

SSL112 - Arch circular under uniform pressure

Abstract:

This test makes it possible to the model check the internal forces on curved beam POU_C_T.

1 Problem of reference

1.1 Geometry

1.1.1 Arches circular

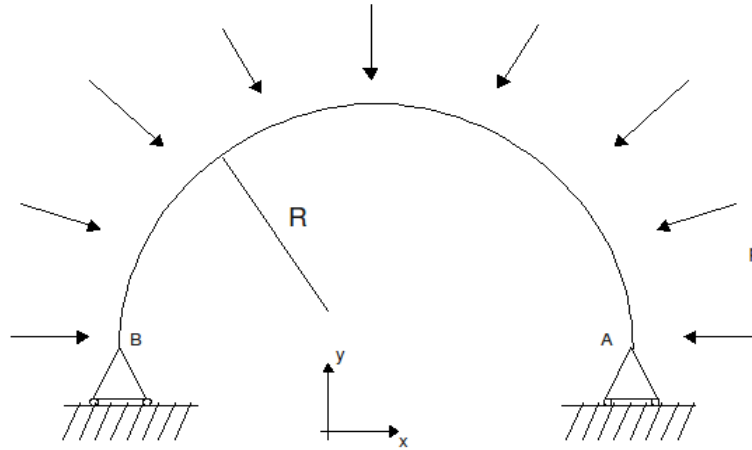


Figure 1.1.1-a : Arch circular.

Radius: $R=1\text{ m}$

1.2 Properties of the materials

Modulus Young: $E=2.10^{11}\text{ Pa}$

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: Distributed force

$p=100\text{ N/m}$ 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 balance equations (plane problem).

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

(p : normal constant distributed loading in any point of the beam).

$N(\theta)$, $V_y(\theta)$, $M_z(\theta)$ indicate the forces (normal, cutting-edge and bending moment) in a point of the arch expressed in the local coordinate system.

Their integration with the limiting conditions:

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

give:

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

2.2 Results of reference

Internal forces for $\theta = 0^\circ, 6^\circ, 42^\circ$ and 60° .

2.3 Uncertainty on the analytical

solution Solution.

2.4 Bibliographical references

- [1] Ratio n° 2314/A of the Institute Aerotechnics "Proposal and realization for new cases tests missing to the validation of beams ASTER"

3 Modelization A

3.1 Characteristic of the modelization

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

3.2 Characteristics of the mesh

It consists of 30 elements `POU_C_T`.

3.3 Quantities tested and Type

results of force	Reference	Variation (%)
$V_y(0^\circ)$	0.0000	5.00E-5
$V_y(6^\circ)$	0.0000	5.00E-05
$N(60^\circ)$	- 1.000E+02	0.100
$MFZ(42^\circ)$	0.0000	3.93E-05

4 Summary of the results

the normal force in the arch (only non-zero force) is calculated with a good accuracy (0,1%) for the adopted modelization.