

ENG-445

Energy and comfort in buildings

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| Cursus | Sem. | Type |
|---|----------|------|
| Civil Engineering | MA1, MA3 | Obl. |
| Energy Science and Technology | MA1, MA3 | Opt. |
| Energy minor | H | Opt. |
| Mechanical engineering | MA1, MA3 | Opt. |
| Minor in Integrated Design, Architecture and Sustainability | H | Opt. |
| Territories in transformation and climate minor | H | Opt. |
| Urban Planning and Territorial Development minor | H | Opt. |

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| Language of teaching | English |
| Credits | 4 |
| Session | Winter |
| Semester | Fall |
| Exam | During the semester |
| Workload | 120h |
| Weeks | 14 |
| Hours | 3 weekly |
| Courses | 2 weekly |
| Exercises | 1 weekly |
| Number of positions | |

Summary

The course presents the fundamentals of energy demand in buildings while emphasizing the need for the comfort and well-being of occupants. In addition, prioritizations and trade-offs between energy and comfort are discussed.

Content

- Energy concepts in buildings
- Building simulation tools: theory and practical exercises
- Indoor thermal comfort
- Indoor air quality
- Building ventilation
- Occupant behavior in buildings
- Passive strategies (solar, thermal mass, natural ventilation, etc.)
- Heat balance at the building level, building envelope
- Heating and cooling demand in buildings

Keywords

Energy demand; human comfort; indoor environmental quality; building envelope.

Learning Prerequisites**Recommended courses**

- Elementary building physics
- General physics: thermodynamics PHYS-106
- Fundamentals of indoor climate CIVIL-212
- Urban thermodynamics CIVIL-309

Important concepts to start the course

- Heat transfer, psychometrics
- Human comfort and indoor climate

- Energy demand in buildings

Learning Outcomes

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

- Estimate heat flows and energy demand in buildings
- Assess / Evaluate interactions between comfort needs of occupants, building envelope and HVAC systems
- Interpret indoor environmental quality standards
- Use building energy simulation software to assess energy and comfort performance of buildings

Transversal skills

- Take account of the social and human dimensions of the engineering profession.
- Demonstrate the capacity for critical thinking
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Communicate effectively, being understood, including across different languages and cultures.

Teaching methods

Lecture presentations, group discussions, exercises

Assessment methods

2 x written tests on the course material: 50%+50%

Supervision

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| Office hours | Yes |
| Assistants | Yes |
| Forum | Yes |

Resources

Bibliography

- Lecture notes (primary source)
- Edward Allen. How Buildings Work: The natural Order of Architecture, 3rd ed.
- Y. A. Çengel; A. J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications. McGraw Hill Education, 5th edition
- ASHRAE Handbook of Fundamentals, 2018
- Different building standards such as ISO 17772, ISO 6946, ASHRAE 55, ASHRAE 62.1, SIA 380/1, SIA 2024.
- Peer-reviewed papers and websites (will be provided throughout the semester)

Ressources en bibliothèque

- [How Buildings Work / Allen](#)
- [ISO 6946, ISO 17772 \(normes ISO en ligne\)](#)

- ASHRAE Handbook : Fundamentals (2021)
- SIA 380/1 (normes SIA en ligne)
- ASHRAE 55
- SIA Cahier technique 2024
- ASHRAE 62.1
- Heat and Mass Transfer: Fundamentals and Applications / Çengel & Ghajar

Moodle Link

- <https://go.epfl.ch/ENG-445>

Prerequisite for

- Thermodynamics of comfort in buildings CIVIL-450
- Indoor air quality and ventilation CIVIL-460