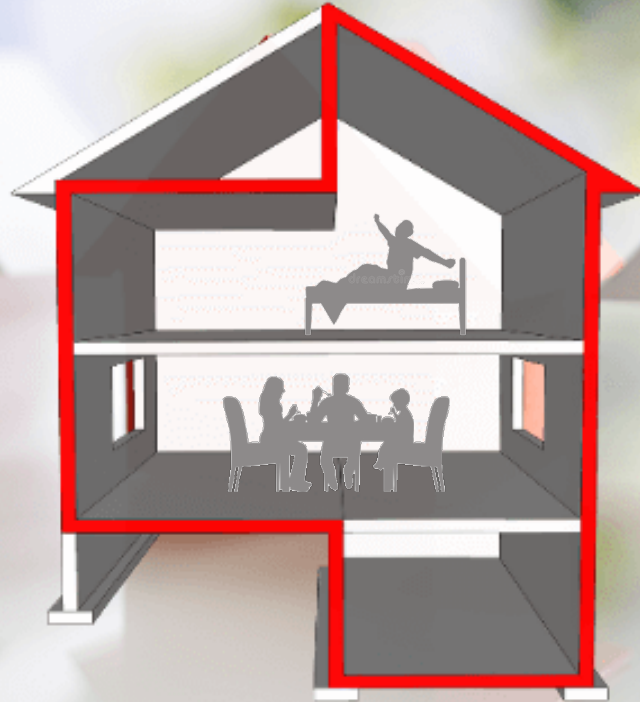


PRACTICE EXERCISES



CIVIL-407
Energy and
Comfort in Buildings

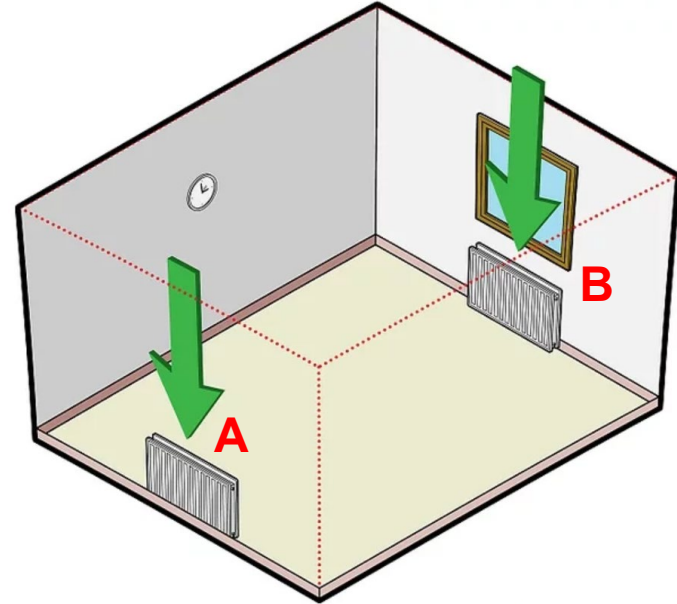
Thermal Systems
for Heating and
Thermal Comfort

Assist. Professor
Dolaana KHOVALYG

20 November 2025

Exercise 1: Positioning of radiators

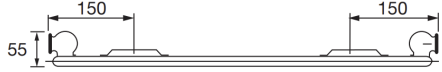
- Consider a room shown and 2 possible placements of radiators.
- What could be the **optimal location** of the **radiator** from **comfort** and **energy perspective**?



EPFL Exercise 2: Radiators

- The heating demand of a **4x4 m²** room to maintain operative temperature of **20°C** is **80 W/m²**.
- What should be the **inlet water temperature (T_{wi})** of the single-wall radiator Type 10 when it is **undersized** vs. **oversized**?
- Use a table provided from a manufacturer's catalogue.

type 10



		hauteur						
longueur	watt	300	400	450	500	600	750	900
450	$\Delta T 50$	145	186	206	225	263	318	370
600	$\Delta T 50$	193	248	275	301	351	424	493
750	$\Delta T 50$	242	310	344	376	439	530	617
900	$\Delta T 50$	290	372	412	451	527	635	740
1050	$\Delta T 50$	338	434	481	526	614	741	863
1200	$\Delta T 50$	386	496	550	601	702	847	986
1350	$\Delta T 50$	435	558	618	676	790	953	1110
1500	$\Delta T 50$	483	620	687	752	878	1059	1233
1650	$\Delta T 50$	531	681	756	827	965	1165	1356
1800	$\Delta T 50$	580	743	824	902	1053	1271	1480
EN 442 - 75/65/20°C		322	413	458	501	585	706	822
EN 442 - 90/70/20°C		411	526	584	638	745	899	1046
valeur n		1,3325	1,3307	1,3297	1,3288	1,3270	1,3242	1,3215

* *Water temperature difference between supply and outlet of radiators is typically limited to $T_{wi} - T_{wo} = 10 \text{ K}$*

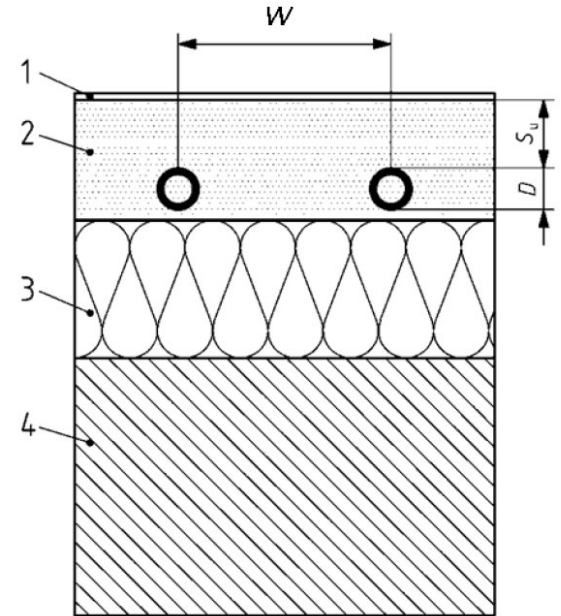
EPFL Exercise 3: Radiant Embedded System (Type A)

- Indoor temperature: $T_{op} = 20^{\circ}\text{C}$
- System Type: **type A**
- Pipe spacing: $W = 15\text{ cm}$
- Pipe diameter: $D = 25\text{ mm}$
- Thermal resistance of the floor covering: $R_{\lambda,B} = 0.15\text{ m}^2\text{K/W}$
- Thickness $s_u = 10\text{ mm}$
- Design heat load: $q = 80\text{ W/m}^2$
- Parameters of the system are provided (see next slide)

Determine:

- Difference between average temperature and room (ΔT_h)
- Supply water temperature (T_{wi}) *
- Compare the supply temperature of the embedded system with the temperature of the radiator

* *Water temperature difference between supply and outlet of embedded systems is typically limited to $T_{wi} - T_{wo} = 5\text{ K}$*



- 1 – floor covering
- 2 – weight bearing and thermal diffusion layer (cement screed)
- 3 – thermal insulation
- 4 - structural base

EPFL Exercise 3: Radiant Embedded System (Type A)

Table A.1 — Pipe spacing factor α_W for types A and C systems

$R_{\lambda,B}$ (m ² K/W)	0	0,05	0,10	0,15
α_W	1,23	1,188	1,156	1,134

Source: ISO 11855-2

α_B - surface covering factor in accordance with the following equation

$$\alpha_B = \frac{\frac{1}{\alpha} + \frac{s_{u,0}}{\lambda_{u,0}}}{\frac{1}{\alpha} + \frac{s_{u,0}}{\lambda_E} + R_{\lambda,B}}$$

where

$$\alpha = 10,8 \text{ W}/(\text{m}^2 \cdot \text{K});$$

$$\lambda_{u,0} = 1 \text{ W}/(\text{m} \cdot \text{K});$$

$$s_{u,0} = 0,045 \text{ m};$$

$R_{\lambda,B}$ is the heat conduction resistance of the floor covering, in m²·K/W;

λ_E is the heat conductivity of the screed, in W/(m·K);

■ For a heating cement screed with reduced humidity, $\lambda_E = 1,2 \text{ W}/(\text{m} \cdot \text{K})$

Table A.2 — Covering factor α_U depending on pipe spacing T and thermal resistance $R_{\lambda,B}$ of the surface covering for types A and C systems

$R_{\lambda,B}$ (m ² K/W)	0	0,05	0,10	0,15
W (m)	Covering factor α_U			
0,05	1,069	1,065	1,043	1,037
0,075	1,066	1,053	1,041	1,035
0,1	1,063	1,05	1,039	1,0335
0,15	1,057	1,046	1,035	1,0305
0,2	1,051	1,041	1,0315	1,0275
0,225	1,048	1,038	1,0295	1,026
0,3	1,0395	1,031	1,024	1,021
0,375	1,03	1,0221	1,018	1,015

Table A.3 — Pipe external diameter factor α_D depending on thermal resistance $R_{\lambda,B}$ of the floor covering and the pipe spacing W for types A and C systems

$R_{\lambda,B}$ (m ² K/W)	0	0,05	0,10	0,15
W (m)	Pipe external diameter factor α_D			
0,05	1,013	1,013	1,012	1,011
0,075	1,021	1,019	1,016	1,014
0,1	1,029	1,025	1,022	1,018
0,15	1,04	1,034	1,029	1,024
0,2	1,046	1,04	1,035	1,03
0,225	1,049	1,043	1,038	1,033
0,3	1,053	1,049	1,044	1,039
0,375	1,056	1,051	1,046	1,042