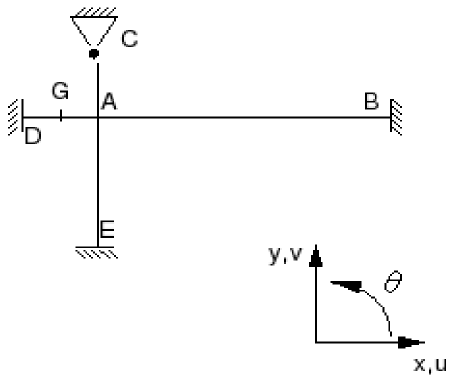
SSLL10 - Gantry with side connections

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.

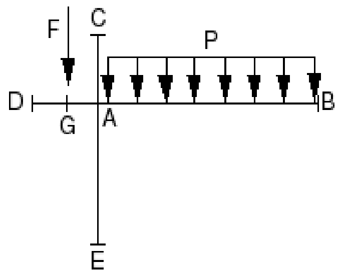
$$A_{AB}=16\ 10^{-4}m$$
$$A_{AD}=1\ \ 10^{-4}m$$
$$A_{AC}=1\ \ 10^{-4}m$$
$$A_{AE}=4\ \ 10^{-4}m$$

1.2 Material properties

Isotropic linear elastic material: $E=2.10^{11}Pa$

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 :

$$M_{AB}=+\frac{pl_{AB}^2}{12}+r_{AB}.C_1$$
$$M_{AD}=-\frac{Fl_{AD}}{8}+r_{AD}.C_1$$
$$M_{AE}=r_{AE}.C_1$$
$$M_{AC}=r_{AC}.C_1$$

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
A	θ , rotation (rad)	0.227118	0,140
A	M_{AB} , moment (Nm)	– 11023.72	– 0,030
A	M_{AC} , moment (Nm)	– 113,559	0,140
A	M_{AD} , moment (Nm)	+12348.588	– 0,009
A	M_{AE} , moment (Nm)	– 1211.2994	0,120

4 Summary of the results

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