Exercises 5.3

1. Using the general Hooke's law, demonstrate the relation between Young's and bulk modulus.

$\sigma = (E/(1+v)(1-2v))(\varepsilon x + \varepsilon y + \varepsilon z)I$

Comparando essa equação com a equação de estresse em termos do módulo volumétrico (K), temos:

$K = (E/(3(1-2v)))$

Portanto, podemos concluir que a relação entre o módulo de elasticidade (E) e o módulo volumétrico (K) para um material elástico linear e isotrópico é:

$E = 3K(1-2v)/(1+v)$

2. Demonstrate the relation below between elastic constants $G = E/2(1+v)$

$E = 3K(1-2v)/(1+v)$

$G = (3K(1-2v)/(1+v))/ 2(1+v)$

$G = 3K(1-2v)/2(1+v)^2$

3. A cylindrical sample of concrete, with 20 cm height and 10 cm diameter, was tested in a uniaxial compression test where axial and radial deformations were registered. At a point during the elastic regime, the following values were logged: axial stress: 20 Mpa, axial deformation: 0.2 mm and radial deformation: 0.015 mm. Find the corresponding material D matrix tobe used in a plane stress linear-elastic analysis.

```
clear all
clc
```

```
syms E nu
```

```
d = E/((1+nu)*(1-2*nu))*[1-nu nu nu 0;
                         nu 1-nu nu 0;
                         nu nu 1-nu 0;
                         0  0  0  (1-2*nu)/2];
sig = [0.0; 20; 0.0; 0.0];
eps = [0.015/100; 0.2/200; 0.0; (0.015/100+0.2/200)];
```

```
A1 = d\sig == eps;
C = solve (A1(2));
A2 = subs(A1(1), E, C);
B = solve (A2);
D = C/(1-B^2)*[1 B 0;
               B 1 0;
               0 0 (1-B)/2]
```

```
D =
```

$$\begin{pmatrix} \frac{8000000}{391} & -\frac{1200000}{391} & 0 \\ -\frac{1200000}{391} & \frac{8000000}{391} & 0 \\ 0 & 0 & \frac{200000}{17} \end{pmatrix}$$