CU 9.2: BUILDING HEATING PERFORMANCE

Director of studies: Eric MOUGEL

General CU objectives:

Know the methods and tools for the design and optimisation of the building envelope, used by thermal/fluid design offices.

CONSISTS OF:

• Dynamic thermal simulation of buildings:
The objective of this first part is to strengthen the mastery of methods and tools for simulation (STD) and regulatory verification of building performance. Initiation will have previously been offered in the second year in the CU8.1.
The student must be able to conduct a complete study of a building on one or more procurement business tools (software).

• PassivHaus standard:
This second part aims to provide the main keys to envelope design and optimisation of needs (winter and summer thermal). This project work is based on the PHPP design/verification tool of the PassivHaus standard.

• Integration and sizing of HVAC energy systems:
This third part should make it possible to design and dimension the main elements of the ventilation and heating systems of buildings, in particular passive buildings

• Advanced tools and methods for building design:
To meet the expectations of tomorrow, the new problems of high-performance buildings, a more precise consideration of the phenomena of transfers and the behaviour of materials is necessary. Design methods, sizing rules will have to evolve.

This last part presents advanced tools and methods for building design, regulatory and normative developments as well as research issues.

Consists of:

- Part 1: Dynamic thermal simulation of buildings
- Part 2: PassivHaus standard
- Part 3: Integration and sizing of energy systems
- Part 4: Advanced tools and methods for building design

Hourly volume

In-person	*Self-directed study*
28.00 H Lectures	**15.00 H**
64.00 H Tutorials	
0.00 H Practicals	

Positioning of the CU in the School reference system:

after semester 8

Units of skills

In accordance with the RNCP sheet

Updated on 11 April 2023

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Part 1: Dynamic thermal simulation of buildings	**Coefficient 1**
Session leaders: Vincent NICOLAS	
Teaching assistants:	
Prerequisites: CU 8.1+(Heat and mass transfer bases (CU 5.3.M4, CU 6.3)) and humid air (CU 5.4.M2)	
Teaching materials: Course notes – Presentation slides – Project	
Assessment methods: Software– Project with report + oral presentation.	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Be able to carry out the complete baseline study of a building on an STD tool. Understand and know how to leverage tool capabilities.	The objective of this first module is to strengthen the mastery of methods and tools for simulation (STD) and regulatory verification of building performance. The student must be able to conduct a complete study of a building on one or more procurement business tools (software). Presentation and learning how to use the tool. – Implementation of a dynamic thermal spreadsheet for a simple case (Excel) – Numerical study of the impact of insulation and thermal inertia – Learning indicators (Brager and Sankey diagram, Amplification on T°ext, Discomfort etc.) – Highlighting the value of ventilation and passive cooling systems (caps, sunshade, etc.) – Application on real project with special case study (e.g. simulation of heat waves or hot climates)	**7.00**	**16.00**	
		7.00	**16.00**	**0.00**

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Part 2: PassivHaus standard	Coefficient 1
Session leaders: Alexis NICOLAS (PAST Enstib– INERGIA), Myriem GUEDOURD (VS –A Lille)	
Teaching assistants:	
Prerequisites: CU 8.1+(Heat and mass transfer bases (CU 5.3.M4, CU 6.3) and humid air (CU 5.4.M2)	
Teaching materials: Course notes – Presentation slides – Project	
Assessment methods: Project with report + oral presentation (pair work).	

Learning outcomes	Description	Number of student hours (in-person)		
		Lectures	Tutorials	Practicals
Be able to optimise the architecture and envelope of a building to achieve the level of heating needs corresponding to the PassivHaus standard.	Students work in pairs on a tertiary building or collective housing project for which they bring the envelope to the passive level (heating needs but also summer comfort criteria). In particular they cover: – the organisation of a building project according to the main phases of the MOP Act, the main stakeholders and their roles, – how to use the PHPP tool, – the concepts and some solutions specific to passive construction: triple glazing joinery with insulating frame, installation mode with insulation returns on frame, slab insulation, passive insulation levels, study and treatment of thermal bridges, airtightness of the envelope and air renewal. Passive buildings...	7.00	16.00	
		7.00	**16.00**	**0.00**

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Part 3: Integration and sizing of energy systems	Coefficient 1
Session leaders: Alexis NICOLAS (PAST Enstib – INERGIA)	
Teaching assistants:	
Prerequisites: CU 8.1+(Heat and mass transfer bases (CU 5.3.M4, CU 6.3) and humid air (CU 5.4.M2)	
Teaching materials: Course notes – Presentation slides – Project	
Assessment methods: Project with report + oral presentation (pair work).	

Learning outcomes	Description	Number of student hours (in-person)		
		Lectures	Tutorials	Practicals
Be capable of designing and sizing the main elements of the ventilation and heating systems of buildings, in particular passive buildings.	The pair works on a tertiary building or collective housing project for which they have brought the envelope to the passive level (see previous part). They learn how to design heating and ventilation systems. In particular, they cover: – the main notions and concepts of ventilation and heating of buildings, – the main elements (generation, distribution, regulation, control) of heating and ventilation systems, – how to read, understand and carry out the principle diagrams in heating and ventilation, – how to read and produce the site plans, – how to establish the bases of the specific technical clauses and Geotechnical Formation Presentation Dossier (DPGF) type descriptive and quantitative public procurement contracts for building projects.	7.00	16.00	
		7.00	**16.00**	**0.00**

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Part 4: Advanced tools and methods for building design	**Coefficient 1**
Session leaders: Romain REMOND, Arnaud BESSERER, Matthias PAZOLD (IBP Fraunhofer, Holzkirchen–D), Nadja REMOND– SCHULTZE (Lignatec, F), Léo MORCHE (PROCLIMA – Schetzingen–D)	
Teaching assistants:	
Prerequisites: CU 8.1+(Heat and mass transfer bases (CU 5.3.M4, CU 6.3) and humid air (CU 5.4.M2)	
Teaching materials: Course notes – Presentation slides	
Assessment methods: individual Class assignment	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Understand the issues and limitations of current design approaches. Know how to use advanced tools and methods for the design of efficient and sustainable buildings	To meet the expectations of tomorrow, the new problems of high-performance buildings, a more precise consideration of the phenomena of transfers and the behaviour of materials is necessary. Design methods, sizing rules will have to evolve. This last module therefore presents: – advanced tools and methods for building design, – regulatory and normative developments – issues that are the subject of research.	7.00	16.00	
		7.00	**16.00**	**0.00**

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