ENG-445

Building energetics

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Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Obl.
Energy Management and Sustainability	MA1, MA3	Opt.
Energy minor	H	Opt.
Minor in Integrated Design, Architecture and Sustainability	H	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The course presents the main methodological topics of energy management in the building by emphasizing on the thermal energy requirements for the the users' comfort. The technical installations are modelled as well. Finally the economic and environmental evaluation methods are presented.

Content

Introduction: Heat energy flows in buildings.
Occupant comfort: various types of comfort (thermal, visual, air quality)
Thermal and visual Comfort: indoor/outdoor climate, parameters influencing the comfort, the equation of Fanger.Heat transfer: conduction, convection, radiation, steady state and transient conditions in the opaque and transparent elements of construction.Insulation materials: principles and types of heat and acoustic insulators.
Humidity in the building: causes, consequences, migration of vapor, model of Glaser.
Heat generation and distribution: heating energy (electricity, gas, district heating, fuel oil, coal, wood, heat of the environment, solar energy) – heating equipments (heat accumulators, boilers, heat exchangers, heat pumps) – heat distribution and transfer.
Envelopes design: protection against humidity, noise; heat losses through walls and roofs.
Energy performance diagnosis: energy expenditure ratio, energy signature, heat insulation, airtightness, measurement of airflow, efficiency of heat generation.
Economic Optimization and choices of energy options: general methods of techno-economic optimization, free parameters and sizing criteria, the annual costs of the various options and the search for optimal configuration, interpretation of the results and final choices.
Case studies – Computer aided design of envelopes and thermal equipments of buildings.

Keywords

Energy flows; building; energy efficiency; comfort; equipments; assessment; economy;environment

Learning Prerequisites

Recommended courses

Elementary physics

Important concepts to start the course

• Heat transfer

- Comfort
- Heating requirement
- Energy flows in buildings
- Energy equipments
- Techno-economic assessment
- Environmental assessment

Learning Outcomes

By the end of the course, the student must be able to:

- Optimize the energy flows in a building
- Estimate the comfort
- Estimate the cost of an energy system of the building
- Estimate the environment impact of an energy system of the building
- Propose relevant options of energy systems of building

Transversal skills

- Write a scientific or technical report.
- Set objectives and design an action plan to reach those objectives.
- Use both general and domain specific IT resources and tools
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.

Teaching methods

Active participation from the students, with IT support and case study

Assessment methods

Group report on the case study : 40%
Two written tests on the theoretical bases : 60%

Resources

Bibliography

Polycopié + C.A. Roulet, Énergétique du bâtiment I et II, PPUR.

Notes/Handbook

Ressources en bibliothèque : Energétique du bâtiment / Roulet
Polycopiés : Energétique du bâtiment