

Use of wastes to create new building materials

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1. INTRODUCTION

a) General information

- School of Building Engineering
 - UPC - Barcelona Tech
 - Medium level studies - Now upgraded
 - 1.500 students in all grades

b) Materials subject

- Second course subject
- Two terms subject
- 200 students in four groups, 5 teachers in total
- Knowledge achieved
 - First term: Concrete, plaster, mortars
 - Second term: Clay, glass, wood, metals, plastic
- Work class developed during second term
- Work class (15 % of the total grade)
- Rest of the subject very theoretical



2. HOW TO INCORPORATE NEW KNOWLEDGES INTO AN OLD SUBJECT

Questions arose:

- Old subject (more than 50 years old)
 - Same themes as ever
 - New knowledge and concepts
 - a) Sustainability
 - b) Life cycle
 - c) Energetic efficiency
 - Conclusions
- Developing all these knowledge in a team work:

USE OF WASTES TO CREATE NEW BUILDING MATERIALS

3. TEAM WORK

a) Aims

- Learning to work in groups
- Researching about new materials
- Being aware of wasting materials in building
- Thinking over properties of materials

b) Evaluation

- Poster delivery (DIN-A1)
- Defending it in front of a jury
- Description of new material
- Testing new material
- Comparing new material with other already existing
- Bibliographic research

FITXA DE CORRECCIÓ DELS POSTERS ACT.17 CLASSE:

NOTA del 0 al 10

Grup	1	2	3
IDEA - Originalitat. - Conceptes bàsics i fonaments teòrics.			
APLICACIÓ - Idoneïtat de l'aplicació proposada. - Propietats analitzades i assajades en relació a l'aplicació proposada. - Adequació dels assaigs realitzats en relació a les propietats avaluades. - Normativa consultada i/o aplicada. O bé, codi tècnic de l'assaig realitzat.			
RESULTATS I CONCLUSIONS - Coherència dels resultats obtinguts. - Criteri tècnic de l'anàlisi realitzada. - Conclusions obtingudes.			
BIBLIOGRAFIA - Utilització de diversos mitjans d'informació. - Credibilitat i fiabilitat de les fonts. - Citació correcta.			
POSTER - Estructura i ordre. - Dimensions lletres i fotografies coherent. - Qualitat de les fotografies. - Disseny, estètica.			
EXPOSICIÓ ORAL - Adaptació al temps d'exposició. - Ús de vocabulari tècnic. - Expressió amb claredat i ordre.			
MITJANA			

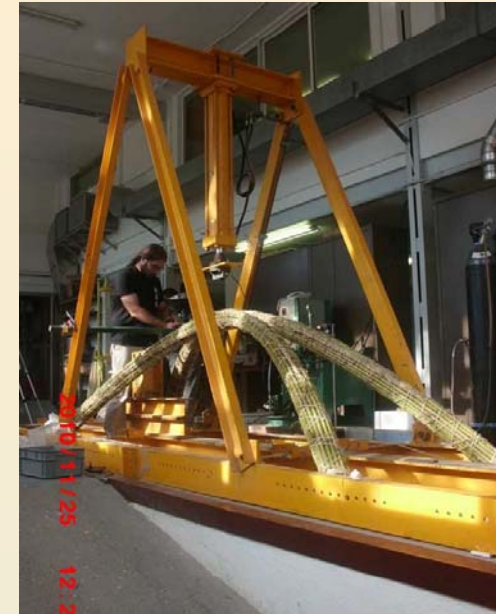
Altres observacions:

c) Facilities

- Two existing labs at school
- Four class groups
- 200 students
- 5 teachers
- 2 hours practical tutorial per week

d) Program

- Four months work
- Teams integrated by four students
- Two deliveries:
 - First including main ideas, bibliography and planning
 - Second one including a DIN-A1 poster, a public presentation and a sample of the material



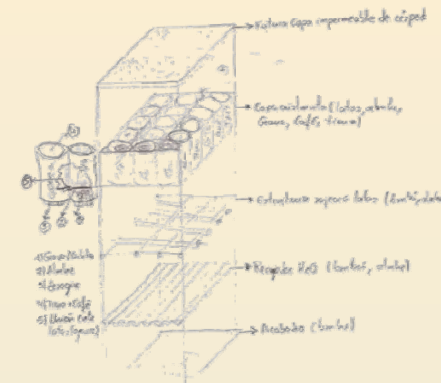
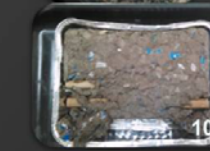
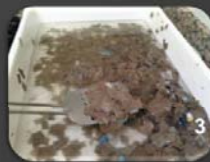
4. RESULTS

a) Some examples

- Different approaches to work

CENTRAL BLOCK MANUFACTURING:

1. Cut the cardboard into small pieces
2. Cut the bamboo with a metal saw and file
3. Put the cardboard in a container or cover it completely with water (leave it 24h)
4. Drain the cardboard to remove the excess water
5. Boil the cardboard with fresh water
6. Drain the cardboard again, ready to make the paste
7. Mix it with a handmade semi-liquid paste (flour, water and salt) to compact.
8. Put the paste into a mould, pressing with spatula.
9. Put the bamboo on.
10. Put the second layer of cardboard over the bamboo, trying to make a uniform superficial layer.
11. Let the pasta dry naturally to remove the water. After 48hours the central block was not completely dry, the solution was to put it in the oven for 1hour



Proceso constructivo

1- Fabricación del cajón: Construcción de un cajón de 50x50x9'8 cm aprox. El cajón está sujeto mediante clavos.	2- Durante la recolecta de las cápsulas éstas se agujeraban estratégicamente mediante agujas y punzones.	3- Unión de los bloques de cápsulas mediante alambres cogidos por cuatro extremos mediante agujeros.
4- Colocación de la cápsula invertida entre el bloque mediante cola adhesiva.	5- Colocación de la malla plástica sobre la cual se disponerán los bloques de cápsulas. Sujeta con cola.	6- Para evitar la movilidad de la malla, construimos un marco perimetral de madera.
8- Colocación de las cápsulas invertidas. Se aprecia como encajan perfectamente.	9- La disposición de la espuma consiste en la colocación de ésta encima y dentro de las cápsulas invertidas.	10- Disposición de los retales textiles encima de la espuma.
		11- Cerramiento del cajón mediante clavos.

- Different testing methods

TESTINGS



1. COMPRESSIVE STRENGTH: THE PANEL LOCATED ON TWO SEPARATE BEAMS TO 50CM, ADDING WEIGHT (> 170KG) ON UP TO RUPTURE.
2. SOUNDPROOFING: BEEPING WITH AN ISSUER UNDER THE PANEL AND A SAMSUNG MOBILE APPLICATION CAPTURE THE DB IN THE UPPER PANEL.
3. THERMAL CONDUCTIVITY: WITH A SOURCE OF RADIATION BELOW THE PANEL, MEASURED WITH A THERMOMETER THE TEMPERATURE BELOW $T^{\circ} > 50^{\circ} C$ AND HIGHER $T^{\circ} = 30^{\circ} C$.
4. FIRE RESISTANCE: WE SUBMITTED THE PANEL TO A DIRECT SOURCE OF FLAME. BURNED 5 MINUTES AND THE TOTAL RUPTURE OCCURRED AT 18 MINUTES.
5. WATER ABSORPTION: ADD 0.5L OF WATER ON OUR ISOLATION AND CALCULATE THE WEIGHT I HAD. COMPARED WITH THE INITIAL WEIGHT AFTER ABSORPTION.

<p>1. <u>Resistance [UNE-EN-ISO 10545 Parte 3:1998]</u></p> <p>1.1. With bamboo: >850N</p>  <p>1.2. Without bamboo: <850N</p> 	<p>4. <u>Frost-resistance [UNE-EN -ISO 10545 Parte 12:1997]</u></p> <p>No changes after 24h</p> 
<p>2. <u>Reaction to fire [UNE-EN 13501-1: 2007]</u></p> <p>Change color (black) No transmit heat to inside</p> 	<p>4. <u>Water-absorption [UNE-EN ISO 62]</u></p> <p>Cardboard block disintegrates</p> 
<p>3. <u>Moisture-dilation [UNE-EN 772-13: 2001]</u></p> <p>No changes after 2h</p> 	<p>6. <u>Resistance to chemicals [UNE-EN-ISO 10545 Parte 3: 1998]</u></p> <p>7.1. Bleach: disintegration of corn stalks 7.2. Ammonia: no changes 7.3. Vinegar: no changes</p> 

CONCLUSION:

- Some interesting final products
Different kinds of building systems



Vegetal roof made of beer cans



Insulation wall made of Nespresso boxes

- Some final products
Different kinds of insulating materials



Insulation made of filters of cigarettes



Insulation made of pine trees needles

b) Main conclusions

- Good way of making students work with raw materials



- Redundant use of resins and chemical glues



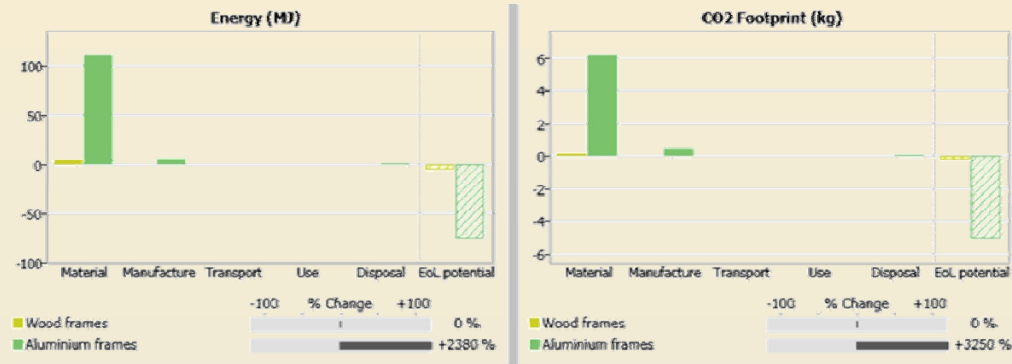
- Lack of facilities: labs, teachers, time
- Home-made essays: lack of a database
- Learning to work in teams



5. FUTURE GOALS

a) Working with CES-EDUPACK

- Verify results
- Quantify and compare with other existing solutions
- Increase the existing database - exchange knowledge with other institutions



b) Collaborative work

- Team work not group work
- Groups limited to three components
- Needs of more quantity of practical hours

c) Experimenting and working with materials

- Thinking over new materials
- Thinking over wastes in building

THANK YOU FOR EVERYTHING

WE WAIT FOR YOU AT BARCELONA

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