SSNV153 - Contact pulley-rope

Summarized:

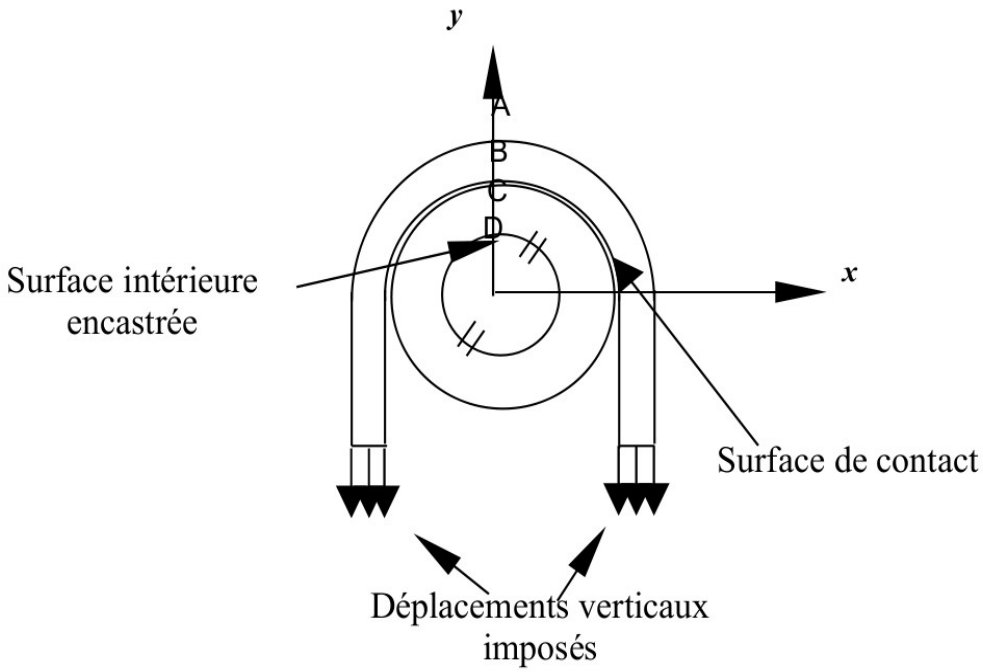
This problem corresponds to a quasi-static analysis of a problem of mechanics with contact without friction. It is about a rope posed on a pulley, whose interior surface is clamped, and drawn on two sides with an imposed vertical displacement.

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

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

1 Problem of reference

1.1 Geometry



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

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

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

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

1.2 Material properties

Plates for the pulley and the rope:

Poisson's ratio: 0.4762

Young's 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 rope except that of the contact.

Loading:

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

2 Reference solution

2.1 Method of calculating used for the reference solution

the reference solution comes of results obtained in [bib1].

2.2 Results of reference

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

2.3 Bibliographical reference

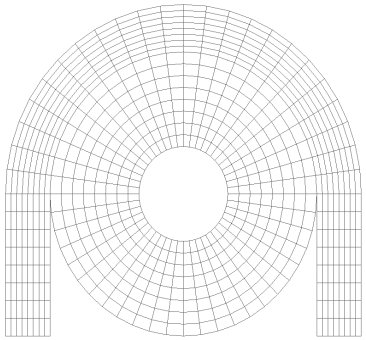
1) P. PAPADOPOULOS “Numerical formulations for contact problems with friction” Newspaper of Theorical and Applied Mechanics GAUTHIER - VILLARS

3 Modelization A

3.1 Characteristic of the modelization

Modelization: 2D_PLAN for the solid elements (QUAD4)

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



3.2 Characteristics of the mesh

Many nodes:	807
Number of meshes and types:	703 QUAD4 and 311 SEG2

3.3 Values tested

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

4 Summary of the results

In this case test, two contact surfaces are not plane. The norm thus changes mesh with another. This discontinuity generates problems of pairing which have a great influence on computation. 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 symmetric (geometries, boundary conditions and loading) according to the axis. y Without regularization of the norm a dissymmetry appears on the axis. x Indeed, horizontal displacements of the points, A and B which C are on the axis then have there non-zero values which do not respect the total symmetry of the problem. With

the regularization of the norm, the solution obtained by means of the continuous method, respects symmetry perfectly. It should however be noted that the mesh generator gibi, used in this case test, does not give a perfectly symmetric mesh and that problems of round-offs very slightly deteriorate the quality of the solution. With this

problem is dealt with the continuous method , of key word CONTACT . Integration is made on the level of the nodes of the mesh. A special attention on the choice of the potential zones of contact is to be taken into account in these problems of nonplane surfaces.