

### **Analogical modelling: materials and building process**

#### Curriculum

2<sup>nd</sup> year, 2<sup>nd</sup> semester - Compulsory

#### Course

Practical exercise included in a lecture entitled "building resources". It is aimed at providing an overall approach of building materials and their use in order to design architectural projects

#### Duration

The theoretical course spreads on 20 hours; the practical course adds 24 hours spread in 4 weeks

#### Staff

One teacher is in charge of the lectures and manages the whole course. Other teachers or assistants help him; each one is in charge of 15 students

#### Specialisation

The manager is an architect teaching construction, one other is an engineer teaching structure. The rest are design studio teachers or assistants.

#### Deliverables

The site for the project is given on the campus in order to be easily observed. A site model at the 1/10<sup>th</sup> scale is made to insert each proposal during the final stage of the exercise. Analogical materials for modelling are let to student's choice, with tools and making methods. They can use bibliography including the lecture's notebook. No other specific knowledge is required.

The given notebook's summary is:

- Human resources: labour, trades, building site organisation,
- Material resources: morphology and physical properties of materials at each scale from atoms combining to manufactured components joining
- Focus on steel, wood, concrete and glass as illustration of 4 typical organisations of material

The practical exercise starts with a lesson about analogy in materials and process.

### Student output

A 10 slide PowerPoint presentation showing step by step the erection of their model.

This exercise attempts to reach two complementary goals:

- One goal is to understand the difference between shape modelling and construction modelling, and more generally to understand the concept of analogy found in all kinds of models.
- Another goal is to integrate some constraints from the building site in the design process by handling elements in the model's space.

Regarding the first goal, the question is what small-scale material, objects or process can account for the real full-scale mechanical properties of each component? This question is relevant for the theory of models well-known by engineers. But we have neither time nor need to teach such a complex theory in our schools of architecture. Furthermore it uses rather sophisticated mathematics. So we base our teaching on a qualitative approach. In this field, physical properties must prevail on visual or morphological properties. The model must show a significant kind of mechanic behaviour under stresses even if it is roughly shaped. That requires a huge effort to separate the outstanding visual characteristics from more modest qualities.

For example, students have proposed to replace glass by thin fried Tunisian paste (brittleness instead of transparency), or laminated glued wood by millefeuille cookies (planar anisotropy instead of geometrical regularity)...

Regarding the second goal, the question is how to manage and operate a mini working-yard respecting space allocation, sequencing and motions? Of course students have not to make mini-tools, but they must find analogical joints or apparatuses. They must also consider the way they have to move their hands to obtain the same kinds of effects than can happen in reality. For example, junctions by bolt or by rivet may be



simulated by staples but not by pins; pins may show pegs. Understanding motions is very constructive; for example how to transport a pre-cast panel from a lorry to its own place? Or how to handle a reinforced-concrete beam? If one catches it by its middle it will break...

In fact, the exercise done during the last three years has consisted of a small but realistic architectural project, i.e. a second entrance hall in the school of architecture. The main assignments are the following: not to change the existing curtain-wall, no deep foundations, light trails on the environment, aesthetic and functional improvement... Each team made up by four the students spends six hours per week in construction studio and has to provide additional work by itself. The first week is spent on sketching, the second week on designing the project, the third week on making the model's components and the fourth week on building the 1/10 scale model, and on taking digital pictures step by step. The jury assesses this building stage and explains successful or misfit operations. One more week is given to the students to achieve the PowerPoint output. This duration is considered as too short. Nevertheless the results are very promising.

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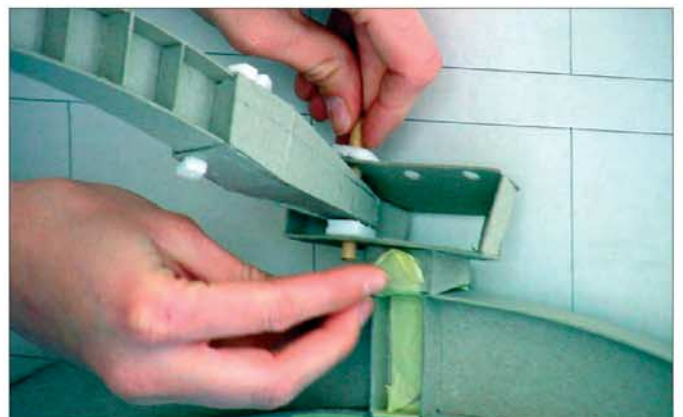
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## The given notebook's

- Human resources: labour, trades, building yard organisation
- Material resources: morphology and physical properties of matter at each scale from atoms combining to manufactured components joining
- Focus on steel, wood, concrete and glass as illustration of 4 typical organisations of material
- The practical exercise is started by a lesson about analogy in materials and process.

## Student output

A 10 slide PowerPoint presentationshowing step by step the erection of their model.



## Curriculum

4<sup>th</sup> year, 2<sup>nd</sup> semester  
Compulsory

## Course description

The exercise is articulated with theoretical lectures and computer analysis, the overall course aiming the development of a design process that integrates technical and architectural aspects.

The exercise consists in designing a small museum with a special focus on integrating good seismic performance with all other architectural features.

## Duration

Lectures: 12h, analysis of basic seismic behaviour: 8h, design exercise: 28h.

## Staff

The global staff/student ratio is of 1 to 15 for the design exercise, with 4 architects teaching design studio, each in charge of 7 teams of 3 students, and 2 engineers teaching construction or structures.

## Hand-outs for the course

Text book on seismic behaviour and design, answer sheets for the analysis exercises, text of exercise assignment (specs, maps, site pics, geotech. data, extracts of regulations, ...), model construction methodology.

## Student output

Visual perceptive model of the project  
Seismic analytical model of the project  
1/100<sup>th</sup> floor plan views

## Model construction materials

Special materials for the construction of the students' projects analogical models to achieve a reasonably representative dynamic behaviour .

