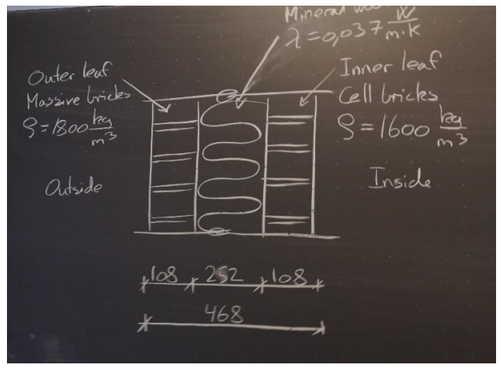
Calculation of U-value

Building component: External wall

Layer	d [m]	λ [W/mK]	R [m2W/K	Note
External surface resistance Rse			0.040	DS 418 p23
Outer leaf ρ = 1800 kg/m3	0.108	0.720	0.150	DS 418 p80 curve B
Mineral wool	0.192	0.037	5.189	From producers website
Inner leaf ρ = 1600 kg/m3	0.108	0.550	0.196	DS 418 p80 curve A
Internal surface resistance Rsi			0.130	DS 418 p23
		ΣR =	5.706	
		U = 1/ΣR =	0.175	W/m2K



Corrections (DS 418 p59)

U = U´+ ΔU

ΔU = ΔUg + ΔUf

ΔU´´ = 0,010		DS 418 p59 Formula A.2
ΔUg = ΔU´´· (Ri/RT) is a correction for air cracks	0.009	DS 418 p59 Table A.1
ΔUf is a correction for wall ties	0.002	DS 418 p61 Table A.2 4 ties/m2 stainless steel
ΔU =	0.011	

Final U-value U = 0.186 W/m2K

Calculation of U-value

Building component: Floor

Layer	d [m]	λ [W/mK]	R [m2K/W]	Note
Internal surface resistance Ri			0.170	p23
Lamination	0.020	0.180	0.111	p 84
Screed	0.020	1.750	0.011	p83
Concrete slab	0.100	2.440	0.041	p83
Insulation polysterine	0.300	0.055	5.455	p86
Capillary breaking layer - dry	0.175	0.085	2.059	p101
Capillary breaking layer - wet	0.075	0.102	0.735	p101
Resistance from soil Rj			1.500	p37
		ΣR =	10.082	
		U´ = 1/ΣR =	0.099	W/m2K

Corrections (DS 418 p59)

U = U´+ ΔU

ΔU = ΔUg + ΔUf

ΔU´´ =	0	DS 418 p59 table A.1
ΔUg = ΔU´´· (Ri/RT)2 is corrections for air-cracks	0.000	DS 418 p59 A.2
ΔUf is correction for wall ties	0	DS 418 p61 table A.2 4
ΔU =		W/m2K
Final U-value =	0.099	W/m2K

Area A =	6.90	m2
Temperature difference ΔT =	10	K
Transmission loss ΦTR = U·A·ΔT =	7	W

Table F.2 Design values for other building materials

Material or use	Density kg/m3	Design thermal conductivity W/mK
Stone, tiles, glass, ceramic		
Granite	2500 –2700	2,8
Gneiss	2400 – 2700	3,5
Basalt	2700 – 3000	3,5
Limestone	2600	2,3
Marble	2800	3,5
Slate	2000 – 2800	2,2
Sandstone	2600	2,3
Tiles, clay	2000	1.0
Tiles, concrete	2100	1.5
Ceramic tiles, porcelain	2300	1.3
Constructional glass	2600	0.8
Plastic and rubber		
Polycarbonate	1200	0.20
PVC	1390	0.17
Polyamide (Nylon)	1150	0.25
Epoxy	1200	0.20
Synthetic rubber	1200	0.24
Linoleum	1200	0,2
Wood and wood-bases boards		
Wood[1)]	450 – 700	0,12 – 0,18
Construction wood (softwood) [1)]	450	0,12
Hard wood[1)]	700	0,18
Plywood	300 – 1000	0,09 – 0,24
Chipboards	300 - 900	0,10 – 0,18
Soil, drainage material		
Moist soil (moraine)	1900	2,3
Coarse cinders in soil	800	0,4
Clay	1200 – 1800	1,5
Sand and gravel	1700 - 2200	2,0

Calculation of U-value

Building component: Ceiling construction

Layer - through truss bottom chord	d [m]	λ [W/mK]	R [m2K/W	Note
Internal surface resistance Rsi			0.100	DS 418 p23 table 6.2.1
Furring - non-ventilated air layer			0.160	DS 418 p24 table 6.4.1
Truss bottom chord - wood ρ = 500 kg/m3 (assumed)	0.100	0.160	0.625	DS 418 p84 table F.2
Insulation on top of truss bottom chord - mineral wool	0.300	0.037	8.108	Provided by manufacturer
External surface resistance Rse			0.040	DS 418 p23 table 6.2.1
Resistance from roof space and roof covering			0.300	DS 418 p25 table 6.5.1
		ΣR =	9.333	
		Ut = 1/ΣR	0.107	W/m2K

Layer - between truss bottom chord	d [m]	λ [W/mK]	R [m2K/W	Note
Internal surface resistance Rsi			0.100	DS 418 p23 table 6.2.1
Ceiling cladding - plaster boards ρ = 900 kg/m3	0.026	0.250	0.104	DS 418 p85 table F.2
Furring - non-ventilated air layer			0.160	DS 418 p24 table 6.4.1
Insulation - mineral wool	0.400	0.037	10.811	Provided by manufacturer
External surface resistance Rse			0.040	DS 418 p23 table 6.2.1
Resistance from roof space and roof covering			0.300	DS 418 p25 table 6.5.1
		ΣR =	11.515	
		Ui = 1/ΣR	0.087	W/m2K

Proportion truss At = 50/900 =	0.056	
Proportion insulation Ai = (900-50)/900 =	0.944	
U´= Ut·At + Ui·Ai =	0.088	W/m2K

Corrections (DS 418 p59)

U = U´+ ΔU

ΔU = ΔUg + ΔUf

ΔU´´ =	0	DS 418 p59 table A.1
ΔUg = ΔU´´· (Ri/RT)2 is corrections for air-cracks	0.000	DS 418 p59 A.2
ΔUf is correction for wall ties	0	No wall ties
ΔU =	0.000	

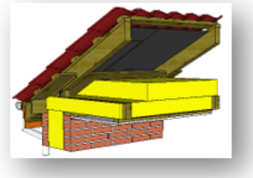
Final U-value =	0.088	W/m2K
Area A =	20.00	m2
Temperature difference ΔT =	32	K
Heat loss Φ =	56	W

Assignment 5 – Calculation of U-value for ceiling construction

Calculate the U-value for the ceiling construction shown at the picture. Detailed information is in the table below.

The ceiling construction has an area of 20 m^2 and the temperature difference is 32 K.

How much is the total heat loss in Watt?
(hint: Φ = U·A·ΔT)



Layer	Material	Thickness [mm]	Density [kg/m^3]	Conductivity λ [W/mK]	Resistance R [m^2K/W]
Ceiling cladding	Plaster board	2 x 13	900	Find in DS 418	
Furring	Is considered as an air layer	25			Find in DS 418 – is considered as a non-ventilated cavity
Trusses	Wood	b x h = 50 x 100 Center distance = 900 mm		Find in DS 418	
Insulation between trusses	Mineral wool	100		0,037 (provided by manufacturer)	
Insulation on top of trusses	Mineral wool	2 x 150		0,037 (provided by manufacturer)	
Roof space	Roof tiles on battens with wind proof under layer				Find in DS 418

Corrections:
Air-cracks – level 0

Calculation of U value

Layer - through truss bottom chord	d [m]	λ [W/mK]	R [m2K/W]	Note
Internal surface resistance Rsi			0.10	DS418 p23 table 6.2.1
Ceiling cladding - plaster boards 900kg/m3	0.026	0.25	0.104	DS418 p85 table F.2
Furring - non-ventilation air layer			0.160	DS418 p24 table 6.4.1
Truss bottom chord - wood p=500kg/m3 assumed	0.1	0.12	0.833	DS418 p84 table F.2
Insulation on top of truss bottom chord - mineral wool	0.3	0.037	8.108	Provided by manufacturer
External surface resistance Rse			0.040	DS418 p23 table 6.2.1
Resistance from roof space and roof covering			0.300	DS418 p25 table 6.5.1
		ΣR =	9.645	
		U´ = 1/ΣR =	0.104	W/m2K

Layer - through truss bottom chord	d [m]	λ [W/mK]	R [m2K/W]	Note
Internal surface resistance Rsi			0.100	DS418 p23 table 6.2.1
Ceiling cladding - plaster boards 900kg/m3	0.026	0.25	0.104	DS418 p85 table F.2
Furring - non-ventilation air layer			0.160	DS418 p24 table 6.4.1
Insulation between trusses - mineral wool	0.4	0.037	10.811	Provided by manufacturer
External surface resistance Rse			0.040	DS418 p23 table 6.2.1
Resistance from roof space and roof covering			0.300	DS418 p25 table 6.5.1
		ΣR =	11.515	
		U´ = 1/ΣR =	0.087	W/m2K

Proportion truss At	0.05		5%
Proportion insulation Ai	0.95		95%
U= Ut*At+Ui*Ai	0.088	W/m2K	
Corrections (DS 418 p59)			
U = U´+ ΔU			
ΔU = ΔUg + ΔUf			
ΔU´´ =	0	DS 418 p59 table A.1	
ΔUg = ΔU´´· (Ri/RT)2 is corrections for air-cracks	#REF!	DS 418 p59 A.2	
ΔUf is correction for wall ties	0	No ties	
ΔU =	#REF!		
Final U-value =	0.088	W/m2K	
Area A =	20.00	m2	
Temperature difference ΔT =	32	K	
Heat loss Φ =	56	W	

Assignment 5 – Calculation of U-value for ceiling construction

Calculate the U-value for the ceiling construction shown at the picture.
Detailed information is in the table below.

The ceiling construction has an area of 20 m^2 and the temperature difference is 32 K.

How much is the transmission loss in Watt?
(hint: $\Phi_{TR} = U \cdot A \cdot \Delta T$)

Layer	Material	Thickness [mm]	Density [kg/m³]	Conductivity λ [W/mK]	Resistance R [m²K/W]
Ceiling cladding	Plaster board	2 x 13	900	Find in DS 418	
Furring	Is considered as an air layer	25			Find in DS 418 – is considered as a non-ventilated cavity
Trusses	Wood	b x h = 50 x 100 Center distance = 900 mm		Find in DS 418	
Insulation between trusses	Mineral wool	100		0,037 (provided by manufacturer)	
Insulation on top of trusses	Mineral wool	2 x 150		0,037 (provided by manufacturer)	
Roof space	Roof tiles on battens with wind proof under layer				Find in DS 418

Corrections:
Air-cracks – level 0

IMPORTANT! Remember to enter references in the "Note" field in the spreadsheet.