SDNL137 – Calculation of non-linear modes of a tube curved with two non-linearities of type annular contact

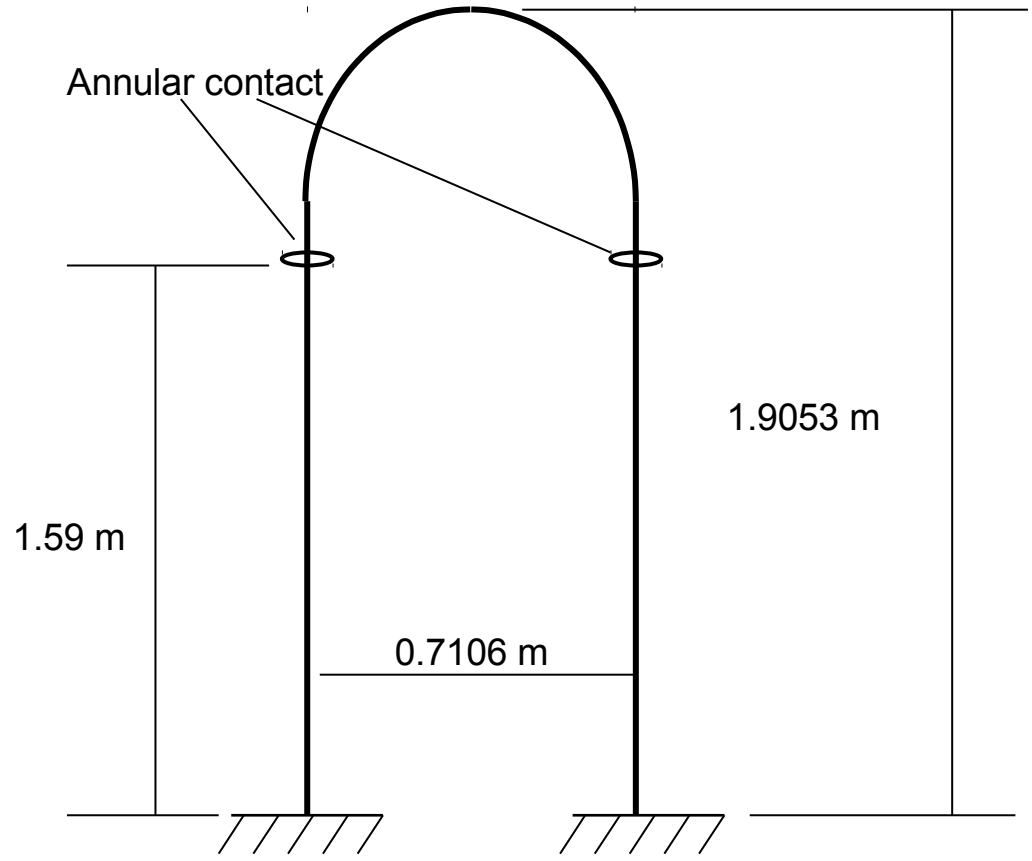
Summary:

The objective of this test is to validate the calculation of non-linear mode with the operator MODE_NON_LINE. One particularly validates the system with a non-linearity of type annular contact.

1 Problem of reference

1.1 Geometry

The following structure is considered:



The tube has an external ray $R_{ext}=11.1110^{-3}m$ and a thickness of $ep=1.2710^{-3}m$

1.2 Properties of material

The material is elastic isotropic whose properties are:

- $E=2.05610^{11}Pa$
- $\nu=0.3$
- $\rho=8357kg/m^3$
- Rigidity of shock: $K_{choc}=410^6N/m$

1.3 Boundary conditions and loadings

The game on the level of the annular contact is $e=2.910^{-4}m$.
The annular contacts were isolated of $0.1e$ nodes of contact.

2 Reference solution

One is interested in calculation of periodic solutions of the system characterizing the non-linear mode thus.

2.1 Method of calculating

For the resolution of the system, one uses method EHMAN [1]. One tries to follow the branch of the periodic solutions starting from the first mode of the subjacent linear system.

2.2 Sizes and results of reference

The selected reference variables are the couple frequency – energy and the stability of the periodic solution obtained.

A periodic solution is found for the couple frequency – energy such as:
$5.2\,Hz < f < 5.5\,Hz$ and $7\,10^{-5}\,J < E < 8\,10^{-5}\,J$

2.3 Uncertainties on the solution

Solution of not-regression.

2.4 Bibliographical references

1 E.H. MOUSSI, Analyzes vibrating structures equipped with located non-linearities with game using the non-linear modes. Doctorate 2013.

3 Modeling A

3.1 Characteristics of modeling

A modeling is used POU_D_E.

3.2 Characteristics of the grid

The grid contains 10 elements of the type SEG2.

3.3 Sizes tested and results

One tests the couple frequency – energy by interpolation starting from the table produced by MODE_NON_LINE. A solution of not-regression is suggested. The values obtained are presented in the table below.

Frequency (Hz)	Energy (J)	Stability of the periodic solution
5.25698	$7.83624\,10^{-5}$	NON_EVALUE

4 Summary of the results

This case test validates the operator of calculation of non-linear modes (MODE_NON_LINE) on a system having a non-linearity of type annular contact.

A solution of not-regression is suggested.