SSNV153 - Contact pulley-cord

Summary:

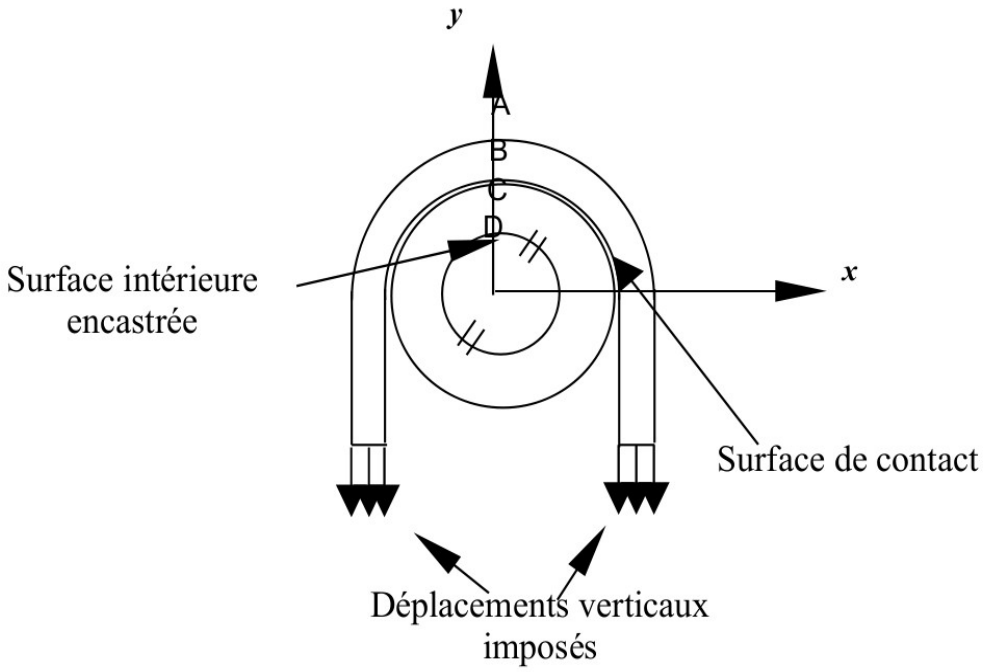
This problem corresponds to a quasi-static analysis of a problem of mechanics with contact without friction. It is about a cord posed on a pulley, whose interior surface is embedded, and drawn on two sides with an imposed vertical displacement.

This test, treated in 2D with elements QUAD4 is implemented to validate the smoothing of the normal of surfaces of contact.

This test is based on 2D results suggested by Papadopolous [bib1].

1 Problem of reference

1.1 Geometry



Thickness of the cord $ep=1\ mm$.

Thickness of the pulley $a=1\ mm$.

Position of the points of reference on the surface of contact (mm)

	x	y	
A	0	4	0
B	0	3	0
C	0	3	0

1.2 Material properties

Plate for the pulley and the cord:

Poisson's ratio: 0.4762

Young modulus: $147.619\,10^5\,N/m^2$

Finite elements of contact:

Integration : Nodes
Parameter of the method:

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Coef_regu_cont =1 .
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1.3 Boundary conditions and loadings

The pulley is blocked:

- on its surface displacement interns is null in the two directions x and y.

No boundary conditions is imposed on the cord except that of the contact.

Loading:

- two vertical displacements are imposed on the two ends of the cord $u=1$

2 Reference solution

2.1 Method of calculating used for the reference solution

The reference solution comes from results got in [bib1].

2.2 Results of reference

Tangential displacements (according to x) at the points $A\,B\,C$ surface of contact.
Value of σ_{yy} at the point C (and thus that of $LAGS_C$)

2.3 Bibliographical reference

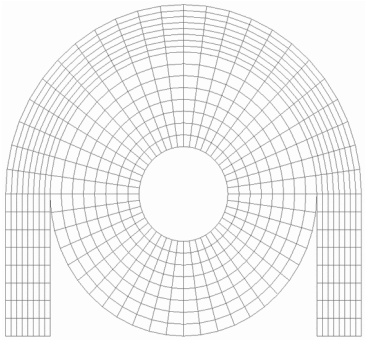
1) P. PAPADOPOULOS “Numerical formulations for contact problems with friction” Newspaper of Theorical and Applied Mechanics GAUTHIER - VILLARS

3 Modeling A

3.1 Characteristics of modeling

Modeling: 2D_PLAN for the solid elements (QUAD4)

The pulley is with a grid with a regular grid using only elements QUAD4. There is the same number of nodes on interior and external surface. For the cord the grid is also regular and understands only elements QUAD4. There are 8 meshs in the thickness of the cord.



3.2 Characteristics of the grid

Many nodes:	807
Many meshs and types:	703 QUAD4 and 311 SEG2

3.3 Values tested

Identification	Reference
DX at the point A	0.0
DX at the point B	0.0
DX at the point C	0.0
$SIYY$ at the point C	-5.97E+05

4 Summary of the results

In this case test, two surfaces of contact are not plane. The normal thus changes mesh with another. This discontinuity generates problems of pairing which have a great influence on calculation. Among these problems, one finds the problem of dissymetrisation, i.e to find results which do not respect the symmetry of the problem. For this case test, the problem is perfectly symmetrical (geometries, boundary conditions and loading) according to the axis y. Without regularization of the normal a dissymmetry appears on the axis x. Indeed, horizontal displacements of the points A, B and C who are on the axis then have there nonworthless values which do not respect the total symmetry of the problem.

With the regularization of the normal, the solution obtained by using the method continues, respects symmetry perfectly. It should however be noted that the maillor gibi, used in this case test, does not give a perfectly symmetrical grid and that problems of round-offs very slightly deteriorate the quality of the solution.

With this problem is dealt with the method CONTINUOUS , keyword CONTACT. Integration is made on the level of the nodes of the grid. A special attention on the choice of the potential zones of contact is to be taken into account in these problems of nonplane surfaces.