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

Summary:

This problem constitutes the fifth CAS-test 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 non-linear: material néo-Hookéen, great displacements and contact-friction.

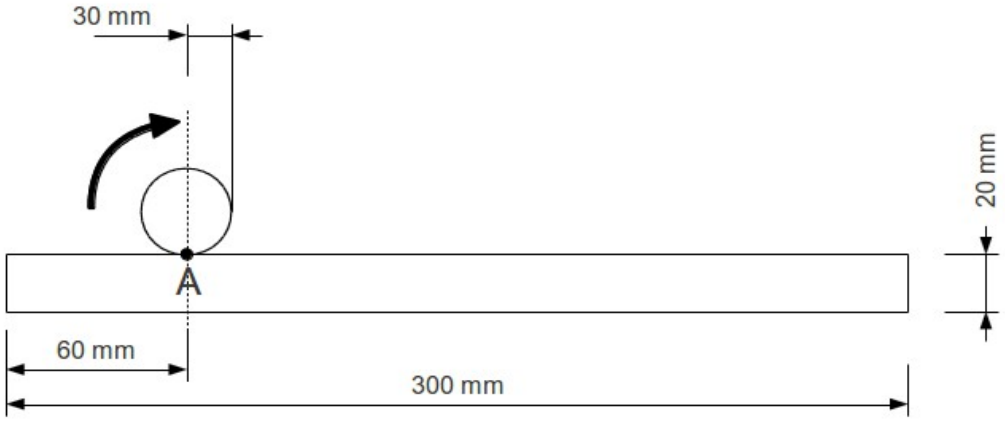
This test comprises only one modeling with:

- Under-integrated quadratic elements
- Formulation 'CONTINUOUS' of contact-friction

1 Problem of reference

1.1 Geometry

The structure is modelled in plane deformations.



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

1.2 Properties of 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 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 from results got with the codes Abaqus and MARC in a benchmark NAFEMS of validation of contact-friction [bib1].

2.2 Sizes and results of reference

Horizontal displacement of the point A (according to x) after complete rotation of the roller.

2.3 Uncertainties on the solution

Important (average of codes).

2.4 Bibliographical reference

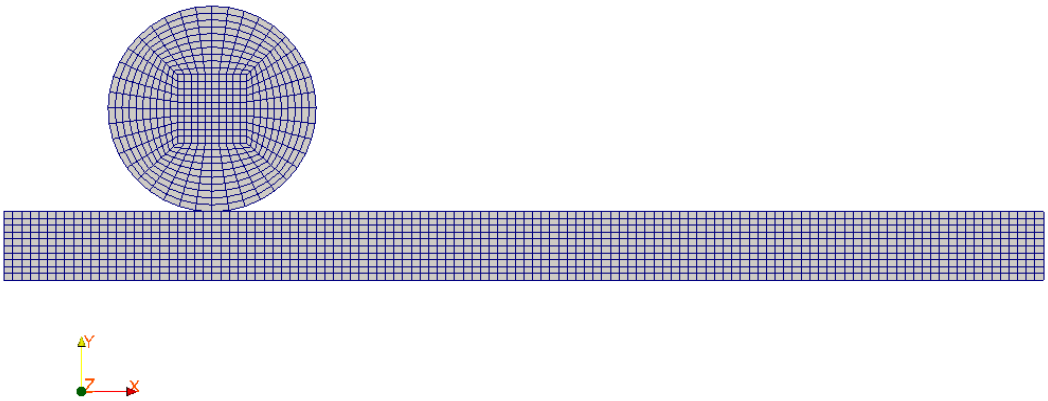
[1] A. KONTER. *"Advanced Finite Element Benchmarks Contact"*. NAFEMS, 2006.

3 Modeling A

3.1 Characteristics of modeling

Modeling is D_PLAN_SI, the formulation of the contact is CONTINUOUS.

3.2 Characteristics of the grid



Many nodes: 4382
Many meshs and types: 1200 QUAD8, 500 QUAD4.

3.3 Sizes tested and results

Identification	Type of reference	Value of reference	Tolerance
DX at 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 continues 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 calculation is 0.49.

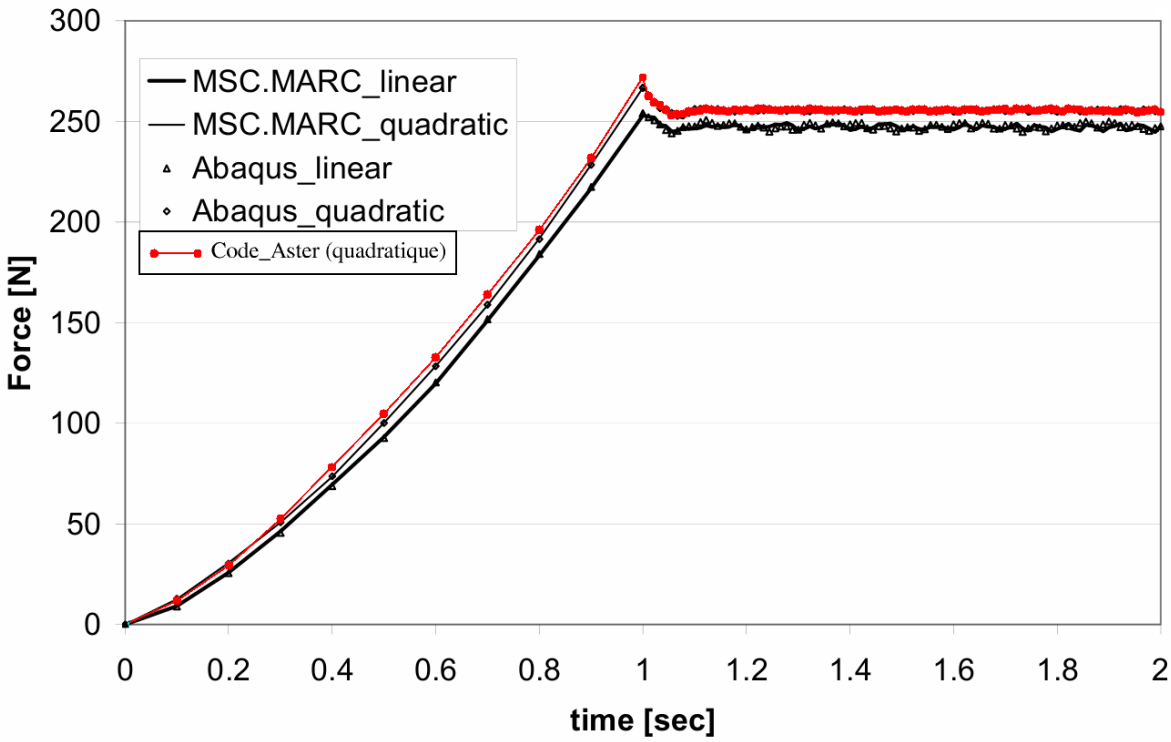


Illustration 1: comparison of the results Abaqus, MARC and *Code_Aster* (force applied to the roller according to the moment)

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*.

One will note that in it *benchmark* difficult:
– only the formulation continues makes it possible to solve calculation
– it is essential to use elements under-integrated to avoid an oscillation of the constraints