SSLL112 - Circular vault under uniform pressure

Summary:
This test makes it possible to check the internal efforts on the curved model of beam POU_C_T.

1 Problem of reference

1.1 Geometry

1.1.1 Circular vault

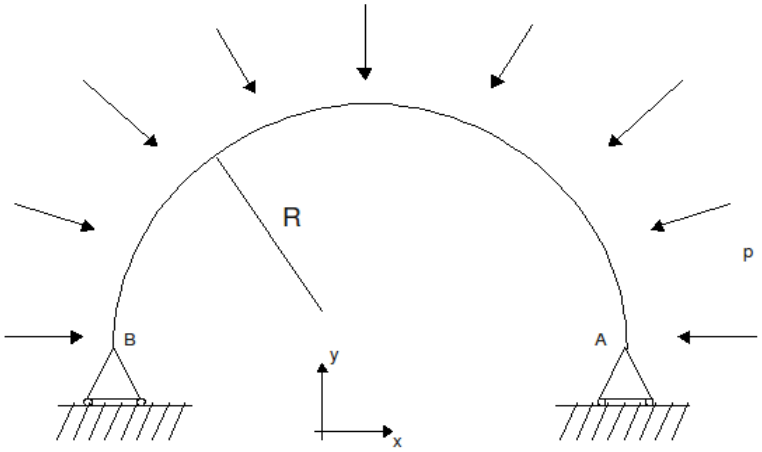

Figure 1.1.1-a : Circular vault.

Ray: $R=1\,m$

1.2 Properties of materials

Young modulus: $E=2.10^{11}\,Pa$

Poisson's ratio: $\nu=0.3$

1.3 Boundary conditions and loading

Boundary condition:

$DX=DY=DZ=DRX=0$ on the point A

$DY=DZ=0$ on the point B

Loading: Force distributed

$p=100\mathrm{N}/m$ on AB

2 Reference solutions

2.1 Method of calculating used for the reference solutions

The beam of the figure [Figure 1.1.1-a] checks the equilibrium equations (problem plan).

$$V_y=\frac{dN}{d\theta},\ N+\frac{dV_y}{d\theta}=-pR,\ \frac{dM}{d\theta}+RV_y=0$$

(p : normal constant loading divided into any point of the beam).
$N(\theta)$, $V_y(\theta)$, $M_z(\theta)$ indicate the efforts (normal, cutting-edge and moment bending) in a point of the vault expressed in the local reference mark.

Their integration with the limiting conditions:

$$V_y(0)=0,\ M_z(0)=0$$

give:

$$V_y(\theta)=0,\ M(\theta)=0,\ N(\theta)=-pR$$

2.2 Results of reference

Interior efforts for $\theta=0°,6°,42°$ and $60°$.

2.3 Uncertainty on the solution

Analytical solution.

2.4 Bibliographical references

[1] Report n° 2314/A of the Institute Aerotechnics “Proposal and realization for new cases tests missing with the validation of the beams ASTER”

3 Modeling A

3.1 Characteristics of modeling

The model is composed of 30 elements curved beam of Timoshenko.

3.2 Characteristics of the grid

It consists of 30 elements POU_C_T.

3.3 Sizes tested and results

Type of effort	Reference	Variation (%)
$V_y(0°)$	0.0000	5.00E-5
$V_y(6°)$	0.0000	5.00E-05
$N(60°)$	– 1.000E+02	0,100
$MFZ(42°)$	0.0000	3.93E-05

4 Summary of the results

The normal effort in the vault (only effort not no one) is calculated with a good precision ($0,1\%$) for adopted modeling.