0015 – Elastic Properties of Contact Solid

Description

Determine the maximum deflection u_x of a cube with the side length $d = 1$m. Cube is made of isotropic material and its self-weight is neglected. Its lower side is fully fixed and the upper side is subjected to the shear loading.

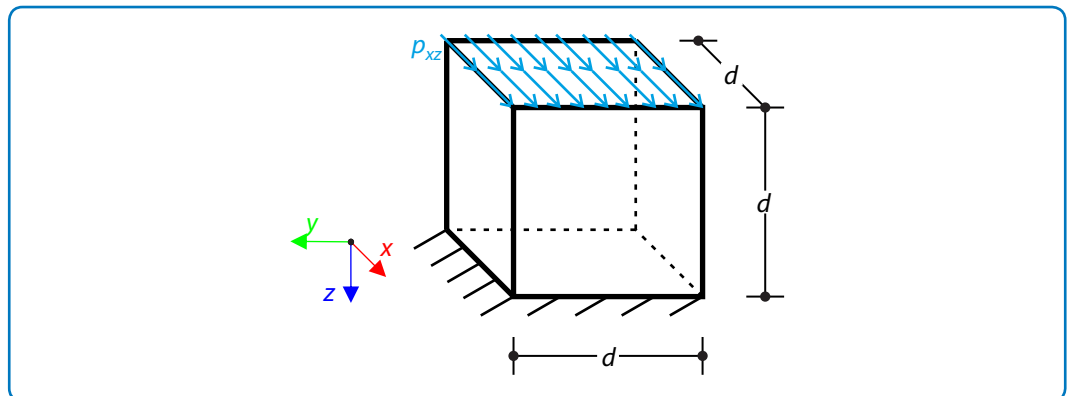| Material	Elastic	Young's modulus	E	12.000	GPa
		Shear modulus	G	6.000	GPa
		Poisson's ratio	ν	0.000	—
		Elastic Friction	C	3.000	GN/m^3
Geometry	Cube	Side length	d	1.000	m
Loading		Shear loading	p_{xz}	0.001	GPa

Figure 1: Problem sketch

Analytical Solution

The shear stress component τ_{xz} is given by

$$\tau_{xz} = p_{xz} \tag{15 – 1}$$

For the elastic deformation of the linear part of the models: Elastic Friction, Coulomb friction and Coulomb friction with limit, following formula can be used:

$$u_x = h\gamma_{xz} = \tau_{xz}\left(\frac{d}{G} + \frac{1}{C}\right) = 0.500 \text{ mm} \tag{15 – 2}$$

RFEM 5 Settings

- Modeled in version RFEM 5.03.0050
- The element size is $l_{FE} = 1.000$ m
- Geometrically linear analysis is considered
- The number of increments is 1
- Full force transmition is set in the direction of the *z*-axis
- Nodes on the lower side are fully fixed and edges of the upper side are prevented from the rotational movement
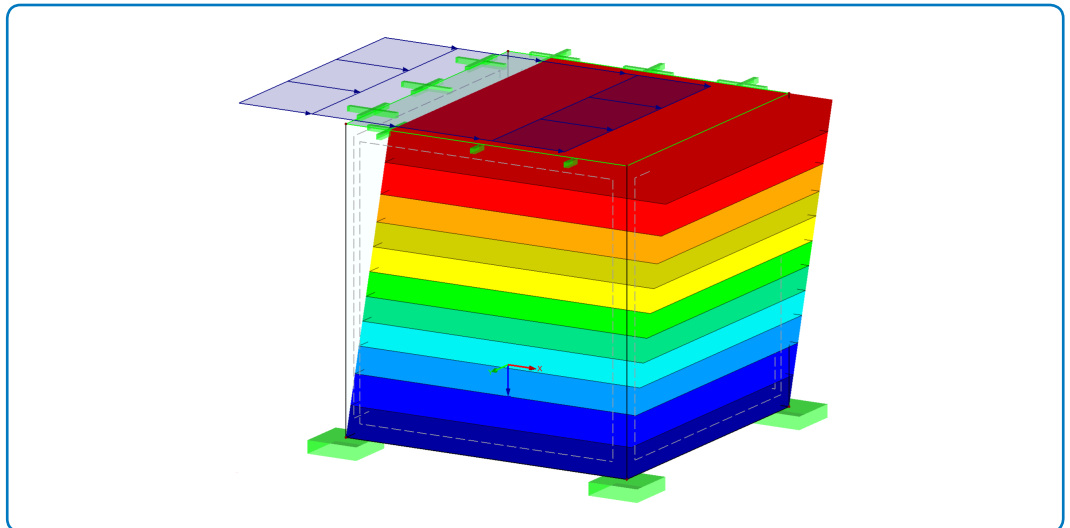
Results

Figure 2: RFEM 5 Solution

Structure File	Program	Entity	Solid Type
0015.01	RFEM 5	Solid	Contact

As can be seen from the following comparison an excellent agreement of the analytical solution with the numerical output was achieved:

Analytical Solution	RFEM 5	
u_x [mm]	u_x [mm]	Ratio [-]
0.500	0.500	1.000