310411 - Reduction, Reutilization and Recycling in Construction

Coordinating unit: 310 - EPSEB - Barcelona School of Building Construction
Teaching unit: 753 - TA - Department of Architectural Technology
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED BUILDING CONSTRUCTION (Syllabus 2014). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Spanish

Teaching staff
Coordinator: Gómez Soberón, José Manuel Vicente
Capellà Llovera, Joaquin

Opening hours

Timetable: Check the School Website (https://www.epseb.upc.edu/), the student attention schedule section.

Prior skills

1.- Generic transversal abilities.
   - Ability of analysis and synthesis.
   - Ability of organisation and planning.
   - Work in interdisciplinary team.
   - Adaptation to new environments.
   - Ecological social commitment.
   - Environmental interest.
   - Research and inventive interest and intuition.
   - Ability to apply new knowledges to the usual practice.

2.- Specific abilities:
   a) Cognitive:
      - Basic knowledges of the behaviour of the materials used in architecture and engineering constructions, like:
        environmental deterioration processes, minimum requirements.
      - General mechanical behaviour and physical properties of the materials.
   b) Procedural-Instrumental:
      - Ability of application of second generation materials on construction processes, either for architecture or engineering elements.
      - Evaluation of variations and its implication in the general behaviour of the materials used on construction.
      - Quantifying of the environmental valuations of the recycled materials.
   c) Abilities-Attitudes:
      - Ability to adapt the current technology of the construction to new alternatives in the construction processes.
      - Predisposition for the application of the recycled materials in the construction.

Requirements

Technical English at basic level or reading level.

Degree competences to which the subject contributes
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Basic:
1. Possess and understand knowledge which provide a basis or opportunity to be original in the development and/or application of ideas, usually in a context of research.
3. The students must be able to apply the acquired knowledges and their ability of resolution of problems in new or little known environments inside more wide environments (or multidisciplinary) related with their study field.
4. The students must be able to integrate knowledges and front to the complexity to formulate opinions from an information which, being incomplete or limited, includes reflections about the social and ethical responsibilities linked to the application of their knowledges and opinions.
5. The students must possess the learning abilities which allow them to continue studying in a way which should be to a large extent self-directed and autonomous.
9. The students must be able to communicate their conclusions and the knowledges and ultimate reasons which support to specialised and non-specialised audiences in a clear mode and without ambiguities.

Specific:
2. Capacity of innovation: identify the reasons and the mechanisms of the technologic and technical changes.

Generical:
6. Prepare the student in the using of tools that are common in the investigation activities, like the analysis and treatment of data, just like methodology and investigation techniques.

Transversal:
7. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
11. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Teaching methodology
- Master exposition classes.
- Active learning.
- Autonomous learning.
- Teamwork.
- Cooperative learning.
- Puzzle method.
- Case method.
- Poster.
- Forum.

Learning objectives of the subject
Te new trending in the study of the optimal life cycle, the new specifications and environmental requirements and the current economic impositions in the construction field, cause that currently we plan to minimise the environmental impact, design beyond the useful life and apply new materials of second generation in the construction field. For these reasons, the general objective of the course is to provide knowledge regarding to how to minimise (Reduce), how to rebuild (Reuse) and how to use alternative materials (Recycle) according to the alignment of the named Horizon 2020.

With the content of this subject it is pretended to provide a coherent answer to questions of big importance for the professional who course it. These questions are related with aspects like: On the one hand the obtaining of the knowledge which allow to adapt the new environmental requirements of the current society to the construction technology, and on the other hand to provide the abilities and competences to adapt, propose, investigate and implement new applications or processes which count on with the concept of reduction, re-using and recycling in their application to the construction.
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The students must acquire the competences, skills and abilities presented before.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 125h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>15h 12.00%</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>5h  4.00%</td>
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<tr>
<td>Hours small group:</td>
<td>5h  4.00%</td>
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<tr>
<td>Guided activities:</td>
<td>10h 8.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h 72.00%</td>
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### Content

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<th>Title English</th>
<th>Learning time: 45h 50m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
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<td>Practical classes: 1h 50m</td>
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<tr>
<td></td>
<td>Laboratory classes: 1h 40m</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
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<tr>
<td></td>
<td>Self study: 33h 20m</td>
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</tbody>
</table>

#### Description:
- 1.1 The environment and the sustainable development.
- 1.2 The wastes, its generation and its typologies.
- 1.3 Waste treatment policies.
- 1.4 The recycling and the cycle of life of the materials.
- 1.5 Management of wastes.
- 1.6 The Analysis of the Cycle of Life (LCA) of the materials.

Planning: The previous module will be taught during the weeks 1, 2, 3, 4 and 5 of the course.

#### Related activities:
- Activities inside class:
  - M1A1 Class. Active learning and evaluation of equals.
  - M1A2 Class. Individual work.

- Activities out of class:
  - M1 A1 at home. Reading/synthesis/expression.
  - M1 A2 at home. Positive interdependence.

- Test:

- Class forum.

- Work of Real Cases.

#### Specific objectives:
- At the end of the module, the student should be able to:
  1. Identify and correlate in writing the environmental deterioration and the generation of wastes.
  2. Express and explain the contaminating vectors.
  3. Explain in writing which are the main atmospheric contaminants.
  4. Define the concept of waste, correlate it with the PNB and with the products of the countries of our context.
  5. Define and apply the concepts of reducing (minimisation), valuation and treatment.
  6. Establish in writing the economic and environmental actuation limits.
  7. Establish flow charts to define the LCA of the materials.
  8. Evaluate and define by means of the LCA optimal alternatives in the construction.
**Description:**
2.1 General concepts of reuse.
2.2 Foundations and containment elements.
2.3 Structural elements.
2.4 Elements surrounding the building.
2.5 Interior elements of a building.
2.6 Electrical and mechanical facilities of the building.
2.7 Practical cases documented.

Planning: This module will be done during the weeks 6, 7, 8, 9 and 10 of the course.

**Related activities:**
Activities inside class:
M2 A1 Class. Teamwork, Make a Poster, Evaluation of equals.

Activities out of class:
M2 A1 at home. Individual work out of class.
M2 A2 at home. Group work out of class, Positive Interdependence.

Test:
RRR M2. Evaluation of questionnaire with multiple choice.
Class forum.

Work of Real Cases.

**Specific objectives:**
At the end of the module, the student should be able to:
1. Explain in writing or orally the advantages of reuse the construction materials, according to environmental aspects, advantages for the project and for the companies.
2. Select with the base of the advantages mentioned, between realise a reuse in situ or process the materials.
3. Could choose which type and in which situations is applicable to reuse foundation elements.
4. Could choose in which situations is applicable the reuse of a structure or part of it.
5. Could choose which type and in which situations is applicable the reuse of surrounding elements of a building.
6. Could choose which type and in which situations is applicable the reuse of interior elements of a building.
7. Could choose which type and in which situations is applicable the reuse of electrical and mechanical facilities elements.
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**title english**

<table>
<thead>
<tr>
<th>Learning time: 32h</th>
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<tr>
<td>Theory classes: 5h</td>
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<tr>
<td>Laboratory classes: 1h 40m</td>
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<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 23h 20m</td>
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</tbody>
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**Description:**
3.1 Production of materials from wastes.
3.2 Recycled concrete sands for new concretes.
3.3 Use of drosses as construction materials.
3.4 Ashes originating from incineration.
3.5 Wastes for the production of thermal and acoustic insulation.
3.6 Application of muds of purification systems.
3.7 Mining wastes.
3.8 Application of sands coming from the demolition in highways.
3.9 Recycling of tyres as elements of paving surfaces.

This module will be done during the weeks 11, 12, 13, 14 and 6 of the course.

**Related activities:**
Activities inside class:

Test:
RRR M3. Evaluation of questionnaire with multiple choice.

Class Forum.

Work of Real Cases.

**Specific objectives:**
At the end of the module, the student should be able to:
1. Define the applications of the garbage from various wastes.
2. Explain the different techniques of processing of the wastes.
3. Define the applications of the recycled materials with content of recycled material.
4. Apply the current regulations of the recycled materials, similarities and differences regarding to the used materials, and reference values of their calculation constants.
5. Identify the variations of the properties of the recycled materials regarding to their different phases or processes, their mechanical behaviour or performances.
6. Identify the variations of the properties of the recycled materials regarding to their durability in general terms.
7. Determine the application of design of dosage or incorporation of recycled materials, taking into account the peculiarities of their composition and mechanical capacity.
Qualification system

1. Evaluation of Equals (EI).
2. Positive Active Involvement (PAP).
3. Work Inside Class (TDA).
4. Work Out of Class (TFA).
5. Questionnaire with Multiple Choice (TRM).
6. Work of Real Cases (TRM).

Final Mark of the Course = (EI x 5%) + (PAP x 15%) + ((TDA+TFQ) x 25%) + (TRM x 30%) + ((TCR+ ETCR) x 25%)

Regulations for carrying out activities

It will be necessary to pass with a mark higher or equal to five in two of the five evaluation methods described here; the two evaluation methods with minimum mark to pass are the 6 and 7. The works or activities delivered out of the deadlines established at the beginning of the course will cause the reduction of their marks. The final individual mark of each student will be the result of the arithmetic mean of the evaluation methods mentioned before.
# Bibliography

## Basic:


## Complementary:


## Others resources:

### Hyperlink

- **Campus de la Asignatura.**

### Computer material

- **Athena. Sustainable Materials.**

- **BEES : Building for Environmental and Economic Sustainability**

- **Cype Arquimedes. Gestión y Control de Obra.**

- **The Net Waste Tool**