

SSNP173 - Contact enters two concentric spheres

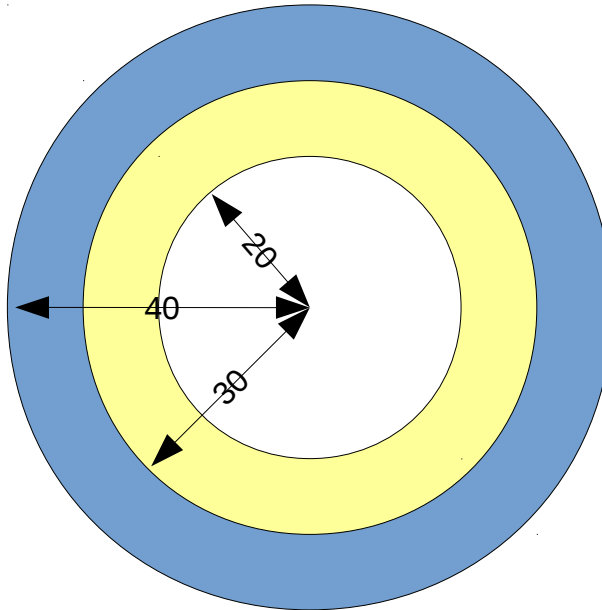
Summary:

This problem corresponds to a quasi-static analysis of a problem of mechanics with contact without friction whose analytical solution is known. One is interested particularly here in integration of the terms of contact by the method *Mortar Room Average Contact* (LAKE) on a curved surface. The grids are incompatible.

1 Problem of reference

1.1 Geometry

One is considered a sphere with an external radius of 30 mm and an internal radius of 20 mm , included in a hollow sphere with an external radius of 40 mm and an internal radius equal to the external radius of the sphere included.



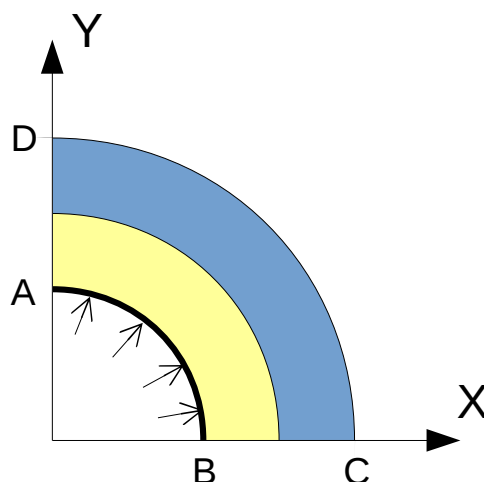
1.2 Properties of material

The material is elastic isotropic whose properties are:

- $E = 2000\text{ MPa}$
- $\nu = 0.3$

1.3 Boundary conditions and loadings

Conditions of symmetry $DX=0$ on surface AD and $DY=0$ on surface BC are forced in order to model only one quarter of the model.



A pressure $P=25\text{ MPa}$ is imposed on surface AB , inside the first sphere. The two spheres are maintained in contact with the interface.

2 Reference solution

2.1 Method of calculating

There exists a known analytical solution with this problem, if one considers R_1 the interior ray and R_2 the external ray, then the radial constraint expressed in polar coordinates is written:

$$\sigma_{rr}(r) = \frac{R_1^3}{R_2^3 - R_1^3} \cdot \frac{R_2^3 - r^3}{r^3} \cdot P .$$

Thus one finds well $\sigma_{rr}(R_1) = P$ and $\sigma_{rr}(R_2) = 0$.

2.2 Sizes and results of reference

One tests the contact pressure on the interfaces, in $r = 30 \text{ mm}$, on both sides of discontinuity. With $R_1 = 20 \text{ mm}$ and $R_2 = 40 \text{ mm}$, one has then:

$$\sigma_{rr}(r) = 4.894179894 \text{ MPa} .$$

2.3 Uncertainty on the solution

Analytical solution.

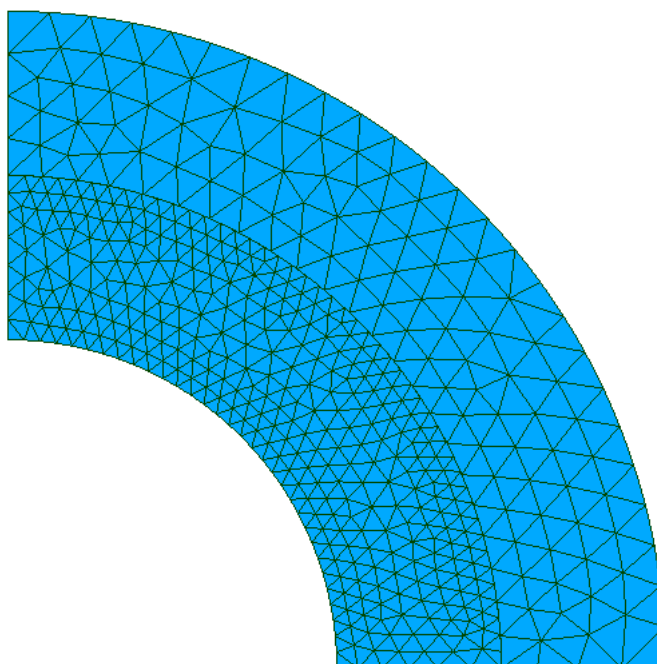
3 Modeling A

3.1 Characteristics of modeling

A modeling is used `AXIS`.

3.2 Characteristics of the grid

The grid contains 851 elements of the type `TRIA6`. Surfaces of contact are not in conformity.



3.3 Sizes tested and results

It is tested the contact pressure on the entirety of surfaces of main contact and slave.

Identification	Type of reference	Value of reference	Precision
LAGS_C	'ANALYTICAL'	4.894179894	1%

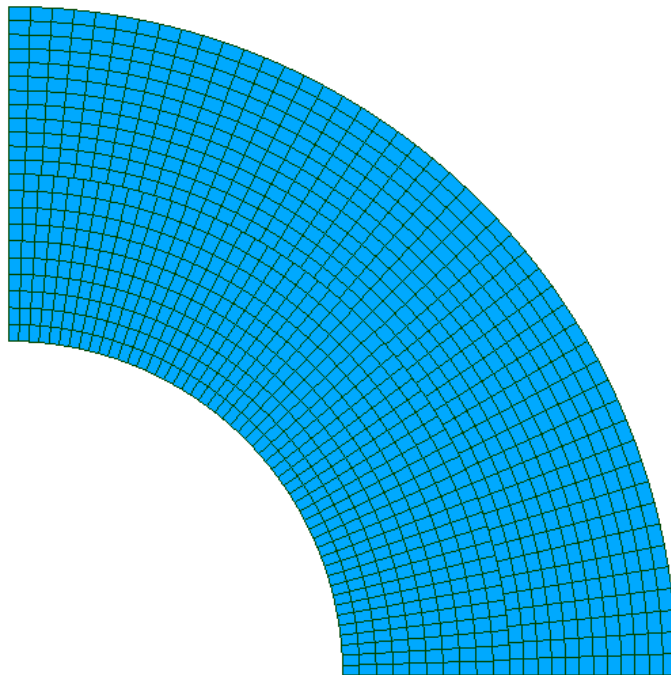
4 Modeling B

4.1 Characteristics of modeling

A modeling is used `AXIS`.

4.2 Characteristics of the grid

The grid contains 1096 elements of the type `QUAD8`. Surfaces of contact are not in conformity.



4.3 Sizes tested and results

It is tested the contact pressure on the entirety of surfaces of main contact and slave.

Identification	Type of reference	Value of reference	Precision
LAGS_C	'ANALYTICAL'	4.894179894	1%

5 Summary of the results

One seeks on this example very simple to test a novel method of integration of the terms of contact based on the subdivision by subelements. This method is activated when one chooses `ALGO_CONT='LAC'` for a zone of contact in formulation `CONTINUOUS`. One thus validates in 2D the method for the quadratic elements, in the case of curved surfaces.