

CIVIL-450

Thermodynamics of comfort in buildings

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Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Civil engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.
Minor in Integrated Design, Architecture and Sustainability	E	Opt.

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

Summary

This course provides an integrated approach to analyzing indoor human thermal comfort by examining the correlation between the outdoor environment, thermodynamic processes in buildings, human thermoregulation, and the local thermal sensation of occupants.

Content

- Overview of the heat exchange between humans and the environment
- Definition of indoor thermal comfort, its requirements, and objective characterization
- Thermal conditioning in buildings, heating and cooling people, emission systems
- Integrated analysis of the relationship between the human comfort and the environment using actual data from lab measurements

Keywords

Human thermal comfort, indoor climatization, heat transfer, energy and exergy analysis

Learning Prerequisites**Required courses**

- Building energetics (ENG-445)

Recommended courses

- General physics: thermodynamics (PHYS-106)
- Building physics (PHYS-118)
- Thermodynamics and energetics (ME-251)
- Comfort and architecture: sustainable strategies (AR-442)

Important concepts to start the course

Heat transfer, human comfort

Learning Outcomes

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

- Characterize local thermal environment and comfort
- Assess / Evaluate energy expenditure to provide indoor comfort
- Carry out measurements of indoor comfort and energy performance using diagnostic instrumentation
- Take into consideration the effect of various modes of heat transfer on human body
- Perform data analysis and presentation

Transversal skills

- Write a scientific or technical report.
- Make an oral presentation.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Demonstrate the capacity for critical thinking
- Communicate effectively, being understood, including across different languages and cultures.

Teaching methods

Lectures, laboratory and group project

Expected student activities

Laboratory measurements (in EPFL-Fribourg) and group work

Assessment methods

2 lab reports and presentations (50% + 50%)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

- Lecture notes (primary source)
- P. O. Fanger, Thermal Comfort, Danish Technical Press, 1970
- K. Parsons, Human thermal environments : the effects of hot, moderate, and cold environments on human health, comfort, and performance;
- Y. A. Çengel, A. J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 5th edition

Ressources en bibliothèque

- [Thermal Comfort / Fanger](#)
- [Fundamentals of Engineering Thermodynamics \(8th edition\) / Moran, Shapiro, Boettner, Bailey](#)

- Heat and Mass Transfer: Fundamentals and Applications,(5th edition) / Çengel, Ghajar
- Human thermal environments / Parsons

Moodle Link

- <https://go.epfl.ch/CIVIL-450>

Prerequisite for

Master projects