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
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	1 weekly
TP	1 weekly
Lab	1 weekly
Number of positions	

It is not allowed to withdraw from this subject after the registration deadline.

Summary

This course takes an experimental, human-centric approach to thermal comfort. Through laboratory measurements and thermodynamic analysis, students characterize the indoor thermal environment and its coupling with human thermoregulation, informing occupant-centered building design.

Content

- Overview of the heat exchange between humans and the environment, thermoregulation
- Definition of thermal comfort, its fundamentals, and objective characterization
- Building-environment interaction, energy and exergy analysis (quality of energy flows)
- Measurement of the indoor thermal environment (instrumentation and experimental methods)
- Integrated analysis of the thermal environment and thermal sensation via lab measurements

Keywords

Human thermal comfort, indoor climate control, occupant-centered building design, heat transfer, energy and exergy analysis, thermoregulation, experimental measurements

Learning Prerequisites

Recommended courses

- General physics: thermodynamics (PHYS-106)
- Building physics (PHYS-118)
- Thermodynamics and energetics (ME-251)
- Energy and comfort in buildings (CIVIL-407)

Important concepts to start the course

Background knowledge in heat transfer

Learning Outcomes

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

- Characterize dynamic performance of heating/cooling systems
- Assess / Evaluate spatial and temporal variation of the thermal environment
- Carry out measurements of human comfort using diagnostic instrumentation
- Take into consideration energy performance of building envelope elements
- Perform data analysis and presentation
- Characterize local thermal environment and personalized comfort
- Take into consideration the effect of various modes of heat transfer on human body

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 on the theoretical background, complemented by two immersive laboratory sessions at the EPFL-Fribourg campus (Smart Living Lab), where students perform instrumented measurements of the thermal environment and evaluate subjective comfort. Labs are organized in March and May. Data analysis, interpretation, and reporting are carried out in groups.

Expected student activities

Attend lectures and two laboratory sessions at EPFL-Fribourg. Work in groups of 3-4 (formed by Week 3) to perform measurements, analyze and interpret data, report and present the results.

Assessment methods

Two lab reports (35% each) and two oral presentations (15% each).

Supervision

Office hours	No
Assistant.e.s	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, CRC Press, 2014
- M. Shukuya, Exergy: Theory and applications in the built environment, Springer, 2013

Ressources en bibliothèque

- Find the references at the Library

Moodle Link

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

Prerequisite for

Master projects