TECHNOLOGY

- **CONSTRUCTION TECHNIQUES**
- **STRUCTURES**
- **ACOUSTIC DESIGN**
- **LIGHTING DESIGN**
- **LOW ENERGY/ENVIRONMENTAL DESIGN**

- CONSTRUCTION I
- CONSTRUCTION II
- CONSTRUCTION III
- CONSTRUCTION IV
- ELECTIVE DESIGN STUDIO IV E (FACILITIES)
- OLD FACTORIES-NEW FACILITIES
- REINFORCED CONCRETE

Dr. K. Adamakis
D. Fillipitzis

CIVIL ENGINEERING DEPT.

- BUILDING STRUCTURES I
- BUILDING STRUCTURES II
- STRUCTURAL [TRANS]-FORMATIONS
- DESIGN-BUILD STUDIO

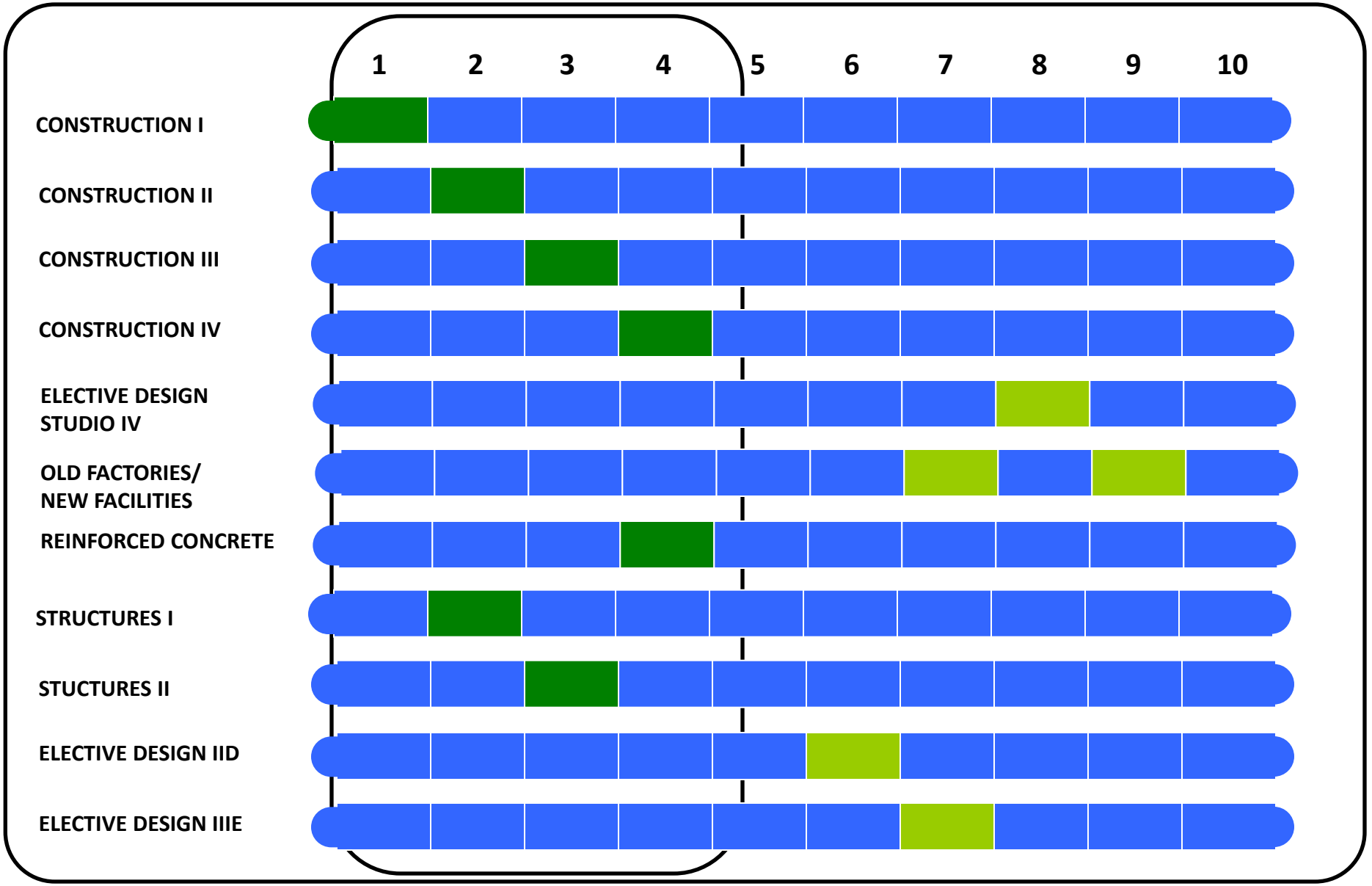
M. Vrontissi

- ACOUSTIC DESIGN
- SOUND ATMOSPHERES & CLOSED SPACES

Dr. N. Remy

- BIOCLIMATIC DESIGN PRINCIPLES
- LOW ENERGY BUILDING DESIGN
- LIGHTING DESIGN I
- ADVANCED ENVIRONMENTAL DESIGN

Dr. A. Tsangrassoulis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REINFORCED CONCRETE
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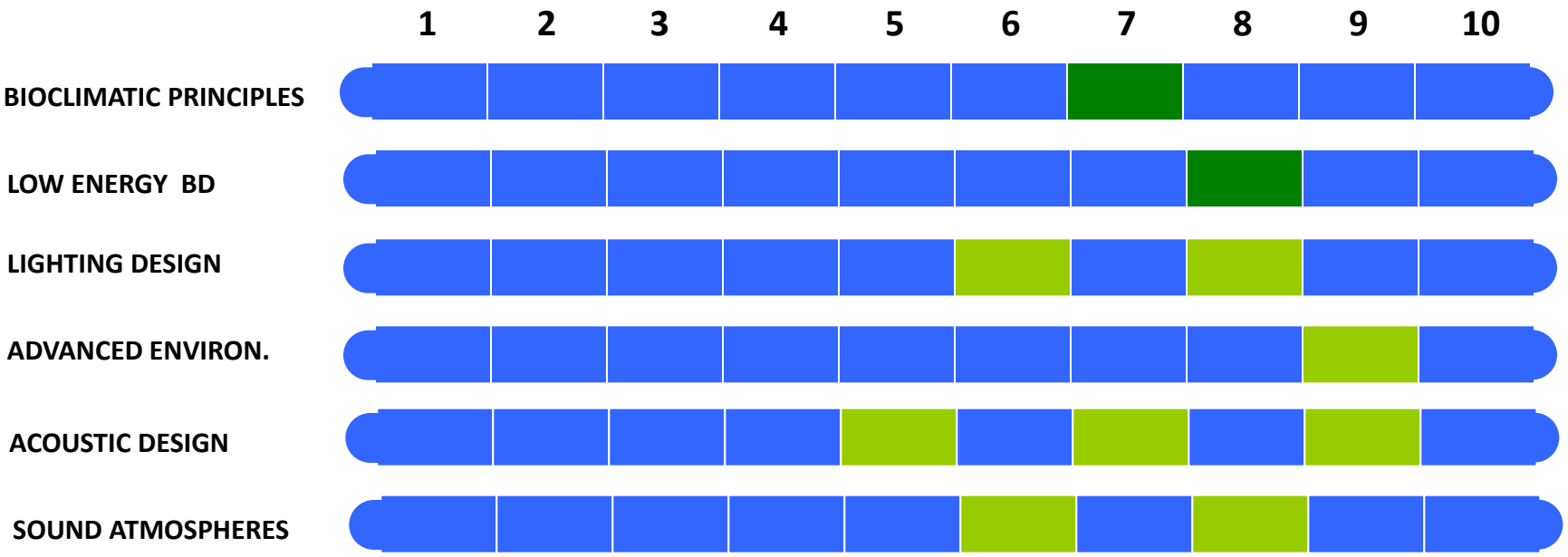
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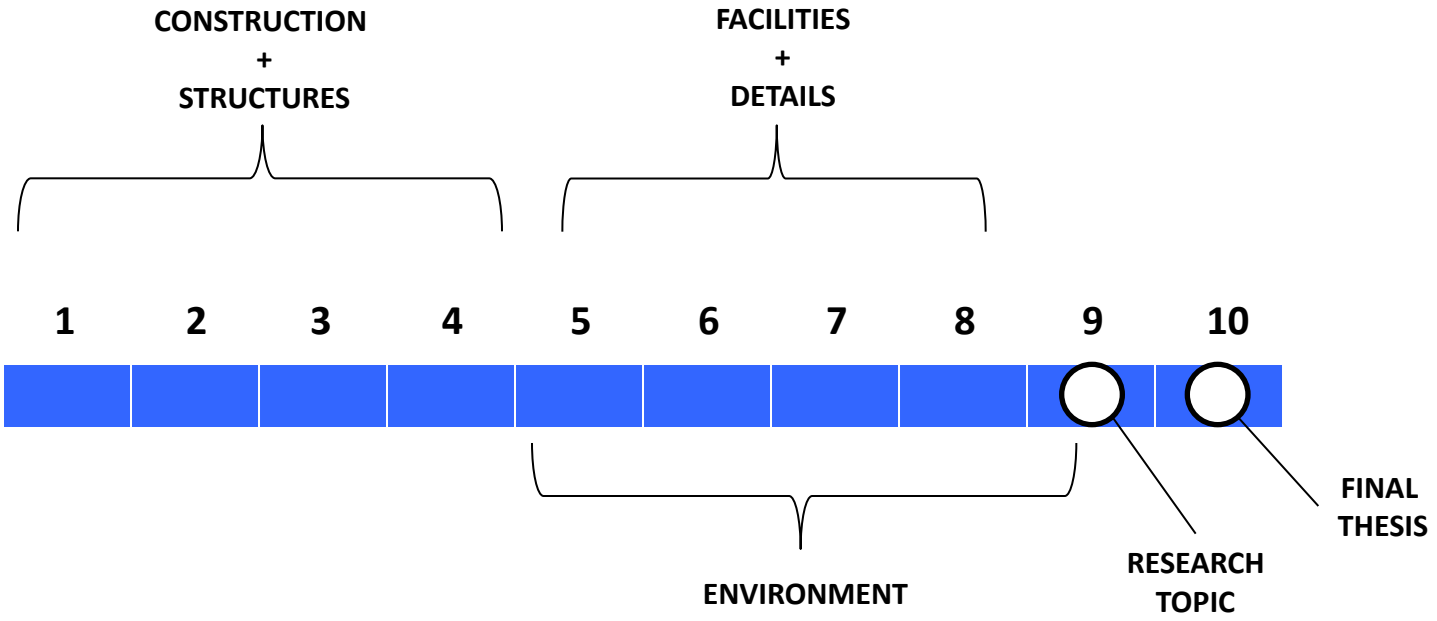
ACOUSTIC DESIGN
SOUND ATMOSPHERES


CONSTRUCTION
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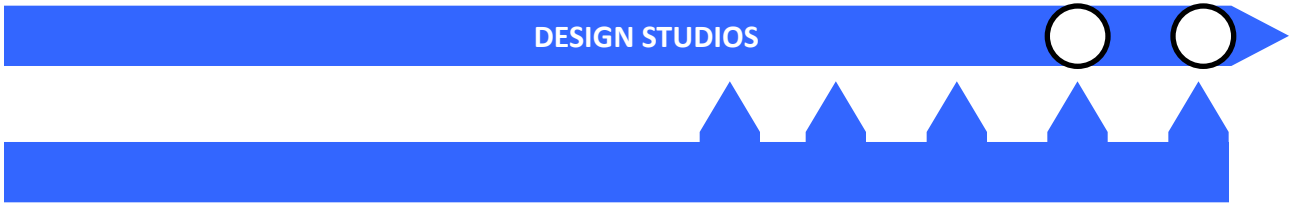
TOPIC
FINAL
THESIS


DESIGN STUDIOS

CONSTRUCTION TECHNIQUES

Contents

•Physical properties of construction materials

•Main families of construction material : Cob, rammed earth, bricks, masonry, wood, concrete, steel, glass

•ecological issues : ecological construction materials ?

Pedagogical approach

•Lectures

•films projection

•1/50e model construction

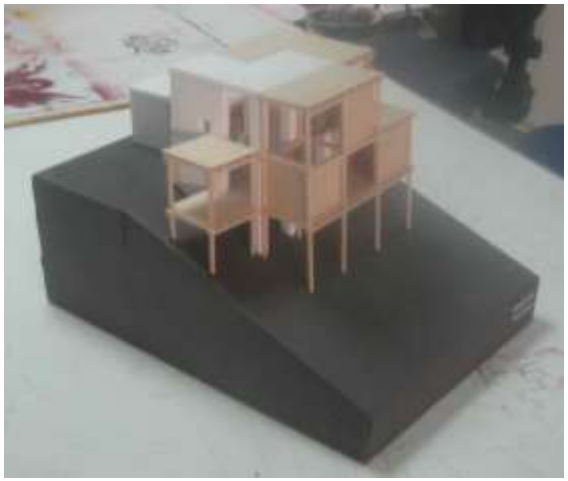
Evaluation

2 projects (1/50e model construction + drawings) :

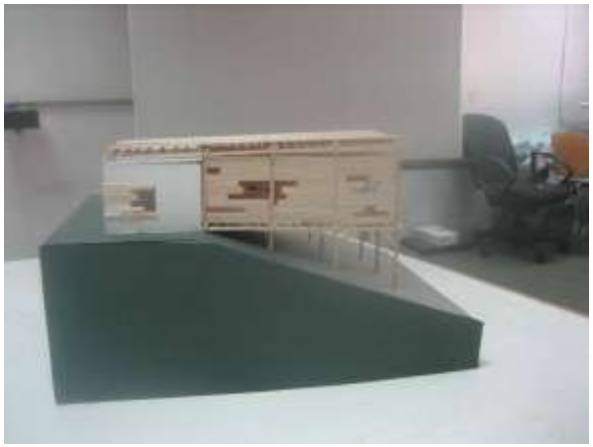
•Mass : 100 m^2 realized only with bricks

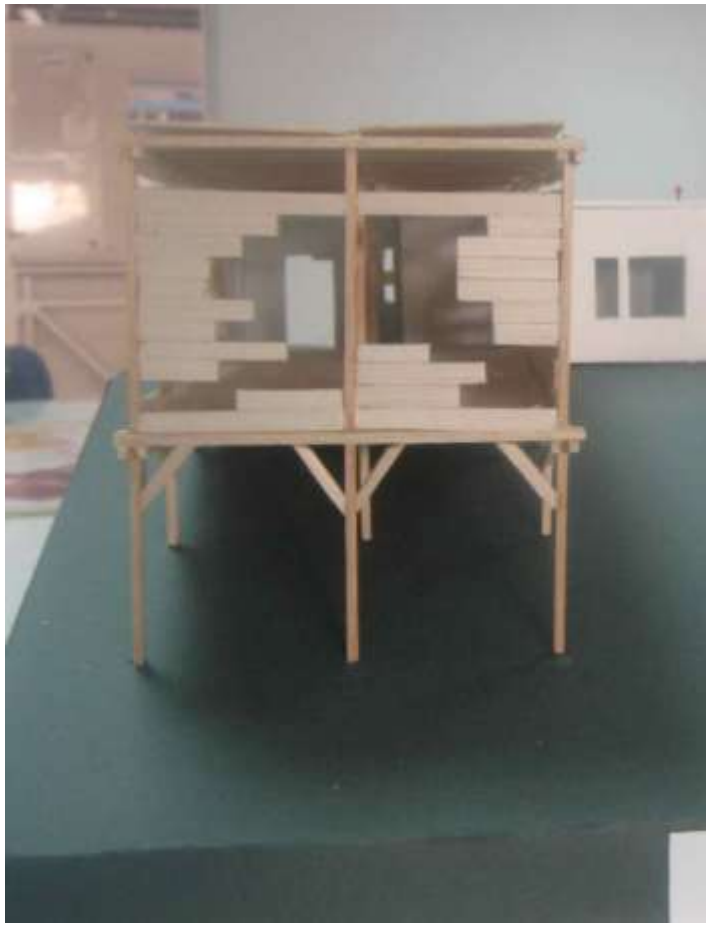
•Mass + light structure : 100m2 realized with bricks and wooden beams and posts

Student works (example 1 : exercice mass + light structure)



Student works (example 2 : exercice mass + light structure)





Goal

To provide the students the ability and scientific knowledge for the production of a synthetically and morphologically complete project, in matters of construction and realization.

Subject

The course follows five basic axes:

1. Lectures

- Load-bearing structures - Foundations
- Outer shell
- Inner shell
- Stairwells
- Frames
- Roofs
- Façade materials
- Steel structures
- Wood structures
- Stone structures
- Prefabrication
- Dry construction

2. Visits to construction sites

3. Mapping exercises

4. Small Research Project

5. Design exercise for the semester

Students are requested to design a small house of one or two storeys.

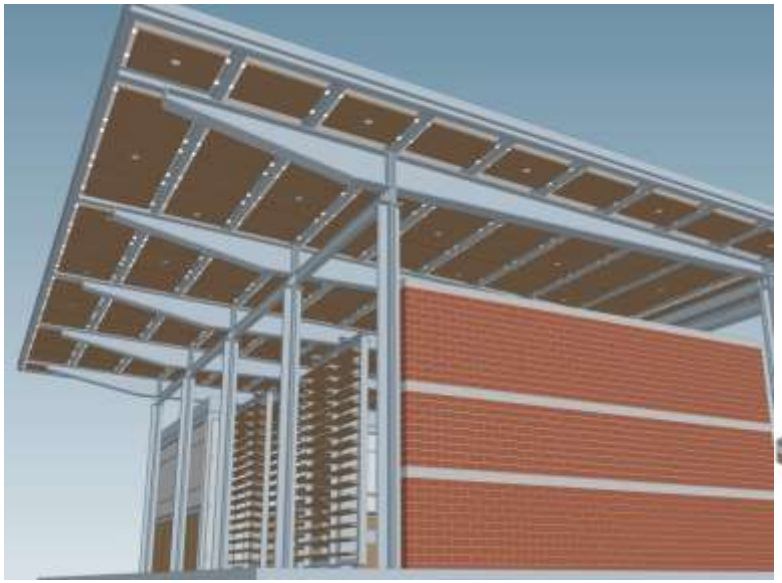
Final Assignment: General construction plans – Scale 1:50 (Construction II)

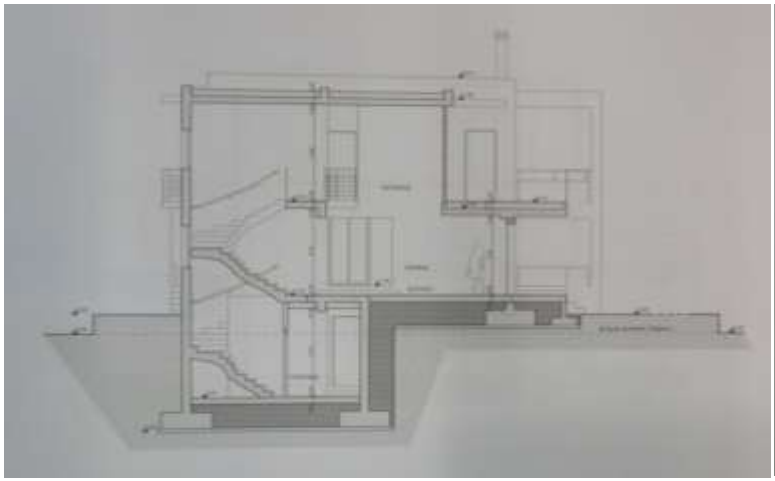
Final Assignment: Plans of details – Scale 1:10 & 1:20 (Construction III-IV)

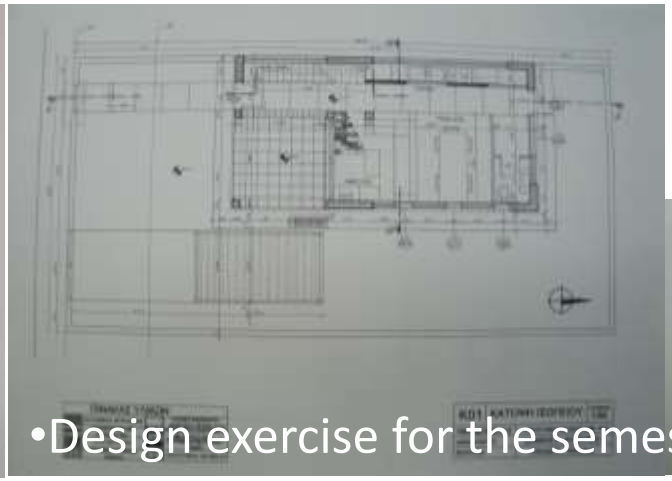
•Mapping exercises

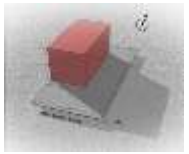
•Lectures

•Visits to construction









•Design exercise for the semester

Goal

The students are requested to elaborate and reflect on the multidimentional design aspects of high-tec multistorey buildings.

Approach Methodology: The course follows four basic axes:

1.Lectures (also from guest lecturers)

Tall buildings – Skyscrapers (historical review) /Tall building bearing structure

Special foundations (ramming, diaphragms, Top-down)

Vertical nodes of communication

Steel buildings/Glass buildings/New technologies of façade formation (twin facades, shading)

Parking spaces/Intelligent buildings/Sustainable architecture/Green roofs

Electromechanical / plumbing facilities

2. Visits to construction sites

3. Educational fieldtrip

4. Design exercise for the semester

The students are requested to design a high-rise building in an existing building plot.

Aim: the students should be able to deal with the architectural and structural problems, choose the materials of the construction body, forecast the facilities and the parking spaces required. The evaluation is a result of the final project presentation at the end of the semester.

• Educational fieldtrip

•Lectures

•Final project presentation

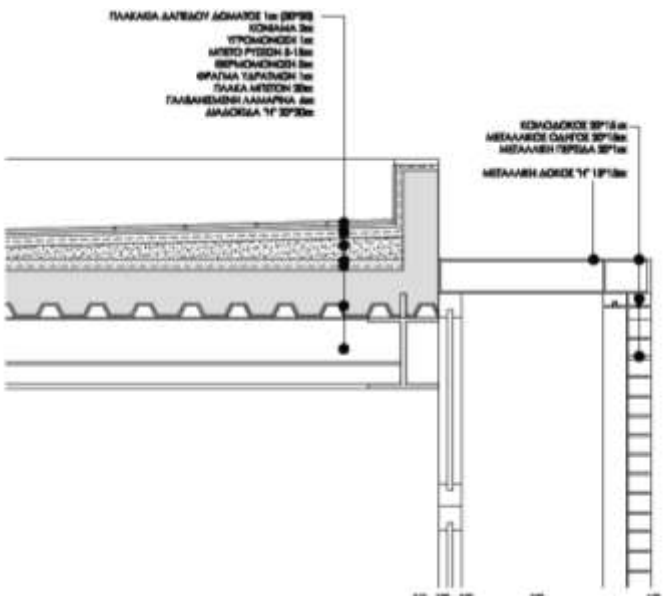
•Visits to construction sites

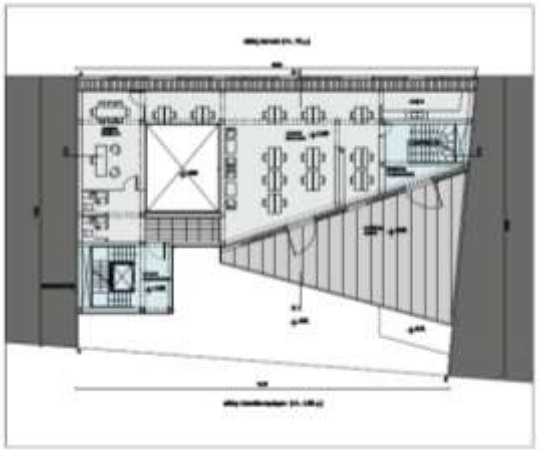
•Final project models

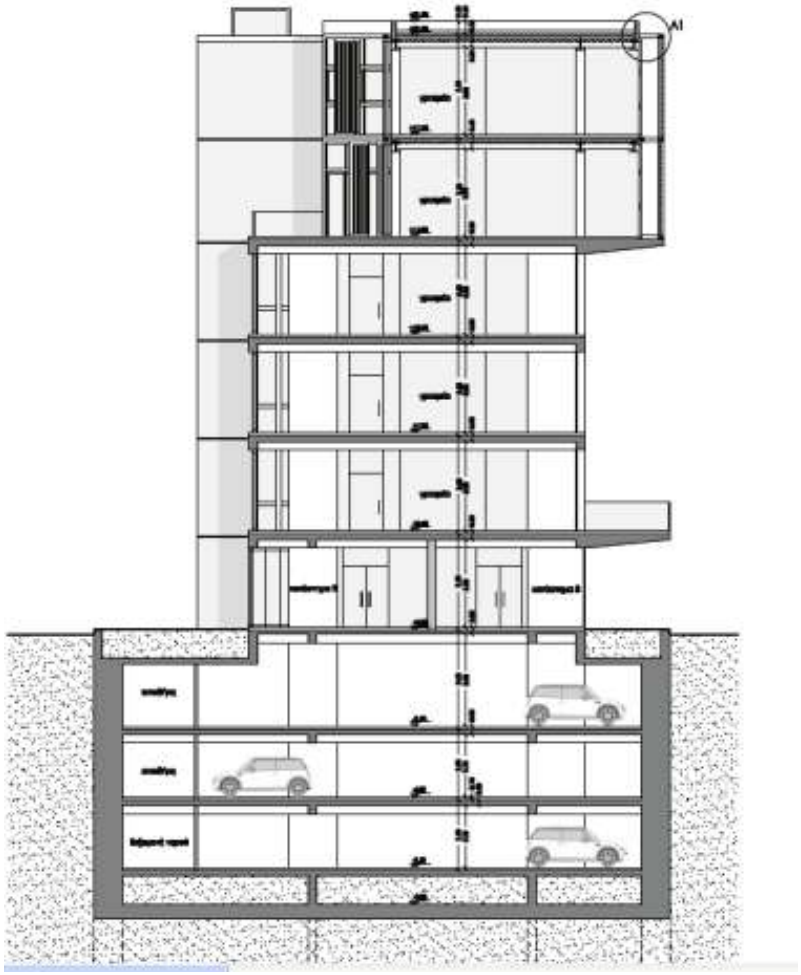





- Final project –3d details







Goal

The students are requested to elaborate and reflect on the preservation and re-use of industrial monuments

Approach Methodology: The course follows four basic axes:

1.Lectures (also from guest lecturers)

- Industrial Archaeology
- The re-use of industrial buildings as a city development tool
- Old building - new use compatibility investigation
- Static methods and strengthening control of the existing supporting structure
- Interdisciplinary approach: from the initial characterization to the final management model
- Industrial building re-use: taking sustainability into account
- Industrial building re-use: Museums – art and cultural centers
- International and Greek paradigms of industrial building re-use

2. Visits to construction sites

3. Educational fieldtrip

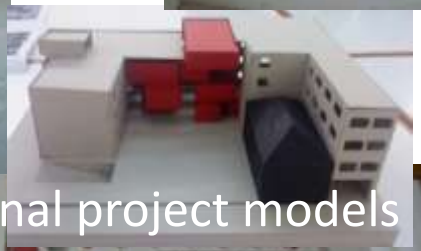
5. Design exercise for the semester

The students are given an existing industrial building.

Aim: the students should be able to deal with the architectural and structural problems, in order to be able to fully serve all new uses. The evaluation is a result of the final project presentation at the end of the semester.

•Visits to construction sites

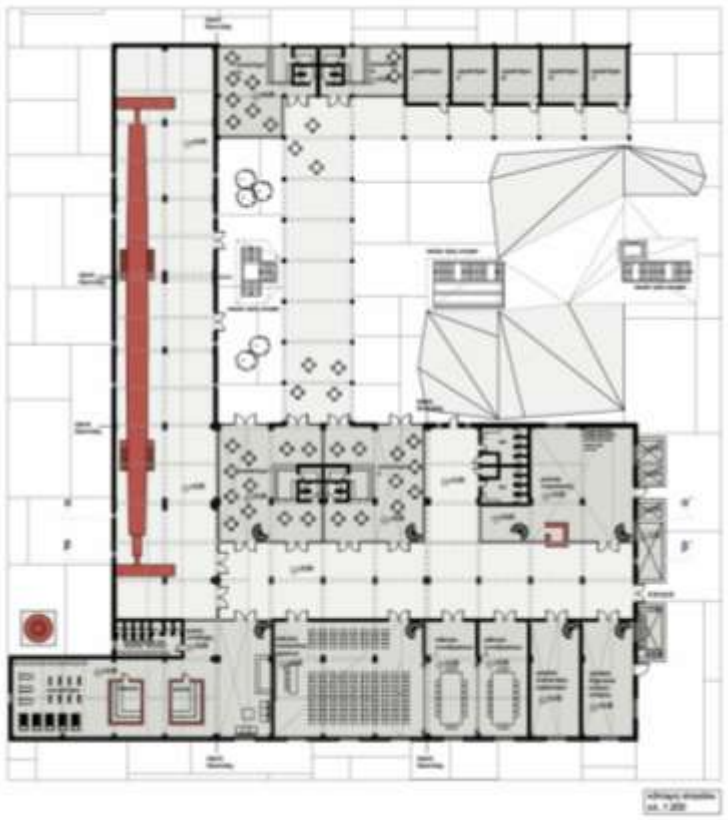
• Educational fieldtrips

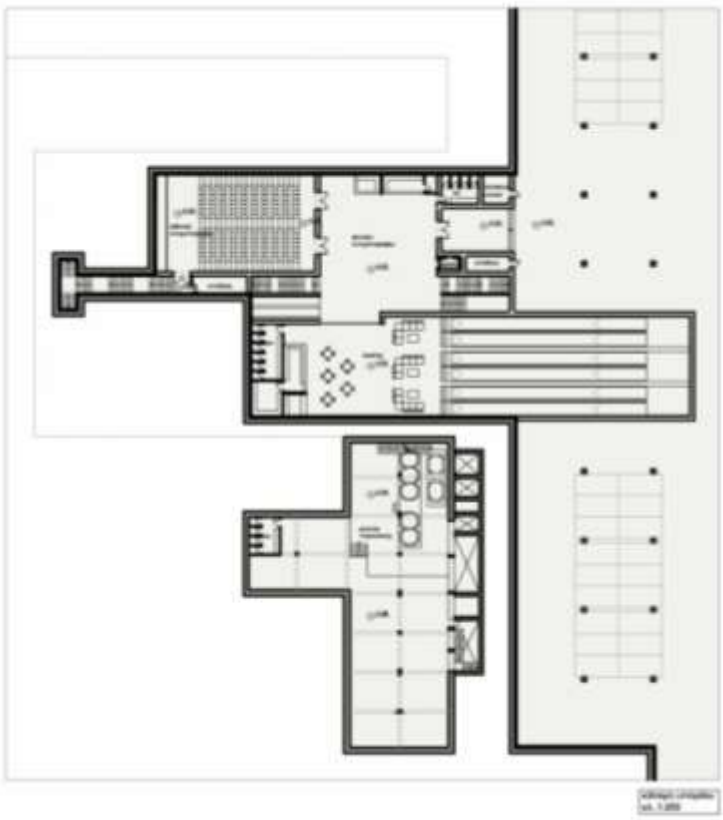


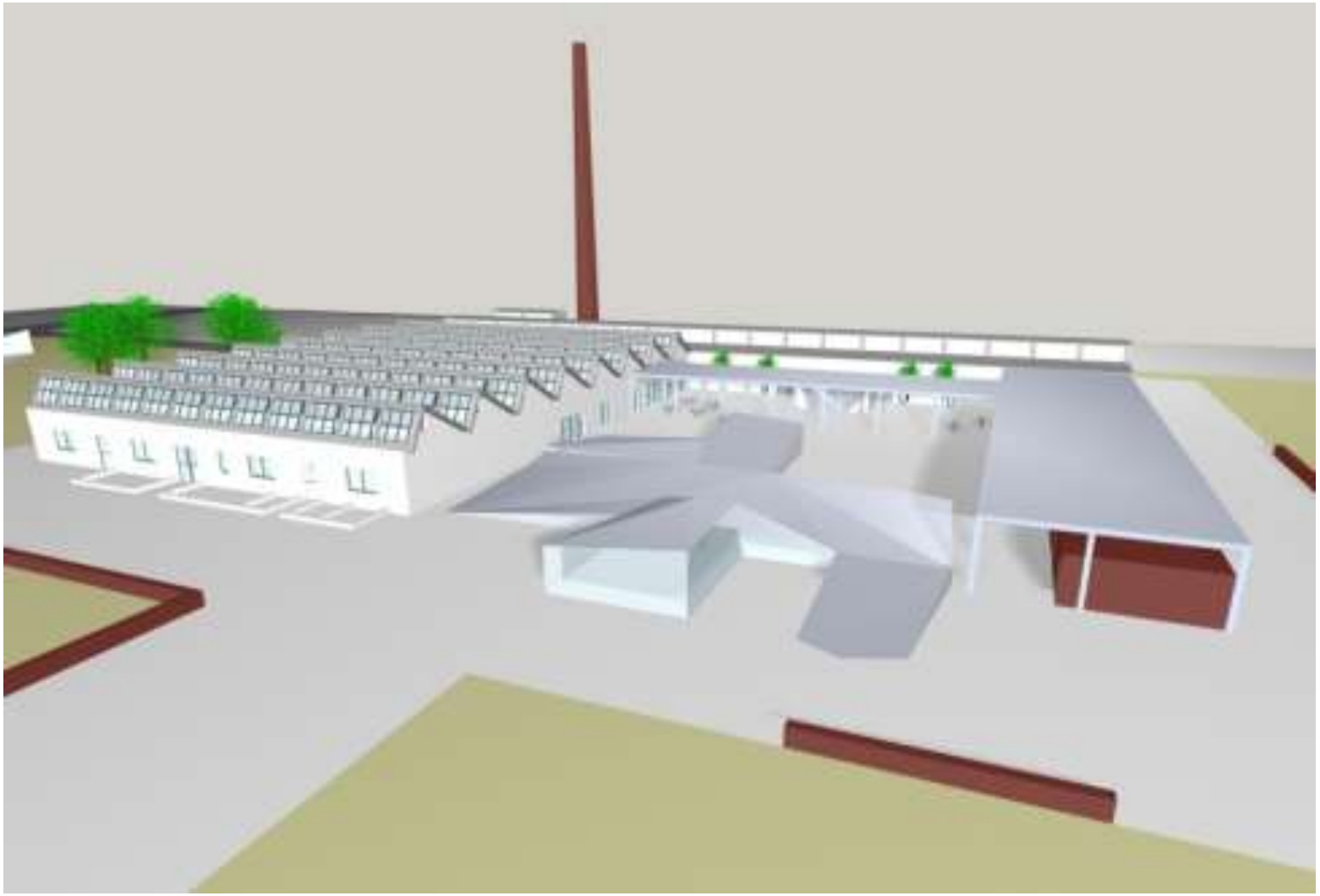
•Final project models

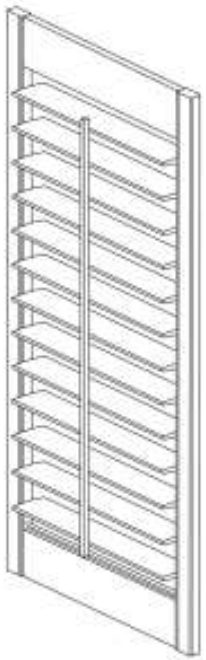
•Lectures

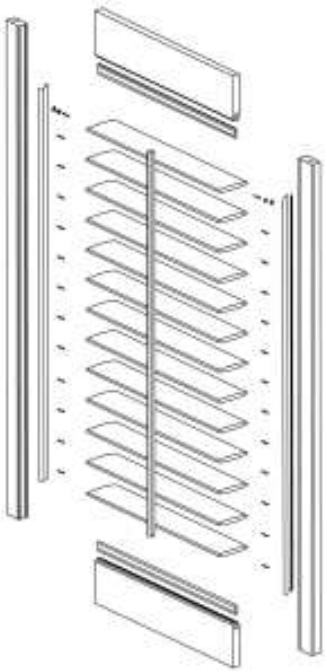
•Final project presentation

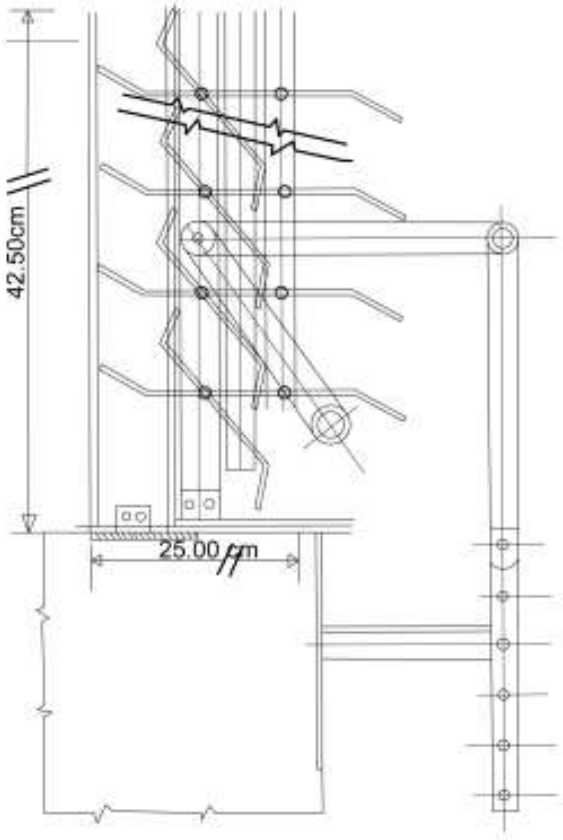








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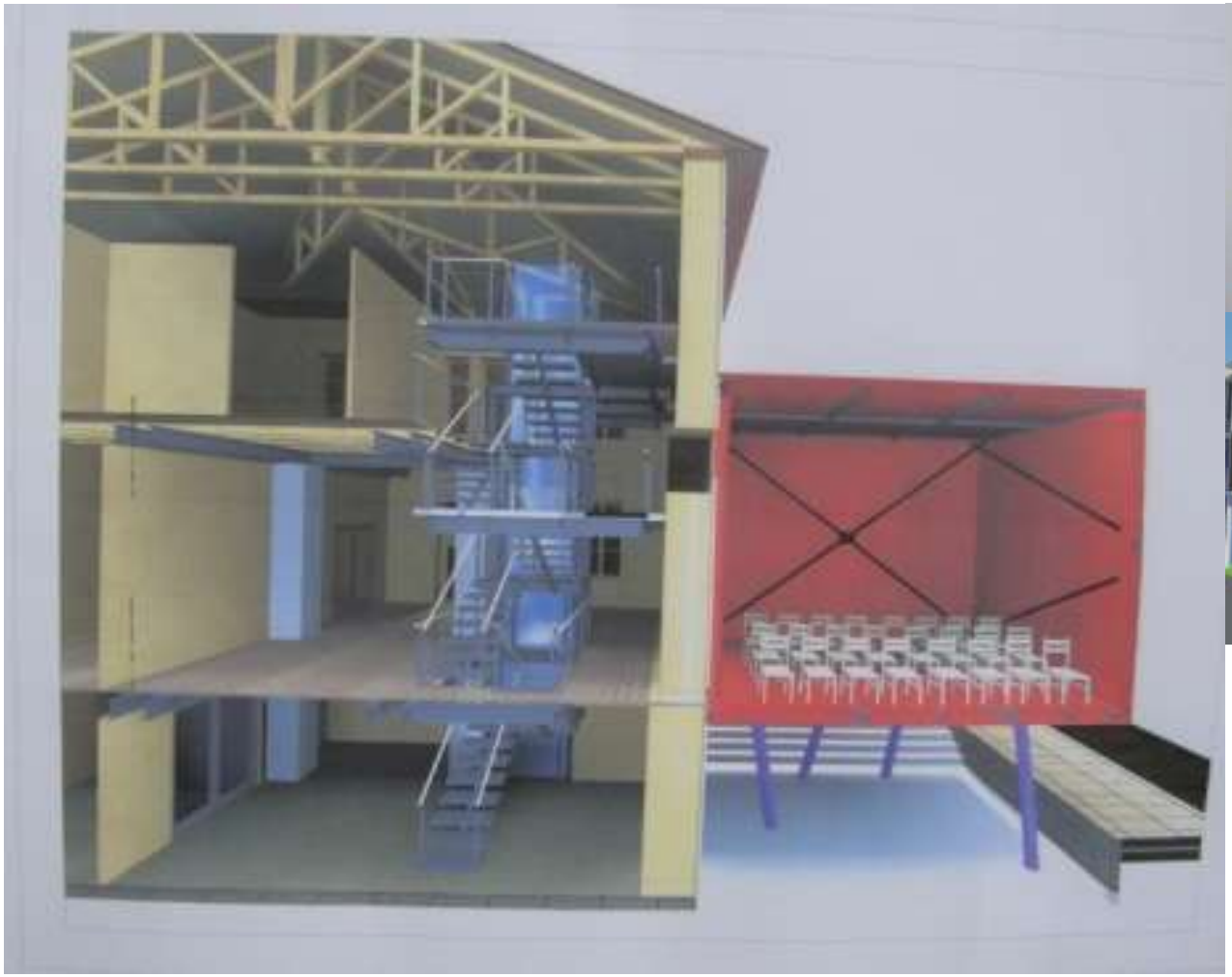


ACOUSTIC ANALYSIS

Contents

•Environmental Acoustics
•Noise and urban forms
•Sonic Identities of the cities (Sound Object, Sound effect and Soundscapes concepts)

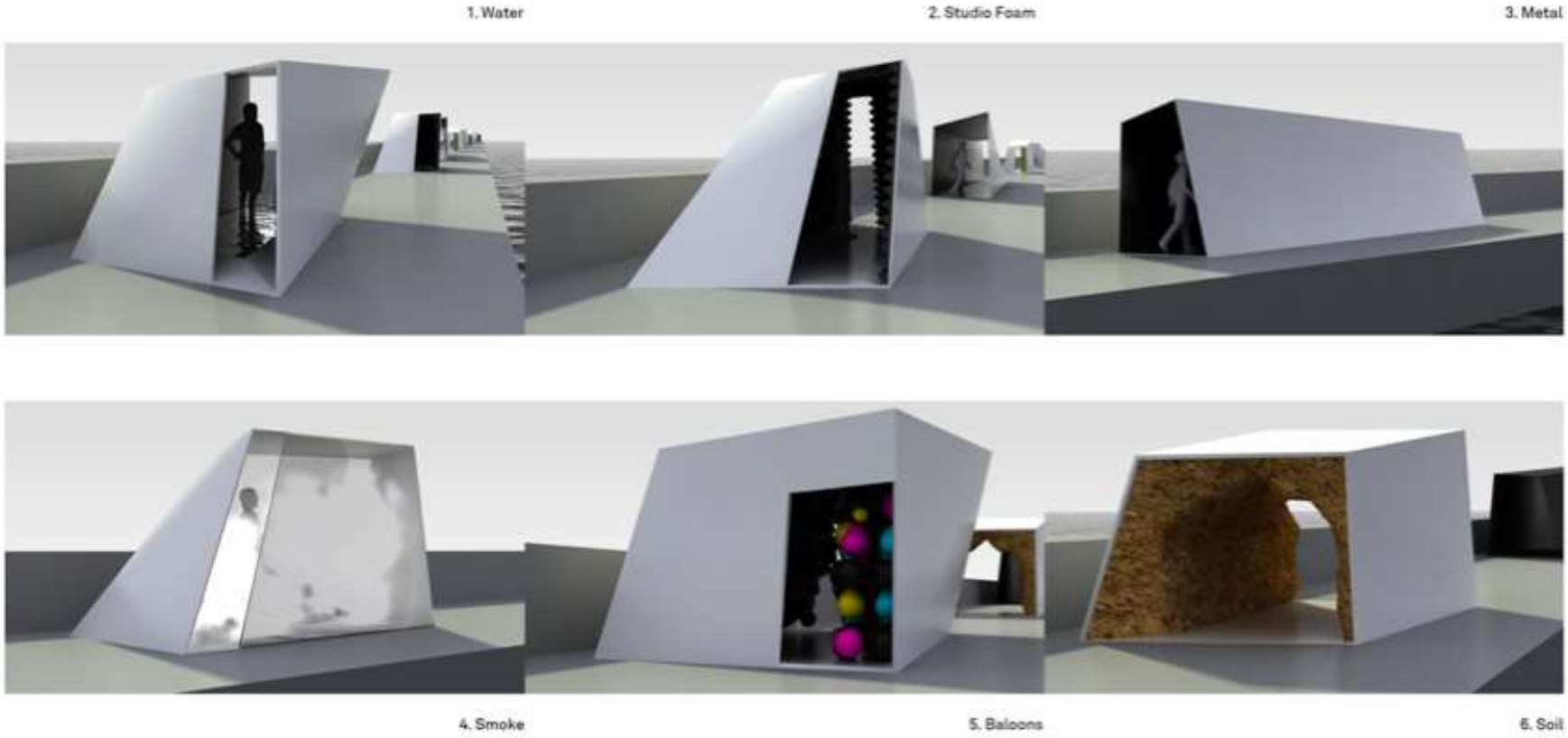
Pedagogical approach

•Lectures
•Measurements - Sound recording
•Case studies

Evaluation

1 study (sound identity of an area)+1 project (exhibition pavilion installed in the public space)

Student works (example 1 – sound pavilions in Volos)



Thodoris Zarbalis, Markos Mazarakis, Akoustiko Design, 2009

Student works (example 2 – sonic plateform in Volos)

Tsakipis Kostas, Aravandinos Pavlos, Akoustiko .

Contents

•Room acoustics
•Sound insulation in buildings

Pedagogical approach

•Lectures
•Measurements
•Calculation – Case studies

Evaluation

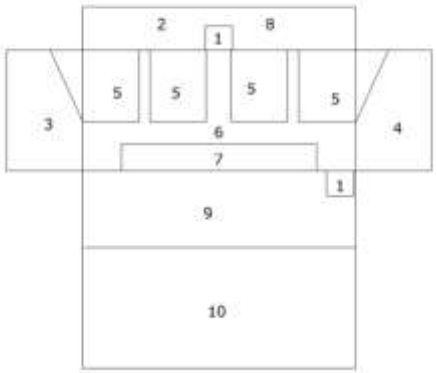
2 Report studies

Measurements

TAM has bought a professional sound level meter to perform acoustic criteria and insulation criteria measurements *in situ* [Black SOLO – 01dB Metravib]

Student works (example 1 – room acoustic)

ΑΝΑΠΤΥΓΜΑ

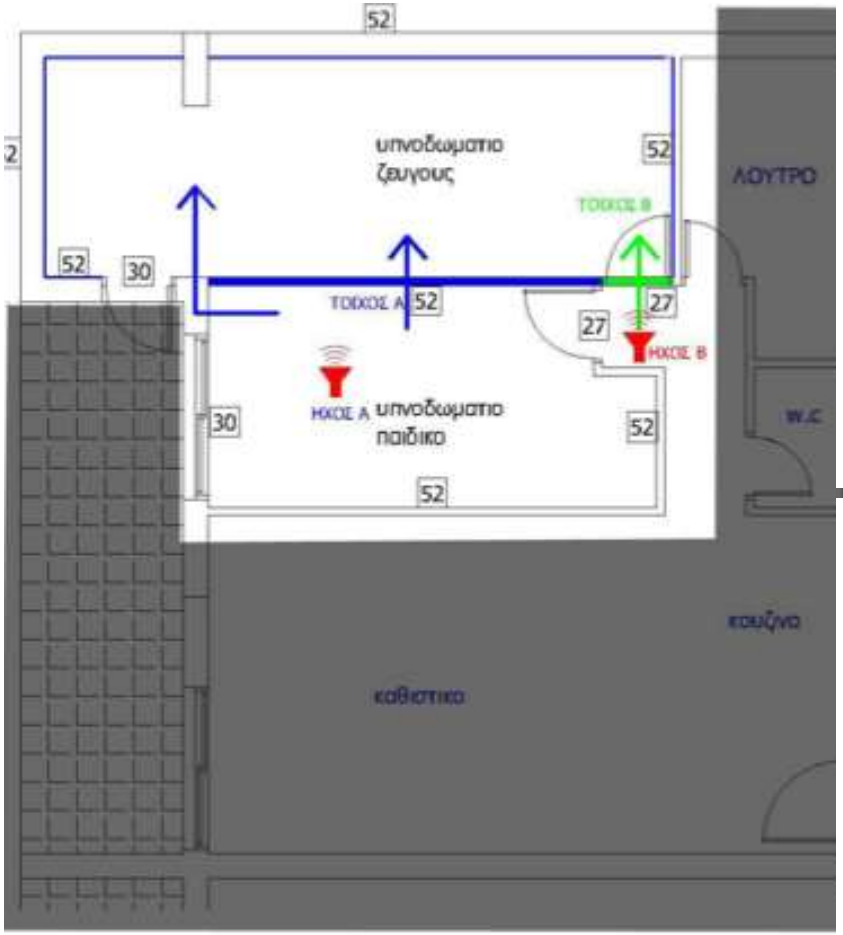


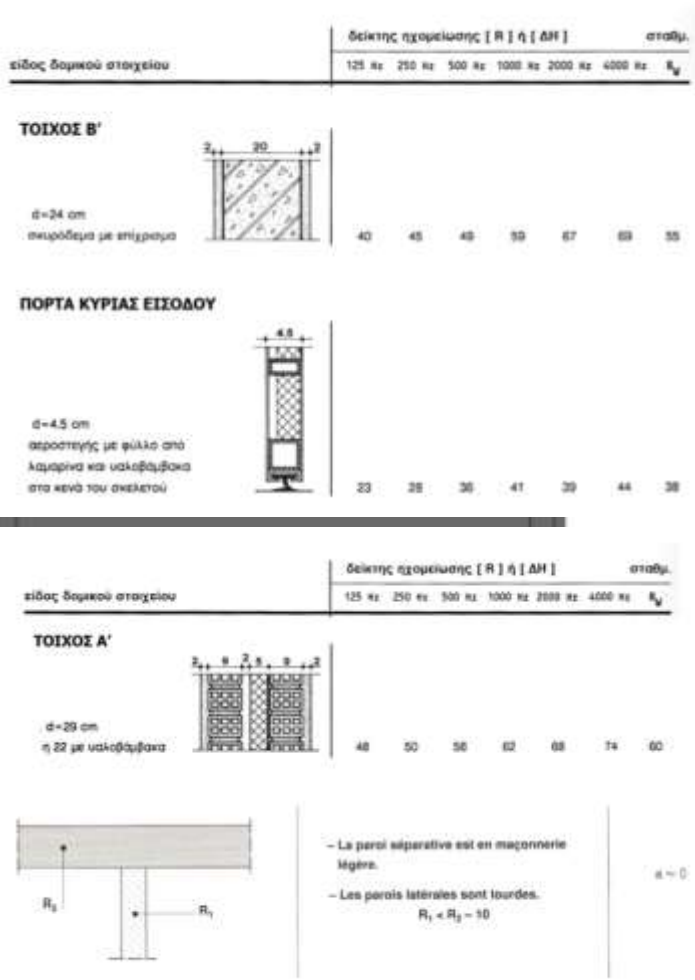
ΥΠΟΛΟΓΙΣΜΟΙ ΤΟΥ ΧΡΟΝΟΥ ΑΝΤΗΧΗΣΗΣ SABINE

	ΣΥΧΝΟΤΗΤΑ HZ					
	125	250	500	1000	2000	4000
a (Sabine) σιδερένια θύρα	0.01	0.01	0.02	0.02	0.03	0.03
A επιφα. 11,25 τ.μ	0.1125	0.1125	0.225	0.2250	0.3375	0.3375
a (Sabine) τούβλα	0.02	0.02	0.03	0.04	0.05	0.07
A επιφα. 203.175 τ.μ	4.0635	4.0635	6.095	8.127	10.158	14.22
a (Sabine) σκυρόδεμα	0.01	0.01	0.01	0.02	0.02	0.03
A επιφα. 68.15 τ.μ	0.6815	0.6815	0.6815	1.363	1.363	2.0445
a (Sabine) σκυρόδεμα	0.01	0.01	0.01	0.02	0.02	0.03
A επιφα.68.15 τ.μ	0.6815	0.6815	0.6815	1.363	1.363	2.0445
a (Sabine) καθίσματα (123)	0.1	0.2	0.3	0.4	0.5	0.5
A επιφα. 137.28 τ.μ	13.728	27.456	41.184	54.912	68.64	68.64
a (Sabine) σκυρόδεμα	0.01	0.01	0.01	0.02	0.02	0.03
A επιφα. 98.04 τ.μ	0.9804	0.9804	0.9804	1.9608	1.9608	2.9412
a (Sabine) ξύλινη σκηνή	0.4	0.3	0.2	0.17	0.15	0.1
A επιφα. 45 τ.μ	18	13.5	9	7.65	6.75	4.5
a (Sabine) λείος σοβάς	0.013	0.015	0.02	0.03	0.04	0.05
A επιφα. 203.175	2.64	3.04	4.0635	6.095	8.127	10.158
a (Sabine) σκυρόδεμα	0.01	0.01	0.01	0.02	0.02	0.03
A επιφα. 170.775 τ.μ	1.707	1.707	1.707	3.4155	3.4155	5.123
a (Sabine) σκυρόδεμα	0.01	0.01	0.01	0.02	0.02	0.03
A επιφα. 280.98 τμ	2.8098	2.8098	2.8098	5.6196	5.6196	2.9412
A total	44.7227	54.3507	66.7462	89.3679	106.3714	116.284
RT	6.1176	5.033	4.0991	3.0615	2.572	2.3528
RT average						3.87

Παρατηρώ ότι το RT average είναι 3,87s ενώ θα έπρεπε να ήταν 0,87s. Άρα πρέπει να χρησιμοποιήσω νέα υλικά ώστε το RT average να γίνει 0.87s.

Student works (example 2 – sound insulation)





The ark materials – Re-use in practice, July, 2011.

Universities
TAM – Volos, Greece
Architecture Départment, Thessaly University
ENSAM – Marseille, France
Ecole Nationale Supérieure d'Architecture de Marseille



WORKSHOPS

The ark materials – Re-use in practice, July, 2011.

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Ecole Nationale Supérieure d'Architecture de Marseille







The ark materials – Re-use in practice, July, 2011.

Universities
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STRUCTURES

TEACHING

mandatory courses (2nd & 3rd semester)

- **BUILDING STRUCTURES I**
- **BUILDING STRUCTURES II**

elective design studio

- **STRUCTURAL [TRANS]-FORMATIONS**
- **DESIGN-BUILD STUDIO**

PRACTICE

projects

- **GEODESIC DOME – ARTIFICIAL SKY**

workshops

- **STRUCTURAL SYSTEMS**
  (cardboard-tubes, tensegrities,
  geodesics, reciprocal frames)
- **ENVIRONMENTAL AND MATERIAL DYNAMICS**
  (sustainable urban actuators, sound generators)

workshops - collaboration

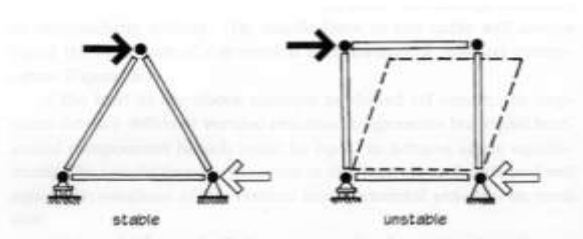
- **ENPC – Ecole des Ponts - ParisTech**
- **CAM – Center for Mediterranean Architecture**
- **ECOWEEK**

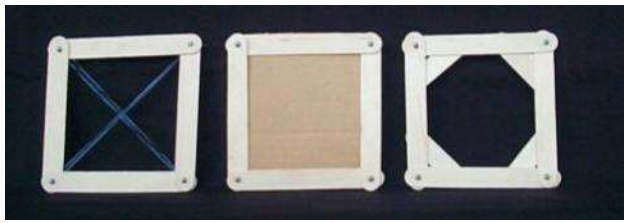
RESEARCH

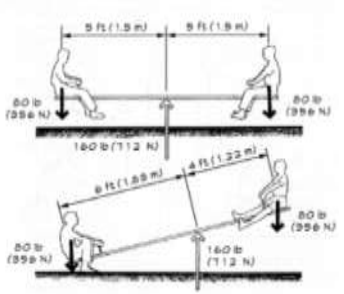
- **Digital Database for Building Structures**
- **Digital Tools in the Design of Geodesic Structures**
- **The Physical Experiment in the Work of R.Le Ricolais**

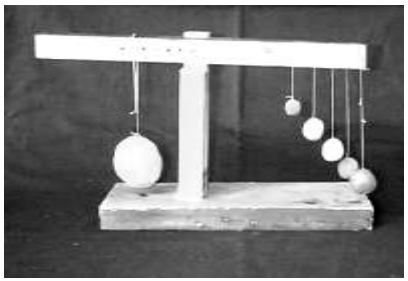
BUILDING STRUCTURES I & II. **2nd and 3rd semester mandatory courses**

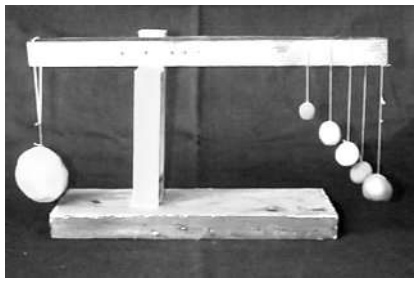
- introduction to the analysis and design of structural elements
- lectures, exercises [analytical methods], hands-on experiments
- understand structural and material behavior as powerful design parameters

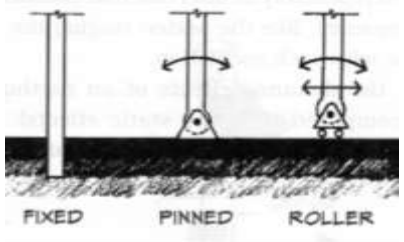


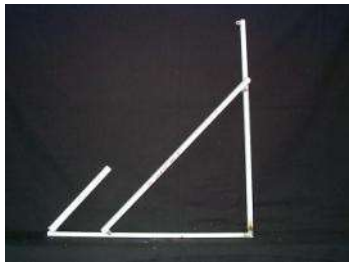


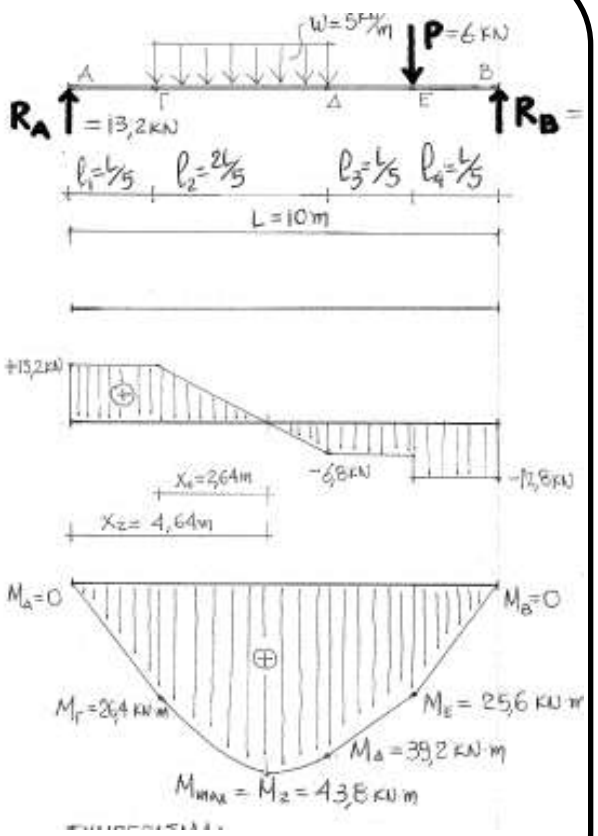




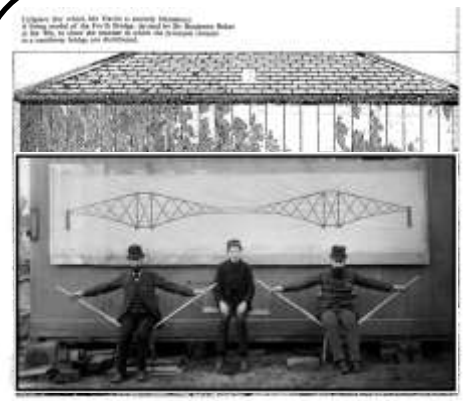




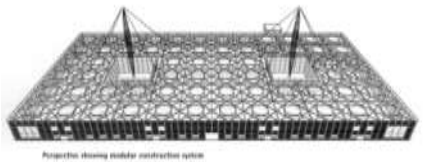


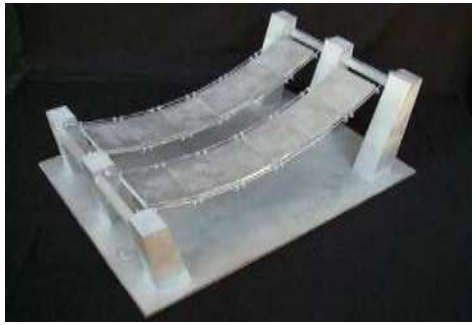


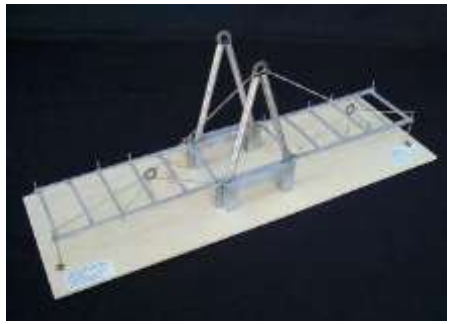
BUILDING STRUCTURES I & II. **2nd and 3rd semester mandatory courses**

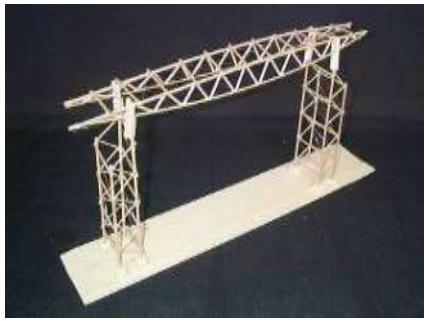


- introduction to the analysis and design of structural elements
- lectures, exercises [analytical methods], physical models
- understand structural and material behavior as powerful design parameters







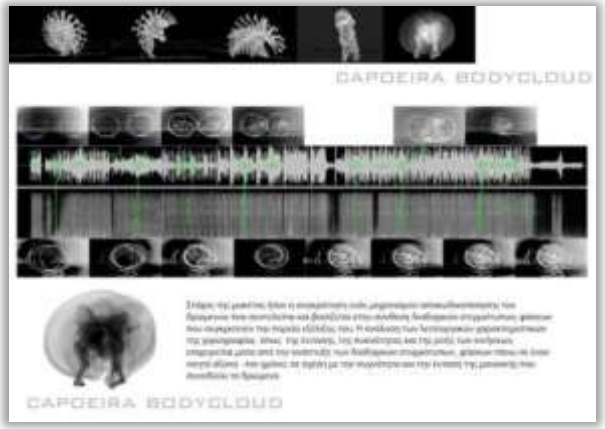


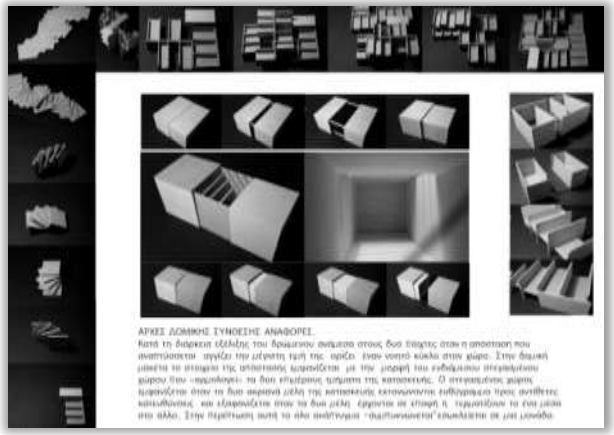
STRUCTURAL [TRANS]-FORMATIONS . 4th year design studio elective

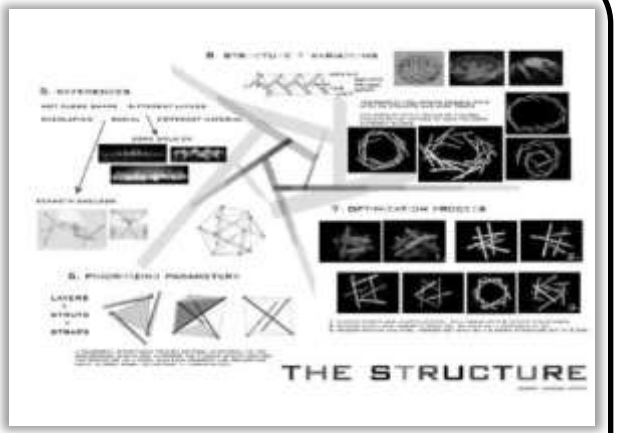
- structural concept + intended variations
- intuitive reasoning
- architectural design methodology informing structural design

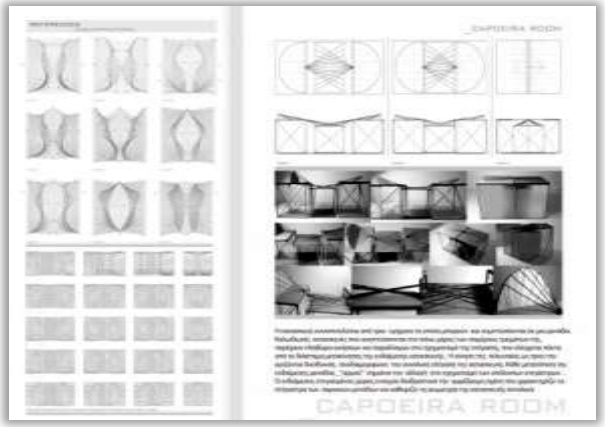
*Structural solutions that arise from the informal impart hidden energies to a building. The connectivity happens through improvising; the equilibrium comes together in ad hoc instants. The **informal** acts as an agent of release. The topography of such building is different, producing with an intuitive rationale a new kind of structure.*

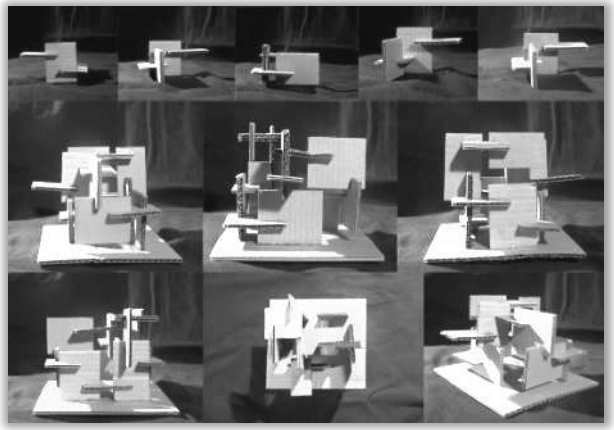
Balmond, C. 1997. *New Structure and the Informal*











DESIGN-BUILD STUDIO. 3rd year design studio elective

1. Full-scale structure
2. Trial-and-error
3. Design + make

PRACTICE-ORIENTED WORKSHOPS












STRUCTURAL EXPERIMENTATIONS



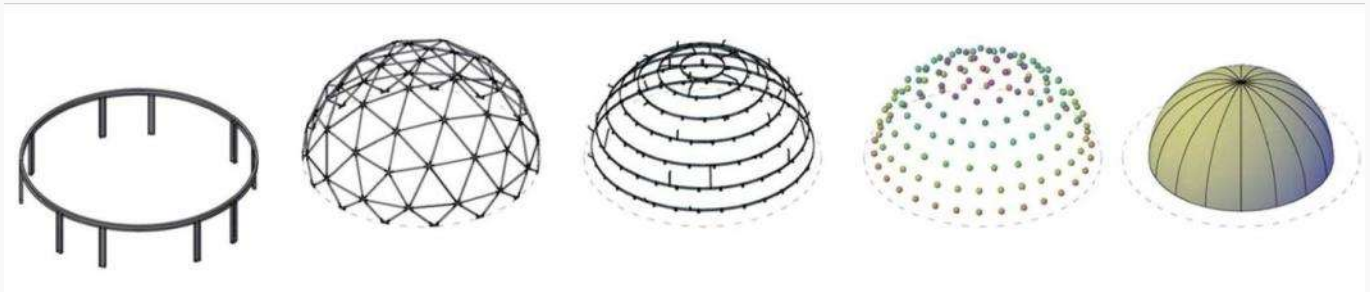


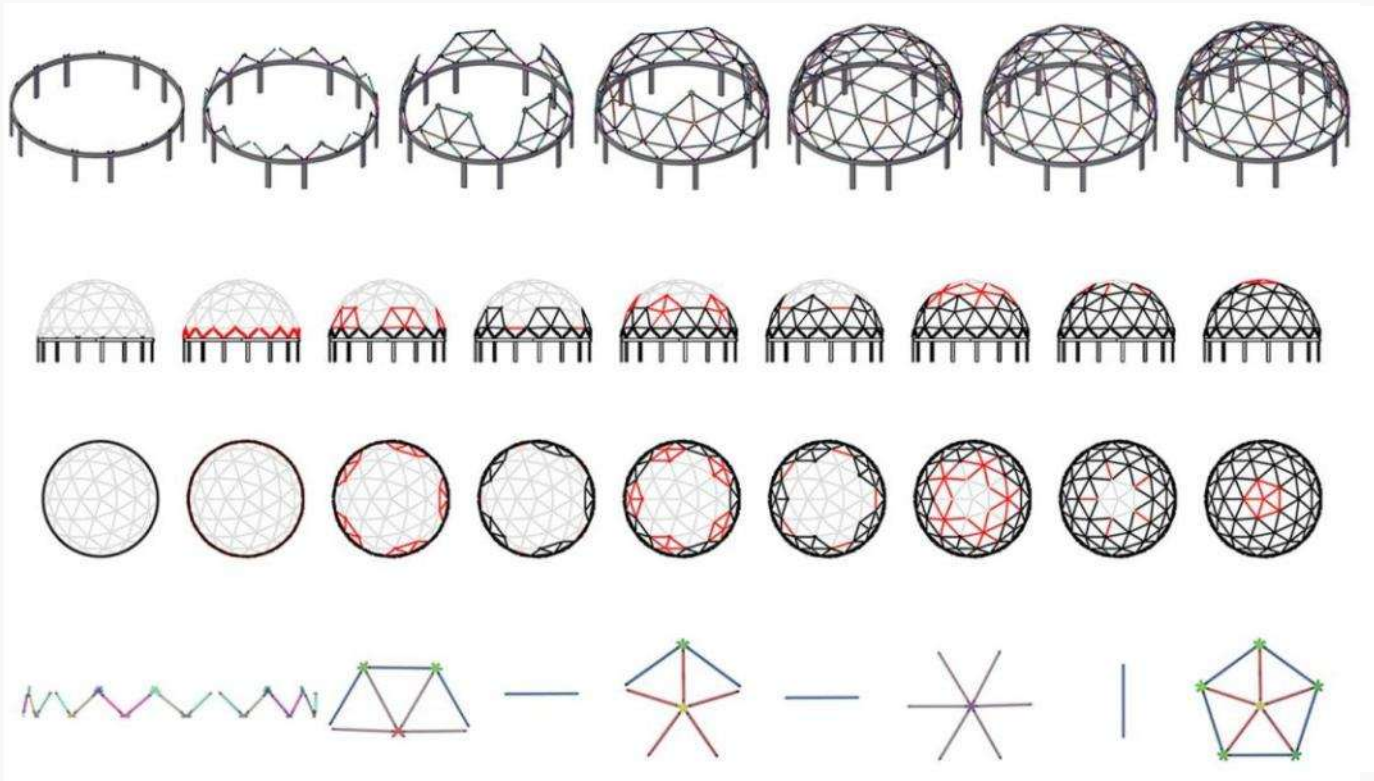
ENVIRONMENTAL DYNAMICS

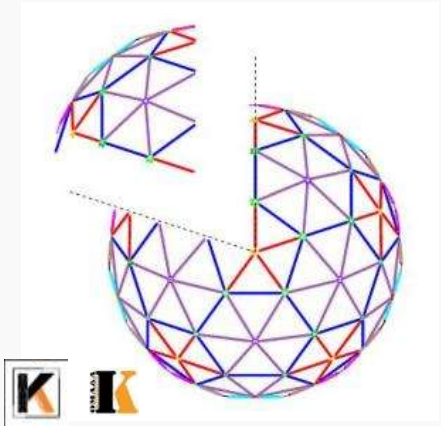



COLLABORATION

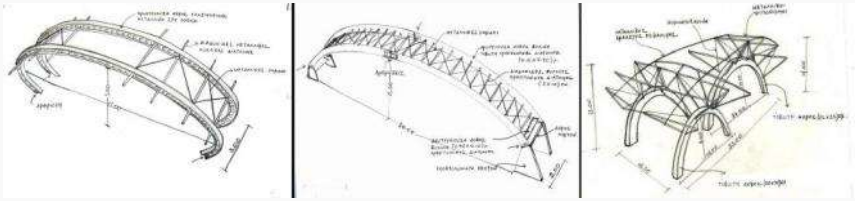
PRACTICE-BASED PROJECT: GEODESIC DOME – BEARING STRUCTURE FOR ARTIFICIAL SKY FACILITY

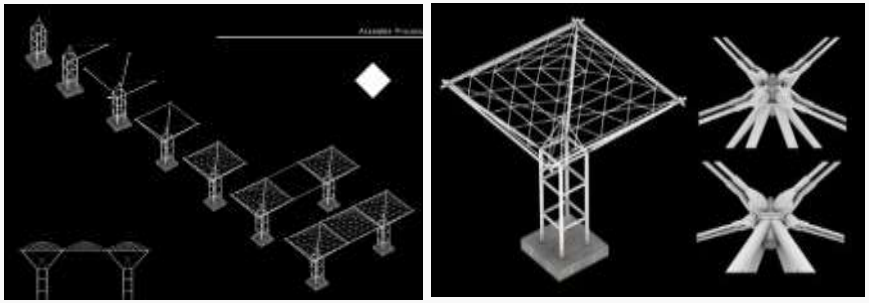


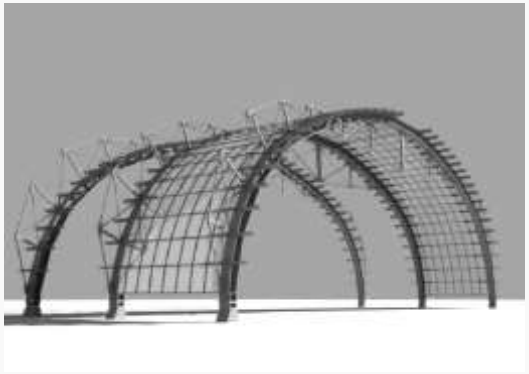


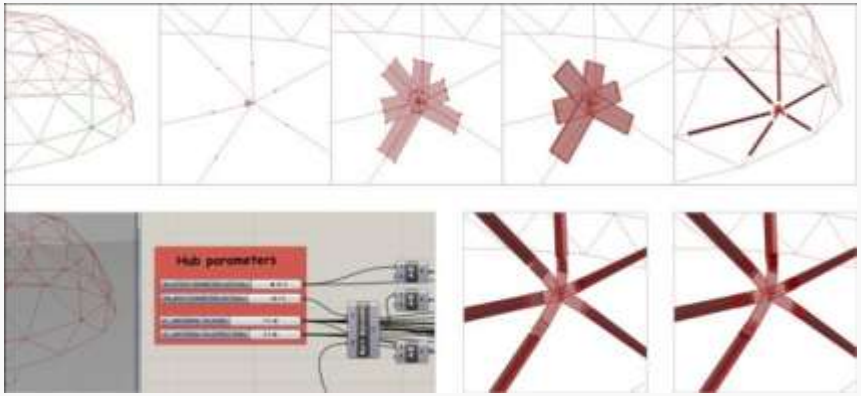


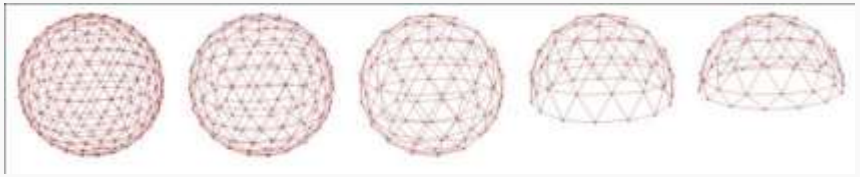
RESEARCH











Vrontissi, M. (2008). *Digital Database of Building Structural Systems: an Educational Tool to Support Multi-disciplinarity and Enrich Design Vocabulary in Preliminary Conceptual Structural Design*. In **Architecture 'in computero': Integrating Methods and Techniques**, Proceedings of the 26th eCAADe Conference

Vrontissi, M., Azariadi, S. (2011). *Digital tools in the architectural design of a geodesic dome*. In **Respecting Fragile Places**, Proceedings of the 29th eCAADe Conference

LIGHTING DESIGN

LOW ENERGY/ENVIRONMENTAL DESIGN

RESEARCH

Latest:
Thalis Research Grant

Participation in national/international technical committies, evaluation of EU Research projects, academic examiner

Latest:
National Code for Building Energy Efficiency, 2010/11

SPECIALIZED COURSES & LECTURES (Glazing & Shading technology, Daylighting systems, Day/Lighting software, Solar Passive Systems)

CONSULTANCY SERVICES (Lighting, Energy& Daylight simulation, LEED support, thermal-visual comfort measurements, energy auditing)

Latest LEED :
COSMOTE Build. 40000 m²

Msc Thesis **PhD**

Grants : 56.000 E

Finished

RESEARCH TOPIC (20-30%) **FINAL THESIS**

ADVANCED ENVIRONMENTAL DESIGN **30** Limit

LOW ENERGY BUILDING DESIGN **80**

BIOCLIMATIC DESIGN PRINCIPLES **80**

LIGHTING DESIGN I **109**

RESEARCH ACTIVITIES

- **THALIS** Research Grant "Development of a novel Intelligent Lighting control system with imaging sensor for optimum daylight exploitation and energy savings", 2012 — **P**
- **LBNL : Advisory work on eLAD** is an eLearning platform for commercial building lighting and daylighting systems being developed under funding by the DOE ,2011-12 — **P**
- **Centre for Renewable Energy Sources:** National Program "BUILDING THE FUTURE",2012 — **C**
- Municipality of Veroia : **URBACT II** «Cultural Heritage & City Development», 2011 — **P**
- **General Secretariat for Research and Technology:** **Innovation Coupons** " Cool Paints and surface temperature", 2010 — **C**
- **UTH research Grant:** "The impact of shading in lighting dimming systems", 2009 — **C**
- **APION KLEOS** Cons. : "Daylight analysis due to lane-covers. "Olympia Odos" Motorway,2009 — **C**

PhDs supervision : 2

PhD supported : 7

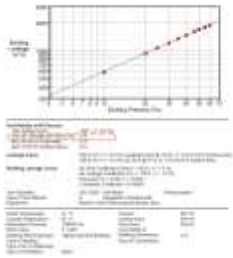
RESEARCH ACTIVITIES

Licenced SOFTWARE : Photopia, Design Builder

SOFTWARE : Radiance, Energy+, Esp-r, Dialux, Relux, CasaNova, Parasol

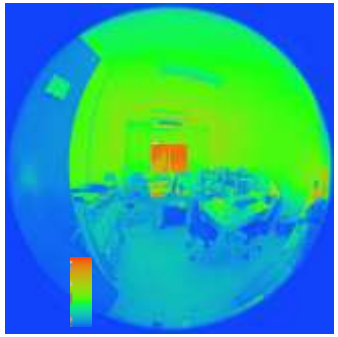
Equipment:

1. **Blower Door System**


2. **Artificial Sky/Heliodon**


3. **Temperature, Humidity, Light & Power meters/dataloggers**



4. **HDR – luminance meter system**

BIOCLIMATIC DESIGN PRINCIPLES

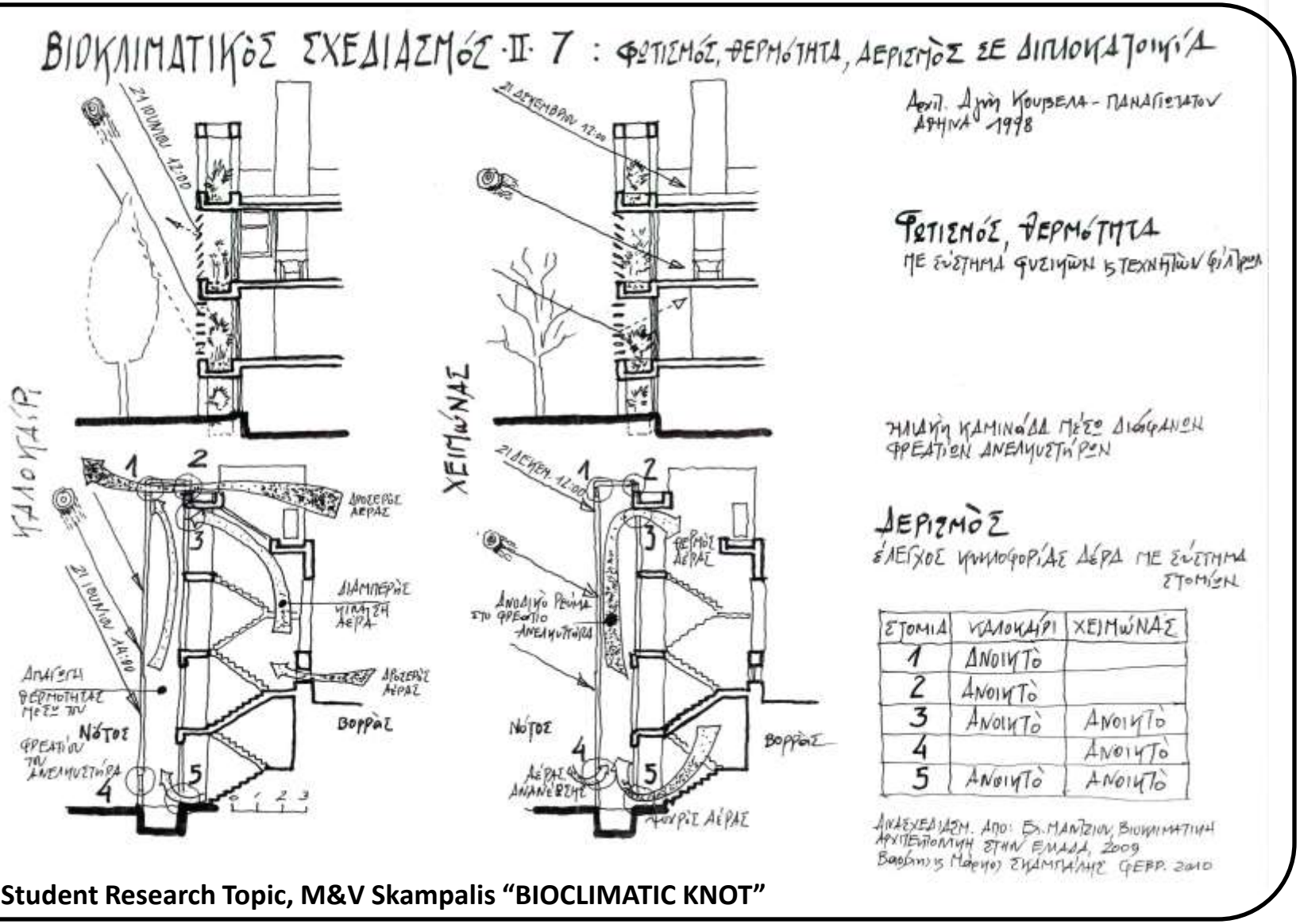
Objectives: Basic design principles of buildings and spaces using local climatic conditions in an effort to achieve comfort together with minimization of resources. Course is separated into three main sections in relation to the environment, the materials and the building.

Contents: Climatic analysis, urban environment, topography, thermal-visual and acoustic comfort, indoor air quality, principles and strategies of natural climatic control (orientation and building form, solar geometry, solar charts, shading, passive solar heating, natural ventilation, daylighting) ecological quality of building materials

Teaching methods: Lectures

Assessment: a) One homework assignment (20%) during semester b) Written exam at the end of the semester (80%)

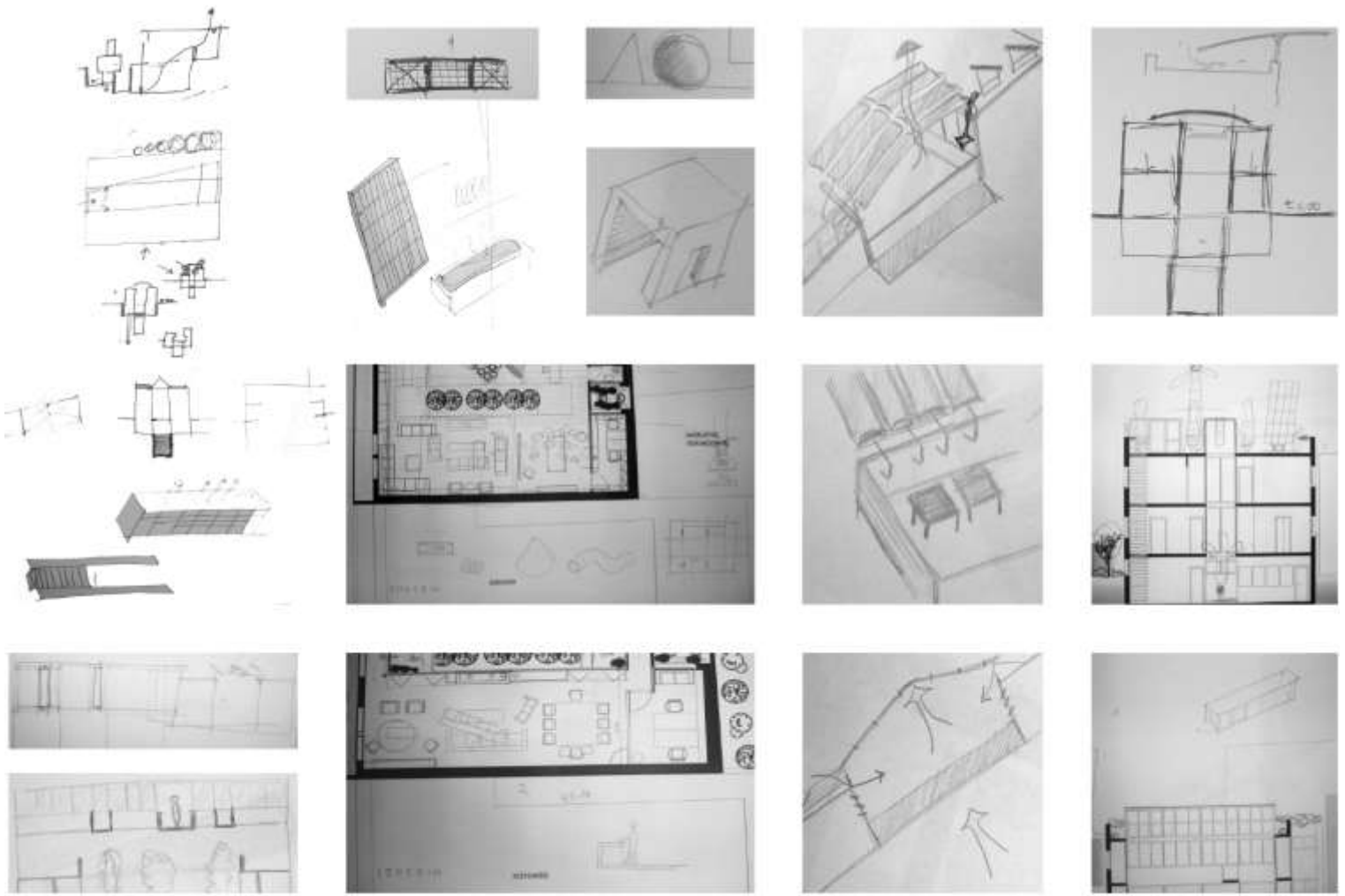
BIOCLIMATIC DESIGN PRINCIPLES



ΕΞΟΔΟΙ	ΚΑΛΟΚΑΙΡΙ	ΧΕΙΜΩΝΑΣ
1	ΑΝΟΙΧΤΟ	
2	ΑΝΟΙΧΤΟ	
3	ΑΝΟΙΧΤΟ	ΑΝΟΙΧΤΟ
4		ΑΝΟΙΧΤΟ
5	ΑΝΟΙΧΤΟ	ΑΝΟΙΧΤΟ

Student Research Topic, M&V Skampalis "BIOCLIMATIC KNOT"

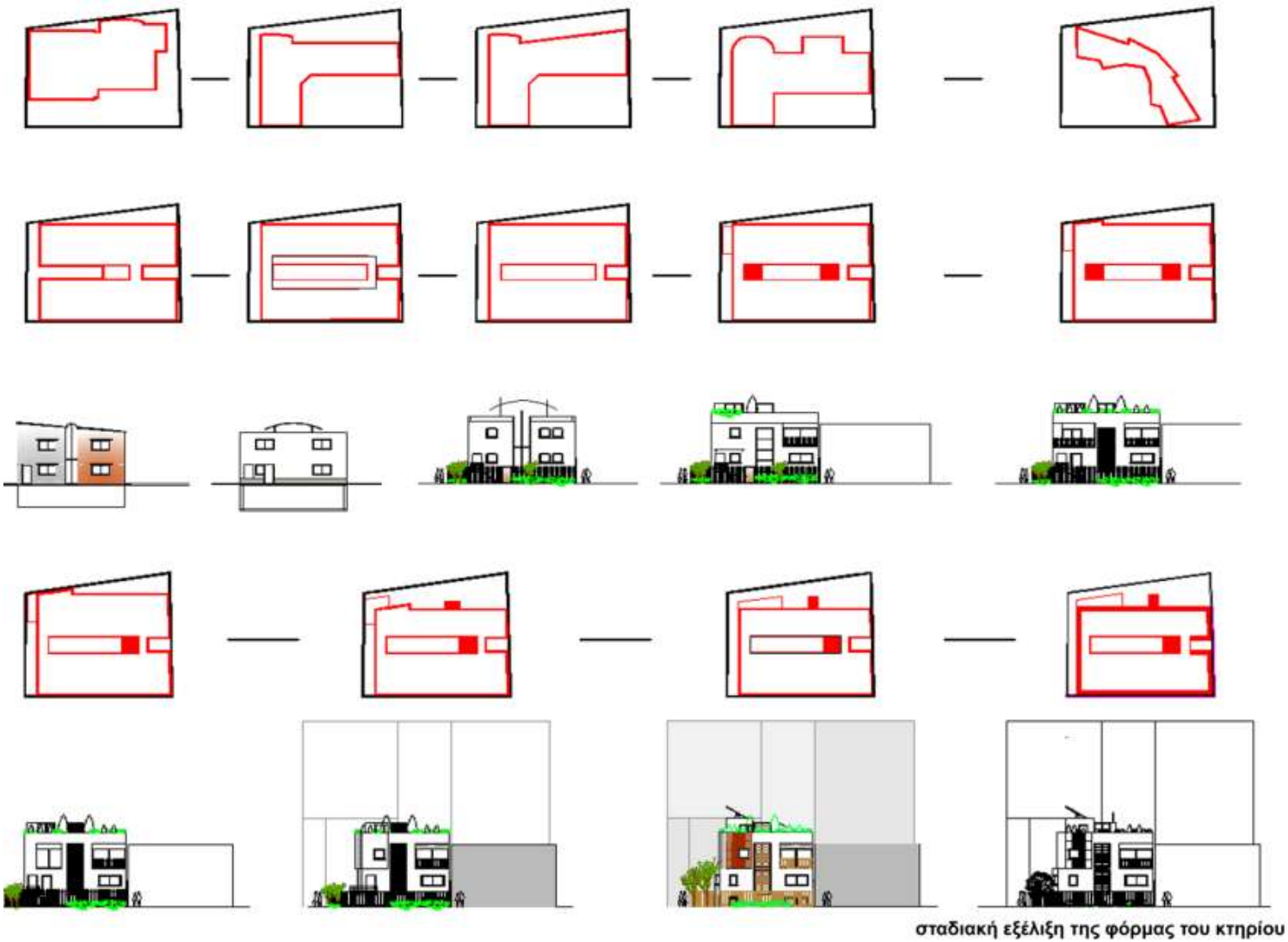
BIOCLIMATIC DESIGN PRINCIPLES



σκίτσα εξέλιξης της σχεδιαστικής πρότασης

Final Thesis : Siapkalh G., "Bioclimatic design, Larisa" , 2009

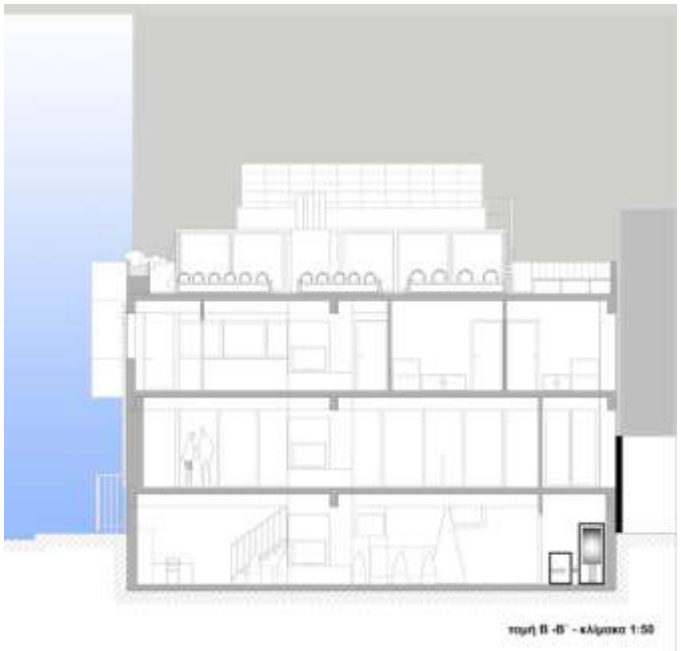
BIOCLIMATIC DESIGN PRINCIPLES

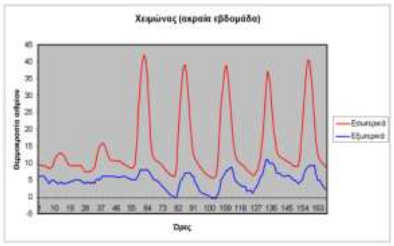


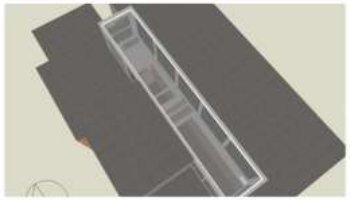
σταδιακή εξέλιξη της φόρμας του κτηρίου

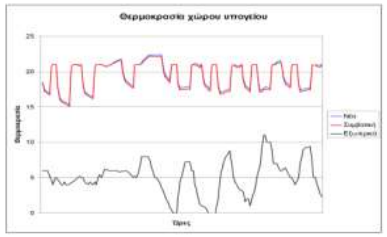
Final Thesis : Siapkalh G., "Bioclimatic design, Larisa" , 2009

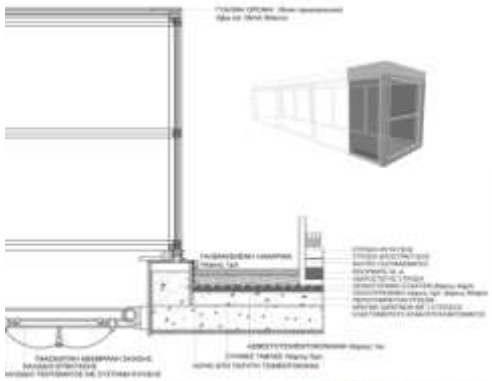
BIOCLIMATIC DESIGN PRINCIPLES

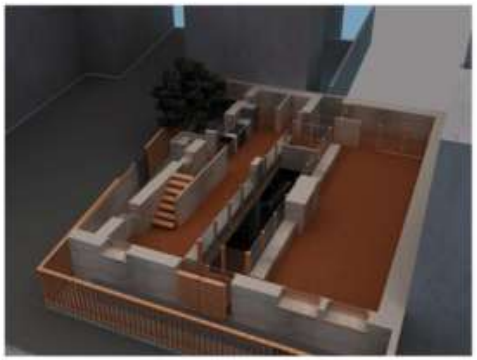






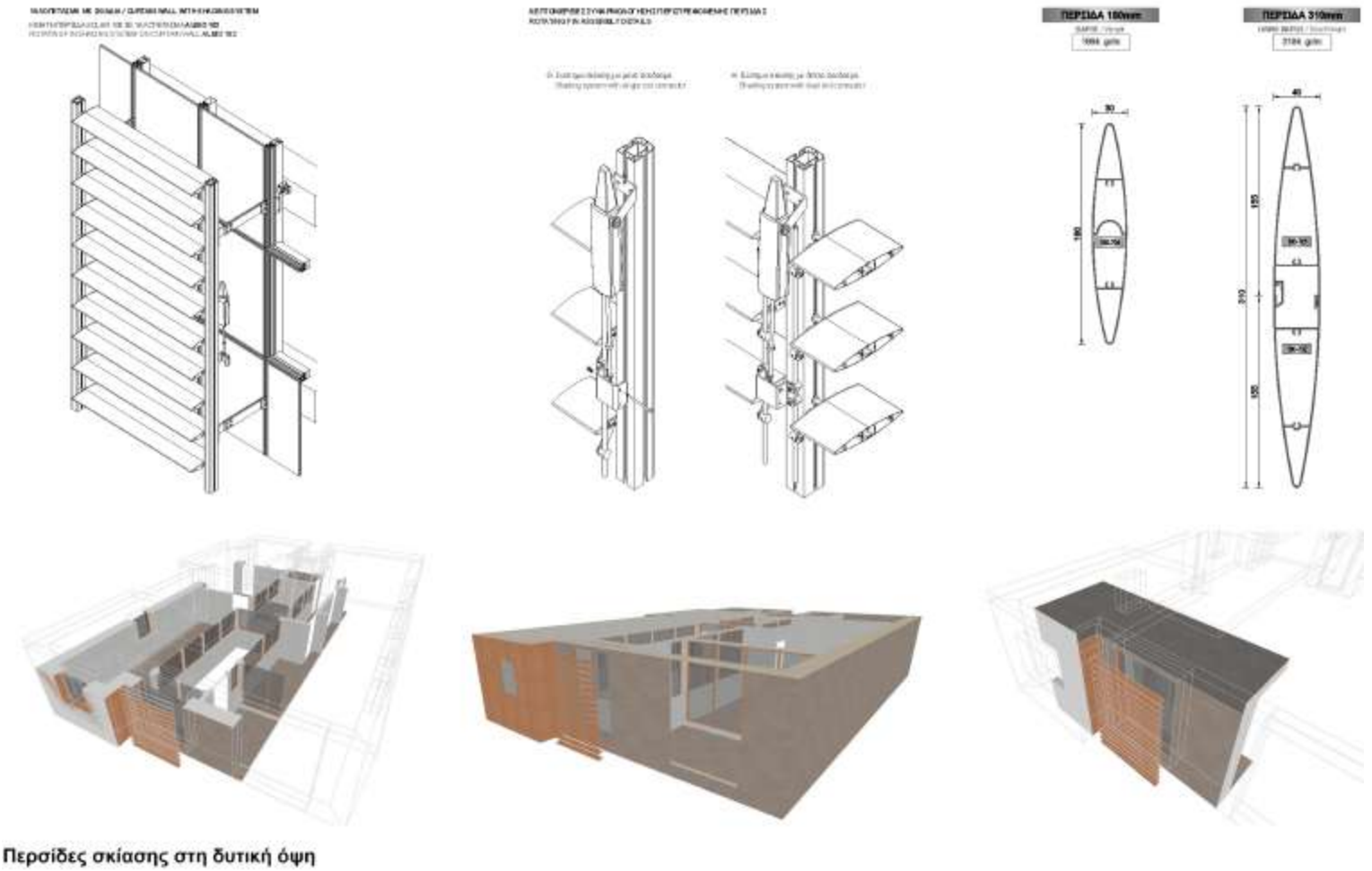






Final Thesis : Siapkalh G., "Bioclimatic design, Larisa" , 2009

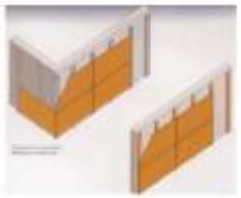
BIOCLIMATIC DESIGN PRINCIPLES



Περσίδες σκίασης στη δυτική όψη

Final Thesis : Siapkalh G., “Bioclimatic design, Larisa” , 2009

BIOCLIMATIC DESIGN PRINCIPLES



Τρόποι τοποθέτησης πανέλων εξωτερικής επένδυσης
Το πλήρες του πανέλου που θα επιλεγεί, καθορίζεται από τα εξής

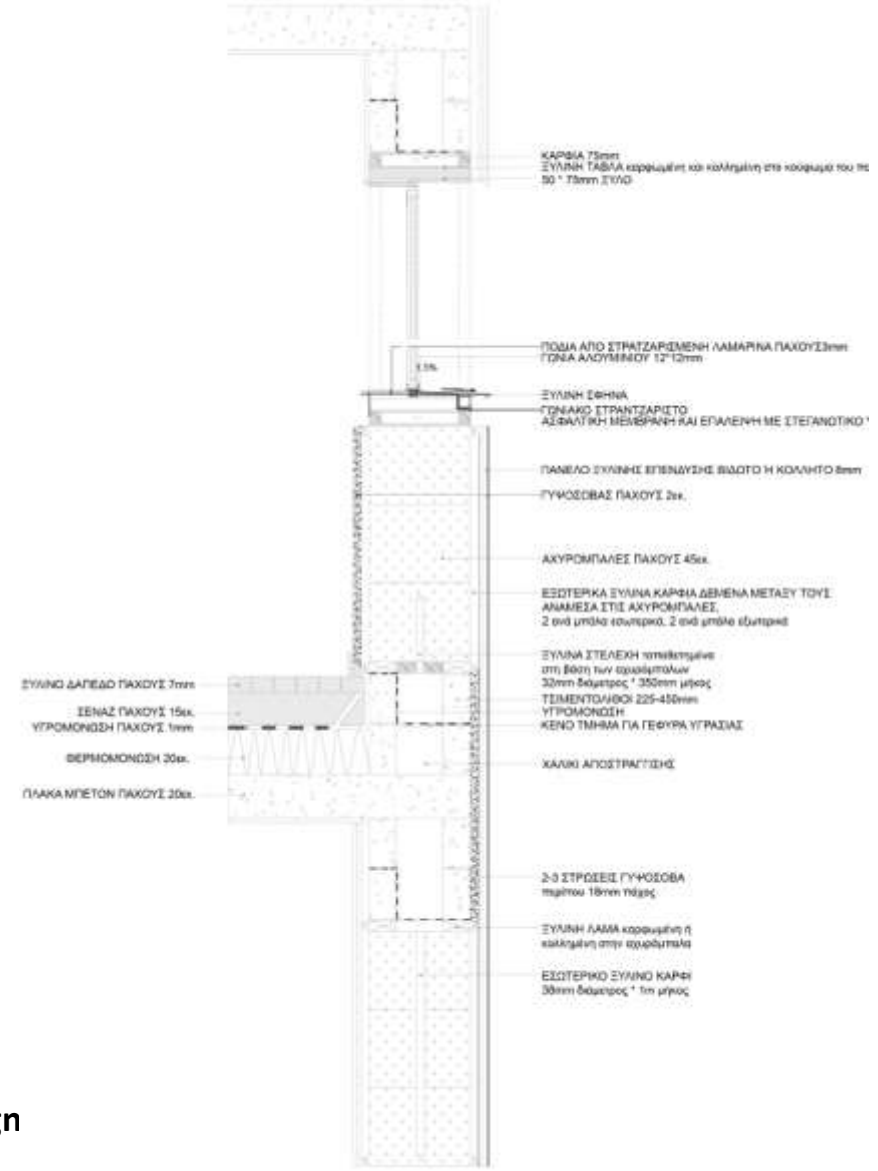
- Επιφάνεια που θα επενδυθεί (τοίχος, ψευδοροφή)
- Διάσταση πανέλου
- Απόσταση μεταξύ των πηγθών στήριξης
- Φορτία που πιθανόν να φέρει

Προκειμένου να τοποθετηθούν σωστά τα πανέλα PARKLEX,
ειδικά σε πλευρικοκλίνους, θα πρέπει να ληφθούν υπόψη οι εξής παράμετροι

- Στήριξη των πανέλων σε απόσταση από την εξωτερική περιοχή του κτηρίου,
ώστε να εξασφαλίζεται κενό για αερισμό
- Να υπάρχουν αρμοί των 4-5mm. Σε περίπτωση που θα ακολουθήσει σφράγισμα
των αρμών, απαιτείται απόσταση μεταξύ τους 8-10mm.
Η στήριξη γίνεται με τους
εξής τρόπους

1) Μεταλλική στήριξη με εμφανείς ανοξείδωτες βίδες 05 ή 07, σε χρώμα ασημί ή στο χρώμα του ξύλου, πάνω σε ξύλινο ή μεταλλικό σκελετό.
2) Στήριξη με ειδική κόλλα πάνω σε ξύλινο ή μεταλλικό σκελετό.

συστήματα εξωτερικής επένδυσης κτηρίου



Final Thesis : Siapkalh G., “Bioclimatic design

LIGHTING DESIGN I

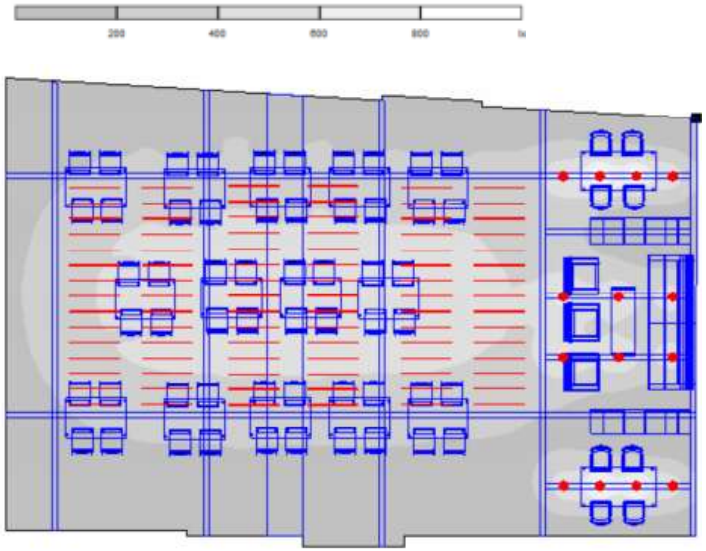
Objectives: Basic knowledge of artificial lighting -daylighting systems' technology. Design principles and requirements. Design Tools. Course is separated into three main sections a) Visual environment b)Available technology c) Design principles.

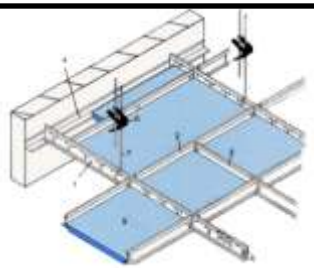
Contents: Perception , Terms & units, Light sources, Control gear , Luminaires, Daylight, Lighting design, Integration of electric lighting-daylighting, Lighting calculations

Teaching methods: Lectures, visits to buildings, lab exercises on the use of calculation tools

Assessment: a) Two homework assignments (40%) during semester b) Oral exam together with a major design project at the end of the semester

Course Project, Achleos M., Konnari V. Fiakkou I., 2010



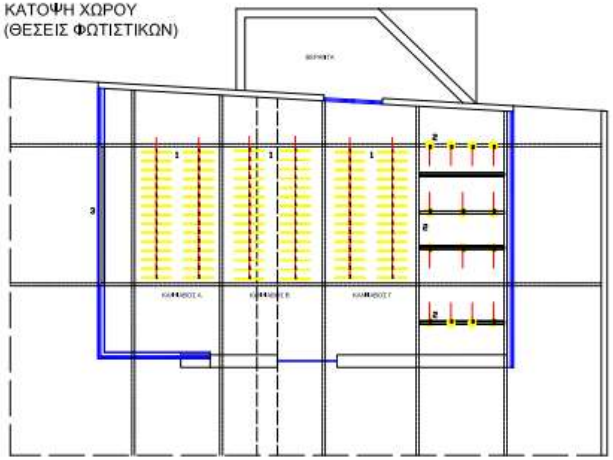


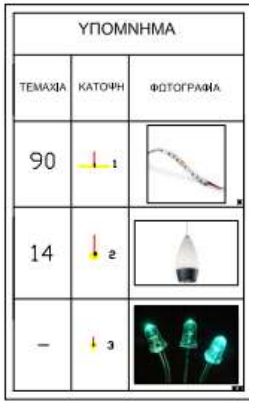
ΣΧΕΔΙΟ ΚΑΤΑΣΚΕΥΗΣ

1. Κύριος Οδηγός
2. Δευτερεύων Οδηγός
3. Δευτερεύων Οδηγός
4. Περιμετρική Γωνία
5. Πλάκα Ψευδοροφής
6. Δοκός Πετσοκόβω
7. Νιάζα Φ44mm

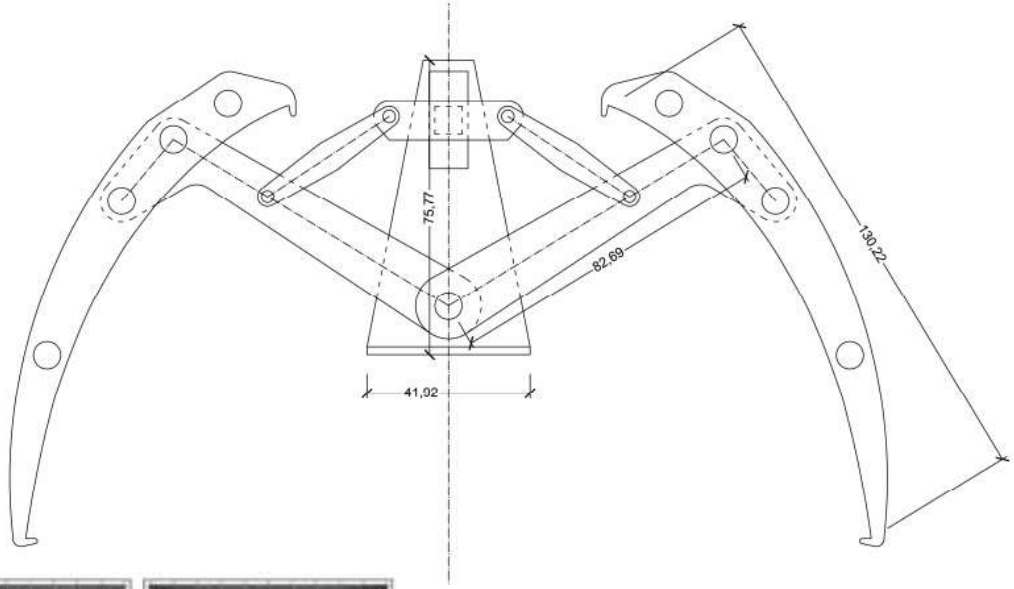
Μέγιστη απόσταση μεταξύ των σημείων ανάρτησης κατά μήκος των κυρίων οδηγών:

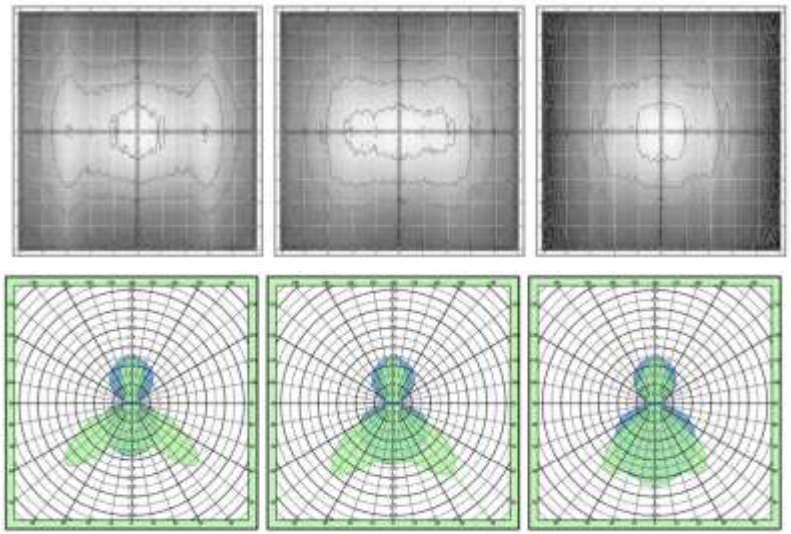
- 0,45m από τον τοίχο
- 1,20m κατά μήκος των κυρίων οδηγών
- 0,15m από το σημείο ένωσης των δύο κυρίων οδηγών

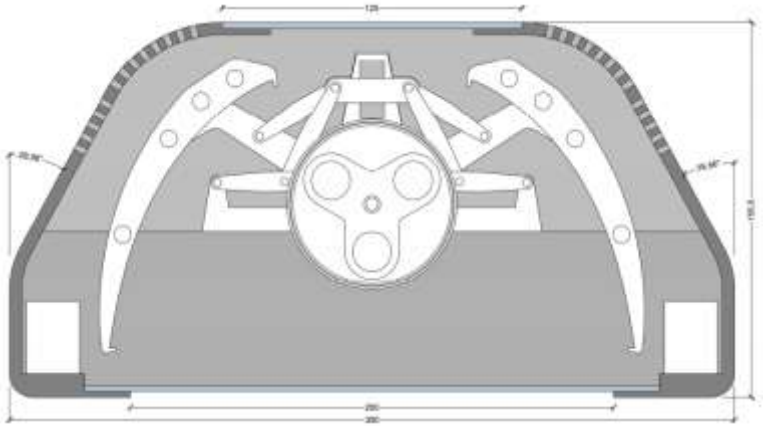




LIGHTING DESIGN I

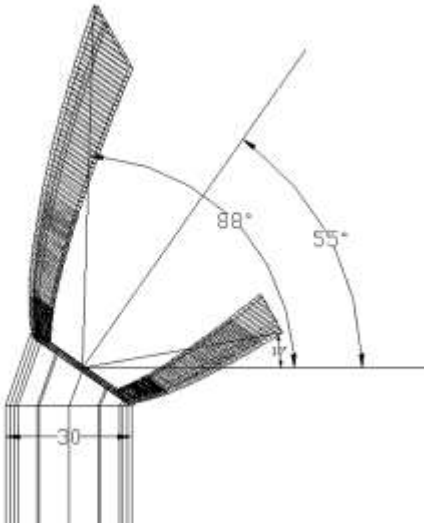






Student Research Topic, A. Mpezes, “Variable distribution/colr luminaire design”, 2008

LIGHTING DESIGN I



Ώρα	Σταθερός συλλέκτης	Κινούμενος συλλέκτης
8:00	-	-
9:00	1%	15%
10:00	2%	18%
11:00	11%	34%
12:00	26%	41%

Student Research Topic, A. Anagonstopoulos, "Anidolic collector for a lightipipe" , 2009

Objectives: Course focus is on the design of low energy buildings and passive systems presenting not only the available technologies but design methodologies as well.
Students should present the skills to:

1. Characterize thermal performance of building materials
2. Avoid certain pathologies of the building skin
3. Define strategies for daylighting, natural ventilation and shading.
4. Design and dimensioning passive systems/active solar systems
5. Estimate the influence of a particular design to the building energy balance.

Contents

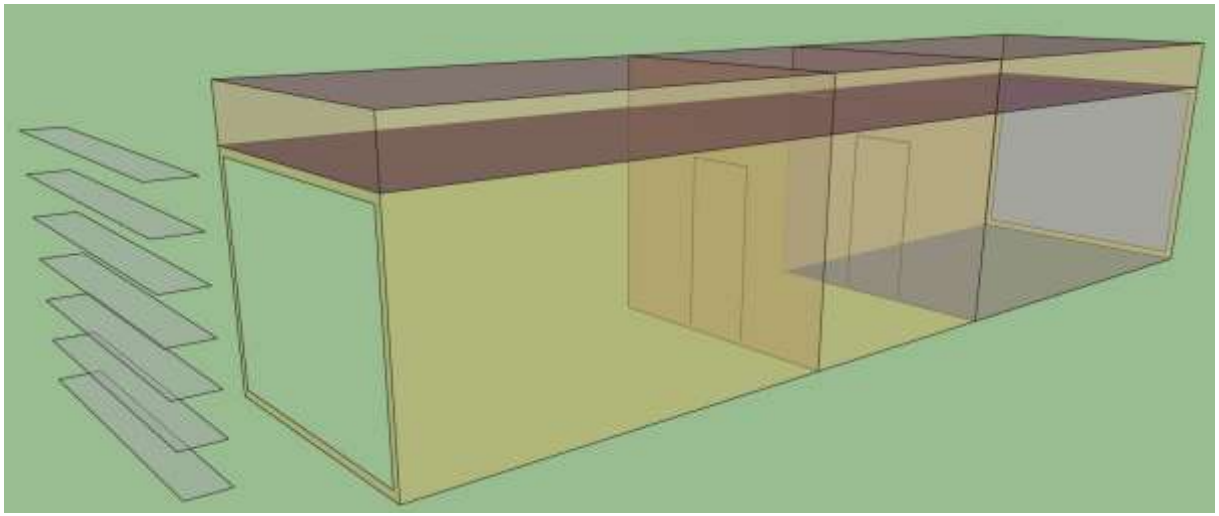
- Energy Policy /International energy standards
- Basic principles for energy efficient buildings, energy balance, building performance.
- Moving to "Zero Energy+Emission Buildings"
- Technologies for energy efficient buildings
- HVAC systems
- Hybrid approach, link between HVAC and building skin
- Design of passive heating systems
- Integrated active solar / PV systems
- Dynamic facades
- Energy Analysis
- Case studies

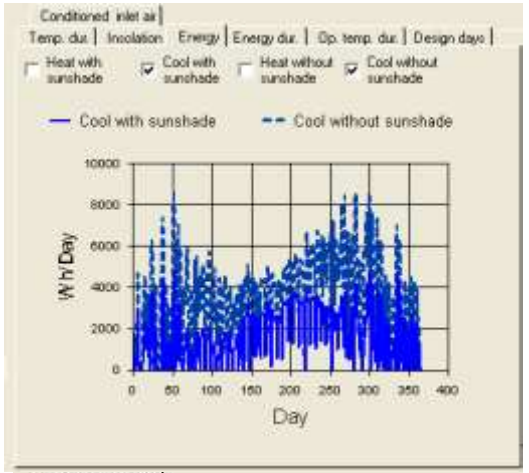
Teaching methods: Lectures, invited lectures , visits to buildings, lab exercises on the use of energy simulation tools.

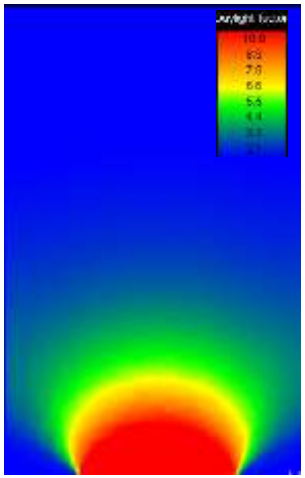
Assessment: : α) Two homework assignments (40%) during semester b) Case study at the end of the semester (60%)

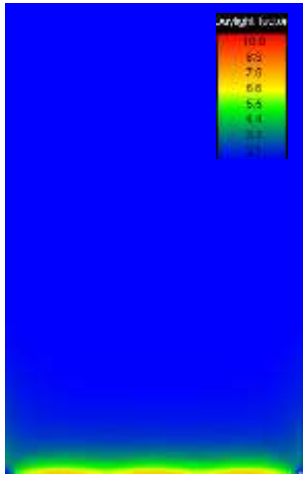
LOW ENERGY BUILDING DESIGN

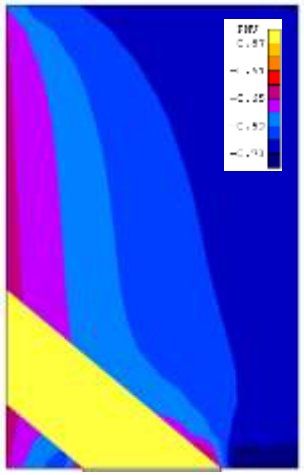
Course Project : Optimize glazing size/shading type /thermal insluation to achieve minimum primary energy consumption. Select the appropriate glazing, shading ,wall insulation and lighting system according TOTEE 20701-1. Examine alternative solutions a) Solar Control glazing b) Place the same size window horizontaly c) increase insulation by 50% d) Install ceiling fans

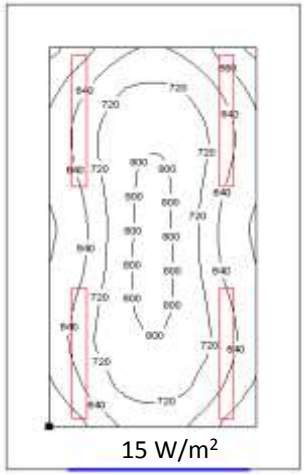


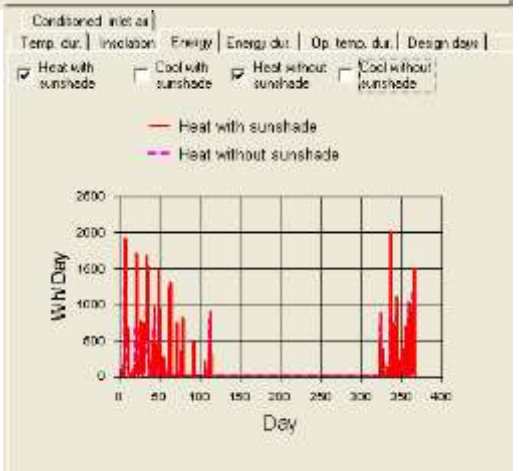




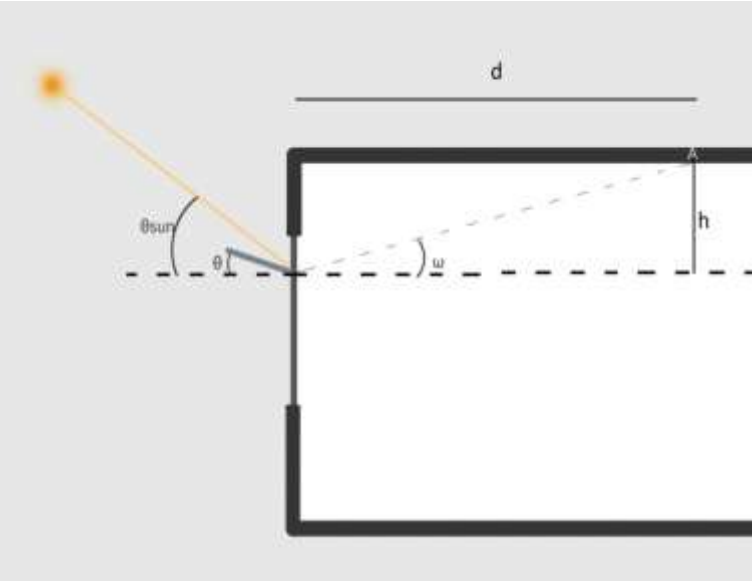


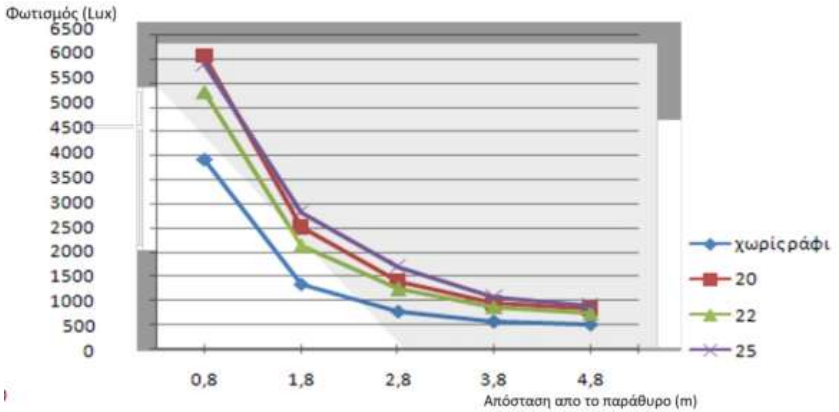




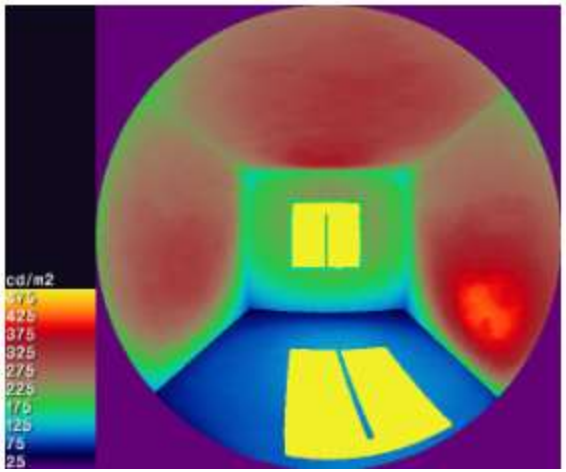


LOW ENERGY BUILDING DESIGN





Χωρίς ράφι



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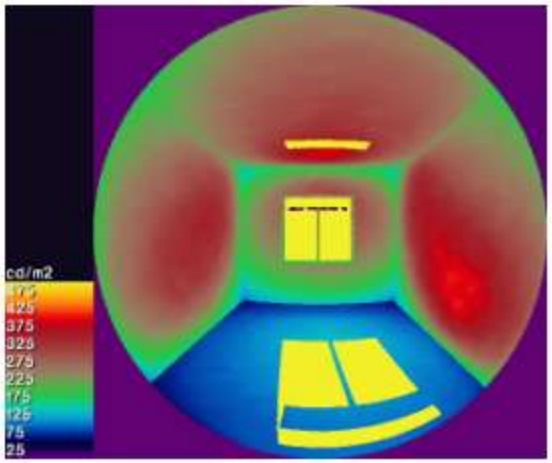
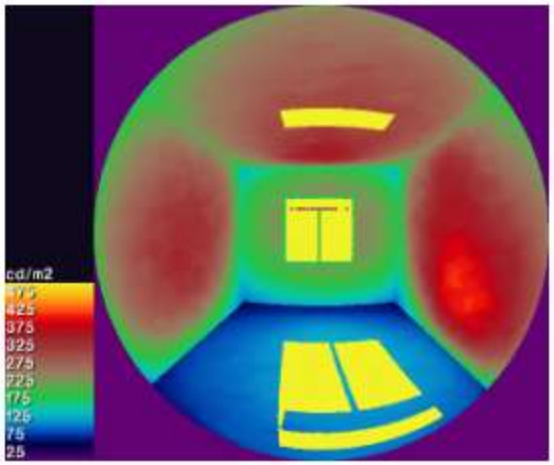
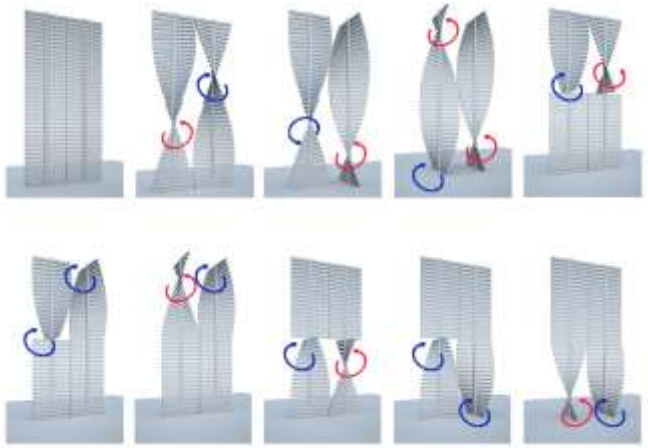


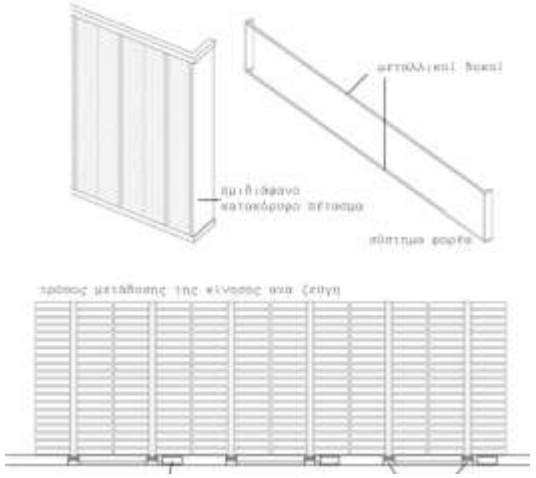
Ράφι με κλίση 22°

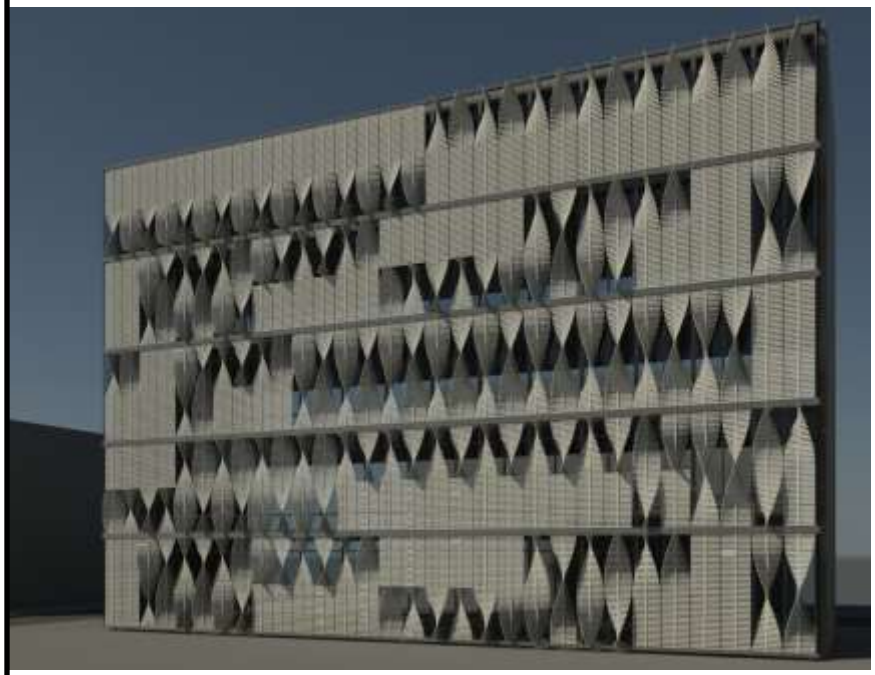


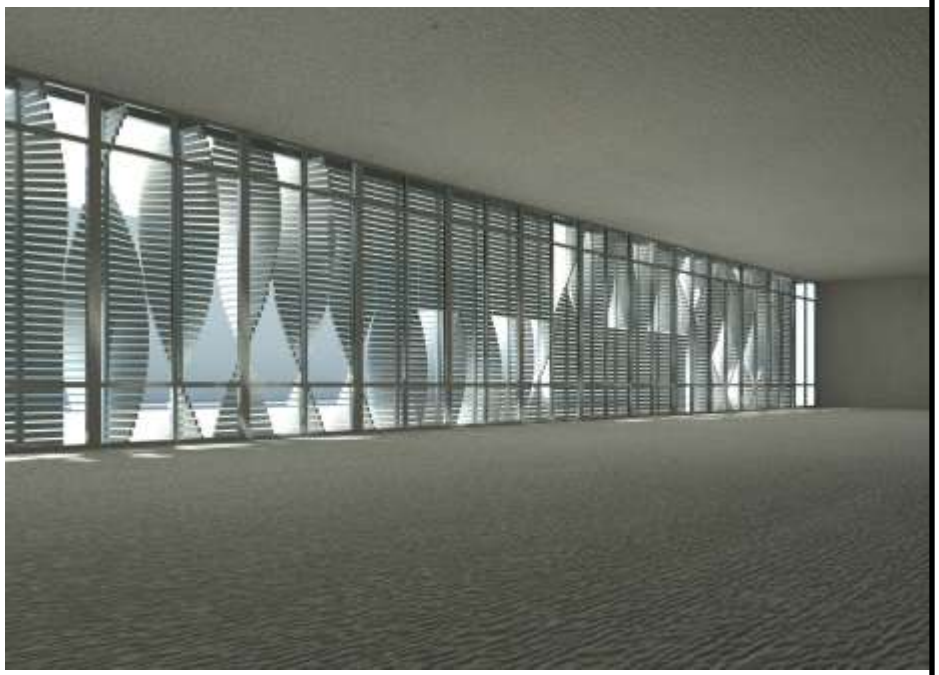
Student N. Kyriopoulou, "Movable lightself", 2012

LOW ENERGY BUILDING DESIGN









Course Project in Msc, Deskatas-Papdhmhtriou, 2011

Goal:

The course concentrates on knowledge provision in the field of energy efficient buildings maximizing comfort (thermal, visual and acoustic) conditions . The goal is the link between architectural design and sustainability, combining optimized performance, occupant satisfaction and reduced energy consumption.

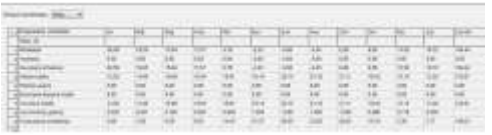
Contents:

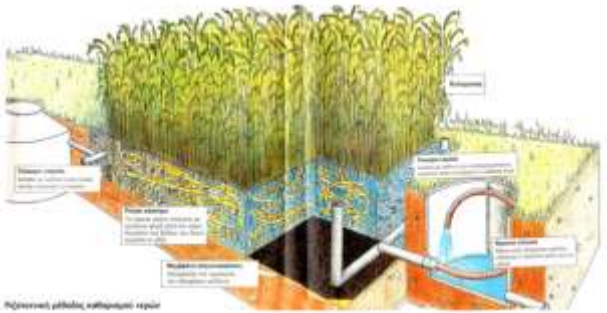
The course covers specific issues relating to:

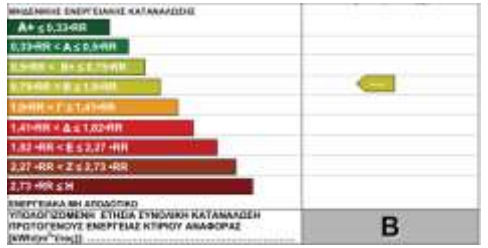
1. Building environmental and energy assessment systems. The requirements of LEED, BREEAM are presented
2. Microclimatic interventions in open spaces.
3. Assessment methodologies (eg energy simulation, life cycle analysis of materials, ecological footprint).
4. Energy audit (building envelope). Technical inspection and design options for improving the behavior of the shell. The lectures are supported by the inspection of a building (using proper equipment such as infrared cameras, various sensors)

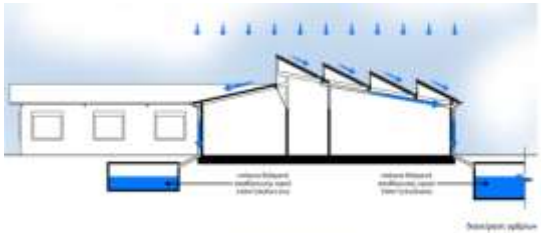
Assessment: : Case study at the end of the semester

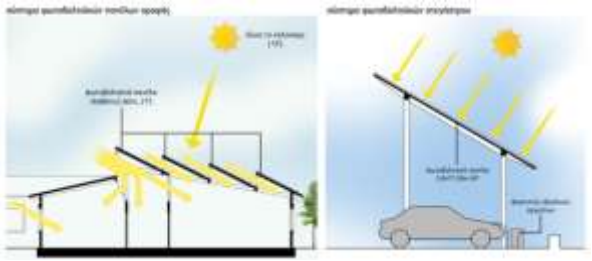
ADVANCED ENVIRONMENTAL DESIGN

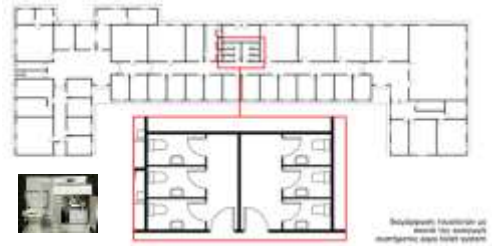


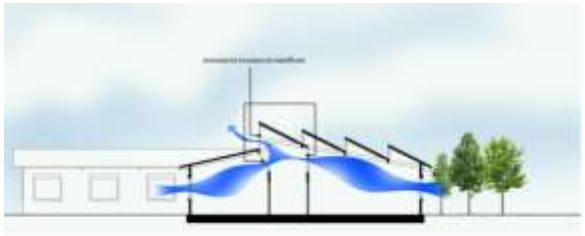












Course Project, Papagikas, Paraskeva A., Tsitsanis D., 2010