



Course edition	2	Academic Year	2023/2024
Ref.	MBUILD12/ M12		
MODULE	SPE/SBD - SUSTAINABILITY IN BUILDING DESIGN		
ECTS	6		
Year/Semester	Y1/S1		
Class hours	4 h/week * 13 weeks = 52 h		
Teaching location	FEUP, Porto, Portugal		

## 1. OBJECTIVES

- Sustainability, besides being a word in fashion, should be a concern for all human beings, in order to improve the possibilities of the survival of mankind in the current millennium.
- Sustainability has many faces. If looking into the Oxford Dictionary, this is what one gets (<https://www.oxfordlearnersdictionaries.com/definition/english/sustainability>):

**sustainability** *noun*

 /səˌstɜːnəˈbɪləti/

 /səˌstɜːnəˈbɪləti/

[uncountable]

1 ★ the use of natural products and energy in a way that does not harm the environment

- a company well-known for its commitment to environmental sustainability

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2 ★ the ability to continue or be continued for a long time

- The strength and sustainability of the economic recovery is still in doubt.

- The use of natural products and energy stand on top, and are usually the main drivers when talking about sustainability. And they should, no question about it: efficient use of energy and materials, trying to include them in a circular economy approach is, undoubtedly, the way forward.
- But I would like to bring your attention to no.2: **the ability to continue or be continued for a long time**.
- Buildings exist for people to use, to perform their activities, may that be work, study, sleep, play, whatever. However, buildings are space, materials, environment, places where one experience feelings. And the way they are perceived or used are different from people to people, even in the same family or work community. A classroom is used by both students and teachers (same space, same technologies, same materials), but they require different responses from it, even in different modules that use the same room.
- Yet, perhaps even more important, "the ability to continue or be continued for a long time" is relevant when talking about housing buildings.
- A house, often, is the home of a family for a long time. But that family evolves. For instance, it may start as a couple, in their early adult life, then children may arrive – first toddlers, after kids, then teenagers –, and, after a while, they leave and the house is again just for the couple. But all these people, that share the same home during some decades, grow in their age and modify the way they look to and how they want their home to perform. Activities to be done change, sleep can become less important than entertaining friends, cooking may become a hobby requiring more space and appliances, a library may have expanded to ask for a dedicated reading corner, what is wanted today may not be the same in a few years or intended for the same people.

- Therefore, “Sustainability” should be perceived as much as energy efficiency and responsible use of materials, as to ensure that what is designed today can adapt to new requirements, both in what concerns its physical materialization and the space it has formatted.
- MBUILD congregates students from many different places and, obviously, with different perspectives about what they will want to do after the course. Some might try to develop a career away from their home country, some will want to go back, with their newly upgraded knowledge and skills, some others will have (or not yet) perspectives that fall in-between. Moreover, in what concerns the design itself of buildings, they may be involved in projects to be implemented, for instance, in the EU, in their country, in other countries, working freelance, for a local company, for a foreign company working abroad, and so on. The possibilities are endless.
- Whatever the situation might be, the fact is that a lot of things will have to be accounted for when designing a sustainable building. Besides, among those, some will be pertinent for some places but not for others, some solutions will be “sustainable” in country A but not in country B.
- This is to say that in “SBD Sustainability in Building Design” we will not concentrate in providing specific answers to the several expertise that are involved in the design of a building. If we tried to do so, we would hit good answers for a couple of contexts but would surely miss the largest part.

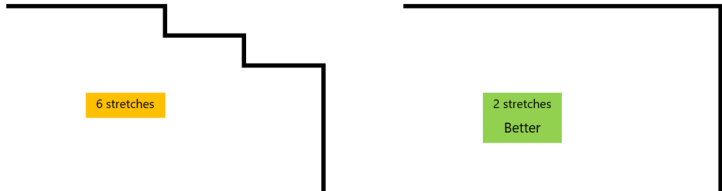
## 2. LEARNING OUTCOMES AND COMPETENCES

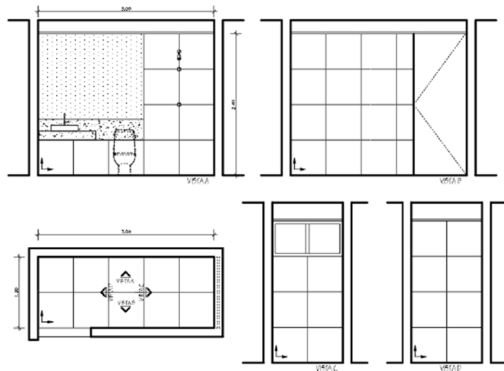
Therefore, Sustainability in Building Design will try to guide the students through the several main expertise in the development of a sustainable building design proposal and, for each, provide a set of reflection/analysis/exploration routes that may help to find the answers, **IN THE CONTEXT OF A SPECIFIC PROJECT**, to:

- What may be the significant and applicable strategies for a sustainable approach;
- What materials could be used that fulfil a sustainable construction attitude;
- What should be done to ensure circularity of the building itself (materials and space);
- What parameters should be investigated to define options;
- How different options can be assessed for decision;
- Where is available relevant information for the specific design area and connected expertise.

The result of this module will be a **Booklet** following the template and examples below. Each group will develop their own research and present their conclusions and, at the end, the Booklet will join all contributions, hopefully giving a wide framework about what should be considered, reflected upon and/or taken into account in the various expertise involved and their interconnections.

**BOOKLET OF STRATEGIES AND CONSIDERATIONS FOR SUSTAINABLE DESIGN – EXAMPLES – TEMPLATE**

BOOKLET OF STRATEGIES AND CONSIDERATIONS FOR SUSTAINABLE DESIGN		
1. Expertise	<b>Water Supply</b>	01/1
2. Issues	Recovering piping when disassembling or transforming building.	
3. What to aim at and why	Have long stretches of piping between accessories, to facilitate dismantling and foster its use in other configurations.	
4. What to prevent and why	Embedded piping in walls or floors as its recovery is difficult and provokes waste and the need of repairs.	
5. How to assess and choose	Number of linear stretches for a given layout.	
6. Sketches and details		
7. Sources of information		
8. Obs.		

BOOKLET OF STRATEGIES AND CONSIDERATIONS FOR SUSTAINABLE DESIGN		
1. Expertise	<b>Architectural Space Design</b>	02/1
2. Issues	Possibility of using standard finishing for wall panels.	
3. What to aim at and why	Define length of partitions as multiples of the material to be used, as well as floor height, to avoid extra work for adjusting dimensions.	
4. What to prevent and why	Partitions with recesses or bulges of smaller dimensions than the elements of the material to be used, creating waste and pieces unable to be reused elsewhere. If necessary, use half-dimension to reduce wasted pieces.	
5. How to assess and choose	Number of finishing pieces needed to be adjusted/Total number of finishing pieces [%]	
6. Sketches and details		
7. Sources of information	Habitação de Baixo Custo - Definição e Estratégias de Desenvolvimento de Projeto. Luciana Costa Correia, FEUP, 2020	
8. Obs.		

### 3. SYLLABUS/TOPICS

1. **Sustainability in Building Design (SBD) Framework:** What is to think "Sustainable". How does a comprehensive design happen? Who is involved and what types of arrangement between stakeholders can exist, and what impact do they have on a sustainable outcome. Definitions; beyond energy and materials; social and physical communities.
2. **Sustainable Architectural Space Design:** What makes a space sustainable in its use as a place to develop activities? What guidelines a designer should follow to achieve such spaces? How can an architect assess several design options? Designing for long-term use; housing and distance-working; use of space and of external areas; private vs. communal facilities; impact of decisions on materials and technical systems; designing with focus on less waste and higher reuse potential.
3. **Sustainable Structural Design:** What makes a structure sustainable in its use in time and in its integration with the other expertise? How the several types of structural concepts accommodate the goal of sustainability? What materials can be used and how do they perform in that respect. Member locations and dimensions, and their impact on future evolutions. How important is disassembly, recycling and reuse in the field of structural elements? What technologies exist for this purpose? Strength ability and member dimensions; impact of protruding elements on future rearrangement of spaces; reuse of structural materials; information about member load bearing capacity.
4. **Sustainable Water Supply and Drainage Design:** What are the sustainable approaches for the supply and the recovery of water? What are today's water supply requirements, and what equipment exists that is adjusted to those requirements. How to develop piping arrangement with installation focused on offsite assembly? How can rainwater extremes be accommodated in building design? What architectural constraints result from the collection and use of rainwater? Availability of water resources and their impact on building fixtures design; appliances for low water debit; extreme weather and public networks; reuse of rainwater; wastewater treatment and reuse of output.
5. **Sustainable Energy Conservation Design:** Materials and strategies for insulation and its impact on the overall physical dimensions of the building. Balancing insulation with ventilation. Approaches for cold and warmer countries and its impact of building inception. Technologies, requirements and constraints for energy production and use at the scale of a building. Strategies for heat and cold environments; shading and inertia; renewable energy harvesting in buildings.
6. **Sustainable Urban Environment Design:** How does the placement and dimensions of a building impact sustainability? How does the urban modelling, at the level of quarter and city, produces impact on sustainability? The core topics include the quality of the stay of people visiting the outdoor public space. That quality is driven by the microclimate and the ability of climate adaptation and resilience, overheating prevention through vegetation and water combined - with the options to communicate with other people in the exterior as well as the interior spaces. Biodiversity strategies can support the quality of outdoor areas. Also particular focus is dedicated to the promotion of local natural energy potentials and a possible interaction with mobility: The connection with the environment is strengthened and mobility management strategies for car-free districts are rewarded.
7. **Reversible States and Tectonics:** The planet is no longer stable and climate is changing. This together with scarcity in materials and resources, is a challenge in the way we built today. We are still today using resources, in ways that leads to exploitation and exhaustion of our landscapes. We need to know the these "new" landscapes and how we create living nature instead of ruins. We need accept equal dependencies, human and non-human – we are all part of the same fluid nature. States indicate that materials, landscapes, cities are in different states and we need to learn about materials and resources (nature), in order to apply circular processes or reversibility. Buildings come from nature, we therefor need to know the value of our common resources and materials and how to make sure they can go back and become nature again or being used again and again. Designing for "reversibility" demands a rethinking of our design approach. We will explore designs within reversible tectonics, including

materials lifecycle to understand where our resources and materials are coming from but also how we design in a reversible way – meaning how do we plan and design for cities, buildings or materials to be reused when it's current state become obsolete.

8. **Sustainable production of buildings:** materials, modularity, offsite construction; sub-contracting, wages and workmanship rotation; productivity in the CI.
9. **Overview:** relevance and application in diverse countries; balancing short-term needs and sustainable approaches.

For each of the main topics referred above, experts will be invited to deliver a lecture/talk, addressing the more pertinent issues under their design expertise. Therefore, the order of the subjects indicated in the Planning may change due to the agenda of the invited speakers.

#### 4. MANDATORY REFERENCES

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To be provided during the classes, according to the development of the themes and the work developed by the students.

#### 5. ADDITIONAL REFERENCES

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- Robinson, H; Symonds, B; Gilbertson, B; Ilozor, B. (2015). Design Economics for the Built Environment: Impact of Sustainability on Project Evaluation. Wiley-Blackwell, ISBN 978-047065909
- Goodhew, S (2016). Sustainable Construction Processes: A Resource Text. Wiley-Blackwell, ISBN 978-1405187596
- Mumovic, D; Santamouris, M (2015). A Handbook of Sustainable Building Design and Engineering (BEST Buildings Energy and Solar Technology). Routledge, ISBN 978-1138965546
- Preiser, W; Vischer, J (2005). Assessing Building Performance. Elsevier, ISBN 0-7506-6174-7
- Changall, S; Mohammad, A; van Nieuwland, M (2015). The construction productivity imperative. McKinsey & Company.
- HM Treasury (2015). Fixing the foundations: Creating a more prosperous nation. HM Treasury, ISBN 978-1474123006
- Barbosa, F et al (2017). Reinventing Construction: A route to higher productivity. McKinsey Global Institute, McKinsey & Company.
- Other resources to be provided during the module.

#### 6. ASSESSMENT TYPE

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- Distributed only (courseworks and activities developed during the semester)

## 7. ASSESSMENT COMPONENTS AND CALCULATION OF FINAL GRADE

### 7.1. Normal assessment

The module will be assessed by:

- Courseworks, to be developed during the teaching period;
- Discussion, at the end of the teaching period.

Group Courseworks	75%
Individual Discussion	25%
	100%

- The global mark will consider equal weight for each topic coursework.

### 7.2. Resit assessment

In the case of students that failed the module in the normal assessment, and as the next instance of the module will occur when they will not be in FEUP, the following procedure will be followed:

- Individual re-submission of TWO of the Courseworks (at student's choice);
- Individual discussion, to be done online;
- The previously obtained grades for the remaining Group Courseworks will be considered for the calculation of the final grade.

## 8. TEACHING STAFF

Name	Position	University	email
Jorge Moreira da Costa JMC	Associate Professor	FEUP/UP	<a href="mailto:jmfcosta@fe.up.pt">jmfcosta@fe.up.pt</a>
Maik Neumann MN	Professor Dipl.-Ing	THM	<a href="mailto:maik.neumann@bau.thm.de">maik.neumann@bau.thm.de</a>
Heidi Sørensen Merrild HSM	Professor Industrial PhD Fellow	AARCH	<a href="mailto:hm@aarch.dk">hm@aarch.dk</a>