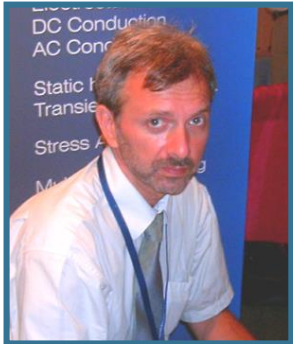




Stress analysis with QuickField



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

Introduction



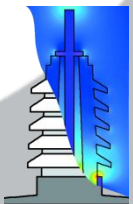
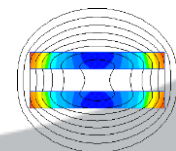
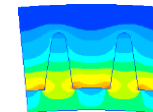
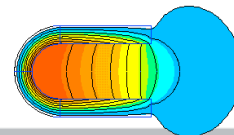
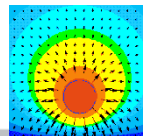
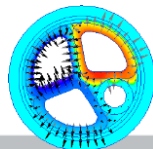
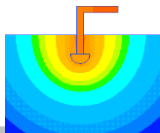
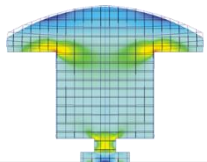
**Alexander Lyubimtsev
Support Engineer,
Tera Analysis Ltd.**

QuicField live demonstration



QuickField Analysis Options

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





Stress Analysis

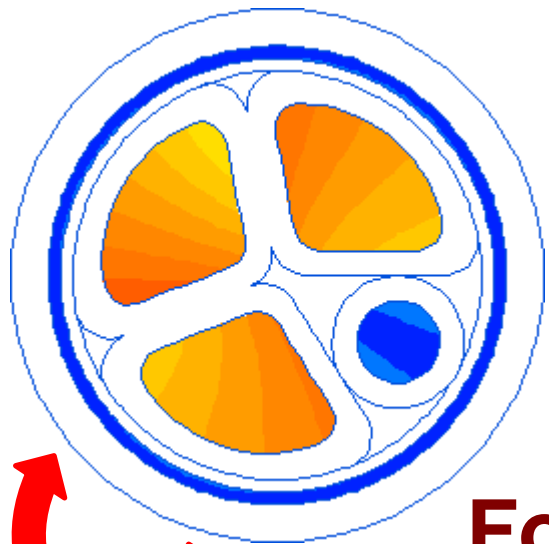
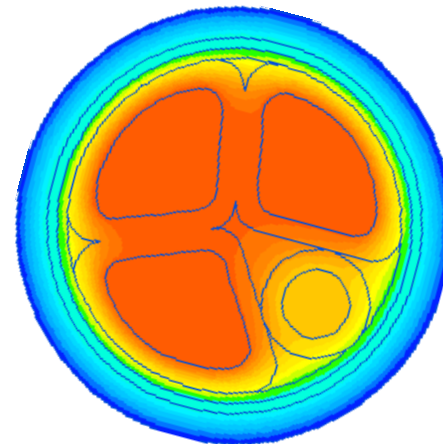
- Plane stress, plane strain, axisymmetric stress problems
- Anisotropic elastic properties
- Distributed and concentrated loadings
- Thermal stresses, magnetic and electric forces
- Various support conditions
- Results: displacements, stress components, principal stresses, Von Mises, Treska, Mohr-Coulomb and Drucker-Prager criteria



MultiPhysics.

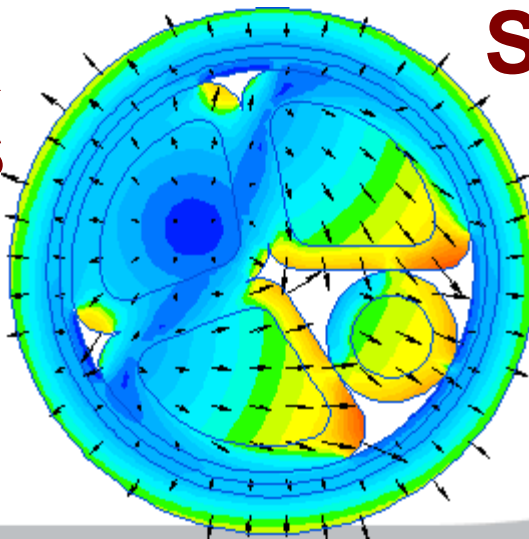
Temperature
Field

Electromagnetic
fields



Thermal
Stresses

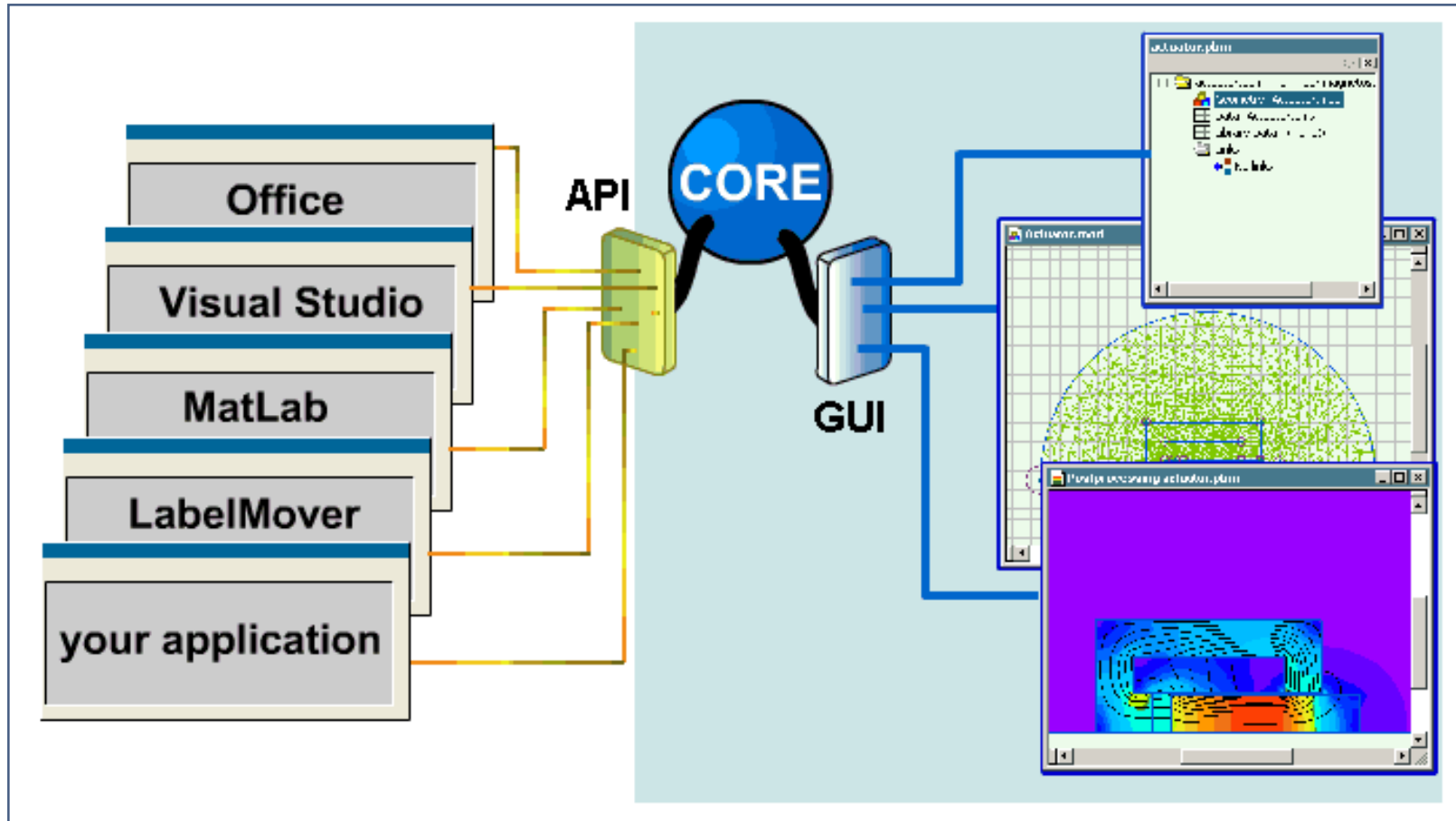
Forces



Magnetic state
import

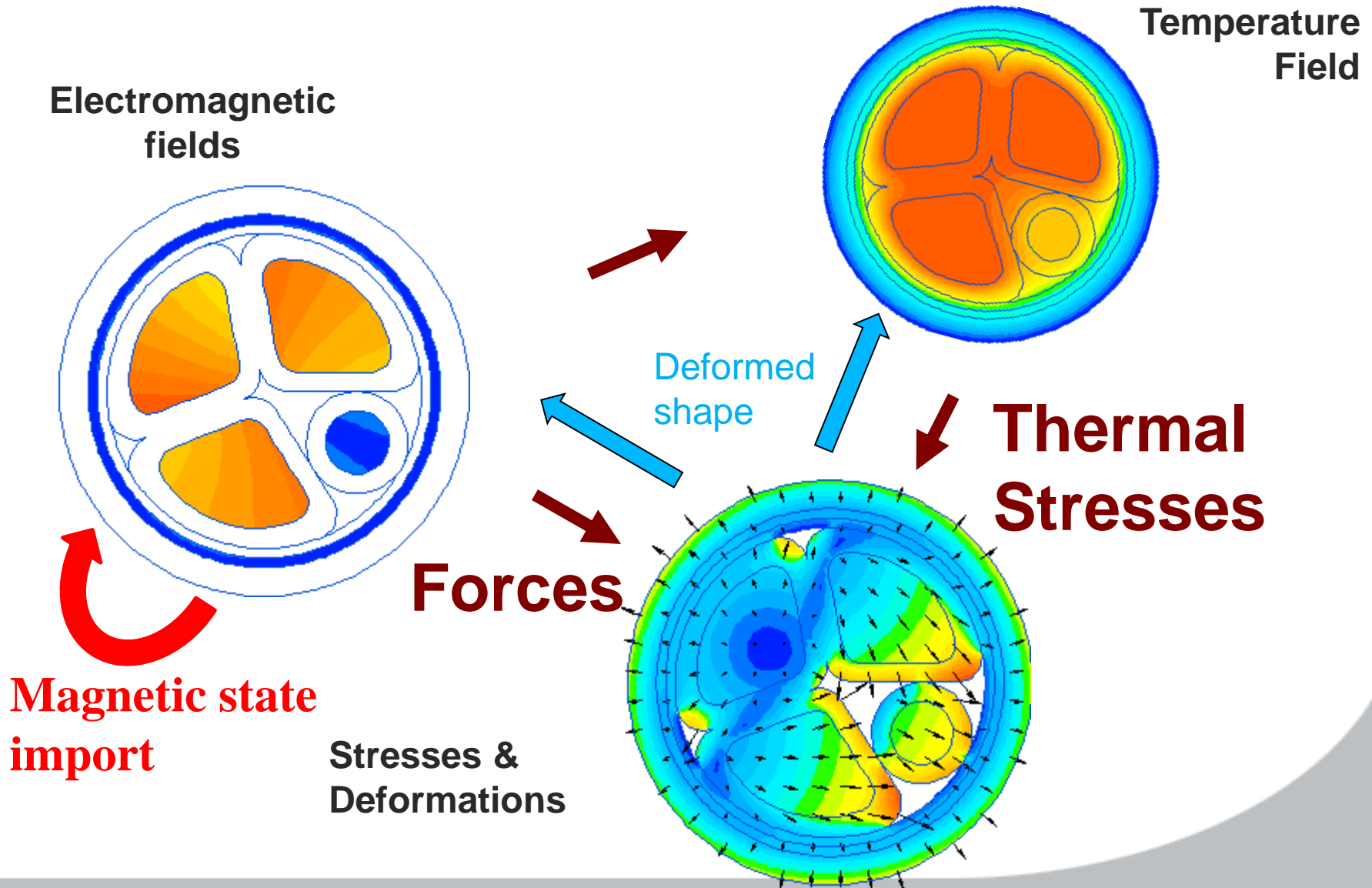
Stresses &
Deformations

Open object interface





MultiPhysics with ActiveField.





QuickField Difference



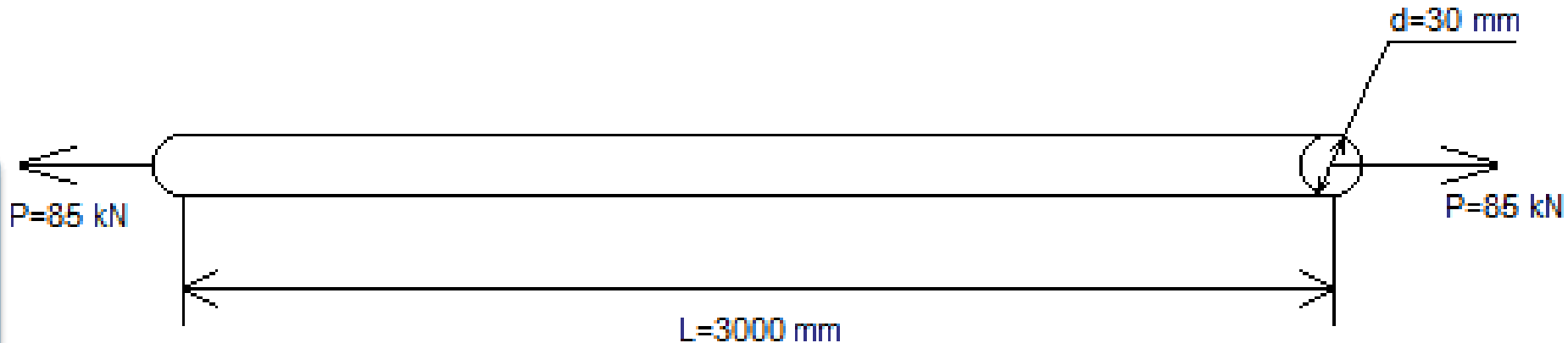


Stress analysis with QuickField

1. Cylindrical rod
2. Perforated plate.
3. Stress distribution in a long solenoid.
4. Pipe subject to temperature and pressure.
5. Bimetallic thermal control
(parametric with LabelMover).
6. Winding force
7. Stress deformed shape.



Cylindrical rod



Problem specification:

Young's modulus $E = 70 \text{ GPa}$;
Poisson's coefficient $\nu = 1/3$

Task:

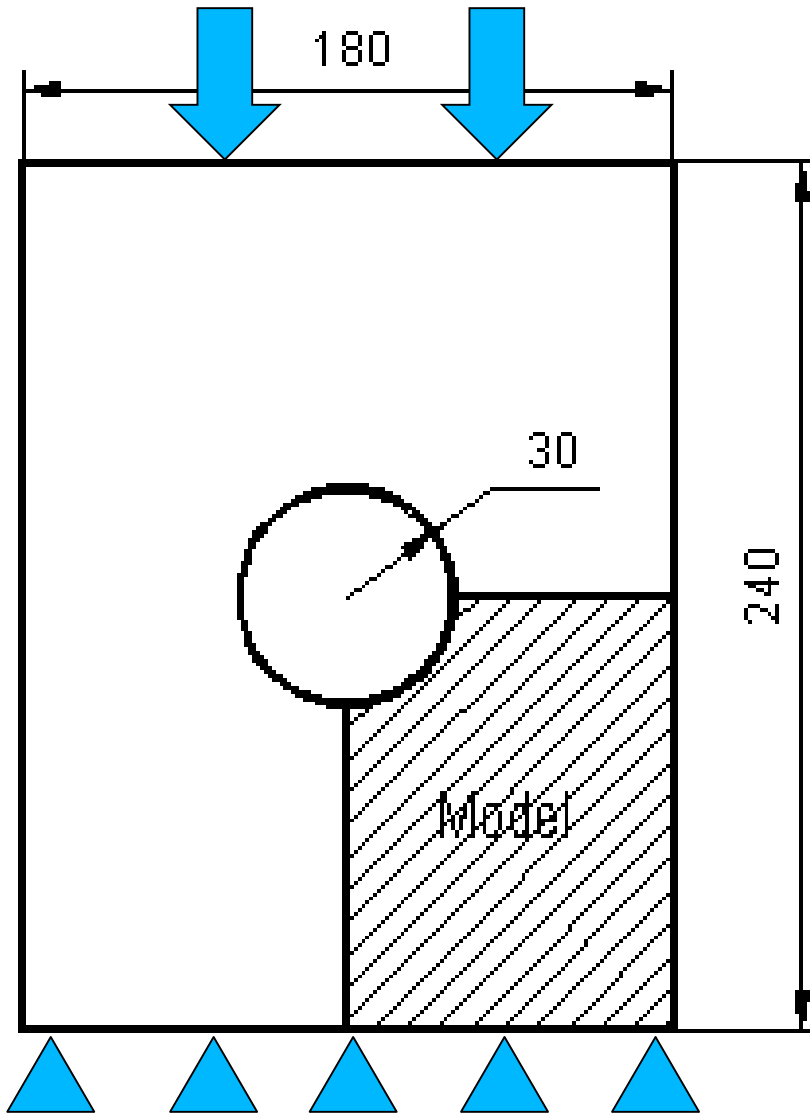
Calculate the rod elongation

Surface force

$$f = \text{Force [N]} / \text{Area [m}^2\text{]}$$



Perforated plate



Problem specification:

Plate thickness 5 mm.

Force density $f_y = -40 \text{ N/mm}^2$

Young's modulus $E = 20.7 \text{ GPa}$;

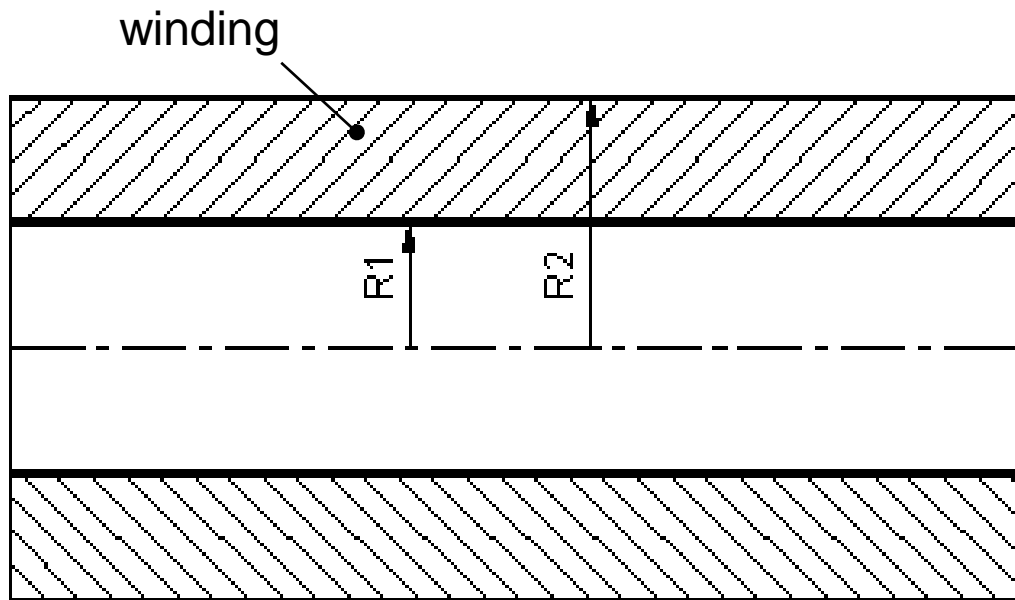
Poisson's coefficient $\nu = 0.3$

Task:

Calculate the stress concentration factor



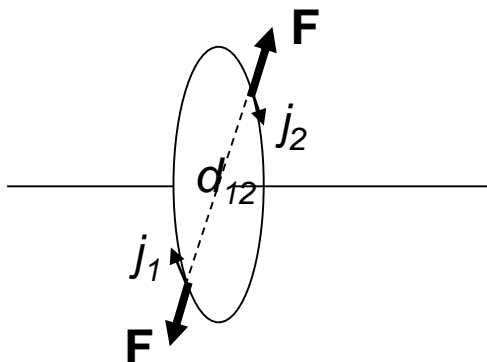
Stress distribution in a long solenoid



$R1 = 1 \text{ cm}$, $R2 = 2 \text{ cm}$

Magnetic force

$$F \sim j_1 * j_2 / d_{12}$$



Problem specification:

Current density
 $j = 0.1 \text{ A/mm}^2$;

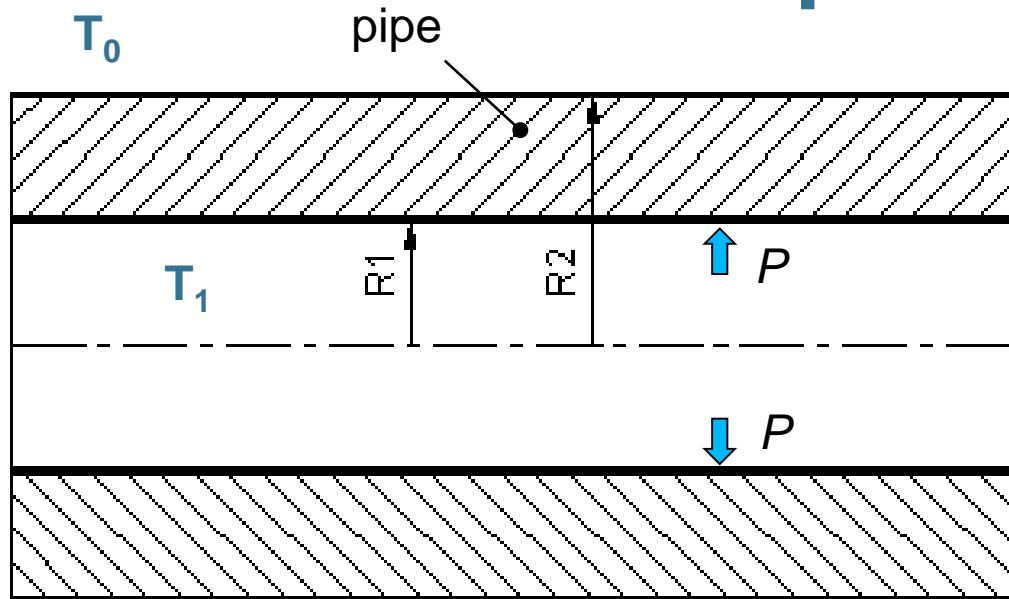
Young's modulus
 $E = 107.5 \text{ GPa}$;
Poisson's ratio $\nu = 0.33$.

Task:

Calculate the stress distribution in the solenoid



Pipe subject to temperature and pressure



$$R1 = 1 \text{ cm}, R2 = 2 \text{ cm}$$

Problem specification:

Inner surface $T_1 = 100 \text{ C}$;
Outer surface $T_0 = 0 \text{ C}$;
Internal pressure $P = 1 \text{ MPa}$;

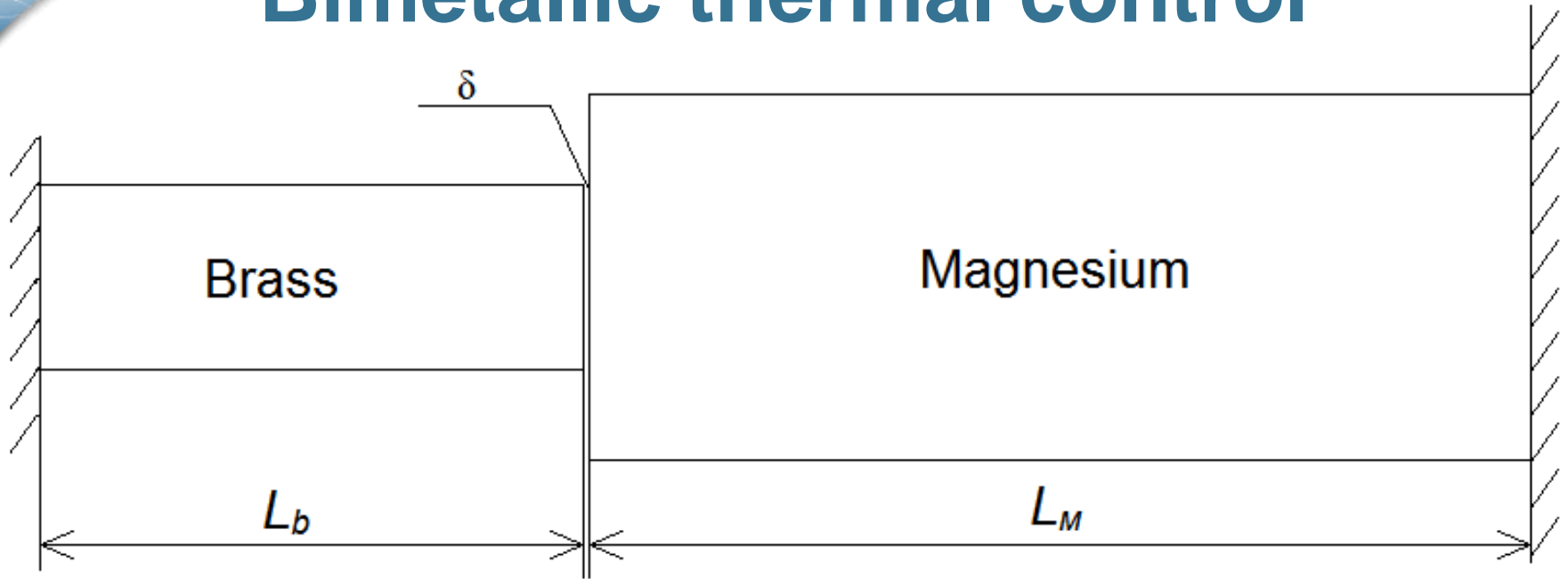
Coefficient of thermal expansion $\alpha = 10^{-6} \text{ 1/K}$;
Young's modulus $E = 300 \text{ GPa}$;
Poisson's ratio $\nu = 0.3$.

Task:

Calculate the stress distribution in the pipe



Bimetallic thermal control



$$L_b = 0.75"; L_m = 1.3"; \delta = 0.005"$$

Task:

Calculate the temperature increase at which the two bars come into contact.

Problem specification:

Brass bar

$$E_b = 15 \cdot 10^6 \text{ psi (103 GPa)}$$

$$\alpha_b = 10 \cdot 10^{-6} \text{ 1/F (18} \cdot 10^{-6} \text{ 1/K)}$$

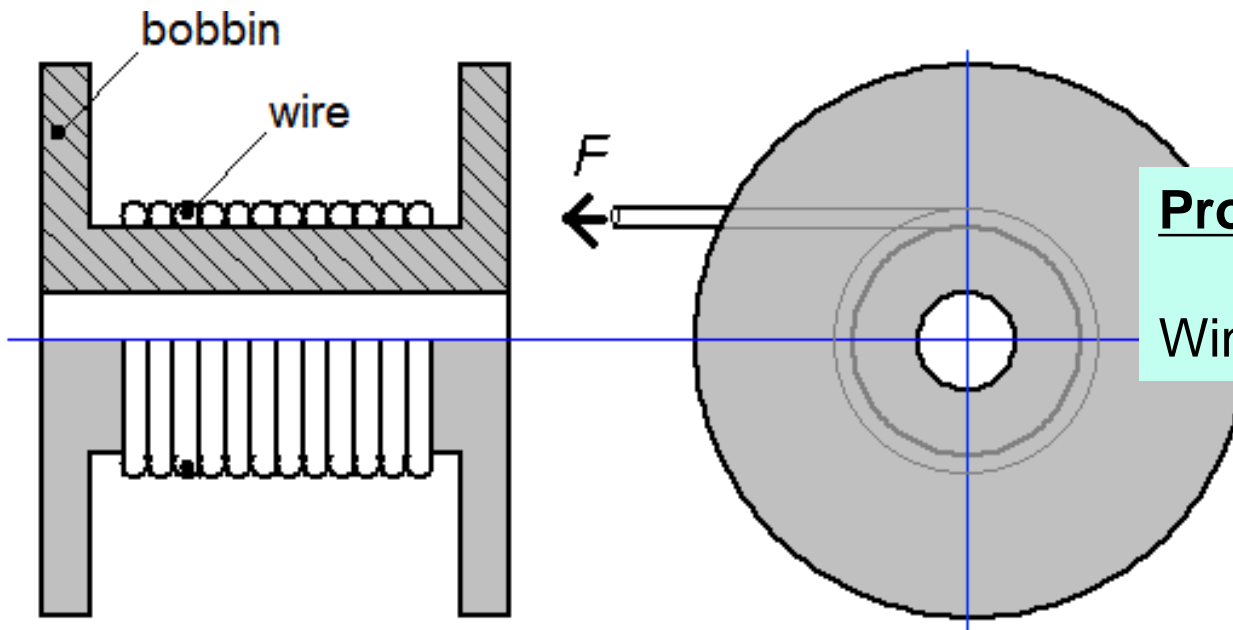
Magnesium bar

$$E_m = 6.5 \cdot 10^6 \text{ psi (44.8 GPa)}$$

$$\alpha_m = 14.5 \cdot 10^{-6} \text{ 1/F (26.1} \cdot 10^{-6} \text{ 1/K)}$$



Winding force



Problem specification:

Winding force, $F = 50 \text{ N}$.

Task:

Calculate the bobbin deformation

Hooke's law elongation

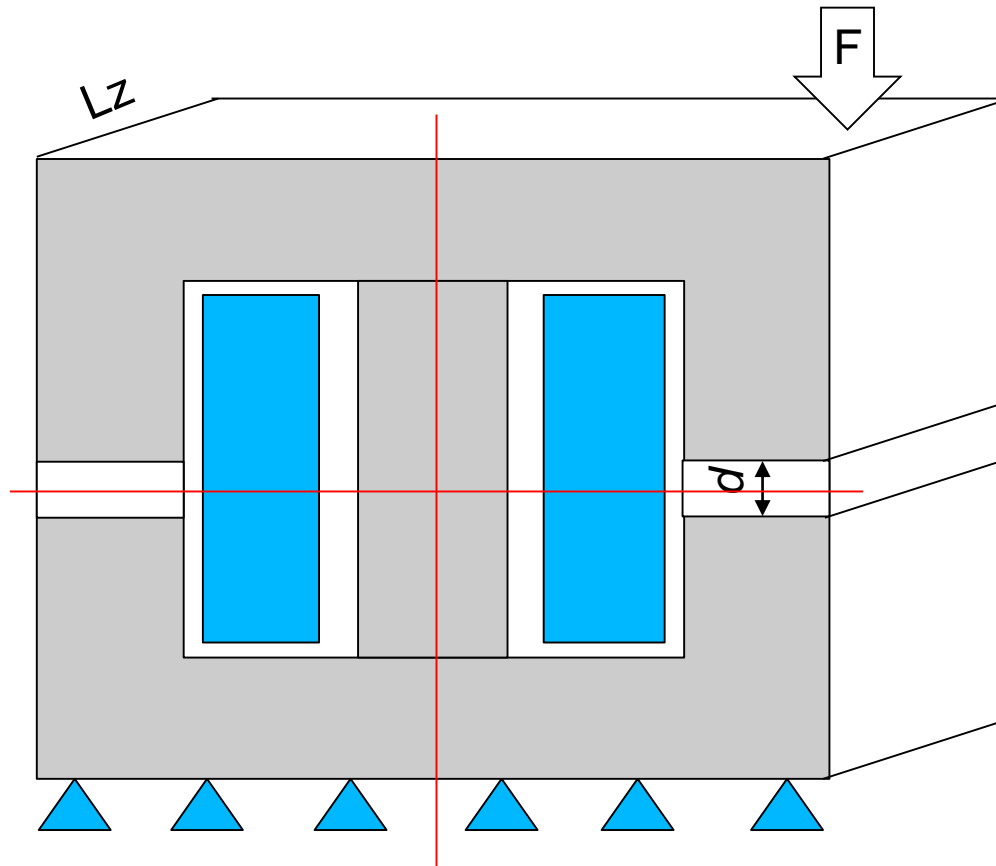
$$dL/L_0 = F / (E \cdot A_w)$$

Thermal expansion

$$dL/L_0 = \alpha \cdot dT$$



Stress deformed shape



Problem specification:

Steel core Young's modulus
 $E = 200 \text{ GPa}$,
Air gap $d = 1 \text{ mm}$
Force applied $F = 2 \text{ kN}$
Model depth $L_z = 80 \text{ mm}$

Calculate:

1. Core displacement.
2. Magnetic flux distribution