

# Software ROOM

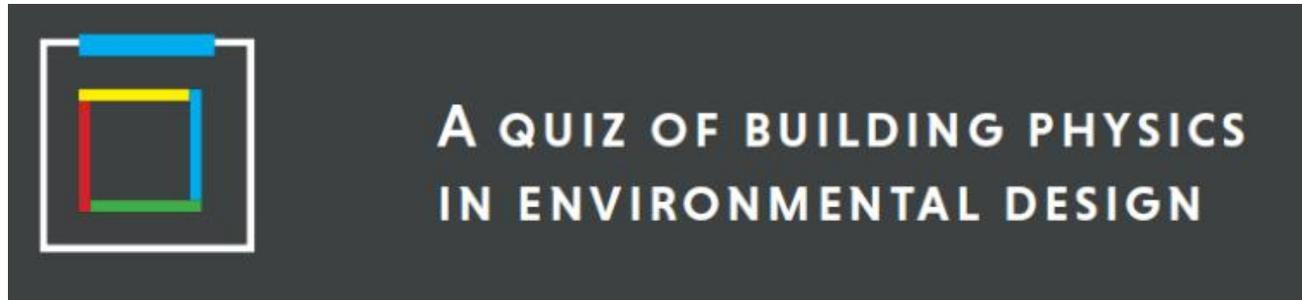
Para análise de Conforto Ambiental de Ambientes Internos

Desenvolvido na Universidade de Bath – Inglaterra

Desenvolvido por **Zhenzhou Weng**

*BEng MSc* Doctoral researcher at University of Bath

Pré e Post QUIZ



**Workshop: Environmental Principles & Architectural Design**

# ROOM



Learning Environmental Design

## INTRODUCING ROOM

an open-access interactive e-learning platform

IN ONE ROOM  
BUILDING PHYSICS  
TOLD WITH DESIGN

### Play with Building Physics

explore the flow of light, air, heat and sound  
in the built environment

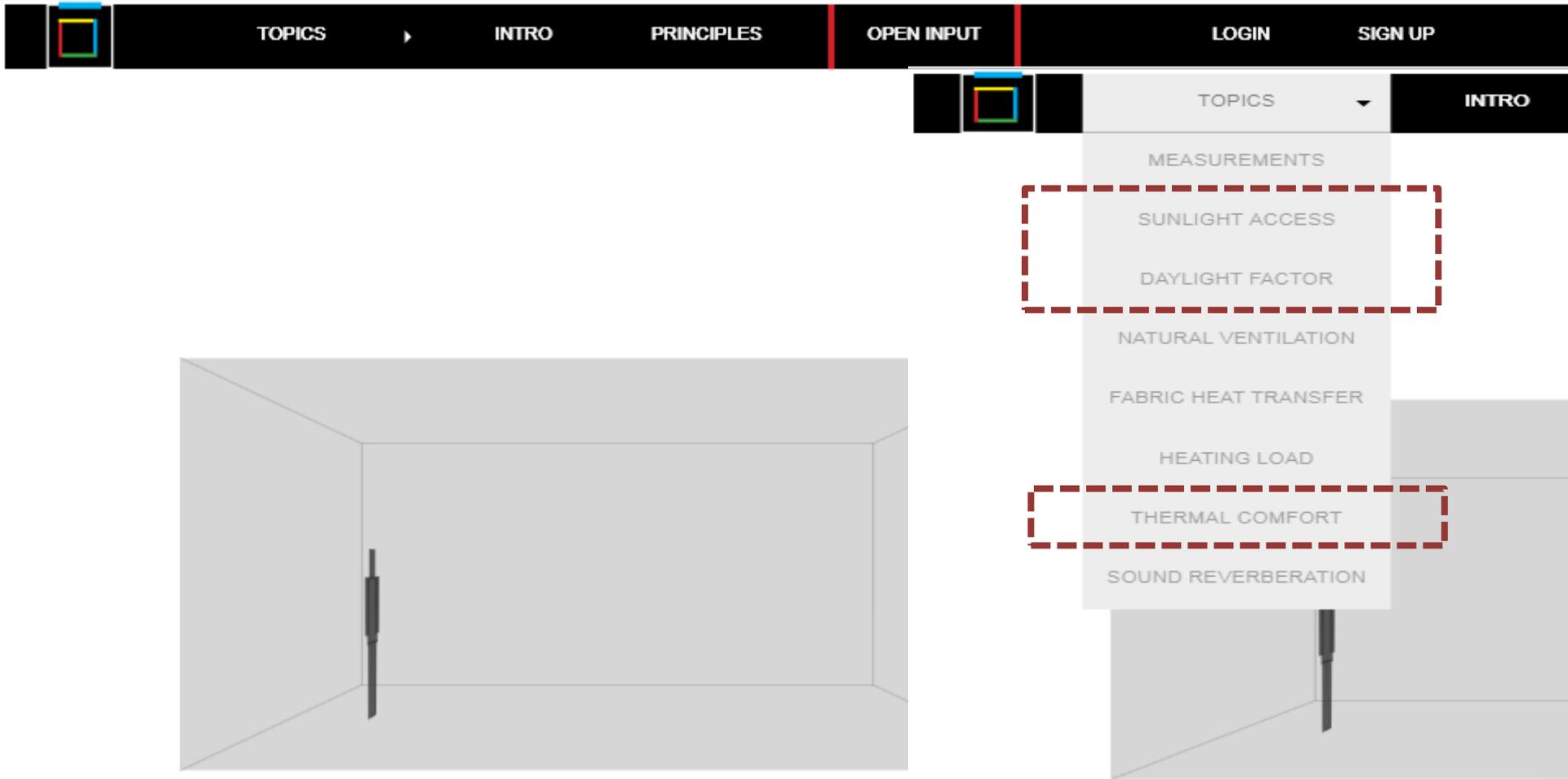
ENVIRONMENTAL  
DESIGN

AN OPEN-ACCESS  
INTERACTIVE E-  
LEARNING PLATFORM

Desenvolvido pelo Arquiteto Weng Zhenzhou - Professor da  
Faculty of Architecture and the Built Environment -  
University of Westminster - Londres.

**Workshop: Environmental Principles & Architectural Design**

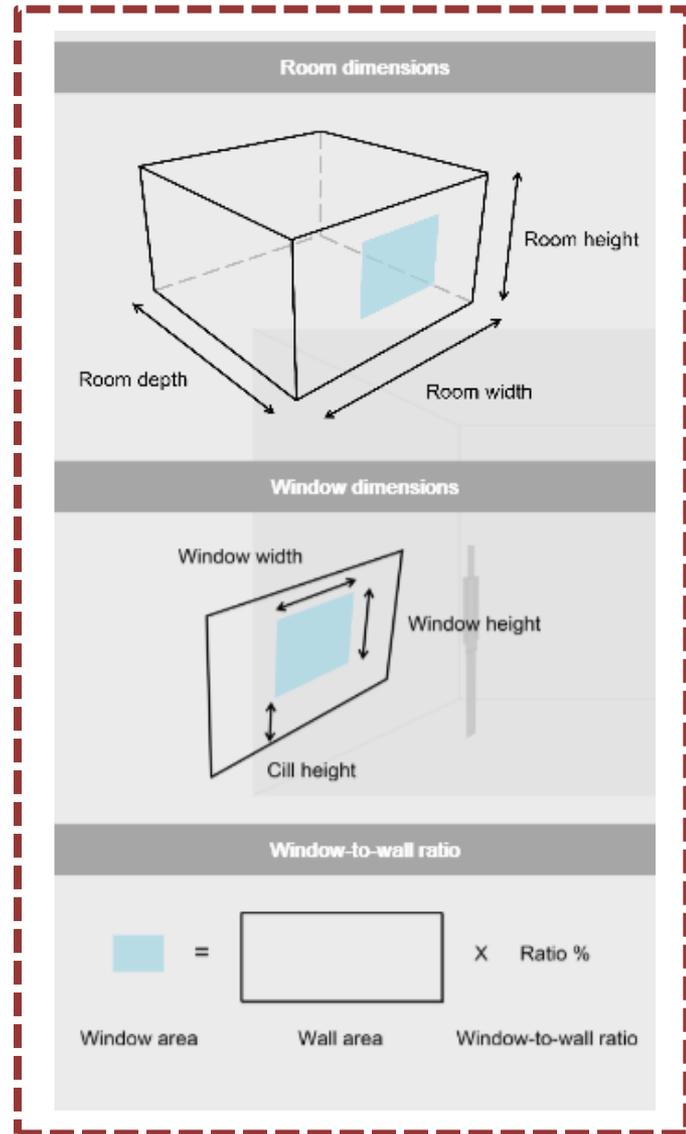
# THE TOOL: ROOM



<http://people.bath.ac.uk/zw305/ROOM/INTRODUCING%20ROOM.html>

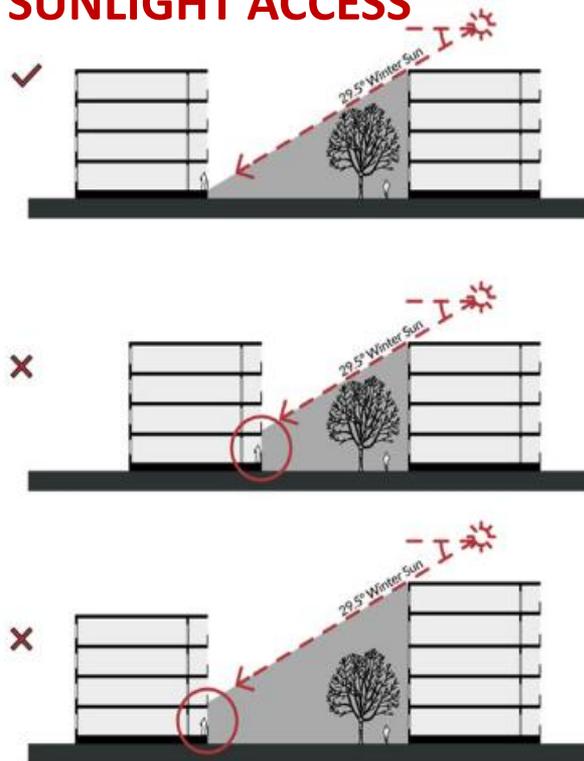
# INTRODUCTION AND PRINCIPLES OF ROOM

***“THE ROOM IS A PROJECT, BASED ON A WEB PLATFORM, WHICH CAN PROVIDE NEW MECHANISMS OF ENVIRONMENTAL COMFORT ANALYSIS THROUGH A DIDACTIC APPLICATION AND EASY ACCESS”***

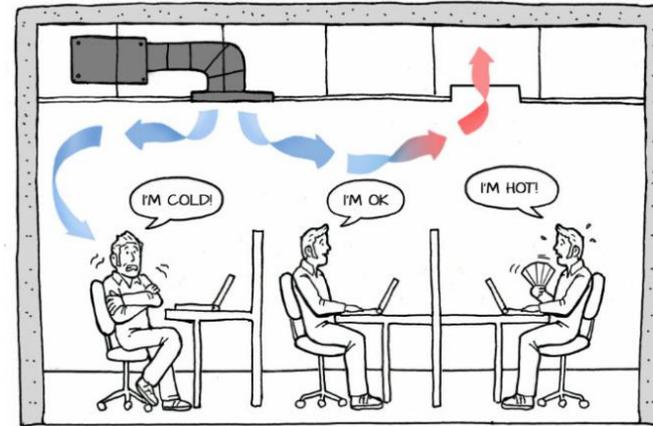


# BASICS TOOLS FOR ENVIRONMENTAL COMFORT: ROOM

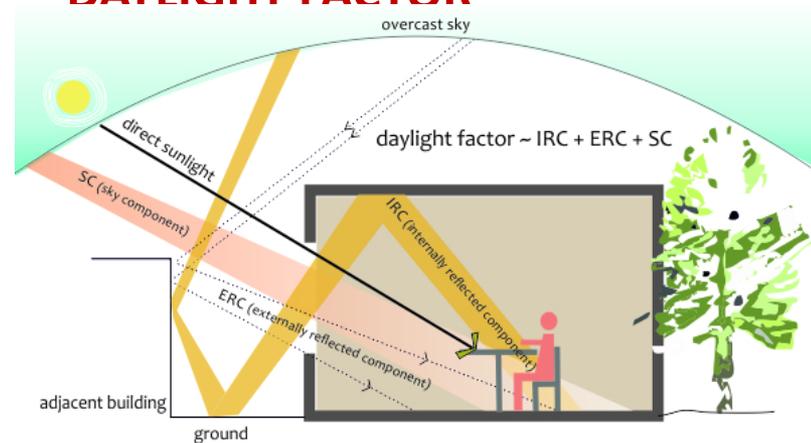
## SUNLIGHT ACCESS



## THERMAL COMFORT



## DAYLIGHT FACTOR



# MEASUREMENTS



TOPICS



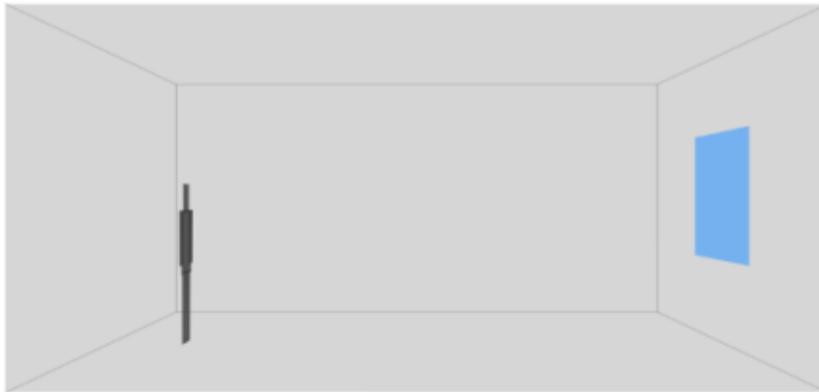
INTRO

PRINCIPLES

CLOSE INPUT

LOGIN

SIGN UP



Room width

Room depth

Room height

Window width

Cill height

Window height

Summary of the geometry of ROOM

Floor area: 47.61 m<sup>2</sup>

Space volume: 157.11 m<sup>3</sup>

Total surface area: 186.3 m<sup>2</sup>

Window-to-wall ratio: 0.14

# SUNLIGHT ACCESS

TOPICS ▸ INTRO PRINCIPLES **CLOSE INPUT** LOGIN SIGN UP

☀ 0 8:15 16:00 24  
8:15 16:00  
☑ daytime hours = 8 hours  
☐ sunlight reaches window hours = 8 hours



Solar altitude = 6°

Solar azimuth = 40.9°  
South

Screenshot ROOM

Start recording ROOM

Room width 6.9 m  
Room depth 6.9 m  
Room height 3.3 m  
Window width 2.25 m  
Cill height 0.95 m  
Window height 1.45 m

ROOM orientation and location

Orientation 0°  
Latitude 51.2° N

Time of the year

Month 1  
Day 1  
Time 9:00

Solar angles

Sun declination angle: -22.96°  
Solar altitude angle: 5.97°  
Solar azimuth angle: 40.89°

# DAYLIGHT FACTOR

TOPICS ▶ INTRO PRINCIPLES **CLOSE INPUT** LOGIN SIGN UP

Daylight factor [%]

In the UK climate (or with similar outdoor illuminance)

50

unnecessarily bright sometimes

10

cheerfully daylit in absence of sunlight

5

well daylit in general

2

1.6%

may need constant lighting

0

Double glazed

Surface finish and light reflectance

0 1

Wall

Ceiling

Floor

Screenshot F

Start recording

# DAYLIGHT FACTOR

Room width  6.9 m

Room depth  6.9 m

Room height  3.3 m

Window width  2.25 m

Cill height  0.95 m

Window height  1.45 m

---

Properties of the window

Window light transmittance  0.7

Window light reflectance  0.1

---

Properties of room surfaces

wall: paint ▶ ceiling: paint ▶ floor: birch ▶

Wall light reflectance  0.5

Ceiling light reflectance  0.7

Floor light reflectance  0.5

Obstruction outside the window

Obstruction distance  3 m

Obstruction height  0.5 m

PARAMETRIC STUDY OFF

---

Daylight factor outputs

Area-weighted-average reflectance: 0.54

Obstruction angle: 0 °

Working plane daylight factor: 1.57 %

# THERMAL COMFORT

TOPICS ▶ INTRO PRINCIPLES **CLOSE INPUT** LOGIN SIGN UP

😊😊😊😊😊😊😊😊😊😊😊😊

👤

Indoor air temperature 21.6 °C

Outdoor air temperature 30.5 °C

Metabolic state of the occupant(s)

Clothing level 1 clo

Metabolic rate 1.8 met

State of the environment

Mean temperature of room surfaces 19 °C

Relative air velocity 0 m/s

Relative humidity of the air 50 %

Thermal comfort outputs

PMV: 0.6

PPD: 12.58 %

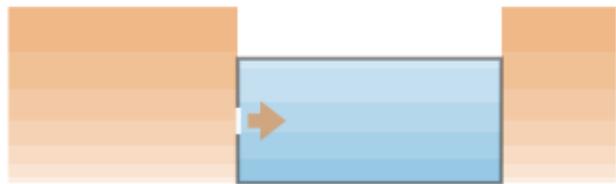
Iterated clothing surface temperature: 25.39 °C

Screenshot ROOM

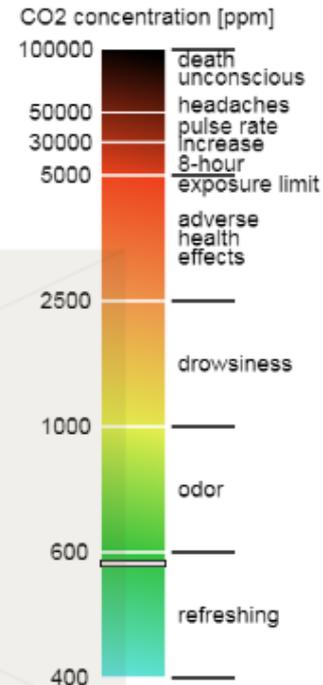
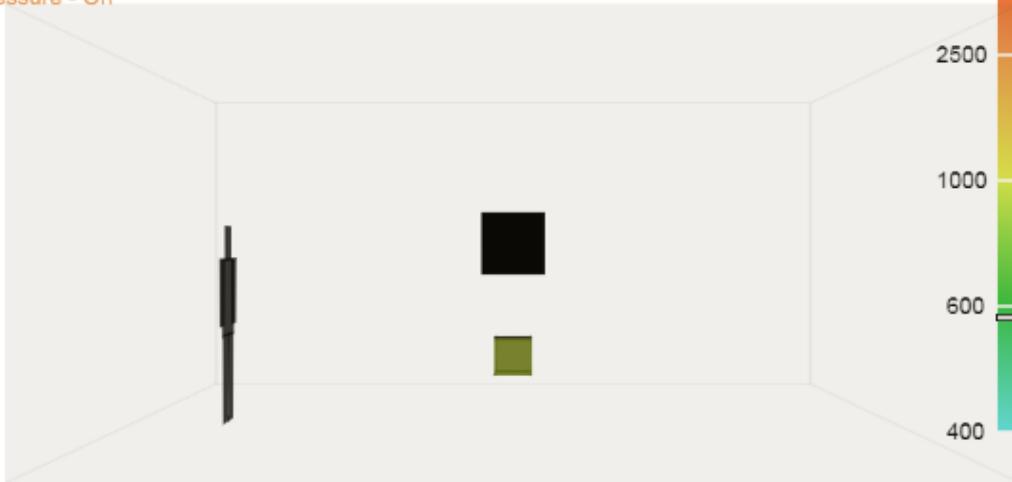
Start recording ROOM

# **COMPLEMENTARY TOPICS**

# NATURAL VENTILATION



Buoyancy Pressure - On



Screenshot ROOM

Start recording ROOM



Wind Pressure - On

Ventilation airflow mainly driven by buoyancy

# NATURAL VENTILATION

Room width  6.9 m

Room depth  6.9 m

Room height  3.3 m

Indoor air temperature  21.6 °C

Outdoor air temperature  30.5 °C

---

Driving force(s) of ventilation air flow

WIND ON  BUOYANCY ON

Wind speed  0.3 m/s

---

Properties of ventilation openings

ONE OPENING

Opening area  0.5 m<sup>2</sup>

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Uncontrollable air leakage

Infiltration air change rate  0.2 ach

---

Occupancy condition

Number of occupants  2

---

Ventilation outputs

Volume flow rate through opening(s): 46.2 l/s

Ventilation rate: 1.06 ach

Infiltration rate: 0.2 ach

Ventilation (including infiltration) heat loss rate per degree C: 65.2 W/K

Total ventilation (including infiltration) heat loss rate: -580.6 W

Indoor CO<sub>2</sub> concentration: 582 ppm

# FABRIC HEAT TRANSFER

TOPICS ▶ INTRO PRINCIPLES **CLOSE INPUT** LOGIN SIGN UP

$T_{out}=30.5^{\circ}\text{C}$   
 $T_{in}=21.6^{\circ}\text{C}$   
 $T_{difference}=-8.9^{\circ}\text{C}$   
Total thermal resistance=0.37 m<sup>2</sup>.K/W  
U-value=2.7 W/m<sup>2</sup>.K  
External wall  
In=0.13 Ex=0.04 Surface resistance [m<sup>2</sup>.K/W]  
Total heat gain rate of a 1 m<sup>2</sup> element of the construction [W]  
=15W

Indoor air temperature 21.6 °C  
Outdoor air temperature 30.5 °C  
Type of construction  
OPAQUE CONSTRUCTION  
Where in the building envelop  
external wall roof exposed floor ground floor  
Material layers and thermal properties  
add layer remove layer  
Layer1 thermal conductivity 0.8 W/m.K (non-insulation)  
Layer1 thickness 80 mm  
NO AIR CAVITY  
Layer2 thermal conductivity 0.8 W/m.K (non-insulation)  
Layer2 thickness 80 mm

Start record

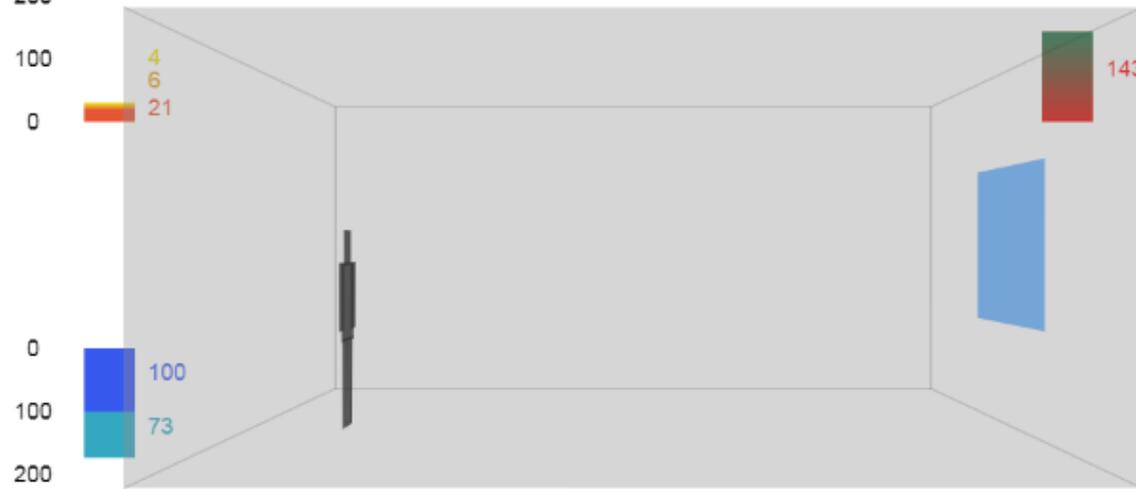
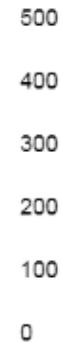
# HEATING LOAD

Annual total heat gains per unit floor area [kWh/m<sup>2</sup>]



Annual total heating demand per unit floor area [kWh/m<sup>2</sup>]

met by **heating system** and **useful solar gains** to be detailed in another tab



Annual total heat losses per unit floor area [kWh/m<sup>2</sup>]

Screenshot RO

Start recording RO

# HEATING LOAD

Room width  6.9 m

Room depth  6.9 m

Room height  3.3 m

Window width  2.25 m

Cill height  0.95 m

Window height  1.45 m

---

Annual average air temperatures

Outdoor air temperature: 10 °C

**MANUAL INPUT**

Indoor air temperature  21 °C

---

Heat losses

External (grey) or Internal (white)

Wall U-value: 0.28 W/m2.K

**MANUAL INPUT**

Ventilation rate: 0.5 ach

**MANUAL INPUT**

Infiltration rate: 0.2 ach

**MANUAL INPUT**

---

Heat gains

Number of occupants  2

Gain from each occupant: 115 W **activity: seated, light work**

Occupancy hours  12 hours

---

Heating load outputs

Annual average fabric heat loss rate: 544.6 W

Annual average ventilation heat loss rate: 399.2 W

Annual average occupant internal gain rate (24-hour mean): 115 W

Annual average lighting internal gain rate (24-hour mean): 31.5 W

Annual average equipment internal gain rate (24-hour mean): 20.3 W

Annual average total net heat losses rate (not considering solar gains): 777 W

Annual total heating demand (heating system + useful solar gains): 6806.5 kWh

# SOUND REVERBERATION

TOPICS ▶ INTRO PRINCIPLES CLOSE INPUT LOGIN SIGN UP

Room width 6.9 m  
Room depth 6.9 m  
Room height 3.3 m  
Window width 2.25 m  
Cill height 0.95 m  
Window height 1.45 m

Sound absorbing properties of room surfaces

Wall average sound absorption coefficient 0.2  
Floor average sound absorption coefficient 0.2  
Ceiling average sound absorption coefficient 0.2  
Window average sound absorption coefficient 0.2

Sound samples

sound: speaking ▶

Reverberation time outputs

Total area weighted absorption: 37.26 m<sup>2</sup>  
Reverberation time (RT60): 0.68 s

**THANK YOU!**