

# Teaching Building Materials: Properties and Life Cycle Analysis

## INTRODUCTION

We describe a teaching activity carried out in the building materials courses of the Building Engineering degree. In recent years, concepts such as sustainability and environmental impact have gained importance, and therefore it is mandatory to include them in the education stage. The main goal of this activity, to make the students aware of the different environmental impact that materials used in the same application can

produce and also which the stages involved to evaluate these contributions are.

In this activity we try to combine the concepts of Life Cycle Analysis together with the study of the intrinsic properties of building materials. As a result, the student will receive an approach of technical properties linked with the environmental aspects.

## CONTEXT

This work is part of the subjects of building materials in the Building Engineering degree. Although the degree has included environmental aspects in many subjects, we consider necessary to extend such content. Often, these contents are simply theoretical and insufficient for future professional practice. In the last course of the degree the students can choose different electives, and some of these are about environmental issues. However, for us is very interesting that the students acquire these concepts in the early courses of the degree in order to consolidate them.



## DESCRIPTION

This work consists on the study of the materials of one modern building of Barcelona. Students are divided in groups of 3 or 4. Each group has to select a building of the 22@ district of Barcelona. 22@ belongs to a new urban masterplan approved in 2000 that aimed at transforming the old industrial area of Poblenou into a technological hub.

Students should visit the building in order to take pictures and identify the materials of the building. Afterwards they have to describe in detail the properties and uses of each material, as well as the building regulation that apply in each case. All this information has to be included in the first deliverable (8 weeks after the beginning of the course).

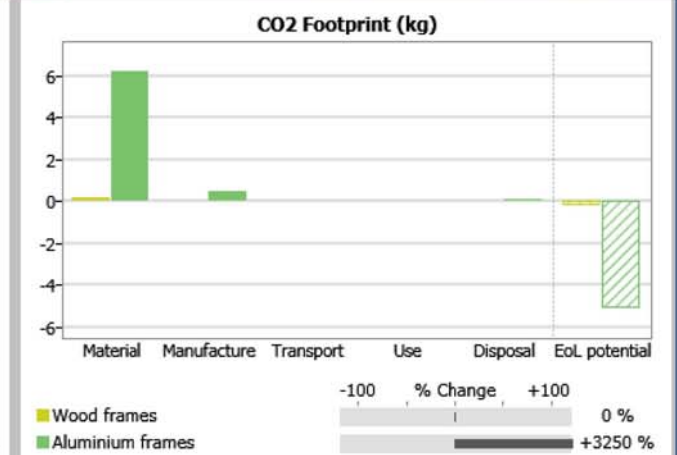
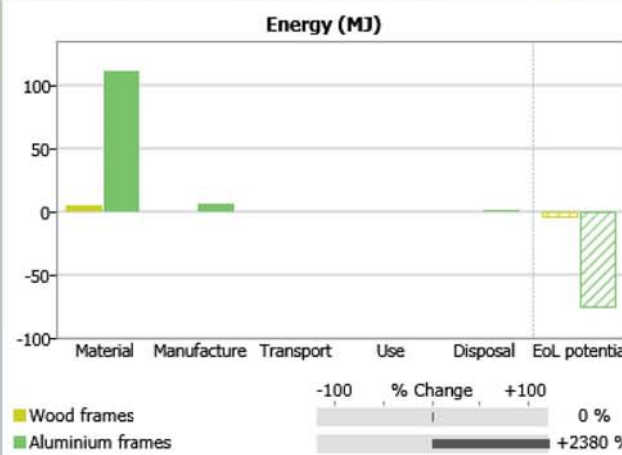
The second part of the activity is based on the study of the environmental impact of building materials. The group has to select one of the materials of the building and compare it with a proposed alternative material.

The final deliverable is a video, where the students should include the description of the building as well as the comparative of the LCA of the chosen materials.

The videos are showed in the last session of the course. The teachers promote the discussion and debate among the students.



IDENTIFICACIÓN DEL MATERIAL	
Nombre del material:	Chapa de acero galvanizado
DESCRIPCIÓN GRÁFICA:	Fotografía/Croquis/Detalle
CARACTERÍSTICAS TÉCNICAS	
<b>Dimensiones</b>	
Ancho:	110 cms
Longitud:	Hasta 1200 cms
Espesor:	0.8 cms
Densidad	7850 kg/m <sup>3</sup>
Composición material:	Chapa de acero revestido con una aleación de aluminio-zinc (composición 55% Al y 45% Zn)
Dureza	142 HBN
Resistencia al fuego	Material no combustible con una gran resistencia al fuego. Protegido con los elementos inertes correspondientes ese valor aumenta a niveles comparables a los de materiales de los sistemas de construcción tradicional o sistemas húmedos.
Modulo elástico:	19.5-20.5 · 10 <sup>10</sup> N/m <sup>2</sup>
Normativa aplicable	<ul style="list-style-type: none"> <li>Procesos de recubrimiento por zincado electrolítico: La normativa de referencia y aplicable a este procedimiento es la UNE EN 12339 para procesos en discontinuo y la PNE-Pr EN 10152 para procesos en continuo.</li> <li>Procesos de metalización por zinc: La norma de referencia para este procedimiento es la UNE EN 22063, además de la normativa ISO 2063 "Recubrimientos de zinc, aluminio y sus aleaciones mediante metalización por termorrociado sobre hierro y acero al carbono".</li> <li>Sherardización: La norma de referencia para este procedimiento es la pr EN 13811.</li> <li>Depósito mecánico de zinc: La norma de referencia en este caso es la pr EN 12683.</li> <li>Procesos de pintado por capas de pinturas ricas en zinc: La</li> </ul>



## RESULTS

In general we have obtained satisfactory results regarding the enthusiasm and motivation of students. They acquire a global knowledge of the different systems of the buildings. At the same time, they analyse several applications of building materials. Furthermore, the students have their first contact with the application of sustainable criteria. The use of the CES EduPack database offers the possibility to perform a quantitative analysis of the footprint (CO<sub>2</sub> emissions) and energy consumption.

VIDRE ARMAT	Característiques tècniques
	Diàmetre: 30 cm Espessor: 6 mm Densitat: 14,5 Kg/m <sup>2</sup> Composició: Vidre colat amb malla metàl·lica Fabricant: Glasfabrik Lamberts GmbH & Co. KG
Normativa aplicable: UNE EN 572-1	
Consum energètic en la seva fabricació: 27,7 – 30,6 MJ/Kg	
Fonts consultades: es.wikipedia.org/wiki/Vidrio_armado www.exportpages.es/fabricantes/vidrio-armado-1074406033-1.htm www.pilkington.com/southamerica/chile/spanish/products/bp/bybenefit/decoration/c_vidriocatedral/default.htm CES EduPack 2012	
Ubicació en l'edifici: en portes d'accés a escales	

Vidre laminat 6+6	Característiques tècniques
	Grosseur: 6mm+6mm Densitat: 2500kg/m <sup>3</sup> Composició: vidres formats per: sílice (73%), sodi (12%) i calci (15%) separats amb butílic de polivinil. Tractament: reflectant al vidre exterior i sense tractament a l'interior. Fabricant: Technal
Normativa aplicable: UNE-EN ISO 12543-2	
Consum energètic en la seva fabricació: 27,7 – 30,6 MJ/kg	
Fonts consultades: http://www.technal.es CES EduPack 2012	
Ubicació en l'edifici: en la façana nord	

## AREAS FOR IMPROVEMENT

After the experience in supervising this study, we found two considerable aspects: First of all, we have observed that the students have lack knowledge about environmental aspects. However this situation should be consider normal due to they are still in the beginning of the degree.

The other aspect that we have considered to improve is lack specific materials in the field of architecture and building. Some materials, usual in our country are not included in the database CES EduPack and this implies make adjustments of the data existing materials.

## CONCLUSIONS

We can conclude that the experience has been grateful. In future courses, the same type of work will be carried out again, but increasing several worked aspects with the support of CES EduPack as a fundamental tool.

Furthermore, we are trying to involve teachers of other subjects in order to improve the transversality aspects of this kind of works.