SSNP157 – Benchmark NAFEMS of validation of the contact 5: *steel roller one rubber*

Summarized:

This problem constitutes the fifth benchmark of a benchmark NAFEMS of validation of contact-friction. The references of the benchmark are obtained with the codes Abaqus and MARC.
This test models the training of a rubber ribbon by a steel roller. The problem is three times over nonlinear: material néo-Hookéen, large displacements and contact-friction.

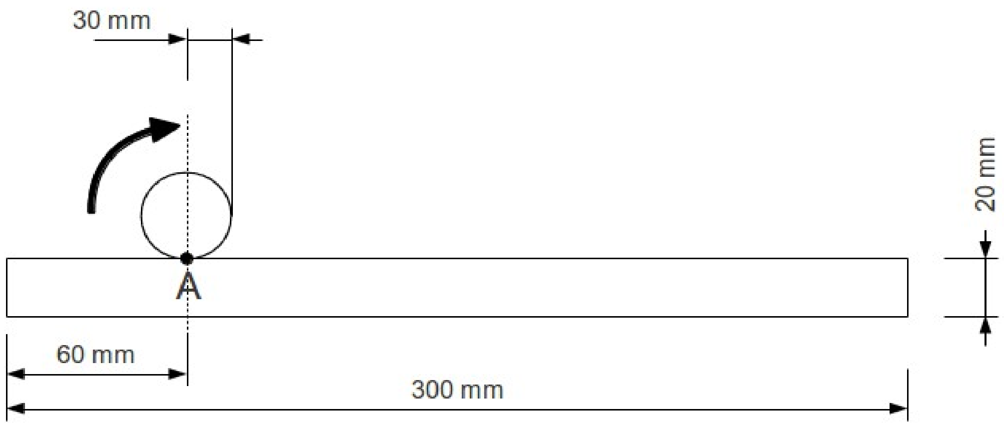
This test comprises only one modelization with:

- Under-integrated quadratic elements
- Formulation "`CONTINUE`" of contact-friction

1 Problem of reference

1.1 Geometry

the structure is modelled in plane strains.



One initially A notes the higher point of the ribbon in contact with the roller.

1.2 Properties of the materials

Roller:

Poisson's ratio: $0{,}3$
Young Modulus: $210000\,N.mm^{-2}$

Ribbon:

Poisson's ratio: $0{,}5$
Material néo-Hookéen: $C_{10}=10\,N.mm^{-2}$

The coefficient of kinetic friction between the roller and the ribbon is worth $\mu=0{,}3$.

1.3 Boundary conditions and loadings

the center of the roller is fixed.
The loading is applied in two stages:

First stage:

- The roller is fixed: $DX=DY=0$
- Vertical displacement imposed on the lower surface of the ribbon: $DY=3\,mm$
- Horizontal displacement blocked on the right side of the ribbon: $DX=0$

Second phase:

- Time rotation of 360° of the roller
- vertical Displacement on the lower surface of the maintained ribbon: $DY=3\,mm$

2 Reference solution

2.1 Method of calculating

the reference solution comes of results obtained with the codes Abaqus and MARC in a benchmark NAFEMS from validation of contact-friction [bib1].

2.2 Quantities and results of reference

horizontal Displacement of the point A (according to x) after complete rotation of the roller.

2.3 Uncertainties on the Important

solution (average of codes).

2.4 Bibliographical reference

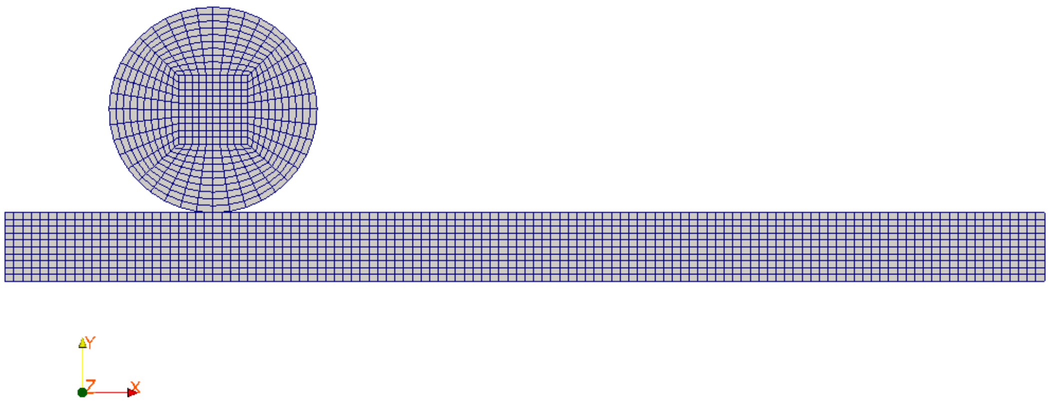
[1] A. KONTER. *“Advanced Finite Element Benchmarks Contact”*. NAFEMS, 2006.

3 Modelization A

3.1 Characteristic of the modelization

The modelization is `D_PLAN_SI`, the formulation of the contact is `CONTINUE`.

3.2 Characteristics of the mesh



Many nodes: 4382
Number of meshes and types: 1200 `QUAD8`, 500 `QUAD4`.

3.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
DX to the point A after complete rotation	"SOURCE_EXTERNE"	-175,0	0,5%

3.4 Remarks

the results got into quadratic with friction by the formulation continue are in very good agreement with the reference as shown in the figure following.
For correctly treating the incompressibility of the under-integrated quadratic elements were used. Moreover in order to minimizing the computing times, the Poisson's ratio adopted in computation is 0,49.

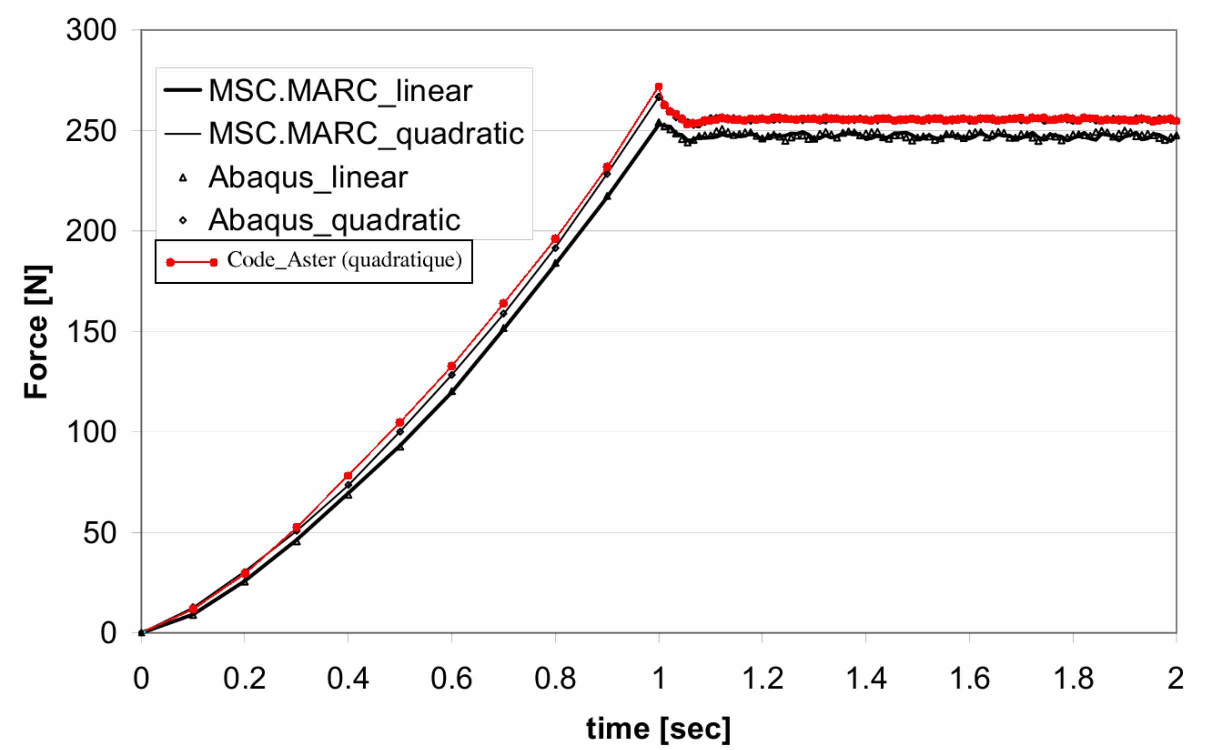


Illustration 1: comparison of the results Abaqus, MARC and *Code_Aster* (applied force with the roller according to time)

4 Summary of the results

This test makes it possible to validate the contact coupled to all other non-linearities compared to references given by commercial computer codes (Abaqus and MARC).
One observes a good agreement between the results of reference and those obtained by *Code_Aster*.

It will be noted that in this *benchmark* difficult:
−only the formulation continues makes it possible to solve computation
−it is essential to use elements under-integrated to avoid an oscillation of the stresses