the opposite side. They contribute to theoretical thinking and ways of conceiving things and the example of the program you showed is just one example of that. I think that yesterday we saw, in one of the slides, the software Cobra that was developed by people from our school who have now left and, I must say, that it's widely used software on building physics. Therefore, my point may have been misunderstood. Of course, at the scientific level, developments happen where the scientists are and these spin off into the industry. We're not slaves of the industry. From my personal experience of organising exhibitions for a long time, once we made a low-tension lamp with 2 bars of stainless steel 1 ½ mm in diameter. There is no architectural school that has the machinery to drill a hole at the top of the stainless steel bar, let alone a school that can drill a hole of 1/10 of a mm through that bar. So, my point is that there is a lot of technology out there that is not accessible to schools simply because it's too expensive and subjected to constant change, and my argument is that our alternative is to go out and have a close look at those who do have the technology and develop it. It isn't the schools that develop technology although we have numerous ideas that we can export and many of our ideas are carried to other domains. Everybody talks about architecture today – information architecture, about patterns or the old concept that we use architecture in computer science, which is a trap, but that's another story! My point is to challenge the issue of how far the school can cope with "making", which is a very interesting concept that I agree and practice. However, in my opinion, in terms of "making", schools will never be avant-garde, unlike "conceiving" which is another matter.

Lucien Denissen: Regarding Ramon Sastre's presentation, I think you made a good statement by saying that architects always want to do more and never do less and students do about the same. I guess it's quite normal because we should always do more. There are new requirements, new intelligence and there is the challenge or risk to do more. On the other hand, I like the idea of how to do less, but I'm afraid I didn't get an answer to the question of how to get students to do less.

Ramon Sastre: What I was trying to say is that the answer is not always a question of adding things on to the problem. Certainly, we have more knowledge, more means, more requirements although the requirements can be grouped according to what Vitruvius said 2,000 years ago. But, the easiest way for students is to act, which means not to think. The problem of adding things is that of secondary effects. What I try to introduce into the minds of students is that if they add things they are not finished because by adding something, they have to look for its effect. Often this is the case (pointing to a visual). Other effects may be the price, the weight of the solution, etc. _ the thinking process hasn't finished! On the other hand, at times, if you don't add things, you don't meet the necessary requirements or expectations. So, I'm not against adding things, provided that when you do, you will look further.

Nikos Panagiotopoulos: On the issue of restoration, I'm pleased that such topics do come up in our Workshops, but there is another issue I want to bring forward. We have ongoing urbanization; although everybody's dream is a house in the country, still cities are growing and there is built substance in our cities from the '60s and '70s and these houses perform far worse than other buildings of the 17th and 18th century. I think there should be some legal means of intervening with this substance, in the first place, in order to rescue building ground and create better quality living spaces for a lot of people. I'm wondering whether anyone has any opinions about this matter.

Rodica Crisan: This is a real problem as we have a lot of dwellings that were built around the period you mentioned with specific problems and this category of dwellings is being given educational attention. As a subjective option, I have included this in my presentation in the form of non-listed historic dwellings. These buildings are in danger now because they are not legally protected and, as they are in an advanced state of decay, they are easily demolished and, for financial reasons, they are replaced by new buildings. Personally, I try to sensitize students to this category of unprotected buildings that have certain cultural value. It is this minor architecture that gives the traditional town its character, but which is practically disappearing.

Ola Wederbrunn: I'd like to address the question of cultural heritage in terms of how we approach restoration and the documentation and measuring of buildings as something that is ongoing and which

does not have any absolute answers. I'm a bit concerned when we talk about Vitruvius because he could be extremely absolute in giving definite answers to questions. Sometimes, when we carry out an investigation of buildings, the buildings themselves will not answer Vitruvius' questions, but the questions related to the specific buildings, and the building stock or existing buildings will not retrocede, providing answers to questions once asked. The point is that there are always different answers. Even with restoration, it's not a matter of just looking for a listed building to maintain it in a certain condition, but rather to give the existing building a meaningful existence that can change or transform in time, just as is the case with human life. Therefore, the crucial question is whether we follow the example of Vitruvius if we are constantly after definite answers, or consider a process in which we don't know the answers, but search for answers that are never constant, but forever changing. Some, of course, will opt for precise answers while others will prefer an ongoing discussion without answers. I would appreciate receiving Ramon Sastre's reaction to this crucial question.

Ramon Sastre: Yes, I must admit that I was somewhat apprehensive about mentioning Vitruvius in my presentation because we live in a different era – 2,000 years after Vitruvius – and at a time when things are far more complex. However, when I was preparing my presentation, I was actually thinking of my students in the first semester to whom I try to convey the idea that many of the problems we face in construction are very old and exactly the same, even if, obviously, some have changed. Take regulations, for example, noise was not a problem, then, whereas we are faced with a different context. The essence, however, is that problems have to be faced, irrespective of whether they are few or many, old or new and, when confronting these problems, you try to respond in terms of that which has to be built and not in words. So, it's items such as bricks, windows, etc and such things need to be seen. Therefore, the response is objects and not abstract words. The problem is that with every idea you have, you add things and every regulation calls for a response, so, sometimes students in their first course are somewhat overwhelmed with all the information, not knowing what to use. Even when we describe buildings and explain that the windows or chimneys are for this or that according to the requirements of the building, it's actually not that easy for them. I must admit that my presentation may have oversimplified this process; however, I wish to modify this impression and state that it is by no means an easy task and we sometimes tend to complicate matters.

Christopher Lowry: My comment will begin in more general terms and will gradually get more specific in reference to what the panel talked about this morning. If I can just go back to what the nature of the conference is and what potentially the conversation we could be having is, we're, generally, at risk of getting into a debate on the capacity for architectural schools to investigate the technical. I'm not sure if I agree with the idea that some architectural schools would never possibly have the abilities to investigate materials, components and construction at a very detailed level. Certainly, within the School at Dundee, the Light Structures' Unit does have very highly specialized machinery for producing components that contribute to structures and construction. I think that there is a level of understanding that goes back to what the panel talked about this morning, which was all very interesting. **You have in your work a unique opportunity to enlighten students to an attitude towards understanding materials because with a lot of our historical architecture, there are very obvious examples of how material is being employed and what it's being asked to do that can contribute to developing an awareness and appreciation for material; so that, when students are faced with contemporary problems of contemporary buildings and of different scales, there is an attitude which they bring into it whether that may be related to stone, concrete, resins, polyurethanes, etc. Once this is learnt, they will then have an inherent attitude to a material and this is what contributes to the research in schools. It is innovation that we saw yesterday exhibited with the optimization techniques. A student leads into research and not that research, in effect, contributes to industry. In some areas, it leads industry.** So, my comment is basically that there is a unique opportunity in reference to what the panel talked about this morning, which is in fact the spirit of what part of the conference is trying to do and what we need to equip our students with. I think that it is precisely this attitude and understanding that is essential for us to equip them with and it can come directly from our area of work.

René Hughes: I wish to say to Ramon that, first of all, Barcelona is a very interesting town architecturally.

Also, you made a statement that is explicit for all students: "new materials and technology for old problems". I'm sure they will like the phrase. But, it seems that the problem lies in human beings, and it is an age-old problem! However, society has undergone an evolution with new needs and requirements so that man-made problems can no longer be resolved only with old means. As a result, with the advent of new materials, schools and industry must be prepared to use them. Carbon fiber is a material that is in circulation and there are many others coming directly from chemical substances. You also mentioned that there is the issue of "adding things on" as a function of new requirements, which I fully agree is a problem. We know that people living in the southern countries, let's say, Barcelona, Spain, do not benefit from the use of large glass panels because they need protection from the sun and heat. So, as you suggested, you can import a product from the North to Barcelona and see if it works, and if it fails you try making shades or sunscreens. The point I'm trying to make is that we must jump on the bandwagon of new materials and technology and follow the new spirit or trend. We could run into difficulty if we think we can always play it safe by following our common sense. However, I'm sure that in the end, common sense will "acclimatize" and guide our thinking in the right direction. It seems that imagination is the clue to resolving problems, even old ones of a more complex nature, i.e. the kind of imagination inspired by various sources coming from different cultures and other fields, such as medicine, science, biology, etc. and adapting it. It is precisely this accommodation and adaptation which is the new spirit of materials and technology.

Ramon Sastre: When I was at school taking a course on materials, as most Spanish schools of Architecture offered at the time, I remember that there were only five materials we needed to learn about, so, it was all very easy then to explain what materials were about. Wood was hardly touched upon as it was not used in Spain for building and there was brick, rock / stone, glass, iron and aluminum, which was just beginning to circulate. **However, when we have hundreds of materials, we are required to change the way we teach materials. Possibly, we will need to explain the properties of materials because this won't affect the amount of materials that will be used the following year. If you know about properties, you can use materials at half the properties you need – that's the spirit of it all. When you have problems, you must have the knowledge to give a response. You can adopt a trial and error method by changing the design, adding things and, of course, the best choice would be an eclectic one by using all the resources you have. Sometimes, it's a question of making a change or simply adding on, which, as previously mentioned, can be a problem. Nevertheless, problems are challenging for those of us working in universities. It's interesting to see whether with the knowledge we currently have of materials we can manage to find a solution. I'm sure that it's this sort of challenge that we like and are after at university.**

Michalis Limenitakis: I'd just like to provide some information in answer to the question of my Greek colleague regarding whether there is any political will to develop a real restoration policy of ancient buildings for people in towns. In France there is such a strategy based on the willingness to bring people from the centre of towns through restoration and renewal or renovation. However, there is also the question of political choice in terms of the price we are willing to pay in order to keep such a strategy alive.

Dimitris Papalexopoulos: I intend to address my question to all those who keep pursuing courses or keep a record of construction courses. The question is, how do you keep track of past courses if the database is built and if, in your viewpoint, there is a strategy of linking different courses and building a common knowledge of restoration at the European level? The second thing is, if the restoration course describing the object and the architecture is seen as a major theoretical problem which is not clearly evident? So, the main question is, do you have a strategy of linking your different courses in a common database?

Herman Neuckermans: I'm not sure that those of us in the front rows have clearly understood your question, so what I'm about to say may indicate some misinterpretation. However, to my knowledge, behavior or acts dealing with the treatment or handling of monuments, especially, is the subject of older charters written in the beginning of the century. However, as Architects and as an Association, we are now issuing a declaration stating how we think that education should be in the future in Europe and all those people who wrote the charters, be it in Venice or Athens.

Dimitris Papalexopoulos: Sorry, but you are not

addressing my question, so I will rephrase it. Each year, we offer restoration lessons and end up with about twenty buildings that have undergone analysis. The following year an additional twenty are analyzed and this number repeats itself year after year. So, I'm wondering whether there is a strategy for putting these buildings in a database. Does this database pose theoretical questions about describing the objects, describing the architecture and describing the construction sequences? Also, do any of you have any strategies in linking different construction lessons so that we can have a common knowledge about historical construction at the European level? I hope that I've made myself clear.

Rodica Crisan: That particular database would be a very interesting one to have. I must say that I, personally, have tried to obtain a research grant for such a purpose, but to no avail. More specifically, the focus of the research was on traditional techniques in European seismic areas.

Dimitris Papalexopoulos: Since there is interest in this area, perhaps we can put it on the agenda for a session next year.

Bjorn Sandaker: There are many topics being brought up simultaneously, but I'd like to comment on something that Karl mentioned and I also referred to in my speech. Industrial production is based on technological know-how and skills on how to transform materials into products. It's this specific knowledge that we can learn from industry despite the fact that this knowledge is somewhat limited by the logic of the industry itself, which is restrained by having to produce mass quantities, and this huge quantity excludes to a certain extent the making of products meant for specific purposes. So, I approve of Karl's attitude suggesting that **we should encourage students to investigate the basic technology of material production and that they should employ this knowledge to think in a different way from the industry.** After all, it is our duty to do so. How you look upon this issue depends on what goals or wishes the architectural school has, i.e. whether the architectural school sees itself as a trade school which produces architects or if it sees itself as a university department that explores architecture. Also, I'd like to ask a question to our colleague from Normandy, whose presentation I was very interested in. I'm wondering whether you described to us a course that you actually run on the culture of technology and historic construction and, if so, where can I find the structure and topics related to the course.

Nicolas Nogue: For example, for metal structures, what I do to explain the evolution of metallic structures in the 19th century is to try to relate all the inventions and innovations of the century and show how they formed a system as well as demonstrating how the engineers and architects worked within the social system. I don't do this for all kinds of materials and it's easier to do it for past periods because we have archives, texts and documents, but we would like to develop this for other cases and more recent buildings and techniques. Therefore, this notion is slightly developed now within the course I run in construction, which is Course 3 of Construction in the 19th and 20th Century, however, I would like to further expand my teaching along these lines.

Michel Paulin: I'm sorry if I'm cross cutting previous questions. I teach an optional course on old techniques in my school and, I think that it's relatively easy to provide knowledge on traditional materials, but more difficult to provide knowledge on the traditional process of building with this material because in all developed countries, the competencies of the craftsman are decreasing more and more. This gives us two options. One is the way of the archeologist involved in experimental archeology, using the same tools and process, which is obviously something we can't do today in everyday building. The other is to replace more or less traditional material with new material and to ask industry to complement our knowledge. Both ways are not efficient, so, I suppose it's a question of developing specific research about new ways for industry to create a special process for assembling and building with traditional materials that would be feasible for the actual builders and specifically efficient with the interactivity of materials. Our Spanish colleague spoke very effectively on this matter. The main problem is how to replace old traditional process. Some industries process new process to get the same result as when we use traditional material. However, I believe that it's not reasonable to hope to conserve old manuals of building for a long time for conservatories. We cannot increase the competencies of common craftsmen, enterprises or teams. I guess it's a very dangerous situation for the future and it's important that we create a network of researchers, either through the EAAE or some other means in order to stir the industry to deal with this specific problem since, at the moment, industry is not concerned

about it. They are concerned with their own products, but not with traditional products. This is a direct way between the completely traditional way of building and the completely modern way with a specific field of research and, as architects, we ought to be leaders in this direct route.

Ola Wederbrunn: I'd like to go back to what Dimitris Papalexopoulos asked. I think it's time for people involved in conservation and restoration to jump out of their closets. Really, all this is extremely necessary – there's so much to be done in this field by working together. I think that we have so much to learn from the building tradition, including traditional construction and traditional materials like concrete, steel, etc. We have a great heritage that doesn't limit itself to wood, brick and earth and it's a modern heritage of the kind that Sandaker portrayed from Prouvé that teaches us a lot about technology. We can't make the glass blocks anymore to replace those that were made for the Salvation Army building in Paris because the market doesn't carry them. A glass block of that size is simply not available anymore because one needs an industry to be able to mass produce them and nobody is prepared to do so anymore. So you would have to go to a small shop somewhere in Norway or Sweden or wherever one could find such a place in order to get this custom made, which would mean having to make the glass block from scratch. That's restoration. Modern restoration also takes into account that we need to work together more and emphasizes that experiencing technology from the start in terms of how to treat materials in construction is extremely important. Therefore, it seems to me that you perceive this forum of technology as a means of stressing the importance of also having some kind of forum for restoration that is geared towards not just the past, but the future as well.

Anders Gammelgaard: What I'm about to say is not in answer to your question, I'm afraid. Anyway, over the last few days, we've heard a phrase that was repeated several times, i.e. "What we should do" and it sounds like a terrible burden on our shoulders! All-the-things-we-should-do when meeting our students -- it sounds like a parental complaint! Teachers and pedagogues are always telling us about "what we should do" in bringing up children instead of exploring "what we want to do". The driving force behind our way of teaching is that we really do what we like to do and I'm certain that if we do, then the students will follow and will be as enthusiastic about learning as we are. I think that it's important that we focus on what we really like to do. Another significant factor that relates to the question raised before and which I would like to repeat is for us to ask ourselves, What is our purpose as teachers and institutions? Is our purpose to educate architects or is it to study architecture? I know we need to do both, but our priority or purpose is for us to study architecture and out of this choice there stems the possibility that very good architects will be produced, whereas by opting for the other – educating architects – we will always be looking at the demands or requirements for being a good architect, which means that our focus will be on what's going on at the moment, outside. The problem with this latter choice is that we will be caught up in a situation where we won't be doing what we like to do, but what is prescribed or we are told to do.

Suzanne Fulop: I'm from the Technological University of Budapest and wish to state that, in my opinion, the construction work of a period building is a special area in the field of architecture and architectural education. Certainly, the traditional solution of reconstruction is basic knowledge for architects and engineers, but the reconstruction of a period building is a special kind of work. The first step always involves expert opinion along the lines of what can be done with a particular building and investigating whether its function can potentially be changed. The decisions taken should be specially made and oriented towards the specific case in question. It seems to me that these are the essential factors to consider in educating students in the traditional solution of reconstructing period buildings.

René Hughes: It would be interesting to make a link with what was said yesterday on the subject of recycling. It appears that in terms of appropriateness or suitability, we can say that the fact that a building undergoes recycling makes allowance for our mistakes. In the not so distant future, buildings will be recycled like cars, but a car has a lifespan of five years whereas a building fifty, which means that some people like Suzanne from Budapest won't have much work. Also, this recycling process will entail the whole building – walls, foundation, and structure, including the mistakes we've made. Of course, it's not a reason for not making a good car or building, but practical for giving us a chance to make mistakes.

Donal Hickey: My comment is a general one. I think that archeology is seen as being a separate piece, restoration as another and so is technology. However,

we should understand that what exists, what was built yesterday and before that all have an inherent genetics, both in terms of the way it was made and why it was made. Through an evolutionary process, we seem to be continually losing technologies and techniques and cease to understand that what happened before is so important in terms of where we want to go. To return to a comment made about codifying and cataloguing techniques from the past in order for them to be transferred, the transfer of technology from one material or technique to another has happened through history. Therefore, I don't see restoration, rehabilitation or archeology as being any different from what we hope to do. There are many lessons to be learnt from what exists in order to understand our direction; so, I don't see restoration as being distinctly different, but merely a mirror of where we want to go. I have a strange example: I went to the Parthenon and photographed an iron tie. There was a codified knowledge and genetics in that piece of architecture, an object that was not fully understood when they came to work on it again. My point is that, perhaps, **there is genetic knowledge that exists in everything around us, and if we don't sufficiently understand or explore it, then we're doomed to make the same mistakes in terms of how we see new techniques. New technology is just part of a continuum in the genetics of how we have moved forward as a society.** It goes back to a comment made yesterday. When we look at old buildings, we try to codify them or apply our rules to the way they function. There was a comment made about old stone buildings or castles where they used tapestries to balance thermal comfort, but this is not something that we can measure analytically. Because buildings have existed for such a long time, there are facets of them that I don't think we really understand. Consequently, we don't attribute value to them as pieces that exist. I think that the codifying of techniques and how things function is really important to understand. If we don't start doing that, we will begin losing realities that are based on techniques and experience that are fundamentally important to understanding our direction.

Session 5: Dynamics and Tendencies

Chaired by Constantin Spiridonidis

Synthesis of the debates of the Workshop

Panel: M. Voyatzaki, H. Neuckermans, Em. Tzekakis, M. Tzitzas

This session attempted to make a synthesis of all previous sessions in order to draw some conclusions on the themes discussed. In the context of this discussion the future of the network of construction teachers will schedule its future activities.

Constantin Spiridonidis: The idea behind the title of this Session, "Dynamics and Tendencies" was to allow for synthesis and articulation of the various debates that have taken place over the last three days. I'm sure you will agree that a synthesis of this nature may not be such a simple process, considering the broad spectrum of information presented here, but our colleagues who have chaired the individual thematic sessions will endeavor to make such an attempt. Before passing the microphone to them, I would like to express my own views as an external observer, since I'm not a construction teacher, and as one who has had the chance of participating in three consecutive conferences. If I were to condense these workshops, I would say that they were structured around two agreements/disagreements and two issues that we did not manage to discuss, but that should be dealt with at a future time.

As far as the agreements are concerned, they are in fact significant because they have laid the groundwork for these discussions. The first being that till now, or at least for the last five years or so, **in schools of architecture, one has been able to recognize two parallel cultures or worlds – that of architectural design education and the culture of construction education. This can be characterized as a meeting of two worlds because, as I'm sure you will agree, the communication between them has not always been optimal, let alone the fact that we have experienced times when these two cultures were completely separate, full of contradictions, animosity and bad chemistry between them. Therefore, this change of attitude represents the agreement for the two cultures to co-exist, which is an educational policy that has been adopted by many schools and which has characterized the education of architects.** However, this co-existence, manifesting itself in different ways in the various schools has by no means spread communication and collaboration. The second agreement is the commonly-shared notion that we live in **a rapidly-changing world with changes happening simultaneously at various levels, political, social, financial, economic, etc. with direct influences on the two worlds of architectural design education and construction education.** This impact has prompted us to consider the necessity of bringing these worlds closer together. It seems to me that throughout our meetings, this agreement has surfaced as a kind of demand, perhaps, an obligation or requirement at times and even a wish at other times. So, what has prevailed is the will to bring those two worlds together and change their chemistry. These demands mainly sprang up from the appearance of new factors or conditions in our understanding of architecture and our understanding of the human being, who is at the centre of architecture. Moreover, **they have been supported by the strong and decisive influence of information technology.** What was interesting to hear in these events was that for the first time we've started to reconsider the design studio, which has undergone change and crisis. Our friends from Denmark mentioned earlier that in their design studio each student has a personal place to work, which is very positive. Generally, **the design studio started losing its glory when students stopped going there as the conditions of work no longer encouraged them to be in the studio because they started working on computers elsewhere.** This necessity has generated a new conception of the studio and what it will eventually be like. Will the studio of the future be an internet arcade in view of recent developments? The point is that things are changing and our discussions must investigate future conditions.

Regarding the disagreements, by following the discussions one could detect two different tendencies concerning the way the participants perceived this link between the two worlds. The first consideration being that **we must bring construction education closer to architectural design education in such a way that there would be an overlapping.** At times, proposals were made

suggesting that the two worlds could coincide with each retaining their individual characteristics in their respective professional activities in the domains of knowledge, practice and conceptualization in relation to the subject matter taught. So this is the first layering conception about how these two elements could be approached, which also appeared in the discussion, but which was not investigated in terms of that layer of concept, but rather an attempt was made to reformulate in a new entity these two worlds or cultures. Because this tendency understands that the two worlds are different and their chemistry is not positive, they look for catalysts. I think that the metaphor "catalyst" Dimitris Papalexopoulos used on the first day is interesting. This **catalyst is needed in order to ensure the articulation of construction design education in a new entity, culture and nature, which will not be the culture of the design nor the previously-existing culture of construction education, but a hybrid of both, where the two parts will not be recognizable or distinguishable, but a mixture.**

Besides this major issue, I wish to refer to two other points that we didn't manage to discuss that, in my point of view, will remain at the heart of the political discussion that has developed in Europe after the reforms introduced by the European Union in the institutional framework of the European schools of architecture. Schools are now required to make their studies and educational systems more transparent, which means that they are to clarify their identity. **I strongly believe that the identity of a school is defined to a large extent by the way the school provides answers to the question of the co-existence and articulation of the two cultures, which, though controversial, are central to the professional education of the architect.** This school identity is what gives the school character or personality in contesting with other schools in the academic market. On the basis of this competition, we will organize the attractiveness of our school in order to cater to mobile students who look for attractive schools.Therefore, I think it's crucial to develop our collaboration in order to ensure the possibilities and means through which methods and viewpoints can be developed along educational lines in an effort to link the two aspects previously mentioned.

The last issue that I think needs development in our discussions is the research aspect. Although it has appeared at various intervals during the course of our encounters, after having followed certain references from the European Union, **it seems that the question of research must become a focal point in this competitive game, not only among ourselves as European schools of architecture, but among those schools outside of Europe as well.** Consequently, the schools should develop research initiatives or find ways of keeping them alive; otherwise, they will always be running after what industry and practice develop. As a result, we will progressively lose autonomy, which at least within Europe is highly valued. In conclusion, I repeat that what I've just presented are personal observations that I wished to share with you as an external observer of your work. My colleagues who have chaired the various panels will now hopefully enrich and add another dimension to this closing session with their own comments and insights. Therefore, I will now ask Maria Voyatzaki for her remarks on the first Session, entitled, "The Teaching of Construction in Contemporary Architectural Education."

Maria Voyatzaki: Although I have not shared my views with the other Chairpeople on this panel, who, by the way, happen to be Chairmen, I'm certain that they would agree with me that when faced with the task of synthesizing on a panel, we each have our own "readings" and interpretations of the various viewpoints expressed and heard. Since we often hear what we want to hear and not what is actually said, I will start with an apology in the case that I may have misinterpreted or misread things either consciously or subconsciously. I would like to use my experience of "wearing the hat" of Coordinator of the Workshop and not just of Chairperson for Session 1 to ask myself if, in fact, on leaving here, we will feel we have answered the question about our future. Anders Gammelgaard, in the extract he originally sent us referred to a suggestion I found very useful and enjoyable. He said that it's a valuable exercise for teachers of construction to go shopping and added that an advantage of our Network meetings thus far is that we can all steal each other's ideas and implement them in our schools in order to improve our situations. In this particular year, there has been very limited reference to what we do or used to do, and when asked to speculate about the future, it seemed rather obscure as if dark clouds hung over us. However, it's just as well because if we could foresee the future, life would be very boring. So, the fact that the future is unforeseeable is an advantage for us educators. This uncertainty about the future is perhaps a means of finding a balance

in the juxtaposition that one can observe in the title of this meeting, which is unlike the previous ones that dealt with 'shopping'. The point is that we can't really shop for the future. There is a contradiction in the nature of the title: on the one hand, there is the romantic notion "visions "related to the teaching discourse while, on the other hand, there is the technocratic term "competences". **The reason I refer to this as juxtaposition is mainly because although it's in the nature of teachers to be romantic and keenly interested in advancing knowledge and learning, we are, nevertheless, also obliged to prepare students as professionals.** We are all aware of the controversy around the issue of educating architects and preparing professionals, and I wouldn't want to fall into the trap of bringing this up, at this point, but actually we are preparing people to face the world of architecture. Therefore, despite the romanticism our teaching entails, we have an obligation to prepare students in the required competences through our educational methods and strategies in order for them to face the realities of the changing world of architecture.

I would avoid answering the question of whether we have really achieved our goal. I think it would be more fruitful for us to leave this meeting with thoughts and questions rather than answers. In any case, we need time for reflection, which is best achieved once we rethink about what has been discussed and, better still, once we re-read the Proceedings of this Workshop. There were many interesting points that were heard throughout the last few days that I have noted. Basically, I could distinguish two predominant schools of thought that appeared in the first and last Sessions which Miltiadis will synthesize later. I feel that there is the school of the new and that of the old and if I can associate this notion with what Constantin tried to express earlier, these two schools are comparable to design and construction in the sense that they seem to be superficially divorced. It seems fitting at this point to quote Dimitris Papalexopoulos who made the distinction between the "flexible" and the "transformable" or to reiterate what I said before, when quoting Greg Lynn's "modernist kit-of-parts" approach as opposed to vacillating smoothly from one approach to another. The difference between them is that in the flexible kit- of-parts' approach, the parts can be separated and thus become distinguishable, but the transformable is seamless, and without seams, the parts cannot be seen. This is also connected to what Constantin talked about in terms of layering. Basically, it seems that we cannot see the future if we are protective of the old, leaning on it as a kind of crutch that we can hold on to safely and securely; although, understandably, we are rooted in the old and these roots cannot be easily eradicated. It's one thing to talk about moving from one phase to another and quite a different matter when referring to an even transition from one situation to another. I would like to make a distinction between the two tendencies and draw your attention to the fact that, **as far as most of us are concerned, this distinction is superficial because in actual fact, there is no clear-cut old or new, but a gradual flow or inter-link of one with the other. Only by perceiving these tendencies as such can we decide that the two are not mutually exclusive, but that they co-exist.** When we teach the new, which we cannot deny, the reality is that we cannot obliterate or ignore the old. This is a point that prevailed throughout our discussions. In the context of this reality, it is also inevitable for us to have a generation gap with our students who are up-to-date and follow the trends. It's scary to think that we're letting the game slip out of our hands when students present their work with all the digital means available and we very often ostracize them by refusing to accept work that is not on paper. We are all aware of this consequence whenever they show up with their laptops on the drawing board. We really ought to listen to what they have to say rather than being too strict about their new methods. **The reason for mentioning this is that, to a great extent, this new digital non-standard architecture is greatly misconceived. As construction teachers, we feel that this new form of architecture has nothing to do with construction. However, this is a wrong starting point and a source of all such misconceptions. Any specialist will tell us that it is the most precise way of defining a form geometrically and, therefore, a form that is easily feasible and constructible. The reason for delving into all this is to help us realize that the two tendencies are not separate. If, on the other hand, we follow the logic that there is one or the other, then it will take a long time for the new "to be born" and a very long time for the old "to die". However, the fact is that there is no need for us to be concerned about the old dying and this was part of the plot or rationale for structuring the four Sessions and to bring you back to basics. In this way, the First Session dealt with discussing contemporary trends in architecture, which effectively affect construction and the need to**

preserve and maintain the basics while remaining open to the new.

Constantin Spiridonidis: Thank you, Maria. Herman Neuckermans will now present his comments as Chairman of the Second Session.

Herman Neuckermans: At first I thought I was invited to provide a synthesis of the Session, but since it was a plenary, I don't see the need to do so. Therefore, I will do the following instead. Firstly, I will share with you a few ideas that I will "take home" from the discussion in my Session, and, then, I will end with two proposals for consideration as future topics for upcoming workshops of this Network. Right from the beginning of our discussion during the Session, it became clear, as Maria has already indicated that the digital reality is with us and will continue to be. There was a remark that was pertinent, emphasizing the fact that, indeed, information is available to all students in vast amounts, meaning that this is not what needs to be taught. However, what we should teach our students is "how to look for this" and "what to look for and why". I believe that this deduction brings us back to the importance of basics, a topic I'll return to later. The second idea that I found interesting in the specific debate was the comment made by a participant while we were discussing the issue of old and new materials which suggested that materials have what I would call "a cultural lifespan" as they go through several phases, "longue durée", "newly discovered" "the archaic or traditional" "the classical" or "mature phase", where materials are widely known and used and the"baroque", marked by exaggerated or excessive use and heading for decline. This particular imagery or metaphor is helpful, perhaps, in our understanding of old and new materials. Along the same lines, it was also mentioned that, in general, acculturation of materials needs time in order for them to be understood and acquire meaning and significance. Moreover, some reference was made to the opinion that materials carry different meanings to engineers and architects. I think that in the different types of societies coexisting, including developing, developed and over developed or post-industrial societies that exist today, one finds that low technology coexists with advanced technology. Furthermore, there were other thoughts that, although non-encompassing are worth-mentioning. The first is that, as one participant noted, when talking about teaching, we tend to burden ourselves with the term "should" rather than liberating ourselves towards personal choice. It's true that, typically, as teachers we have used this term far too frequently in our discussions and I wish to take this opportunity to apologize for the lot. **Surely our focus is that of invention and discovery through experimentation; moreover, concepts are very important as well.** Finally, a point that was presented as a question, as I perceived it was that, perhaps, **we may be moving in the direction of performance-based design, which is an intriguing issue and still a subject for debate.** These were the main points I retained from the discussion, and to add a personal note on the margin, so to speak, in terms of speculating about what we will potentially focus on in the future, I would estimate that **it's back to basics, and I will attempt to formulate this perception with a set of key words that are opposites. To begin with, I would say that teaching needs to explain "why" and not "how" because the "how" is subject to change during a student's lifetime whereas the "why" involves teaching the fundamentals that ensure lifelong activity. Also, I know that there is still a debate without any decisive answers between the notions of "conceive –compute" and "compute – conceive" but, in my opinion, first comes the conception and then the computation.** Another key word that I consider useful for future teaching is **"fundamentals"** rather than **"encyclopedia"** (encyclical learning). Moreover, there are the "competences"_ questioning ourselves about student achievement, including Ramon Sastre's common-sense suggestion. I think that, on the whole, this attitude towards teaching will guarantee design independence of the architect since we can easily move into a situation where we have all kinds of specialists that we can call on for advice, but from my personal experience in designing, I need to have some kind of design independence or expert autonomy so as to avoid having to consult others at all times due to ignorance or limitations. For example, if I design a structure with bars, it will soon be important for me to know if the element in question is in compression or in tension, and I can't always ask an engineer about such matters while I'm designing. Therefore, constructive thinking should be part of what Nigel Cross calls the "designerly "way of thinking and that's inclusive. Apart from returning to basics and how this can unfold through different principles that could be discussed more in detail, **another issue deserving attention would be the data bases.** In fact, data bases and case studies were repeatedly mentioned throughout our meetings in various contexts. I think this is a very important issue in which the digital realm plays a

major role. Although my purpose is not to advertise here, you may already know that we in our CADLAB have developed, after many years of research, a system called "Dynamo" (a dynamic memory of architecture on line). The address of the website is *http://dynamo.kuleuven.ac.be,* which contains by now 540 projects, not just images, but full documentation with images, plans and other data, sometimes texts. The cases in the data base are partially the results of student assignments like for example analysis of houses in Belgium. Everyone can access the data base for free, provided you first sign up in order to belong to the 'club' and be legally safe in terms of copyrights. I hereby invite you to log on and to collaborate with us. All together, I think it is better to co-operate than to create each of us our separate little number of digital cases. So, there are thousands of files that you can use free of charge. All you need is a password to sign up because there is a copyright on the program. One can't display images on the internet without belonging to a club. I would suggest to all those that will eventually use this data bank that we make a deal where you, yourselves, also contribute to the data bank some buildings or architecture of your interest. I'm convinced that in all schools of architecture, we all use at least 20 of the same paradigmatic examples of architecture. Of course, I've seen these buildings in real life and there is nothing better than to actually see them, but students have neither the financial means nor time to do so, and the digital realm offers the opportunity for such buildings to be described. Let's take for example la Villa Savoy, which is a trivial example included in the education of old architecture. You describe it in full detail and put it on the web, and if several schools would choose at least one of these buildings and input it, then every school would have information on them all. I think this is a great idea and, of course, I'm merely making a suggestion; the rest is up to you. This kind of data bank, also referred to in the context of conservation has three windows or ways of looking at the data, which means, first, through the window of "theory" in order for you to have access to it through the tendencies. For example, "occurrence" is where you find examples of Spanish minimalism while the second window, the core one deals with design and design-oriented key words. Then, there is the third, which is "theory" or "history". We could, however, make a data bank on construction. Some of you might be thinking that you are already doing this for yourselves, so why bother? The problem is that this can be very costly in terms of not just making the program, but having to retrieve and store the systems as well. In this context, I wish to refer to another matter. In Europe, there is one system that I know which has an interesting idea in terms of data bank. It's called Ariadne, a wide European project where pedagogical material can be stored, and, technically, Helsinki, London, etc. are all part of it. If other schools wish to have access to the input, for example, a course on history via the internet, it would take a lot of time. So this system, funded by European means is such that the person making the input sends it to the main computer, which happens to be in our University, and during the night it dispatches it to all participants so that by morning all the universities and participants have a quick up-dated version as you needn't wait for the files to navigate through the Net. So, what I'm giving you here is an "appetizer" and without going into much detail, I think that the issue of data bank can be considered in the context of construction and / or conservation.

Constantin Spiridonidis: Thank you, Herman, for your information and remarks. The 3rd Session entitled the Teaching of Construction and the Environment was chaired by Manolis Tzekakis.

Emmanuel Tzekakis: Instead of summarizing the Session, I would prefer to take this opportunity to express some thoughts that I've developed not only during the last few days, but over a period of time. Perhaps, the audience will find them interesting. My impression is that over the last few years European universities and schools of architecture are facing a new external environment. If you are an optimist, you'll say they're facing new **challenges,** but if you're a pessimist, you'll assume they're facing new **dangers.** I will mention a few of these in order for us to have some idea of what lies ahead of us, although most of them have already been discussed. **One of them is the challenge of information technology.** I have been following this challenge since the early '70s. In the beginning I remember that everybody thought that with the arrival of computers, architecture would become an automated process, so people started finding ways for the computer to become an architect. Happily, after a few years, this was totally abandoned and we moved to a new era where the computer was a substitute for the drawing board, which was a much better idea, of course. Now, the years have passed and we see new tools developing from this substitute, providing opportunities for us to do many things that could not be done ten years ago. All this has brought about

change in many different ways and every school has its own ideas of how to use these new opportunities. **Another area of change is that of competition, which has existed for a long time, but today we face competition in a new dimension.** First of all, there is competition between countries, even if we consider ourselves European. Then, there is the competition between schools in the same country and across Europe as well as competition on a global scale between European Schools and those of other parts of the world. This is a rather complex problem whose answers are not so clear cut. **The third challenge or danger is the problem of compatibility.** We are now 25 European countries and some form of compatibility will have to come from somewhere. This is an on-going discussion, of course, and this compatibility as a need contradicts the idea of competition. Nevertheless, we will have to be resourceful in finding a balance. We must be compatible between ourselves in order to exchange students, teachers and material, but we will also need to keep competitive Heads otherwise things are not going to operate too well. In the face of such challenges or dangers, we need to look inside the school, which has been part of our discussion over the last few days, especially in terms of what is happening under the headings of design and that of construction. Between these two factors lies the crux of the matter and what is most revealing. I can't say for certain what will happen next within the realm of these two chapters in architecture, but what I do know is that in the area of design, there will be changes in one way or another, and the same applies to construction. **If you perceive design and construction under a "roof" called architecture and, in not knowing their outcome in terms of their development over the next few years, then you would have to find ways to piece these together.** Therefore, I will make such an attempt by borrowing from my minimal experience in a totally different sector, away from architecture. For the last three years, I have been involved in innovation in the business field, and, from there, I would like to adopt two terms that are useful in determining how we could proceed next year or in the future. One such term is **"road map",** which is a set of instructions that can help a business achieve a certain goal. In our case, we should, now, try to put behind us the notion of "visions" as dealt with in this meeting and move forward in order to formulate possible road maps that will enable us to see the scenarios of the future for the items we have been discussing. Therefore, I would suggest "road maps" as substitutes for "visions".

The second word I wish to advocate, which I hope you are all aware of is **"bench marking",** which is a standard of measurement that helps a business know itself, understand how it works and develop an awareness of why it obtains certain results. Therefore, bench marking is a good tool to adopt in order to help us determine which of the possible road maps for the future would be more useful. Moreover, I don't think it's possible to specify one future because I believe that in the years to come we will be facing multiple futures. **I must add that I'm not even completely certain that there is a bench-marking tool to effectively make us find the right way.** Nevertheless, it's a good route to follow if we want to explore a step further what we have experienced here in terms of visions. Finally, I may not have provided an actual summary of points discussed by our panel, but I've certainly expressed my thoughts.

Constantin Spiridonidis: Thank you, Emanuel, for your suggestions and for setting us on course. The last Session was the Teaching of Construction and the Rare and Traditional Knowledge chaired by Miltiadis Tzitzas.

Miltiadis Tzitzas: One of the advantages of being the last speaker is that since so much has already been said, I can be brief for the sake of all concerned. The disadvantage, however, is that in being heard last, I must make more of an effort to stimulate my audience. In the final Session, although the discussion was somewhat generalized, two of the themes were highly concentrated on the old and rare technology and, we were pleased to have found so many common factors between ourselves and Bucharest, which contributed to our realizing that something good has come out of all this, as is usually the case with such meetings where an open exchange of views and ideas is very beneficial. Furthermore, I'd like to point out that, in general, throughout the last few days, we have been discussing the future of our fledgling new architects who virtually "come out of our hands". **Another point that I think was somewhat overlooked is the differences that we have in our countries, which should definitely be seen in a positive light. The reason for this is that on closer examination and in a spirit of friendship and brotherhood, one will find that these differences are not what pull us apart, but rather they are the diversity of**

resources that will draw us closer together in the future. The way young architects practise is quite different from the South, let's take for example, Greece than from the North, let's say, Denmark. However, I haven't seen any differences in the good student, that is, a student who doesn't actually need us because he/she is improving and working irrespective of whether that student has studied in Greece or Denmark or vice versa. The point is that there are different ways of articulating our trade or profession. Therefore, the way we teach our students differs in subtle or minor ways according to the special orientation or tendency of each country or culture. In other words, **as was mentioned on the first day by Anders Gammelgaard, it's not a question of how we do things in the fine details, but generally "the way we teach" and "the way we transmit the teaching of construction or design".** I do not separate these two because they go together and this is the way it is taught in our school.

I will now refer to some notes I made in order to be a little more concrete. In terms of the **new technologies** which received much attention during the last few days, personally, not all of my colleagues in this school think the same, **but a way of separating them from the rest is for these to be seen as new tools that should be adapted to the way we teach.** I think that this adaptation should be a gradual process for us since for students and young people coming into the school, this is not a problem because in some ways they are better than we are in using these resources. In any case, new technology should be incorporated in the way we teach with all the beneficial results that can be derived from it and by no means should we be afraid of it. In this school and, particularly, in the classes we run in teaching "architectural technology", as we call it, which is a more general term for "construction", we incorporate the new technology and it works very well. Even in the rehabilitation of old buildings, in reference to what I mentioned this morning, we use new technology and it has been adapted quite successfully because it is simply a tool to help us better understand the knowledge that exists in old buildings. Therefore, it is not a contradiction, but actually, as Maria mentioned before, the old and the new coming together and operating extremely well.

In conclusion, I'd like to close by saying that what I've gained through our meetings this year and last year at Isle d'Abeau both for myself and my teaching activities is that through our discussions we are provided with an opportunity to assess ourselves in terms of whether we are actually doing a good job in our schools. It's a way for us to check ourselves by discussing, making comparisons and adapting or making leeway for minor differences that exist in the individual schools. It seems that by our continuing to adopt an even greater attitude of open-mindedness, we can all profit from this experience.

Constantin Spiridonidis: Thank you, Miltiadis, for the suggestions. We will now open the discussion to include final questions and comments from the audience.

Final Discussion

Jerzy Gorski: I'd just like to assert that it would certainly be a very good idea to invite the studio teachers to join us in the future for discussion. In our school, we have very similar experiences to those we've heard about and seen here. Moreover, we have an association of technical teachers, as I explained last year, and we used to meet twice a year to discuss construction, structures, etc. Studio teachers were always invited to these meetings although only a few would attend; perhaps, the others didn't think it was worthwhile to do so. Somehow, after a few years, the meetings started to die out, mainly because the novelty had worn off as we knew each another well and were all quite familiar with each others' opinions on such matters. Also, the meetings didn't manage to change much in the school except for some minor changes, but, they did provide another experience. Whenever the architectural design time would finish, the students would hang their works in the exhibition hall and the whole staff would go around inspecting them and a discussion would follow. Usually, there were questions from our colleagues about how we teach construction as they didn't know anything about this. When we showed them what we teach and how we teach it, they were very surprised at the amount of knowledge we transmit or pass on. **Therefore, I think that a meeting with the studio teachers would steer our discussion and provide an opportunity for us to look at our work from a different angle or another side, which would be very useful.** So, if it's possible to organize such a meeting, it would certainly be a great idea!

Constantin Spiridonidis: I believe that yours may not be the only school with such a problem.

Dimitris Papalexopoulos: I have two points I would like to bring up. The first is the notorious "divide": design / construction. I've mentioned that design teachers do not talk about the divide because it doesn't exist for them and they don't invite construction teachers to meetings. So, for me the divide does not exist or it's not the central problem, which is very ambivalent as a proposition or as an answer to Constantin regarding the two layers. The second point is about information and data bases in terms of whether there is a challenge for architectural / construction building, which concerns construction education, but much more architecture on the whole. We are all aware that 70% of the cost of any product is information cost. Everybody produces information. What instigates the problem, according to a chief innovator of Microsystems that I invited in a construction lesson at the School of Architecture last week, is that we have produced so much information that we don't have the tools to manage it. **We have produced content, but the time has come to move from content to knowledge. In order for this to occur, they expect from the different professionals (architects, construction teachers, etc.) to structure this content into knowledge. It's obvious that if we can get passed this notorious "divide" we will move on to a major debate which is going on at this time. We are all talking about information management and, hypothetically, we all want as architects the 3-D model of a building to become the axis and vehicle of this information from programming to design and construction to the use of the building. This is not just a theory, but a strong professional demand and teaching objective as well.**

Jean-Marie Bleus: I'm from St. Luc, Liege. It's about five or six years since I met Constantin in Drama, here in Greece, on a workshop, and I'm somewhat surprised by what he's just said, which I found very interesting. I remember we were on a boat reflecting on the issue of time and so far today, you have made no reference to time. You talked about two levels, two different things coming together. However, I think that this is completely impossible because they are two different entities. The way I perceive this is almost as if each of these took a look at the other like lenses zooming in and looking at the earth and a person from outside in. This is merely a reflection!

Constantin Spiridonidis: I think I should clarify my point. I believe that there is a kind of distance in individual schools between the department of construction and the department of design since different staff members work in one and the other. The fact is that they are different specializations with specific domains of knowledge, exerting different powers within the schools through their respective departments – that's the situation. As a result, the knowledge that students acquire through this education presents itself in two parts. So, the question is how we articulate these distinct areas of knowledge. The point I made in the discussion was that one could easily detect two distinct and separate models of articulation, each with a different focus, as Prof. Gorski suggested and, which as layers must find ways of collaborating. The other means, perhaps, more profound is in the perspective of Dimitri, i.e. by perceiving these areas as one and the same, without any differences. These two viewpoints represent two different approaches to understanding the world of architecture and education. My intention is not to pass any value judgments on any one of these since that would be another issue altogether. However, I think we should at least try to look at this reality in order to understand it and, perhaps, even investigate the possibility of developing them either together or separately or through some other strategy.

Christopher Lowry: Regarding these last comments, if we go on the assumption that there are two situations, I'm trying to think about how those conversations would begin in an effort to take a more inclusive step in bringing the two together. One of the things that would be interesting to do next time is for us to talk about or demonstrate examples of that inclusiveness applied right from the start. You find that many situations that are being touched on are happenings where the architectural tutor will sit with the student developing a project and then will bring in the structural engineer or another engineer later on down the line when the design concept has already been developed, in which case the consultation has not been inclusive. Surely this kind of consultation would be more beneficial if it is timed earlier, right at the beginning so that the ideas could be included or incorporated into the actual design. It would be interesting to actually see some examples where all of the factors are sat down and considered right from the start with all of the people that input the knowledge and teaching. In effect, you're right in saying that before anything actually appears on paper and the student puts forward an idea and then reflects on it, you are actually bringing everyone back to the starting line, if you like, where

it's invention on everyone's part in terms of what they're bringing into the student's work. I think it would be a very good idea to really see students' work and then we'll see if there are more smiles than grumbles about the different disciplines.

Constantin Spiridonidis: Inclusiveness is indeed a useful word for the purpose of this discussion, and I wish to remind you that last year, we had the opportunity of following some inclusive examples from both approaches. After all, we're all looking for inclusiveness, but there are different answers to this inclusive tendency. I agree that your suggestion is really very useful and I remember that last year everyone left the meeting quite pleased because we had experienced the efforts of others toward inclusiveness and by understanding others, we naturally gain a better understanding of ourselves. Certainly there is the possibility of continuing this particular discussion next year in a slightly different way, perhaps.

Miltiadis Tzitzas: I don't particularly like repeating myself, but what Christopher mentioned has given me an incentive to mention a cause of our school. In the 4th year, we have a design studio that runs for two semesters and there are two teachers on the course, one teaching design and the other construction, both working together with the group of students, which, of course, is the optimal way to obtain a good design. This allows input from the very beginning on how construction is to be incorporated, including how it affects design and how design affects construction, etc. Some very interesting work has come out of it, but not in the total studio group. Surely, we have learned through trial and error. In the first years construction and design are taught separately because it is thought that students, generally, have to adapt to some knowledge and then for it to be composite in later years, but the fact of the matter is that it doesn't work like that. When students reach the 4th year and are faced with having to work together for the exam studio, they don't necessarily have the understanding of the basic things that were taught in the previous three years because, for example, they didn't perceive the importance of this knowledge then. Therefore, it seems that a very beneficial thing for us to do would be to incorporate the collaboration of design studio and construction from the start in a very different way so as to convey to the students the notion that those two go together, if building is the objective, that is. I stress the latter because; as is the case with architecture today, not all students, on leaving school, end up building.

Boel Hellman: I come from Stockholm and also consider myself an observer here, today, because I'm from the purely design part of architecture, if it's the case that you think about the disciplines as two separate worlds in the way it was described earlier. **However, I would like to talk about another focus – the perspective of the students –because they are, in fact, the future! So, the answer to the question of what our future is all about is, without question, our potential students.** When you are in the basic design courses as I am with a group of 20 students that we teach during the first two years of their architectural program, then you realize how big a role you play for them. In fact, they often make such statements as "Can you imagine how important you have become to us?" or "You represent our entire understanding of what architecture means to us." I must admit that I was somewhat frightened to realize all this because when we first start off as teachers, we take our role and the institution for granted and don't really realize that we are the institution; so that in the eyes of the students, I am the school. Then, we also realize that they have no idea of what architecture is and that the onus is on us to tell them what architecture is. **So, if they think that there is a dividing line between architecture and construction, then it's simply because this is what they've learned in their first year.** In our case, we started off as a group consisting of an artist, an engineer and two architects as an experiment. Within the school they don't think that this difference you've mentioned exists, but there are the outsiders who come and remind them that they belong to different sectors. Then, we get students asking us how construction can be separated from architecture. Obviously, they are not aware that this is a problem that has existed within the field and a part of its tradition. The point is that from the point of view of the students, the first years are crucial in determining their conception of what architecture is. Later on, we can teach them as much as we want, but this first impression or initiation cannot be erased or wiped out.

Maria Voyatzaki: I would totally agree with Boel Hellman and combine her thoughts with what Christopher Lowry said to propose two words: continuing education. What I mean is that the education of an architect should be thorough, extending from beginning to end in order for him / her to break down the boundary line between construction and design. If we can go back to

something I said during our last meeting, if you talk to historians and theoreticians, they would say the same about their relationship with design, i.e. that theory has to be taught with design from the first to last year so that students avoid making unnecessary disconnections between subjects. Therefore, there is a question of feasibility and logistics in a school of architecture, which I think suggests nodal points in the education of architects, which means that at certain points during the educational process, they are reminded of things. In our school, for example, we have the advantage in the first three years to teach students this relationship between design and construction quite smoothly, and then they have an integrated project in the 3rd year with SMI project between design and construction. In the 4th and 5th years, when they have gained consciousness of what they're doing in design, they don't deal with construction anymore as there is no demand in the diploma thesis to discuss materiality and tectonics regarding their proposition. I don't think that we are the only school of the kind, but there are many schools that remain conceptual in the upper years because they think that knowledge in construction is limited and that it can be covered in the first year of education. As a result, they are deprived of real experimentation and innovation in construction, but integrate it with design conceptual thinking and the transition from concept to building. Basically, it's a question of handling a school curriculum to maintain continuity from beginning to end without really insisting on being in the studio throughout since a studio has to put emphasis on other subjects. **On the whole, however, in all subjects there needs to be reminders (nodal points) throughout the education of an architect, whether that involves the relationship between design and construction, design and theory, design and history, etc.**

Bjorn Sandaker: I'd like to thank my colleague from Stockholm for what she said. **I'm not so comfortable with this idea of construction versus design because construction deals greatly with design and design implies construction.** The design teachers at my school are very concerned about construction and the construction teachers are concerned about design; so, it's more a question of matter versus space and how these two relate. Matter and material relate in space in different ways, depending on the way you look upon it – as matter or limit or border space or whether matter is part of a constituent space and expressing a space. I would be very pleased if this polarization between construction and design would not be so prominent, although this may have something to do with the different cultures. It's fair to say that Scandinavian architecture has always been very concerned with down-to-earth factors such as climate or materials and this tradition still exists. Anyway, where I come from there is no precise distinction.

Chris Williams: I think this issue of polarization is very interesting, particularly the last contribution made by Constantin. If I had been asked before coming here what was the major polarization among the architectural members of staff, I would have said, on the one hand, staff members interested in construction and design as one category, and separate from that group would be the theoreticians. The question I would ask, at least from the perspective of the United Kingdom and looking from the outside, because I'm an Engineer, not an Architect, is where do the future teachers of construction come from? Certainly, in the United Kingdom, the tradition for university teachers in Physics, Sciences and Engineering is that you do studies as an undergraduate and then go on to do a Ph.D. You then have to work as a post-doctoral for two or three years and then become a lecturer. **There is actually no space in that to gain design experience and largely because of that, in architecture, certainly in our school, all the permanent staff members that have been appointed in recent years have been theoreticians.** Even if you wanted to find somebody to teach construction, it would be very difficult to find someone that would fit the standard university requirement. In our University, the University itself gets very much involved in the appointment of staff and the Department of Architecture couldn't say we wanted this person unless the University agreed that the person had the right profile, which would largely be a research profile and, therefore, a theoretician. One last point, on this business of research, I'm wondering, if someone had done something interesting in terms of construction education, is there a good refereed journal that they could write this material in? If not, then you'd get no "brownie points" as we say in English. **In other words, it wouldn't count with university authorities unless it's published in a refereed journal; so, starting a refereed journal on construction-design teaching would actually be very helpful, just in terms of the academic professional requirements.**

Elisabeth Shotton: Chris, just as a short answer to

your question, there is the "Journal of Architectural Education". The JAE is bringing out an issue on construction very soon, so they accept that type of entry all the time. This comes from North America, the University of Berkley, I think, so it's possible that you people are not aware of this here.

Maria Voyatzaki: We get the Journal, but there's rarely an article on construction.

Elisabeth Shotton: Yes, but they're working on a new issue.

Maria Voyatzaki: That must be a special issue because there isn't one at the moment dedicated specifically to construction and that's what Chris was referring to.

Elisabeth Shotton: Isn't the whole point about the fact that there shouldn't be a journal dedicated to technology, but a journal dedicated to architecture, which is both technology and design?

Maria Voyatzaki: Yes, you're absolutely right, but the truth of the matter is that most of the articles in the JAE are on history, theory and their pedagogy rather than the pedagogy of construction as well. I have very rarely seen the integration of the two.

Elisabeth Shotton: Perhaps, the integration is already happening.

Herman Neuckermans: I'd just like to comment on what Chris Williams said. Indeed, by taking on researchers or people who have gone through the research track without any practice, some of these are bound to be part of the design teaching team. But, as far as we're concerned, our solution to this problem is that they are not entitled to do design teaching alone, but as part of a team.

Spyros Raftopoulos: It's interesting to hear all these opinions, but I get the impression that we sometimes go around in circles and repeat the same things. Nevertheless, I have the feeling that even as construction teachers, as we call ourselves, we don't have an absolutely common language. What I mean by that is that when Miltiadis Tzitzas referred to our case, here, in Athens, although we do consider ourselves construction teachers, we, nevertheless, also teach design in so much as that when we join a studio, we don't separate the construction teaching from the design teaching; so, in actual fact, from the beginning we do teach design, but we possibly emphasize construction, in contrast to somebody else who is a pure designer. However, we do not separate it, especially in the latter part of our studies. Now, I have the feeling after listening to people that there are some that are more clear-cut construction teachers and, in many cases, they are also those who also do statics, engineering, calculations, etc. It would be interesting for everyone to possibly identify their profile and more or less specify what they do in their schools. Then we might be able to better understand each other. Another problem that we face a lot, which I discussed with Elizabeth earlier and which I heard our colleague from Stockholm also mention is that of student numbers, which is an important factor. It's ideal to have a class or studio of 20 students with two or three tutors and a completely different situation to have a class of 75 or 100 people with only 2 tutors. In that case, you have to adapt the teaching of design and construction to the specific number because the contexts are different. This is also part of the common language I'm referring to. We must identify the size of the school and class or studio size, then we may be able to understand why one school or teacher adopts one process whereas others another. If I had in a design studio across the drawing table 5 or 6 students, I could spend a lot of time with them and cover a lot more work with them, I suppose. Depending on my personal capabilities and abilities of the students themselves, we could produce more qualitative work. But, when I have 75 people and a critique to do, even if it's twice a week as I have, starting at 3:00 P.M. and finishing at 10:00 p.m., then I can assure you that it is a very tiring experience, as you can appreciate. However, I do not wish to dramatize this situation, here, in Athens, but simply to share one of our problems. Nevertheless, in reference to my original point, if only we could have a common language, we could certainly understand how people feel about teaching construction and design and adopt some of the ideas in an effort to improve our way of teaching. Regarding what my colleague from Thessaloniki, Manolis Tzekakis, mentioned in terms of drawing information from other fields or professions, I would agree with him whole heartedly and insist on the fact that we should not isolate ourselves in architecture and in the way we think as architects and, even more so, as construction teachers. Let's keep an open mind; there are people out there in the outside world that could broaden our horizons.

René Hughes: I'd like to make an association with a remark made by Jerzy Gorski, but first of all, I want to express my agreement with the statement of our Swedish colleague that our future is the students.

Indeed, this is a very appropriate thought and hopeful way of closing our meeting. This statement, however, coming from an architect-teacher assumes a certain direction in the educational course and I'm wondering whether this would be interpreted in the same way by a construction teacher or a history teacher. It seems that the architect, either in or outside the school is expected to be competent in architecture, techniques, construction, history etc. and when this architect arrives in the school, if he is alone, he is expected to teach everything. Usually, it's the case that there are a lot of students and not enough time, so he / she needs to share his / her competence with other specialists (engineers, historians, sociologists, etc.) Therefore, I don't think that we can talk about a common language. **There are different languages, but a common objective, which is architecture.** The language of the engineer differs from that of the studio-architect, but they both work towards a common goal called architecture. Therefore, I'll join Gorski in saying that **the way to improve teaching in a school is to have a good team. In a football team, for example, there are those working in and outside the field who speak different languages, but they all have a common purpose – to score a goal.** In the school, there is understanding and respect for other fields whether it's studio, construction, history, etc. The point is not to separate them so that if we're talking about engineering, you let the specialist have his / her say. If it's a question of the history of architecture, then, surely the studio teacher can handle it because it's part of the architect's background, but the essence is that school time needs to be shared with those that speak the various specialist languages, united under a common theme, architecture. Therefore, I fully support Gorski's suggestion of inviting other professionals from other fields to enter our discussion because our intention is not to "rob" or even wield power in the studio, but to understand the competences of each field.

Johannes Kaeferstein: I'm from Faduz, Liechtenstein, and I wish to support that opinion because I think that it is possible to create teams. In addition, I would like to go back to the point mentioned earlier concerning the need for schools to define their profiles and, it is apparent that through this process of defining profile, we will have very different people working towards the same goal. In fact, we are actually trying to do this ourselves in Liechtenstein. Although we are a very small school, we soon discovered that we simply can't teach everything. Being here among all of you, it is obvious that construction-design has many layers, each with a very different understanding of what this is. So we're trying to do less, not more, and concentrate (as it is a large enough area) on the alpine-cultural region, extending from Slovenia to include Spain, France, Italy, Germany, Austria and Liechtenstein. In focusing our efforts towards this region, which has culture and geographic and topological characteristics, we immediately derive construction out of it. This also gives us a basis or context on which to start thinking about what direction construction or design can take within the specific cultural region.

Krimizi (A student from Athens Technical University): **I thought you would be interested in hearing the point of view of a student. I feel very frustrated with the fact that you still divide design from construction. When I applied to the School of Architecture, I thought I would learn to build a house or building with the materials and tools used in construction. Yet, when I came here, I realized that there are two separate things here, design and construction. It's really unfair! The fact that a brick fits into the palm of my hand perfectly is a result of design – architectural-construction design. Therefore, don't put us in a position of having to choose between being technocrats and artists. During the construction lessons I have the feeling that I'm one hundred percent technocrat while, during the design lesson, I feel like an artist or designer. This is unfair for both the field of architecture and for us as students. Therefore, don't make us choose because we are all those things in one, artist / designers and builders.**

Constantin Spiridonidis: I think that this is a perfect conclusion for this meeting and this epilogue provides an inspiration for the next workshop on the theme "Don't make us choose" where we would present teaching approaches that avoid choice. That's simply an idea. I will now ask Maria to make some announcements and, probably, express some ideas of her own for the future.

Maria Voyatzaki: It's usually part and parcel of routine procedure to thank certain people for their contribution to our workshops, in general, but after the student's emotional outcry, it could only be a very sincere and deep expression of appreciation. The heart and soul of the local Institution should receive priority in being thanked for offering us this wonderful venue and I will eagerly propose that

since restoration of the building is scheduled to be completed in three years' time that perhaps a future meeting could be held here, then, as a way of inaugurating the new building. Therefore, I would like to thank Prof. Spyros Raftopoulos and Prof. Miltiadis Tzitzas for looking after us and for having made the necessary arrangements in order for this Workshop to run smoothly. Also, I wish to thank them for allowing us to gain access to the Olympic Village, which we will tour tomorrow, as well as arranging for the specialist researcher, Prof. Manolis Korres for allowing us to visit the Parthenon and who I'm sure will provide us with a detailed and highly specialized tour of the ancient site, which is a unique opportunity and privilege, as we will all realize tomorrow.

I would also like to thank others who took time out of their overcharged timetables and daily lives to enrich and stimulate our thoughts and debates They are the keynote speakers, Dimitris Papalexopoulos from the National Technical University of Athens, Chris Williams from the Bath University School of Architecture and Civil Engineering, Cyrille Simmonet from the Geneva School of Architecture, Ed van Hinte from the Hague, Netherlands, Bjorn Sandaker from the Oslo School of Architecture in Norway and Pierre Lorent from Brussels for their very stimulating lectures. Moreover, I would like to thank the participants who took the time to prepare abstracts and deliver presentations as a means of sharing their experiences and providing more food for thought during the sessions. Moreover, I would like to thank all our members and participants for your presence, continuing support and valuable contributions.

Finally, this last thank you is actually a belated one from last year and meant also for the forthcoming work to come on this particular Workshop. Lina Di Ciocco-Kirittopoulou is the person who, as of last year, has transcribed our tapes and formalized and edited the dialogues and discussions into written texts for our proceedings' publications. She took the initiative to join us here in Athens for this Workshop in order to match faces to voices, so to speak and out of a sincere interest in gaining a deeper understanding of these meetings. I would like to thank her for all the wonderful work she has done and for the effort she has put in interpreting the content of the non-native speakers' contributions so as to make our proceedings sound fluent and coherent.

Lina Di Ciocco-Kirittopoulou: I would like to also take this opportunity to express my thanks to Profs. Maria Voyatzaki and Constantin Spiridonidis for all the arrangements they kindly made for me to attend this meeting. Being in Athens, just prior to the Olympic home coming and seeing the marvelous transformation of this world capital, as well as experiencing the Acropolis through the eyes and expertise of such a distinguished scientist as Prof. Manolis Korres was indeed a privilege. I am also very grateful for the experience of being in that historic building of the National University of Athens, which is such a fine example of eclectic architecture, and participating, even if as listener, to a distinguished panel of speakers, keynote lecturers and academicians. I will cherish all the individual conversations and the learning derived from this rich educational experience. Since my task for EAAE-ENHSA has been related to the skills of listening and interpreting information spoken by non-native speakers, I do sincerely hope that in this process I have not taken anything amiss.

Aerni Markus
Royal Institute of Technology
Oestermalmsgatan 26 10044 Stockholm
SWEDEN
Tel: +46 70 53 66 103, Fax: +46 8 64 220 64,
e-mail: markusa@arch.kth.se

Atakara Cemil
Eastern Mediterranean University
Faculty of Architecture
Gazimagusa Via Merson 10, room 001 Kyrenia
NORTHERN CYPRUS
Tel: +90 542 852 9925, Fax: +90 392 365 0918,
e-mail: cemil.atakara@emu.edu.tr

Billard Alain
School of Architecture and Landscape of Bordeaux
Ecole d'Architecture et de Paysage Domaine de Raba -
Avenue de la Liberation 33405 Talence
FRANCE
Tel: +33 5 57 35 11 00, Fax: +33 5 56 37 03 23,
e-mail: eapbx@bordeaux.archi.fr

Bleus Jean-Marie
Institut Superieur d'Architecture Saint-Luc Architecture
Boulevard de la Constitution 41 B-4020 Liege
BELGIUM
Tel: +32 4 341 8114, Fax: +32 4 341 8113,
e-mail: jmbleus@skynet.be

Boel Hellman
Royal Institute of Technology Oestermalmsgatan 26
10044 Stockholm
SWEDEN
Tel: +46 73 02 03 150, Fax: +46 8 64 220 64,
e-mail: boelh@arch.kth.se

Christiansen Karl
Aarhus School of Architecture
Norreport 20 8000 Aarhus
DENMARK
Tel: +45 89360000, Fax: + 45 89130645,
e-mail: karl.christiansen@a-aarhus.dk

Crisan Manon Rodica
'Ion Mincu' University of Architecture and Town Planning
"Ion Mincu" School of Architecture
Str.Academiei 18-20, Sector 1 70109 Bucharest
ROMANIA
Tel: +40 13077145, Fax: +40 1 3123954, 2119435
e-mail: rodica@larh.iaim.ro

Crisan Mircea
'Ion Mincu' University of Architecture and Town Planning
"Ion Mincu" School of Architecture
Str.Academiei 18-20, Sector 1 70109 Bucharest
ROMANIA
Tel: +40 13077192, Fax: + 40 1 3123954,
e-mail: rodica@larh.iaim.ro

Cuchi Albert
Vallès School of Architecture ETS Arquitectura del Vallès
Pere Serra 1-15 08190 Barcelona
SPAIN
Tel: +34 934017884, Fax: +34 9340 17901,
e-mail: alberto.cuchi@upc.es

Delpire Denis
La Cambre Architecture
72 Caussee de Bruxelles 7000 Mons
BELGIUM
Tel: +32 479 270882, Fax: +32 65844729,
e-mail: delpire@swing.be

Denissen Lucien
Higher Institute for Architectural Sciences,
Henry van de Velde Department of Design Sciences
Mutsaardstraat 31 B-2940 Antwerp
BELGIUM
Tel: +32 3 605 62 76, Fax: +32 3 605 62 76,
e-mail: lucien.denissen@hotmail.com

Evagelinos Vagelis
National Technical University of Athens School of
Architecture Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3912

Franca Jean-Pierre
School of Architecture Paris-la-Villette Ecole
d'Architecture Paris-la-Villette 144 Rue de Flandre
75 010 Paris
FRANCE
Tel: +33 1 44 65 23 32, Fax: +33 1 44 652301,
e-mail: jpfranca@club-internet.fr

Fulop Susanna
Budapest University of Technology and Economics
Faculty of Architecture
Department of Building Construction Etele ut 62/a VI 21
H-1115 Budapest HUNGARY
Tel: +36 1 4631306, Fax: +36 1 4633949,
e-mail: zsfulop@epsz.bme.hu

Gammelgaard Nielsen Anders
Aarhus School of Architecture
Norreport 20 8000 Aarhus
DENMARK
Tel: +45 89360000, Fax: + 45 89130645,
e-mail: anders.gammelgaard@a-aarhus.dk

Gatermann Harald
FH Bochum University of Applied Sciences
Faculty of Architecture D 44 801 Bochum
GERMANY
Tel: +49 234 3210107, Fax: +49 234 3200107,
e-mail: harald.gatermann@fh-bochum.de

Geens Erik
W & K Dep Architectuur Sint-Lucas
Paleizenstraat 65-67 B -1030 Brussels
BELGIUM
Tel: +32 2 242 0000, Fax: +32 2 245 14 02,
e-mail: info@archb.sintlucaswenk.be,
erikgeens@pandora.be

Gorski Jerzy
Warsaw Technical University Faculty of Architecture Ul.
Koszyakowa 55 00-659 Warsaw
POLAND
Tel: +48 602710443, Fax: +48 22 6283236,
e-mail: 104jg@arch.pw.edu.pl

Goulielmos Francis
National Technical University of Athens
School of Architecture Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3900, Fax: +30 210 772 3898,
e-mail: francis@central.ntua.gr

Grèzes Denis
Grands Ateliers de l'Isle d'Abeau
Boulevard de Villefontaine BP 43 Villefontaine
FRANCE
Tel: +33 4 7496 8870, Fax: +33 4 7496 8871,
e-mail: denis.grezes@lesgrandsateliers.fr

Heistercamp Marcel
Department of Architecture W&K Sint-Lucas
Hoogstraat 51 B-9000 Gent
BELGIUM
Tel: +32 9 2251 000, Fax: +32 9 2258 000,
e-mail: Marcel.m.j@heistercamp.be

Hickey Donal
Dublin Institut of Technology School of Architecture
9 Kilbarrack Avenue Dublin 5 Dublin
IRELAND
Tel: +353 1839 5659, Fax: +3531 839 6494,
e-mail: arcus@eircom.net

Hoyet Nadia
Ecole d'Architecture de Versailles
5 avenue de Sceaux 78 000 Versaiiles
FRANCE
Tel: +33 139 074000, Fax: +33 139 074099,
e-mail: nadia.hoyet@wanadoo.fr

Hugues René
Ecole d'Architecture de Saint Etienne
1 rue de Buisson 42 003 St Etienne
FRANCE
Tel: +0033 47742 3542, Fax: +33 477 42 3540,
e-mail: rene.hugues@st-etienne.archi.fr

Hunyadi Zoltan
Budapest University of Technology and Economics
Faculty of Architecture, Department of Building
Construction Fodor Lejto 5 H-1121 Budapest
HUNGARY
Tel: +36 1 4631306, Fax: +36 1 4633949,
e-mail: zhunyadi@epsz.bme.hu

Kaeferstein Johannes
University of Applied ScienceS Liechtenstein
Faculty of Architecture
Furst Franz Josef Strasse FL-9490 Faduz
LIECHTENSTEIN
Tel: +4232651127, Fax: +4232651121,
e-mail: Johannes.kaeferstein@fhl.li

Limenitakis Michalis
Ecole d'Architecture de Clermont Ferrand (EACF)
71 Bd. Cote Blatin 63 000 Clermont Ferrand
FRANCE
Tel: +33 4 73 34 71 57, Fax: + 33 4 73 61 13 60,
e-mail: limenarchi@wanadoo.fr,
limen@clermont-fd.archi.fr

Lorent Pierre
Focus International
Training and Certification of Security and Health
Coordinators on Temporary and Mobile Building Sites
Val de Seigneurs 71 Herendal, b.11-B-1150 Brussels
BELGIUM
Tel: +32 2742 1415, Fax: +32 2742 1416
e-mail: pierre.lorent@sefmep.com

Lowry Christopher
University of Dundee School of Architecture,
DOJC College Matthew Building, 13 Perth Road DD1
4HT Dundee
UNITED KINGDOM
Tel: +44 1382 34 52 64, Fax: +44 1382 203 631,
e-mail: clowry@dundee.ac.uk

Magliocco Adriano
Facolta di Architettura de Genova
Stradone S. Agostino 37 16 123 Genova
ITALY
Tel: +39 9010 2095 766, Fax: +39 01020 95 790,
e-mail: magliocc@arch.unige.it

Malindretos Michalis
Aristotle University of Thessaloniki
Faculty of Architecture Univesrity Campus
GR-54 124 Thessaloniki GREECE
Tel: +30 231 099 5593, Fax: +30 231 0995469,
e-mail: malindre@arch.auth.gr

Melet Ed
Academie van Bouwkunst/Hogeschool in Amsterdam
Academy for Architecture Koningin Wilhelminalaan 517
2274 BD Voorburg
NETHERLANDS
Tel: +3170 3857015, Fax: +31 20 6232519,
e-mail: e.melet@planet.nl

Meschke Hans-Juergen
Ecole d'Architecture de Paris-la-Villette
144, Avenue De Flandre 75019 Paris
FRANCE
Tel: +33 144 65 2331, Fax: +331 4465 2301,
e-mail: hans-j.meschke@gmx.de

Neuckermans Herman
University of Leuven Dpt Architecture Kasteel van
Arenberg 3001 Leuven
BELGIUM
Tel: +32 16 321366, Fax: + 32 16 321984,
e-mail: Herman.Neuckermans@asro.kuleuven.ac.be

Nogue Nicolas
Ecole d'Architecture de Normandie
27 rue Lucien Fromage 76 160 Darnetal
FRANCE
Tel: +33 2 32 83 42 00, Fax: +33 32 83 42 00,
e-mail: ecole@rouen.archi.fr

Novi Fausto
Facolta di Architettura de Genova
Stradone S. Agostino 37 16 123 Genova
ITALY
Tel: +39 9010 2095 757, Fax: +39 01020 95 790,
e-mail: novi@arch.unige.it

Panagiotopoulos Nikos
Aristotle University of Thessaloniki
Faculty of Architecture Univesrity Campus
GR-54 124 Thessaloniki GREECE
Tel: +30 231 099 5512, Fax: +30 231 0995504,
e-mail: npanagio@arch.auth.gr

Papalexopoulos Dimitris
National Technical University of Athens School of Architecture
Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3912, e-mail: dplxs@otenet.gr

Paulin Michel
Ecole d'Architecture de Lyon
3 rue Maurice-Audin 69 120 Vaulx-en-Velin
FRANCE
Tel: +33 4 78 79 5066, Fax: +33 478 8040 68,
e-mail: michel.paulin@lyon.archi.fr

Perin Jean-Marie
School of Architecture Paris-la-Villette
144 Rue de Flandre 75 010 Paris
FRANCE
Tel: +33 01 4700 6436, Fax: 0033 147006436,
e-mail: jmperin@freesurf.fr

Raftopoulos Spyros
National Technical University of Athens
School of Architecture
Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3912, Fax: +30 210 772 3898,
e-mail: raft@central.ntua.gr

Raiteri Rossana
Facolta di Architettura de Genova
Stradone S. Agostino 37 16 123 Genova
ITALY
Tel: +39 9010 2095 889, Fax: +39 01020 95 790,
e-mail: raiteri@arch.unige.it

Remy Nicolas
Grenoble, School of Architecture
60, Avenue de Constantine BP2636 38036 Grenoble
FRANCE
Tel: +33 476 69 83 36, Fax: +33 476 69 83 73,
e-mail: nicolas.remy@grenoble.archi.fr

Sabbe Alain
Faculte Polytechnique de Mons
9 rue de Houdain 7000 Mons
BELGIUM
Tel: +32 65 37 4502, Fax: +32 65 37 4600,
e-mail: alain.sabbe@tiscali.be

Sandaker Bjoern Normann
Oslo School of Architecture
P.B. 6768 St. Olavs Plass 0130 Oslo
NORWAY
Tel: +47 22 99 71 03, Fax: +47 22 99 71 87,
e-mail: Bjoern.Sandaker@aho.no

Sastre Ramon
Vallès School of Architecture
ETS Arquitectura del Vallès
Pere Serra 1-15 08190 Barcelona
SPAIN
Tel: +34 934017880, Fax: +34 9340 17901,
e-mail: ramon.sastre@upc.es

Shotton Elisabeth
University College Dublin
School of Architecture Richview, Clonskeagh Dublin 14
Dublin
IRELAND
Tel: +353 1 716 2785, Fax: ,
e-mail: elizabeth.shotton@ucd.ie

Simonnet Cyrille
University of Geneva
Institute of Architecture site de Battelle, 7, rte de Drize,
CH-1227 Carouge/Geneva
SWITZERLAND
Tel: +41 022 705 9794, Fax: +41022 7059789,
e-mail: cyrille.simonnet@archi.unige.ch

Simonin-Adam Christine
Ecole d'Architecture de Normandie
27 rue Lucien Fromage 76 160 Darnetal
FRANCE
Tel: +33 1 46 368117, Fax: +33 147 97 6495,
e-mail: christine.simonin-adam@noos.fr,
ecole@rouen.archi.fr

Spiridonidis Constantin
Aristotle University of Thessaloniki
Faculty of Architecture Univesrity Campus
GR-54 124 Thessaloniki GREECE
Tel: +30 231 099 5589, Fax: +30 231 0458660,
e-mail: spirido@arch.auth.gr

Touliatos Panagiotis
National Technical University of Athens
School of Architecture
Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3912

Tsvetcova Mariana
University of Architecture, Civil Eng. and Geodesy
Faculty of Architecture, Civil Engineering and Geodesy
Mladost 1, bl. 52, vh. A, ap. 12 1784 Sofia
BULGARIA
Tel: +35 9 888 877 006, e-mail: marianadio@abv.bg

Tzekakis Emmanuel
Aristotle University of Thessaloniki
Faculty of Architecture Univesrity Campus
GR-54 124 Thessaloniki
GREECE
Tel: +30 231 099 5501, Fax: +30 231 0995504,
e-mail: tzek@otenet.gr

Tzitzas Miltiadis
National Technical University of Athens
School of Architecture
Patission 42 106 82 Athens
GREECE
Tel: +30 210 772 3914, Fax: +30210 772 3898,
e-mail: miltis@central.ntua.gr

Van de Vreken Koen
Higher Institute for Architectural Sciences,
Henry van de Velde Department of Design Sciences
Mutsaardstraat 31 2000 Antwerp
BELGIUM
Tel: +32 32 32056170, Fax: +32 32 03 226 04 11,
e-mail: k.vandevreken@ha.be

Van Hinte Ed
Pinksterbloemplein 66 2555 ER
The Hague
NETHERLANDS
Tel: +31 70 3595850, Fax: +31 6 21824716,
e-mail: ejhint@wxs.nl

Vanggaard Ole
Royal Danish Academy of Fine Arts
School of Architecture Philip de Langes Alle 10 1435
Copenhagen
DENMARK
Tel: +45 32 68 6000, Fax: +45 32 68 6236,
e-mail: ole.vanggaard@karch.dk

Voyatzaki Maria
Aristotle University of Thessaloniki
Faculty of Architecture Univesrity Campus
GR-54 124 Thessaloniki GREECE
Tel: +30 231 099 5544, Fax: +30 231 0458 660,
e-mail: mvoyat@arch.auth.gr

Wederbrunn Ola
Royal Danish Academy of Fine Arts
School of Architecture Philip de Langes Alle 10 1435
Copenhagen
DENMARK
Tel: +45 32 68 6000, Fax: +45 32 68 6236,
e-mail: ola.wedebrunn@karch.dk

Wiiliams Chris
University of Bath School of Architecture
Claverton Down BA2 7AY Bath
UNITED KINGDOM
Tel: +44 1225 826826,
e-mail: c.j.k.williams@bath.ac.uk


visions..