SSNP165 – Boxing ring one block

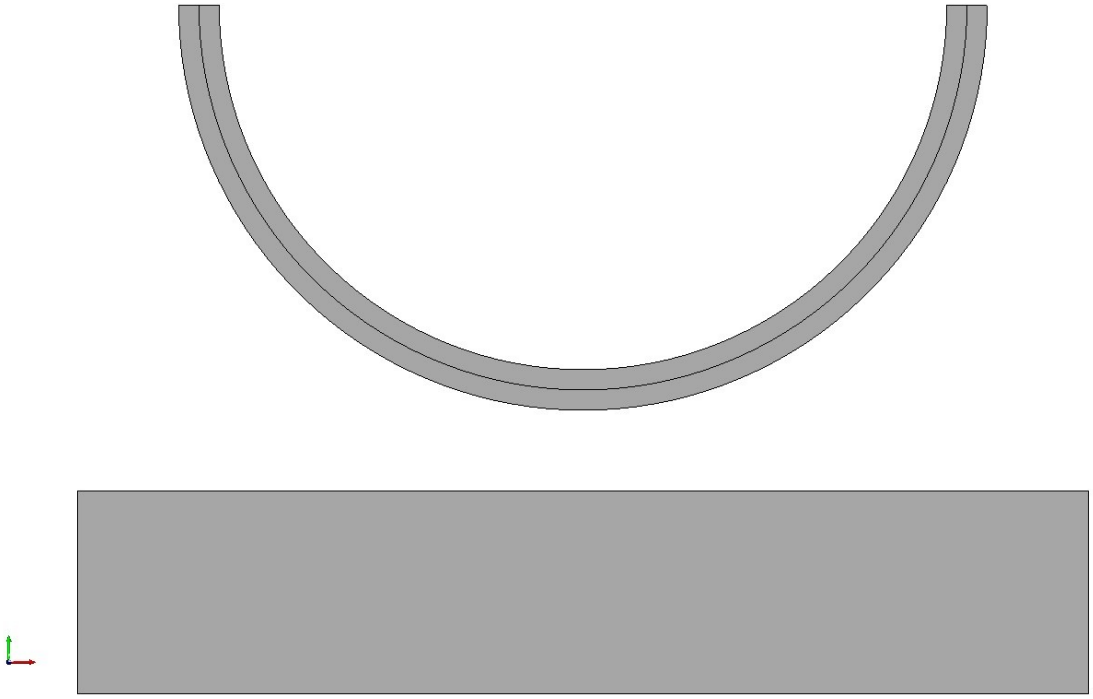
Summary:

This test consists in crushing a half-ring on a block with a condition of contact between the two. There are two modelings in plane deformation, with and without friction and a modeling without friction in Mortar pairing, ALGO_CONT=LAC and cutting LAKE. The validation is in not-regression.
This test is very discriminating on the advanced methods Lagrangian type increased with generalized Newton.
It is inspired by the digital example 'Elastic boxing ring and block' of the publication [1] .

1 Problem of reference

1.1 Geometry

The half-ring consists of two parts interior and external, the same thickness $5\,mm$. The ray of neutral fibre is of $95\,mm$. The block is a rectangle of dimensions $50\,mm$ by $250\,mm$. The initial distance between the block and the half-ring is of $20\,mm$.



1.2 Properties of material

The law of behavior used is elastoplastic with linear isotropic work hardening (VMIS_ISOT_LINE).
The material of the interior part of the ring is characterized by:

- $E=100\,000\,MPa$
- $\nu=0.3$
- $\rho=2.7\mathrm{E}-5\,kg.mm^{-3}$
- $\mathrm{D\_SIGM\_EPSI}=9.0\mathrm{E}4\,MPa$
- $\mathrm{SY}=10.\mathrm{E}100\,MPa$

The material of the part external of the ring is characterized by:

- $E=1\,000\,MPa$
- $\nu=0.3$
- $\rho=2.7\mathrm{E}-5\,kg.mm^{-3}$
- $\mathrm{D\_SIGM\_EPSI}=9.0\mathrm{E}2\,MPa$
- $\mathrm{SY}=10.\mathrm{E}100\,MPa$

The material of the block is characterized by:

- $E=300\,MPa$
- $\nu=0.3$
- $\rho=2.7\mathrm{E}-5\,kg.mm^{-3}$

- $D\_SIGM\_EPSI = 10.MPa$
- $SY = 10.E100\,MPa$

1.3 Boundary conditions and loadings

The lower edge of the block is blocked such as $DX = DY = 0$.
A displacement $DX = 0$ and $DY = -90\,mm$ is imposed at the two ends, in the plan XZ, half-ring.

2 Reference solution

2.1 Sizes and results of reference

This test is a test of not-regression.

2.2 Bibliographical references

[1] *With mortar-based frictional broad contact for formulation deformations using Lagrange multipliers, Mr. Tur, F.J. Fuenmayor, P. Wriggers, 2009*.

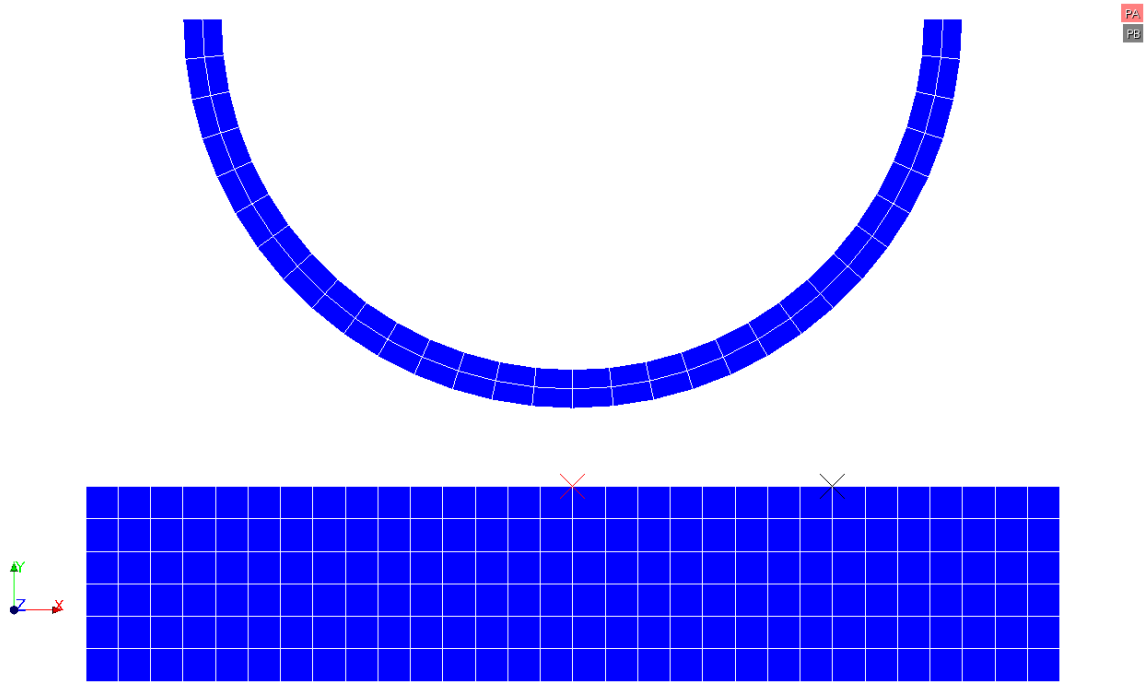
3 Modeling A

3.1 Characteristics of modeling

A modeling is used D_PLAN.
The contact between the half-ring and the block is without friction.

3.2 Characteristics of the grid

The grid contains 240 elements of the type QUAD4.



3.3 Sizes tested and results

One tests displacement on two points of the zone of contact. The point A, located at the medium in $X=125\,mm$ and the point B, located in $X=23/30*250\,mm$, the goal being to have always one of the two points in contact lasting calculation, in spite of the deformation of the half-ring.

Identification	Type of reference	Tolerance
Not A - DX	'NON_REGRESSION'	0,001%
Not A - DY	'NON_REGRESSION'	0,001%
Not A - LAGS_C	'NON_REGRESSION'	0,001%
Not B - DX	'NON_REGRESSION'	0,001%
Not B - DY	'NON_REGRESSION'	0,001%
Not B - LAGS_C	'NON_REGRESSION'	0,001%

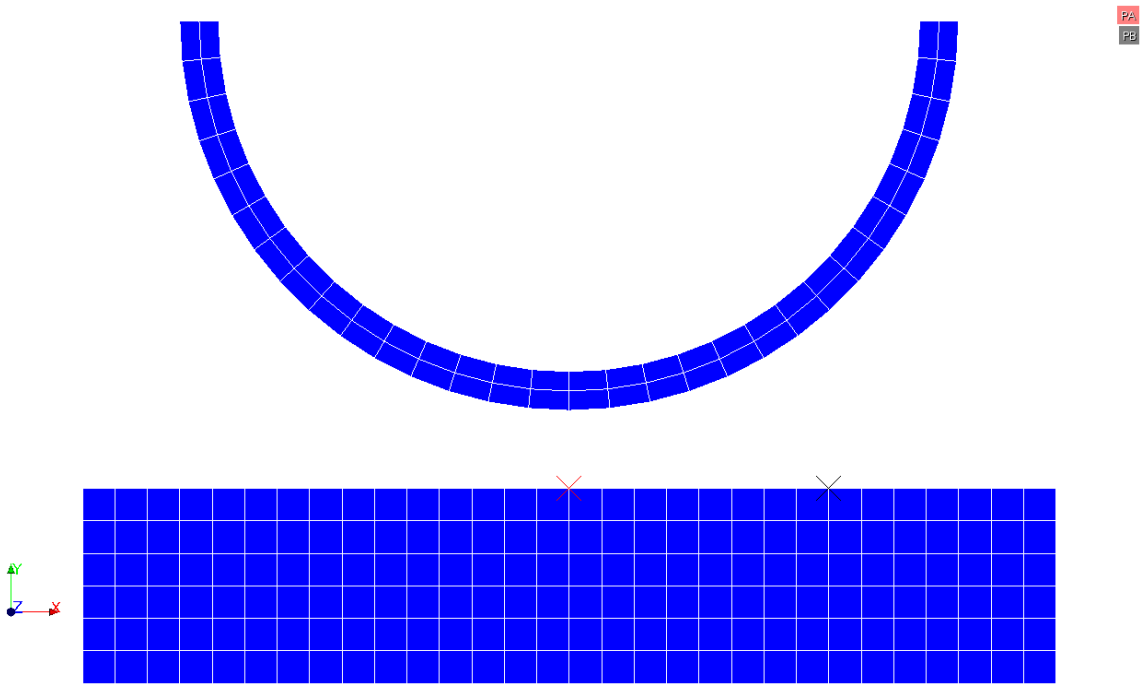
4 Modeling B

4.1 Characteristics of modeling

A modeling is used D_PLAN.
The contact between the half-ring and the block is with friction. The coefficient of friction of Coulomb is of $0,5$.

4.2 Characteristics of the grid

The grid contains 240 elements of the type QUAD4.



4.3 Sizes tested and results

One tests displacement on two points of the zone of contact. The point A , located at the medium in $X=125\,mm$ and the point B , located in $X=23/30*250\,mm$, the goal being to have always one of the two points in contact lasting calculation, in spite of the deformation of the half-ring.

Identification	Type of reference	Tolerance
Not A - DX	'NON_REGRESSION'	0,001%
Not A - DY	'NON_REGRESSION'	0,001%
Not A - LAGS_C	'NON_REGRESSION'	0,001%
Not B - DX	'NON_REGRESSION'	0,001%
Not B - DY	'NON_REGRESSION'	0,001%
Not B - LAGS_C	'NON_REGRESSION'	0,001%

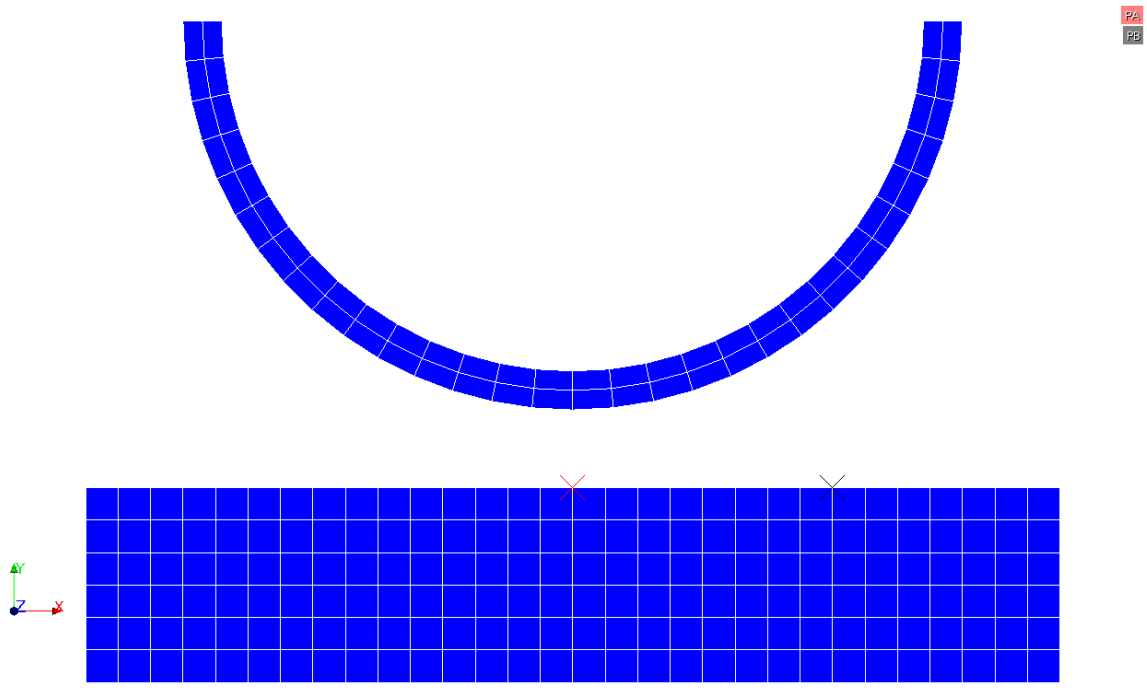
5 Modeling C

5.1 Characteristics of modeling

A modeling is used D_PLAN.
The contact between the half-ring and the block is without friction. The pairing of the type is used MORTAR with DECOUPAGE_LAC, ALGO_CONT=LAC and the keyword is validated TYPE_JACOBIEN = 'BRINGS UP TO DATE'.

5.2 Characteristics of the grid

The grid contains 240 elements of the type QUAD4.



5.3 Sizes tested and results

One tests displacement on two points of the zone of contact. The point A, located at the medium in $X=125\,mm$ and the point B, located in $X=23/30*250\,mm$, the goal being to have always one of the two points in contact lasting calculation, in spite of the deformation of the half-ring.

Identification	Type of reference	Tolerance
Not A - DX	'NON_REGRESSION'	0,001%
Not A - DY	'NON_REGRESSION'	0,001%
Not A - LAGS_C	'NON_REGRESSION'	0,001%
Not B - DX	'NON_REGRESSION'	0,001%
Not B - DY	'NON_REGRESSION'	0,001%
Not B - LAGS_C	'NON_REGRESSION'	0,001%

6 Summary of the results

The observation of the deformations makes it possible to conclude that the solution calculated by *Code_Aster* is in agreement with that presented in reference [1].