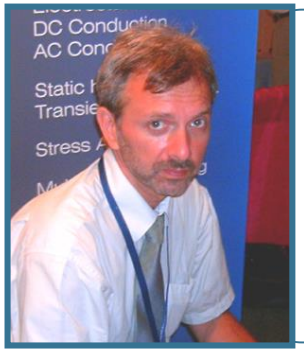
Building thermal insulation simulation with QuickField

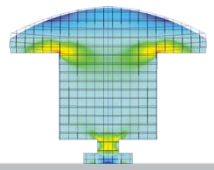
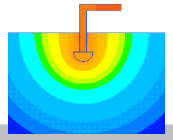
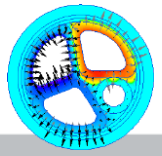
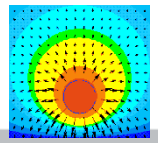
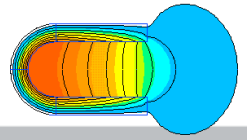
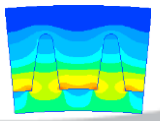
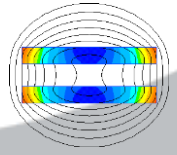
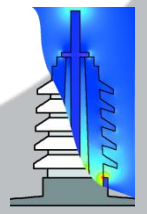


Vladimir Podnos,
Director of Marketing and Support,
Tera Analysis Ltd.

Alexander Lyubimtsev
Support Engineer
Tera Analysis Ltd.

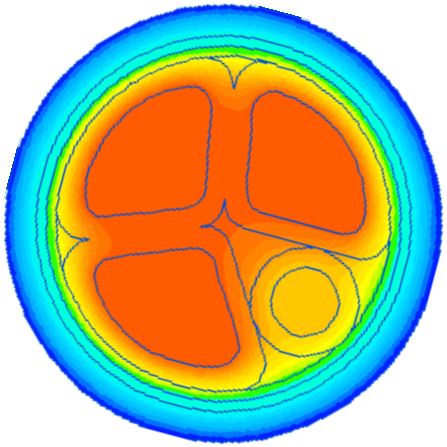
QuickField Analysis Options

Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetic
Electric analysis suite	
Electric Problems	Electrostatics (2D,3D) and DC Conduction
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	
Thermal and mechanical problems	Steady-State Heat transfer
	Transient Heat transfer
	Stress analysis

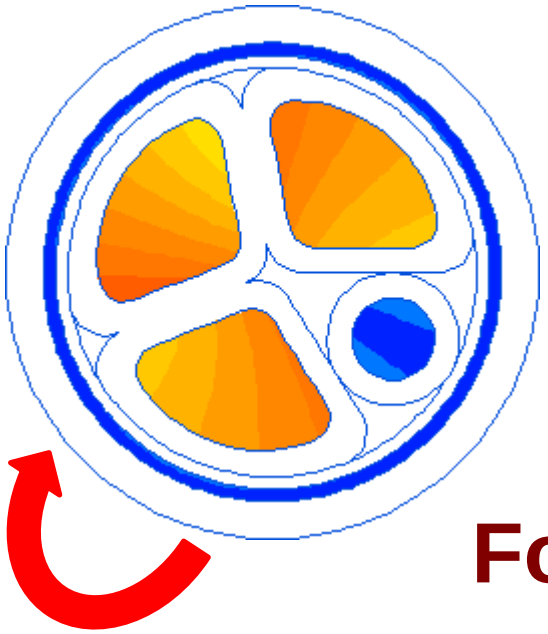









MultiPhysics

Temperature Field



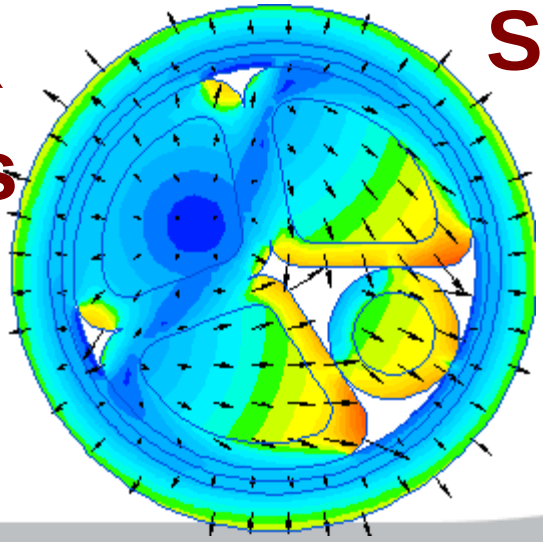
Electromagnetic fields



Losses

Thermal Stresses

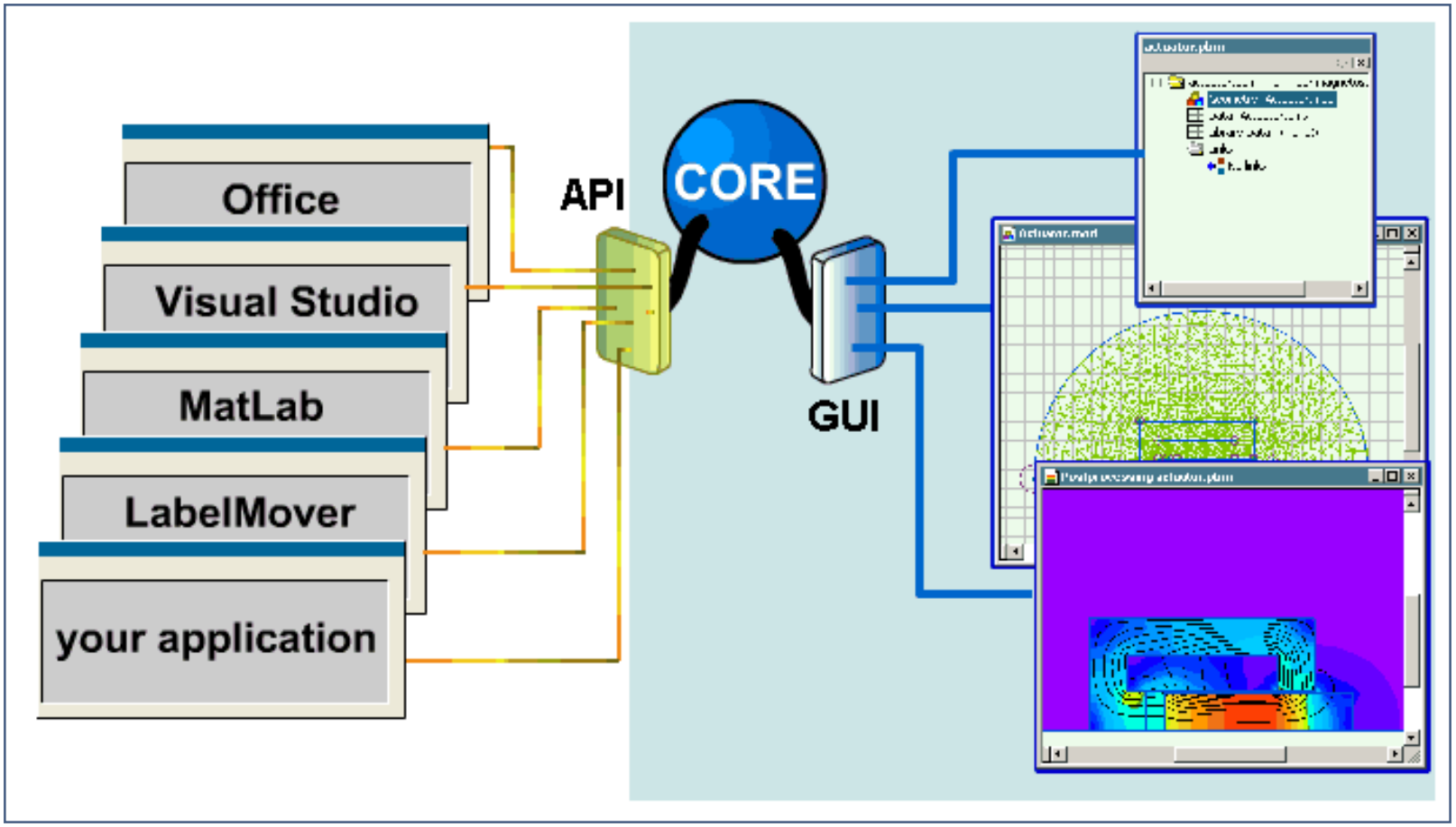
Forces



Magnetic state import

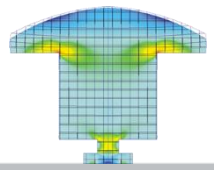
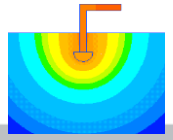
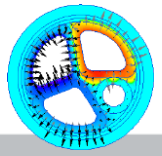
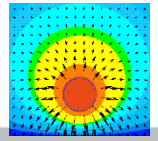
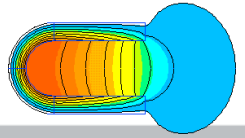
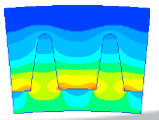
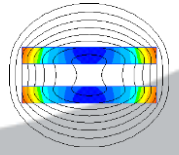
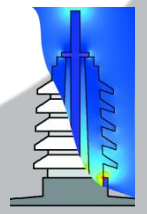
Stresses & Deformations

Open object interface



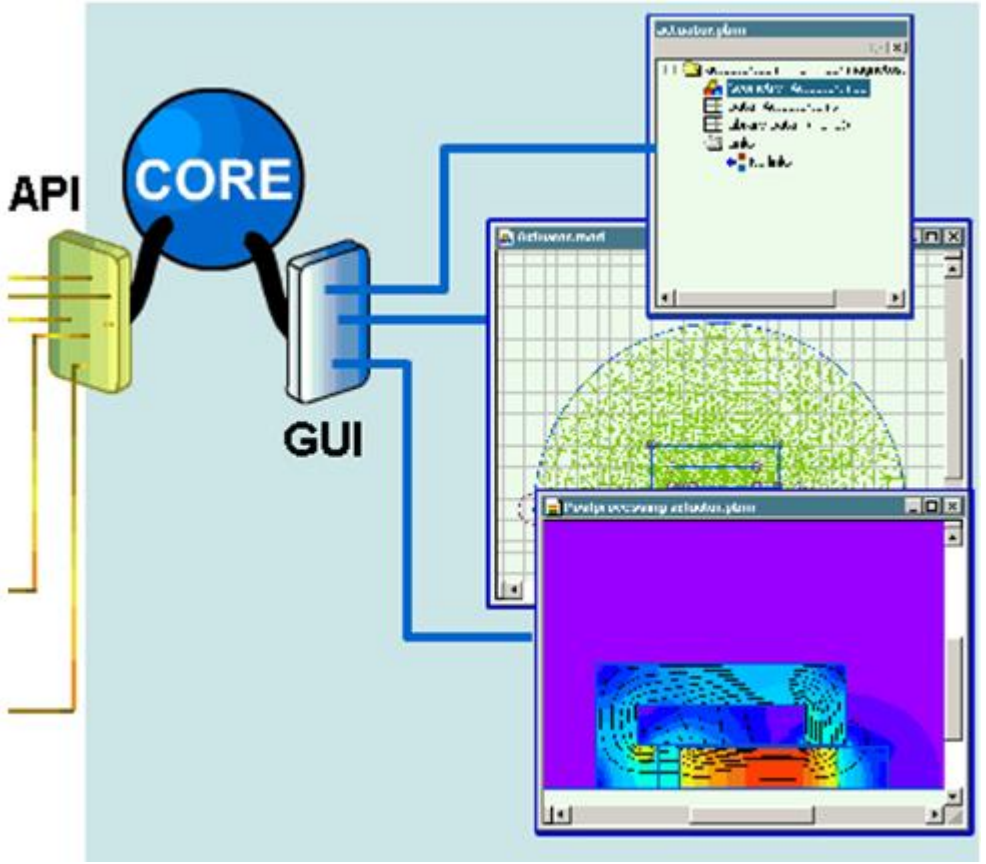
QuickField Analysis Options

Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetic
Electric analysis suite	
Electric Problems	Electrostatics (2D,3D) and DC Conduction
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	
Thermal and mechanical problems	Steady-State Heat transfer
	Transient Heat transfer
	Stress analysis

Open object interface

Microsoft Excel spreadsheet for automatic calculation of the equivalent thermal conductivities of the air gaps in the frame (per ISO 10077-2:2012. Thermal performance of windows, doors and shutters)



QuickField Difference

Building thermal insulation simulation with QuickField

Alexander Lyubimtsev
Support Engineer
Tera Analysis Ltd.

Building thermal insulation simulation with QuickField

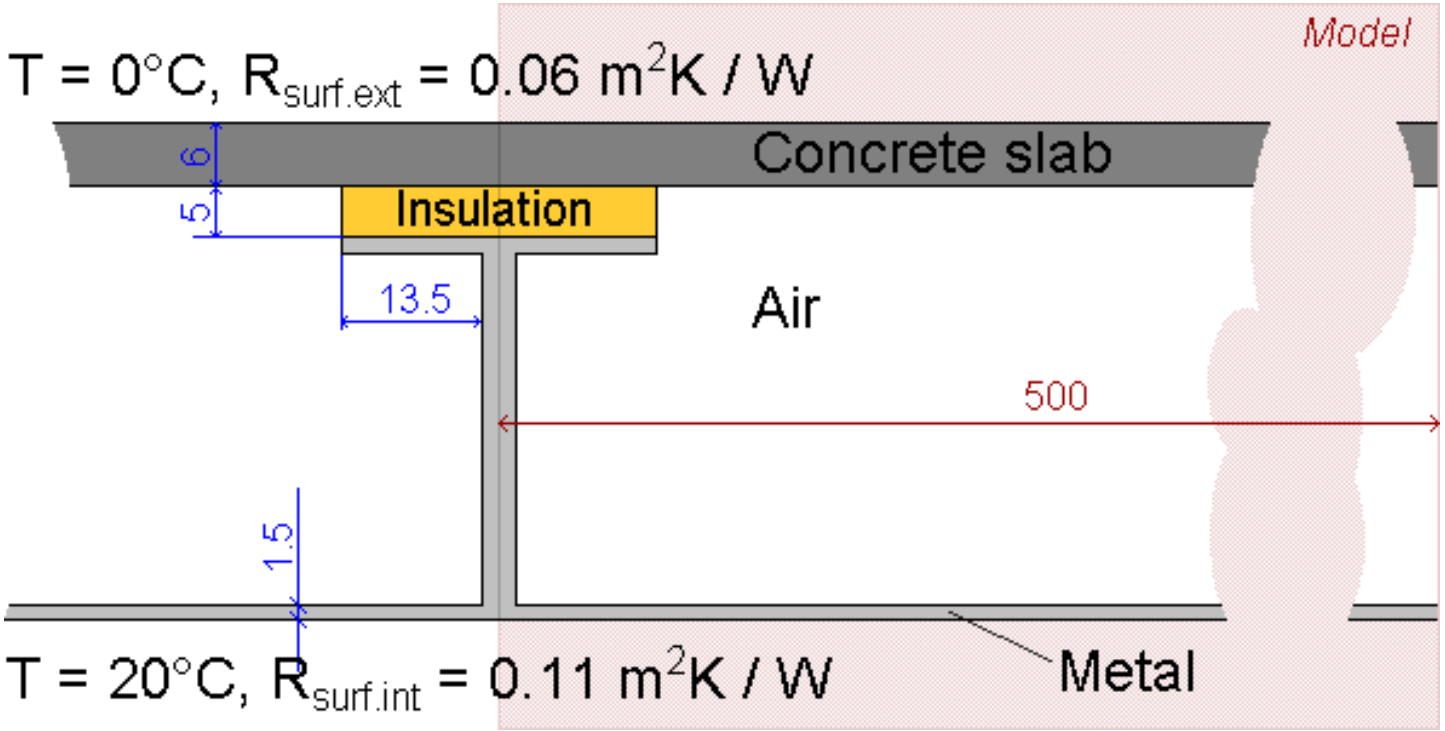
Verification:

ISO 10211:2007 ISO 10077-2:2012

Show cases:

1. Heat losses through windows
2. Balcony slab
3. Flat roof to wall abutment
4. Shallow foundation thermal resistance

ISO 10211:2007. Thermal bridges in building construction



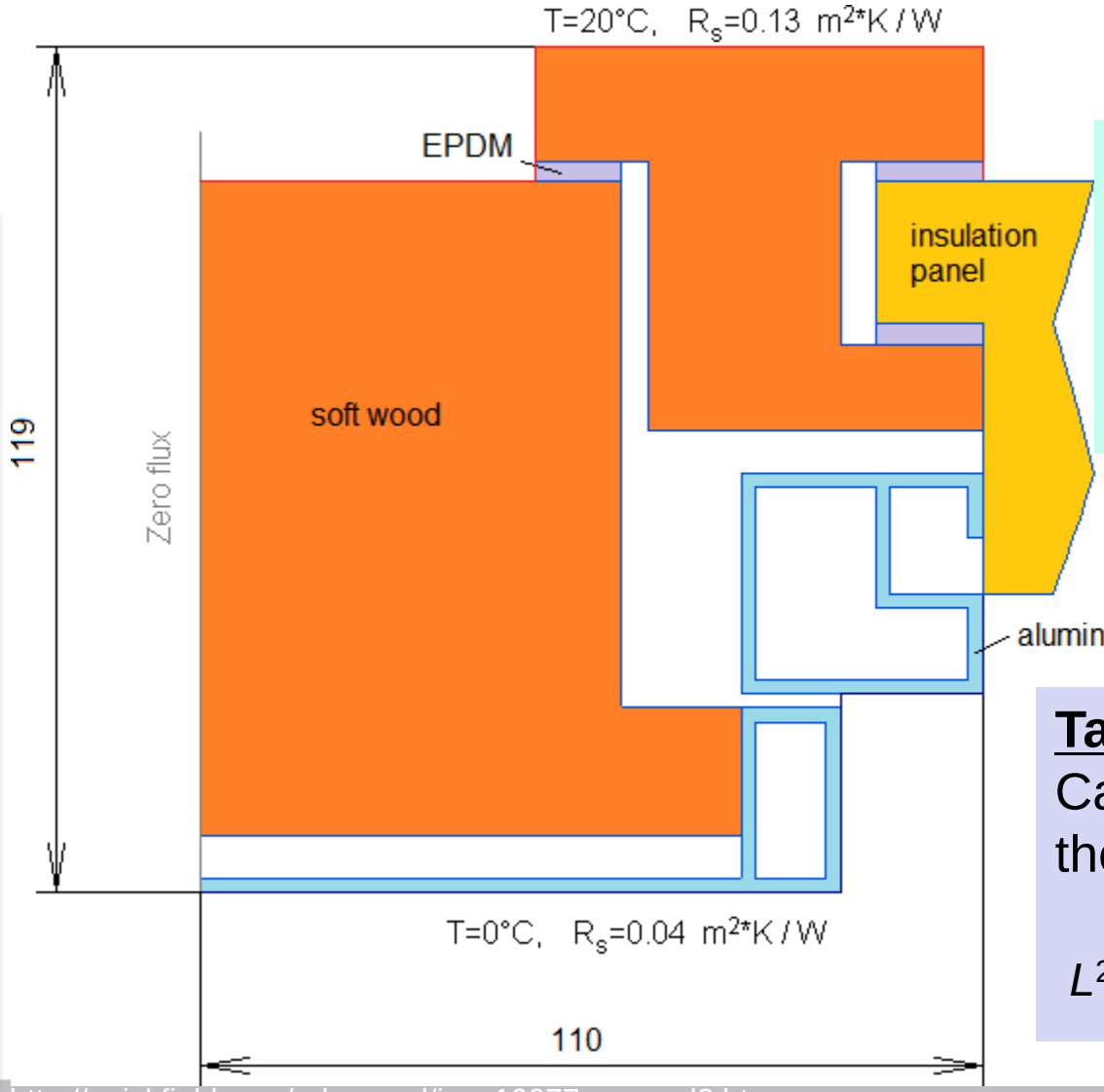
Problem specification:

Concrete	λ_1 = 1.15 W/K·m
Insulation	λ_2 = 0.12 W/K·m
Air	λ_3 = 0.029 W/K·m
Metal	λ_4 = 230 W/K·m

Tasks:

Calculate temperature in the reference points

ISO 10077-2:2012. Thermal performance of windows, doors and shutters



Problem specification:

EPDM	λ_1 = 0.25 W/K·m
Panel	λ_2 = 0.035 W/K·m
Aluminium	λ_3 = 160 W/K·m
Wood	λ_4 = 0.13 W/K·m

Convection (~ΔT)
+
Radiation (~ΔT^4)
=> Effective thermal conductivity

Tasks:

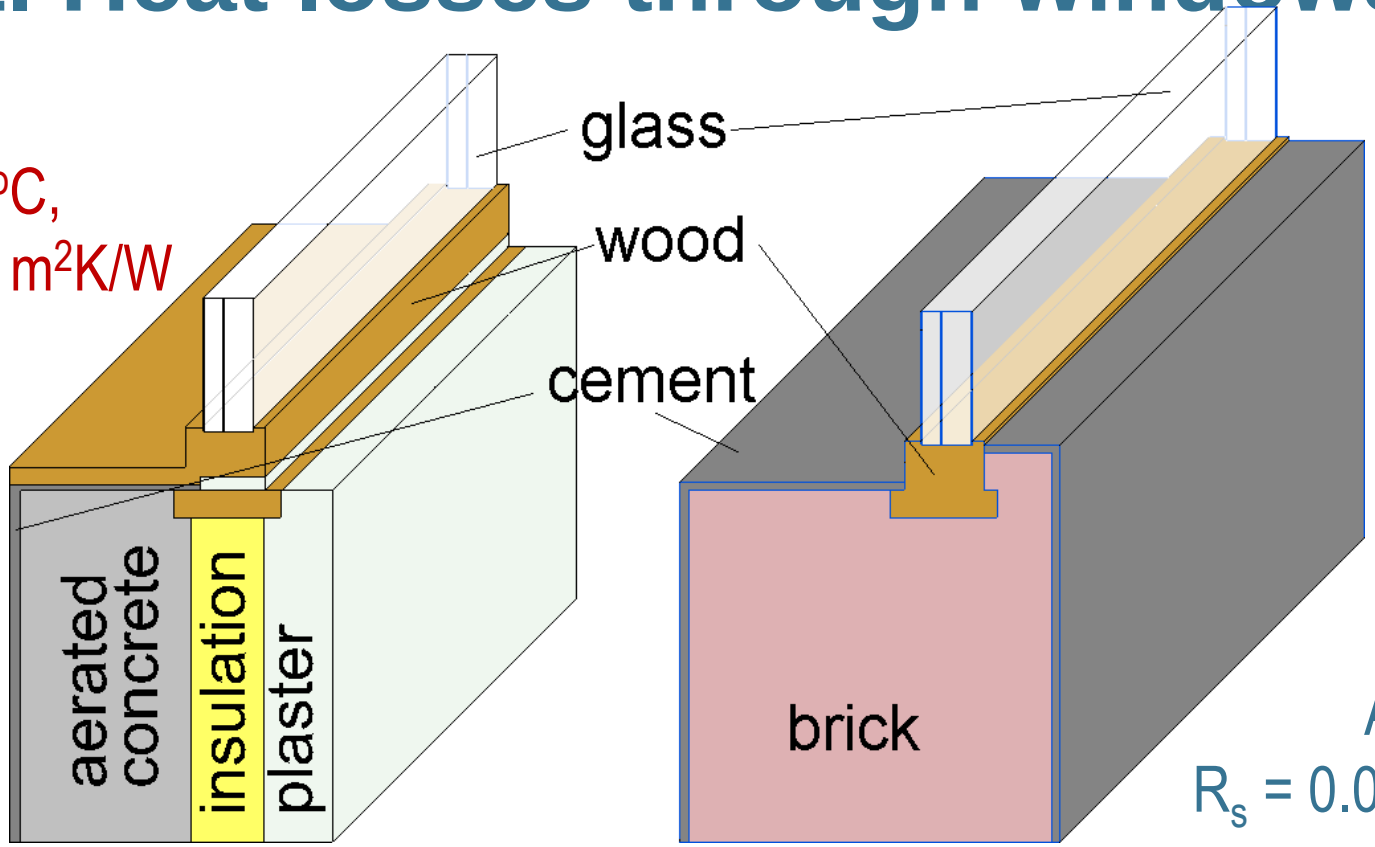
Calculate two-dimensional thermal conductance

$$L^{2D} = \frac{Heat\ flux\ per\ length\ [W/m]}{Temperature\ difference\ [K]}$$

http://quickfield.com/advanced/iso_10077_case_d2.htm

1. Heat losses through windows

Air, + 20 °C,
R_s = 0.11 m^2K/W



Air, - 32 °C
R_s = 0.043 m^2K/W

Problem specification:

Glass	λ_1 = 0.76 W/K·m
Brick	λ_2 = 0.81 W/K·m.
AAC	λ_4 = 0.15 W/K·m
Insulation	λ_3 = 0.048 W/K·m

Tasks:

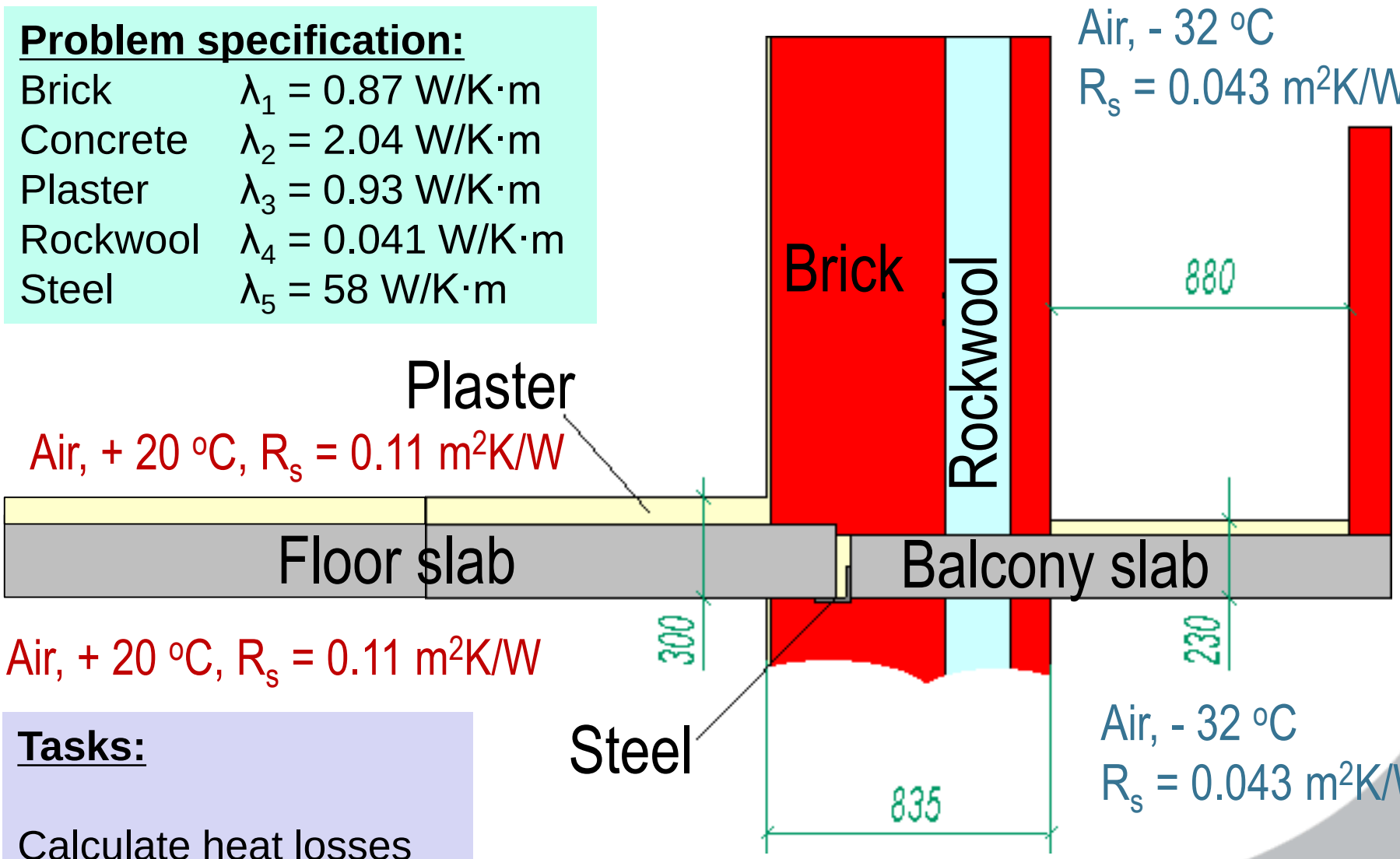
Calculate heat losses

This simulation example is a courtesy of D.V. Krajnov
Kazan State University of Architecture and Engineering

2. Balcony slab

Problem specification:

Brick	$\lambda_1 = 0.87$ W/K·m
Concrete	$\lambda_2 = 2.04$ W/K·m
Plaster	$\lambda_3 = 0.93$ W/K·m
Rockwool	$\lambda_4 = 0.041$ W/K·m
Steel	$\lambda_5 = 58$ W/K·m

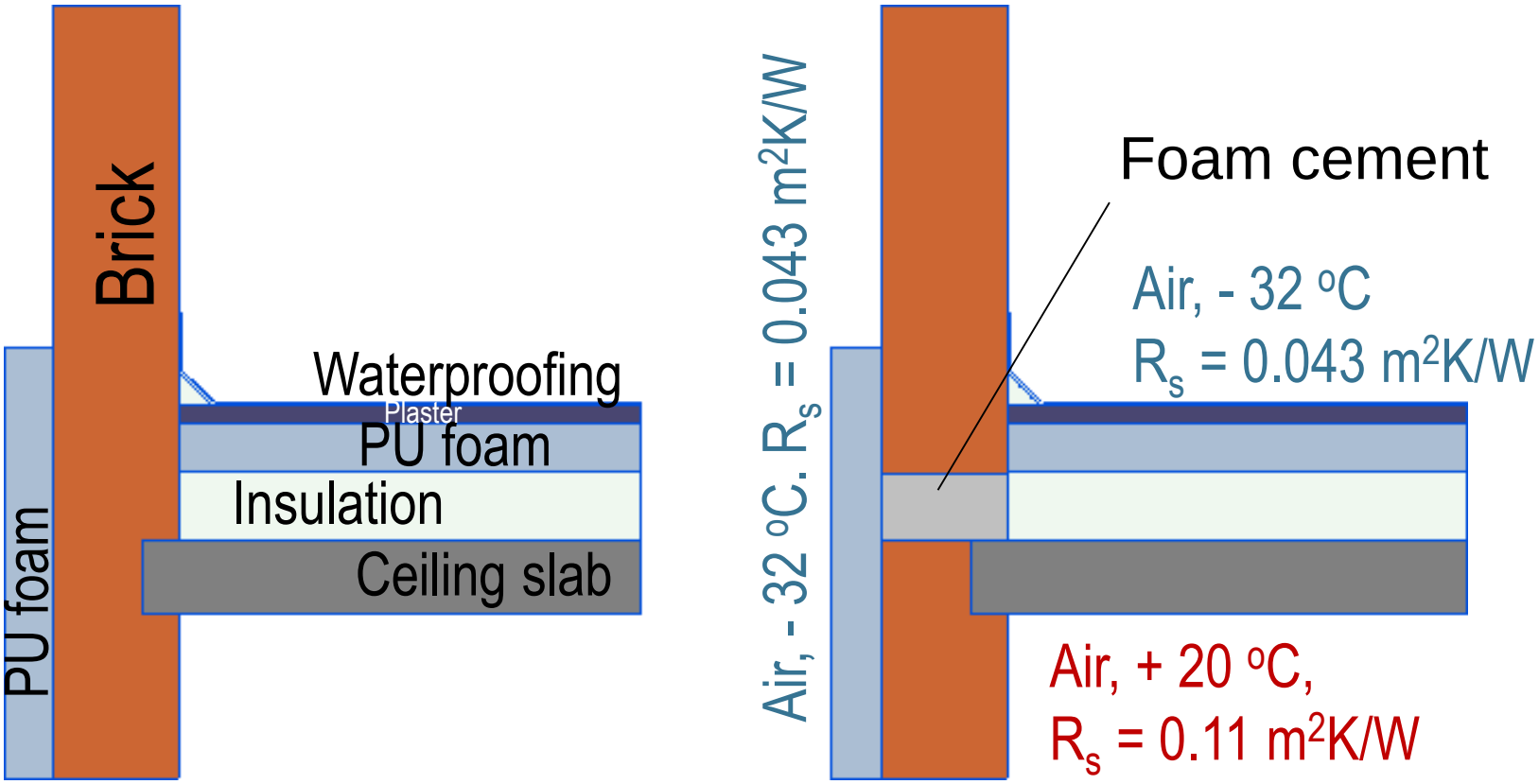


Tasks:

Calculate heat losses

This simulation example is a courtesy of D.V. Krajnov
Kazan State University of Architecture and Engineering

3. Flat roof to wall abutment



Problem specification:

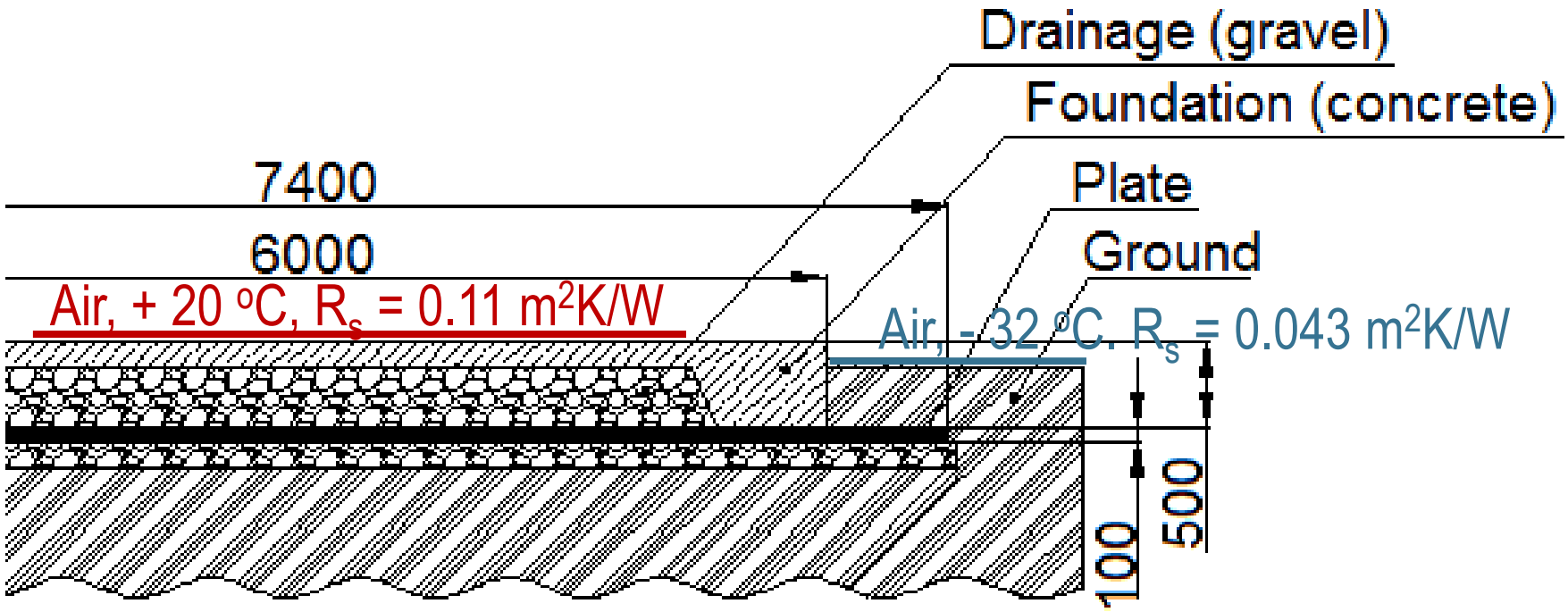
Brick, plaster	λ_1 = 0.9 W/K·m
Concrete	λ_2 = 2.0 W/K·m
Foam cement	λ_3 = 0.15 W/K·m
Insulation, PU foam	λ_4 = 0.045 W/K·m

Tasks:

Calculate heat losses

This simulation example is a courtesy of D.V. Krajnov
Kazan State University of Architecture and Engineering

4. Calculation of the shallow foundation thermal resistance



Problem specification:

Ground	λ_1 = 0.89 W/K·m
Gravel	λ_2 = 0.36 W/K·m
Concrete	λ_3 = 1 W/K·m
Insulation plate	λ_4 = 0.031 W/K·m

Tasks:

Calculate thermal conductance

$$L^{2D} = \frac{Heat\ flux\ per\ length\ [W/m]}{Temperature\ difference\ [K]}$$