

## SSLL10 - Gantry with side connections

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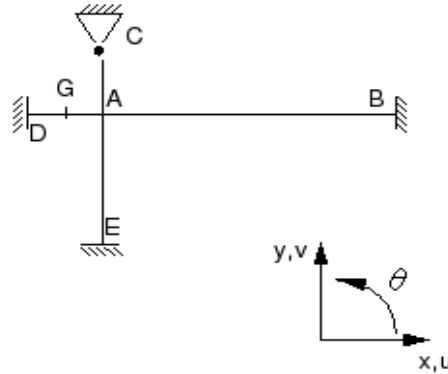
### Summary:

Static test in linear elasticity, being used to validate the elements of right beam `POU_D_T` for a specific loading and a loading distributed (keyword `FORCE_POUTRE`).  
The relations and moments bending are tested.

## 1 Problem of reference

### 1.1 Geometry

Problem plan



| Beam | Length               | Moment of inertia                   |
|------|----------------------|-------------------------------------|
| $AB$ | $l_{AB} = 4\text{m}$ | $I_{AB} = \frac{64}{3} 10^{-8} m^4$ |
| $AC$ | $l_{AC} = 1\text{m}$ | $I_{AC} = \frac{1}{12} 10^{-8} m^4$ |
| $AD$ | $l_{AD} = 1\text{m}$ | $I_{AD} = \frac{1}{12} 10^{-8} m^4$ |
| $AE$ | $l_{AE} = 2\text{m}$ | $I_{AE} = \frac{4}{3} 10^{-8} m^4$  |

$G$  is in the middle of  $DA$ .

Another characteristic of the beams not being used for calculations: the beams are of square section.

$$A_{AB} = 16 \cdot 10^{-4} m$$

$$A_{AD} = 1 \cdot 10^{-4} m$$

$$A_{AC} = 1 \cdot 10^{-4} m$$

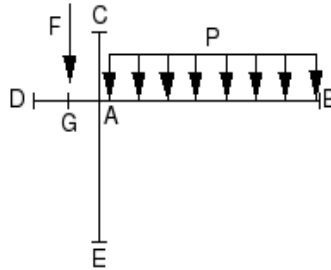
$$A_{AE} = 4 \cdot 10^{-4} m$$

### 1.2 Material properties

Isotropic linear elastic material:  $E = 2 \cdot 10^{11} Pa$

## 1.3 Boundary conditions and loadings

- 1) Not  $C$  : articulated ( $u_C = v_C = 0$ ).



Specific force in  $G$  :  $F = -10^5 N$

Force distributed on the beam  $AD$  :  $p = -10^3 N/m$

## 2 Reference solution

### 2.1 Method of calculating used for the reference solution

One poses:

$$k_{An} = \frac{EI_{An}}{l_{An}}$$

with  $n=B, C, D$  or  $E$

$$K = k_{AB} + k_{AD} + k_{AE} + \frac{3}{4}k_{AC}$$

$$r_{An} = \frac{k_{An}}{K}$$

with  $n=B, C, D$  or  $E$

$$C_1 = + \frac{Fl_{AD}}{8} - \frac{pl_{AB}^2}{12}$$

- Rotation in  $A$  :

$$\theta = \frac{C_1}{4K}$$

- Moment in  $A$  :

$$M_{AB} = + \frac{pl_{AB}^2}{12} + r_{AB} \cdot C_1$$

$$M_{AD} = - \frac{Fl_{AD}}{8} + r_{AD} \cdot C_1$$

$$M_{AE} = r_{AE} \cdot C_1$$

$$M_{AC} = r_{AC} \cdot C_1$$

### 2.2 Results of reference

Value of rotation and the moments in  $A$  .

### 2.3 Bibliographical references

- 1) Guide VPCS - Edition 1990.

## 3 Modeling A

### 3.1 Characteristics of modeling

Elements POU\_D\_T

- 1 element for the section *AG*
- 1 element for the section *GD*
- 1 element for the section *AE*
- 1 element for the section *AC*
- 1 element for the section *AB*

Boundary conditions:

```
DDL_IMPO (
  TOUT=' OUI',      DX=0,  DRX=0,  DRY=0
  NOEUD= (D, B, E),  DX=0,  DY=0,  DRZ=0
  NOEUD=C,          DX=0,  DY=0
)
FORCE_NODALE NOEUD=G  Fy = -1. 105
FORCE_AUTRE   MAILLE=AB Fy = -1. 103
```

### 3.2 Characteristics of the grid

5 elements POU\_D\_T  
6 nodes

### 3.3 Sizes tested and results

| Not      | Size and unit                      | Reference   | % difference |
|----------|------------------------------------|-------------|--------------|
| <i>A</i> | $\theta$ , rotation ( <i>rad</i> ) | 0.227118    | 0,140        |
| <i>A</i> | $M_{AB}$ , moment ( <i>Nm</i> )    | - 11023.72  | - 0,030      |
| <i>A</i> | $M_{AC}$ , moment ( <i>Nm</i> )    | - 113,559   | 0,140        |
| <i>A</i> | $M_{AD}$ , moment ( <i>Nm</i> )    | +12348.588  | - 0,009      |
| <i>A</i> | $M_{AE}$ , moment ( <i>Nm</i> )    | - 1211.2994 | 0,120        |

## 4 Summary of the results

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The results show the good performance of the elements `POU_D_T` in cross-bending under loading concentrated and distributed (`FORCE_POUTRE`).