



Universitat de Lleida

DEGREE CURRICULUM

# SUSTAINABLE CONSTRUCTION

## 3

Academic year 2015-16

## Subject's general information

<b>Subject name</b>	Sustainable Construction 3
<b>Code</b>	101433
<b>Semester</b>	1r Q Continuous Assessment
<b>Typology</b>	Optional
<b>ECTS credits</b>	6
<b>Theoretical credits</b>	0
<b>Practical credits</b>	0
<b>Office and hour of attention</b>	with appointment
<b>Department</b>	Medi Ambient i Ciències del Sòl
<b>Teaching load distribution between lectures and independent student work</b>	60 h in the classroom (40%) 90 h self employment (60%)
<b>Modality</b>	Presencial
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.
<b>Language</b>	English
<b>Degree</b>	Degree in Architectural Technology
<b>Distribution of credits</b>	Dr. Jérôme Barrau: 6 credits
<b>Office and hour of attention</b>	with appointment
<b>E-mail addresses</b>	jerome.barrau@udl.cat

Dr. Jerome Barrau

## Subject's extra information

Subject that requires continuous work throughout the semester in order to achieve the goals. We suggest you the joint realization of Sustainable Construction 2, due to the great interction between both subjects. You can find educational materials and other documents related to the subject Campus: <http://cv.udl.cat>

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## Learning objectives

- Assess the main parameters that affect the energy efficiency of buildings.
- Know the different standards of sustainable construction and the differences between national regulations on energy efficiency in buildings.
- Interpret the main concepts related to energy certification and energy audits.
- Apply the state, regional and local rules and regulations.
- Know and use the tools to study the improvement of energy efficiency of buildings.
- Take measurements to analyze the energy efficiency of buildings.
- Develop procedures for energy rating and energy audits of buildings.
- Generate documents of energy certification of buildings from government programs.

## Competences

### Strategic competences of UdL

- UdL2 Command of a foreign language.

### Cross-disciplinary competences

- EPS3. Capacity to convey information, ideas, problems and solutions to both a specialized and no specialized public.
- EPS7. Capacity to work in situations with a lack of information and/or under pressure.
- EPS8. Capacity of planning and organizing the personal work.
- EPS9. Capacity for unidisciplinary and multidisciplinary teamwork.
- EPS13. Capacity to consider the socioeconomic context as well as the sustainability criteria in engineering solutions.

### Specific competences

- GEE12. Manufactured or traditional constructive systems and materials knowledge, its varieties and physics and mechanical characteristics that define them.
- GEE13. Capacity to adapt the materials of construction to the typology and use of buildings; manage the reception and the quality control of the materials, its use in the building works, the execution control of the units of work and the performance of tests and final proofs.
- GEE20. Knowledge of the environmental impact evaluation for building and demolition process, of sustainability in buildings, and of the procedures and techniques to determine the energy efficiency in buildings.
- GEE21. Capacity to apply technical rules to the building process, and produce documents of technical specification of the procedures and constructive methods of buildings.

## Subject contents

Unit 1. INTRODUCTION

- 1.1. Comfort and energy
- 1.2. Energy and Environment
- 1.3. Residential Sector
- 1.4. Environmental assessment of buildings

## Unit 2. ENERGY EFFICIENCY

- 2.1. Definition
- 2.2. Regulations
- 2.3. Energy certificates
  - 2.3.1. Definition
  - 2.3.2. Features
  - 2.3.3. Objectives
  - 2.3.4. Scope
- 2.4. Energy audits
  - 2.4.1. Definition
  - 2.4.2. Features
  - 2.4.3. Objectives
  - 2.4.4. Scope
- 2.5. Standards of energy efficient buildings

## Unit 3. PARAMETERS AFFECTING THE ENERGY PERFORMANCE OF BUILDINGS

- 3.1. Classifications
  - 3.1.1. By phase
  - 3.1.2. By type of involvement
- 3.2. Parameter Description
  - 3.2.1. Parameters relating to the thermal envelope of buildings
  - 3.2.2. Parameters related to passive systems of buildings
  - 3.2.3. Parameters for active systems in buildings
    - 3.2.3.1. HVAC Systems
    - 3.2.3.2. Lighting Systems

## Unit 4. MEASUREMENT TECHNIQUES FOR THE ANALYSIS OF THE ENERGY CHARACTERISTICS OF A BUILDING

- 4.1. Thermography
  - 4.1.1. Fundamentals
  - 4.1.2. Using a thermal imager
  - 4.1.3. Analysis of thermal images
- 4.2. Thermal equipment measurements
- 4.3. Electrical equipment measurements
- 4.4. Analysis by thermal flow meters
- 4.5. Renovations and infiltration measurements
- 4.6. Monitoring

## Unit 5. ENERGY AUDITS

- 5.1. Introduction
  - 5.1.1. Audits in the context of energy efficiency
  - 5.1.2. Regulations
  - 5.1.3. General objectives
  - 5.1.4. Benefits
  - 5.1.5. Best Practices
  - 5.1.6. Types of audits
  - 5.1.7. The market for energy audits
- 5.2. Procedure to conduct an energy audit
- 5.3. Relationship between energy audits (EN 216 501), control and regulation systems (UNE EN 15232) and energy management systems (UNE 216301)
- 5.4. Criteria for evaluating proposals for improvement
  - 5.4.1. Calculation of energy costs
  - 5.4.2. Economic feasibility analysis

## 5.5. Examples

### Unit 6. LIFE CYCLE ASSESSMENT (LCA)

### Unit 7. BACKGROUND PAPER SAVING ENERGY (DB-HE) THE TECHNICAL BUILDING CODE

#### 7.1.DB-HE1: Limitation of energy demand

##### 7.1.1. Simplified option

##### 7.1.2. General option: Software LIDER

#### 7.2. DB-HE2: Efficiency of thermal installations

#### 7.3. DB-HE3: Energy efficiency of lighting installations

#### 7.4. DB-HE 4: Minimum solar contribution to hot water

#### 7.5. DB-HE 5: Minimum PV contribution to electricity

#### 7.6. Relationship between the DB-HE and reducing the environmental impact of building

### Unit 8. ENERGY CERTIFICATES

#### 8.1. Introduction

#### 8.2. Procedure for energy certification of buildings

##### 8.2.1. Simplified option

##### 8.2.2. General option: Software CALENER

##### 8.2.3. Simplified option CE2

#### 8.3. Scale and energy indicators of the grade

#### 8.4. Specifics of the software CALENER GT

#### 8.5. Other tools for building simulations

## Methodology

The main methodology of the course will be divided into:

- 1.-Sessions of theoretical lectures, where the teacher will expose theoretical concepts required for the acquisition of knowledge and for the proper conduct of the practical sessions.
- 2.-Problem sessions, where the teacher will make some examples, but where the students will take an active part in the learning process, by working in small groups or individually.
- 3.-Laboratory sessions, where the students will work in group some practices related to the topics covered in the theoretical sessions.

## Development plan

The development plan will follow the order of the content.

Introduction: 2 hours

Unit 1: 2 hours

Unit 2: 6 hours

Unit 3: 12 hours

Unit 4: 8 hours

Unit 5: 8 hours

Unit 6: 12 hours

Unit 7: 6 hours

Assessment activities: 4 hours

## Evaluation

### **Assessment test 1 (PA1): individual written test, 40%**

Units 1 to 4

### **Work on the limitation of the energy demand and energy certification (AA1) Project, 30%**

Unit 7: Limitation of the energy demand of buildings:

File LIDER

Excel file simplified options

Analysis results document

Unit 8: Procedure for energy certification of buildings:

Excel file simplified option CE-2

File CALENER

Analysis results document

### **Energy audit work (AA2) Resolution of a case study, 15%**

Units 5-6: Quantitative assessment (energy level, economic and environmental) of the sustainability proposals applied to the building object of the activity AA1

### **Oral presentation AA1 and AA2 results (AA3) Oral, 15%**

Clarity of presentation

Respect the rules

Personal contributions

Originality and realism of the proposals

### **Recovery exam, individual written test: Units1 to 8, 70%**

## Bibliography

Recommended Bibliography

### **Books**

Eficiencia energética en edificios: Certificación y auditorías energéticas. Francisco Javier Rey Martínez, Eloy Velasco Gomez. Madrid. Thomsoncop., 2006.

Análisis y gestión energética de edificios: métodos, proyectos y sistema de ahorro energético. William H. Clark II. Mac Graw Hill. 1998.

Guía técnica para el aprovechamiento de la luz natural en la iluminación de Edificios. Grupo de Trabajo formado por el Comité Español de Iluminación (CEI) y el Instituto para la Diversificación y Ahorro de la Energía(IDAE).

IDEA. 2005.

Guía técnica Contabilización de consumos. Asociación Técnica Española de Climatización y Refrigeración (ATECYR). IDEA. 2007.

Guías Técnicas para la Rehabilitación de la Envolvente Térmica de los Edificios. Asociación Nacional de Industriales de Materiales Aislantes (ANDIMA). 2007.

Els graus-dia de calefacció i refrigeració de Catalunya. Resultats a nivell municipal. Generalitat de Catalunya. Departament de Treball, Indústria, Comerç i Turisme. Institut Català d'Energia. 2003

## **Scientific papers**

Do LEED-certified buildings save energy? Not really... . John H. Scofield. Energy and Buildings. 41 (2009) 1386–1390.

## **Web references**

IDAE- Institut per a la Diversificació i l'Estalvi de l'Energia

<http://www.idae.es/>

ICAEN- Institut Català d'Energia

<http://www.icaen.net/>

Codi Tècnic d'Edificació

<http://www.codigotecnico.org/>

Agenda de la construcció sostenible

<http://www.csostenible.net/>

Infodomus. Construcción Sostenible y Eficiencia Energética

<http://www.infodomus.ws/>

E-nergias: Portal de l'energia per als edificis

<http://www.e-nergias.com/www/index.html>

Plataforma Edificació Passivhaus

<http://www.plataforma-pep.org/>

Arquitectura y clima (pàgina en francès)

<http://www-climat.arch.ucl.ac.be/>

Comitè Europeu de normalització. Àmbit de la construcció

<https://www.cen.eu/cenorm/sectors/sectors/construction/index.asp>

## **Audiovisual material**

Porta bufant (Blower door): Funcionament i interpretació de resultats

<http://www.youtube.com/watch?v=OvWAoL5uR3c>

<http://www.youtube.com/watch?v=LGHnx4qmDj0>

<http://www.youtube.com/watch?v=a-C9lcIEQcc>

Casa bioclimática

<http://www.youtube.com/watch?v=CKX1gbHlqeM>

Edificio bioclimático del CENER

<http://www.youtube.com/watch?v=ahFjOoXrVnM>

## **Other materials in the Virtual Campus**

Guia docent de l'assignatura

Material didàctic

Llistat de propostes de temes de PFG

Manuais d'usuaris dels programes oficials LIDER i CALENER

Manual LIDER de URSA

Plan estratégico España Sector Edificación 2004-2012

ESTUDIS MONOGRÀFICS Núm.14



## Regulation

*All regulations are available in digital format on the virtual campus.*

Documento Básico HE - Ahorro de energía

REAL DECRETO 47/2007, de 19 de enero, por el que se aprueba el Procedimiento básico para la certificación de eficiencia energética de edificios de nueva construcción.

Opción Simplificada para la Calificación de Eficiencia Energética de Edificios de Viviendas. IDAE.

Escala de Calificación Energética para Edificios de Nueva Construcción. IDAE.

Directiva 2002/91/CE del Parlamento Europeo y del Consejo, de 16 de diciembre de 2002, relativa a la eficiencia energética de los edificios.

Ordenança solar tèrmica de Lleida. Butlletí Oficial de la província, núm. 99. 21 de Juliol de 2005.

DECRET 21/2006, de 14 de febrer, pel qual es regula l'adopció de criteris ambientals i d'ecoeficiència en els edificis.

UNE 216501:2009 Auditorías energéticas. Requisitos.

UNE 216301:2007 Sistema de gestión energética. Requisitos.