LECCION 3 - EJERCICIO 1 (14.1) v.2005 - SOLUTION TO GO FROM PLANE STRAIN TO PLANE STRESS

INICIO

```
Off[General::"spell1"]
Off[General::"spell"]
```

```
ClearAll[Em, ν, Emstar, νstar];
```

DEFINICION RELACION DEFORMACIONES-TENSIONES - DEFORMACION PLANA

FACTOR

Em = MODULO ELASTICIDAD - ν = COEFICIENTE DE POISSON

```
? E
```

E is the exponential constant e (base of natural logarithms), with numerical value ≃ 2.71828. >>

```
EfacDp = Em * (1 - ν) / ((1 + ν) * (1 - 2 ν));
```

MATRIZ RELACION DEFORMACIONES-TENSIONES

```
Edp = EfacDp * {{1, ν / (1 - ν), 0}, {ν / (1 - ν), 1, 0}, {0, 0, (1 - 2 ν) / (2 (1 - ν))}};
```

```
Edp // MatrixForm
```

$$\begin{pmatrix} \frac{Em\,(1-\nu)}{(1-2\nu)\,(1+\nu)} & \frac{Em\,\nu}{(1-2\nu)\,(1+\nu)} & 0 \\ \frac{Em\,\nu}{(1-2\nu)\,(1+\nu)} & \frac{Em\,(1-\nu)}{(1-2\nu)\,(1+\nu)} & 0 \\ 0 & 0 & \frac{Em}{2\,(1+\nu)} \end{pmatrix}$$

```
Edp / EfacDp // MatrixForm
```

$$\begin{pmatrix} 1 & \frac{\nu}{1-\nu} & 0 \\ \frac{\nu}{1-\nu} & 1 & 0 \\ 0 & 0 & \frac{1-2\nu}{2\,(1-\nu)} \end{pmatrix}$$

DEFINICION RELACION DEFORMACIONES-TENSIONES - TENSION PLANA

FACTOR

```
EfacTp = Em / (1 - ν^2);
```

MATRIZ RELACION DEFORMACIONES-TENSIONES

$$Etp = EfacTp * \begin{pmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{pmatrix};$$

```
Etp // MatrixForm
```

$$\begin{pmatrix} \frac{Em}{1-\nu^2} & \frac{Em\,\nu}{1-\nu^2} & 0 \\ \frac{Em\,\nu}{1-\nu^2} & \frac{Em}{1-\nu^2} & 0 \\ 0 & 0 & \frac{Em\,(1-\nu)}{2\,(1-\nu^2)} \end{pmatrix}$$

```
Etp / EfacTp // MatrixForm
```

$$\begin{pmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{pmatrix}$$

PLANTEAMIENTO DEL PROBLEMA

```
EdpS = Edp /. {Em → Emstar, ν → νstar};
```

```
EdpS // MatrixForm
```

$$\begin{pmatrix} \frac{Emstar\,(1-\nu star)}{(1-2\,\nu star)\,(1+\nu star)} & \frac{Emstar\,\nu star}{(1-2\,\nu star)\,(1+\nu star)} & 0 \\ \frac{Emstar\,\nu star}{(1-2\,\nu star)\,(1+\nu star)} & \frac{Emstar\,(1-\nu star)}{(1-2\,\nu star)\,(1+\nu star)} & 0 \\ 0 & 0 & \frac{Emstar}{2\,(1+\nu star)} \end{pmatrix}$$

```
Etp // MatrixForm
```

$$\begin{pmatrix} \frac{Em}{1-\nu^2} & \frac{Em\,\nu}{1-\nu^2} & 0 \\ \frac{Em\,\nu}{1-\nu^2} & \frac{Em}{1-\nu^2} & 0 \\ 0 & 0 & \frac{Em\,(1-\nu)}{2\,(1-\nu^2)} \end{pmatrix}$$

IGUALAMOS DOS DE LOS TERMINOS - PORQUE DOS SON LAS INCOGNITAS: Emstar y νstar

```
EdpS[[1, 1]]
```

$$\frac{Emstar\,(1-\nu star)}{(1-2\,\nu star)\,(1+\nu star)}$$

```
Etp[[1, 1]]
```

$$\frac{Em}{1-\nu^2}$$

```
Ecuacion1 = EdpS[[1, 1]] == Etp[[1, 1]]
```

$$\frac{Emstar\,(1-\nu star)}{(1-2\,\nu star)\,(1+\nu star)} == \frac{Em}{1-\nu^2}$$

```
Ecuacion2 = EdpS[[1, 2]] == Etp[[1, 2]]
```

$$\frac{Emstar\,\nu star}{(1-2\,\nu star)\,(1+\nu star)} == \frac{Em\,\nu}{1-\nu^2}$$

RESOLVEMOS EL SISTEMA DE ECUACIONES

```
solucion = Solve[{Ecuacion1, Ecuacion2}, {Emstar, νstar}]
```

$$\left\{\left\{\text{Emstar} \to \frac{\text{Em} + 2\,\text{Em}\,\nu}{(1+\nu)^2},\ \nu\text{star} \to \frac{\nu}{1+\nu}\right\}\right\}$$

COMPROBACION

```
Simplify[EdpS /. solucion[[1]] // MatrixForm]
```

$$\begin{pmatrix} \frac{\text{Em}}{1-\nu^2} & \frac{\text{Em}\,\nu}{1-\nu^2} & 0 \\ \frac{\text{Em}\,\nu}{1-\nu^2} & \frac{\text{Em}}{1-\nu^2} & 0 \\ 0 & 0 & \frac{\text{Em}}{2+2\,\nu} \end{pmatrix}$$

```
Etp // MatrixForm
```

$$\begin{pmatrix} \frac{\text{Em}}{1-\nu^2} & \frac{\text{Em}\,\nu}{1-\nu^2} & 0 \\ \frac{\text{Em}\,\nu}{1-\nu^2} & \frac{\text{Em}}{1-\nu^2} & 0 \\ 0 & 0 & \frac{\text{Em}\,(1-\nu)}{2\,(1-\nu^2)} \end{pmatrix}$$