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RamSeries - Validation Case 12

Stretched cylinder, free ends

Version
15.1.0

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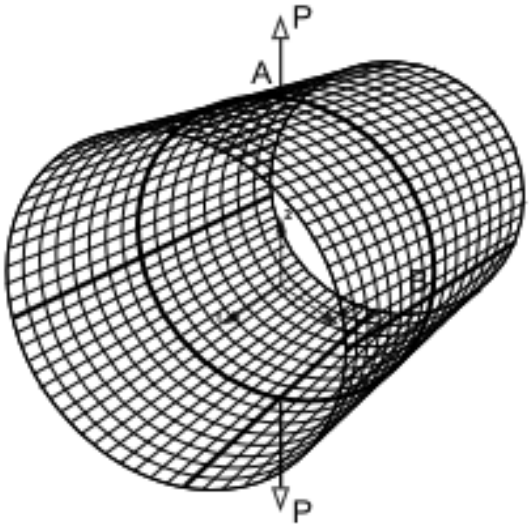
1 Validation Case 12 - Stretched cylinder, free ends

Model Description

This test case is based on the Non-Linear test "Stretched cylinder with free ends", described in Ref. [1], and several other references.

A cylindrical shell is stretched by two opposite forces P applied at the middle section and its boundaries are free, as shown in the following image:



With:

R = 4.953 m

L = 10.35 m

h = 0.094 m

Due to the symmetry, only one-quarter of the cylinder is analyzed.

The material is assumed to be linear elastic:

E = $10.5e10^{6}$ Pa

μ = 0.3125

Results

For the sake of validation, a simulation was run using the properties described in the previous chapter, and with the following load and problem conditions:

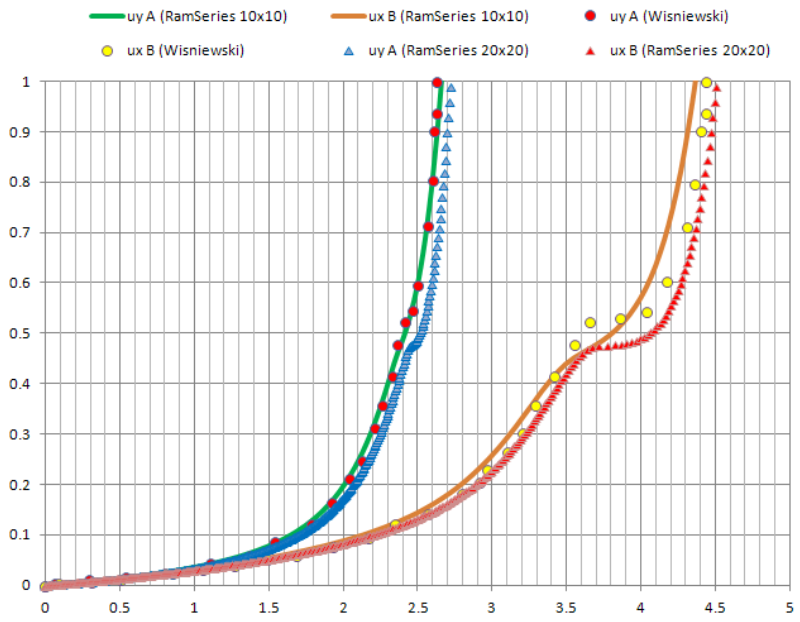
Mesh:

Two linear structured triangular mesh of 10x10 divisions (221 nodes) and 20x20 divisions (841 nodes) were used.

Displacements results:

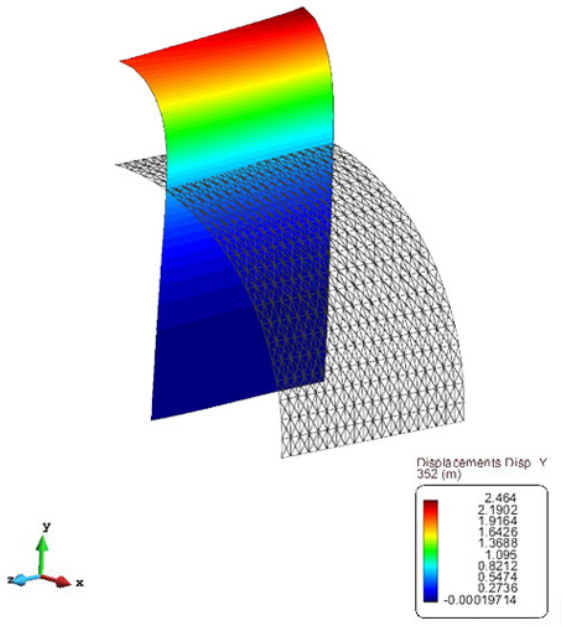
The nonlinear solution was obtained for a load of P_{ref} = 4.0e4 N, with ΔP = 100 N (400 increments).

The next graphs show the evolution of the displacements of points A and B versus the load factor ($\lambda=100*P_i/P_{ref}$), obtained with RamSeries, until the convergence value at P_{ref} ($\lambda=1$). Results for different meshes compared with those coming from the reference (Wiesniewski, Ref. [1]), which uses Green strain formulation for deformations, are shown in the next graph. The small differences are due to the different formulation used in RamSeries for the deformations (co-rotated formulation).



Non-linear solutions (RamSeries VS Reference)

Next image shows the defomed geometry for P_{ref}.



Deformed geometry at P_ref (RamSeries)

References

[1] K. Wisniewski. Finite Rotation Shells: Basic Equations and Finite Elements for Reissner Kinematics. Springer (2010).

[2] Bjorn Haugen. Buckling and Stability Problems for Thin Shell Structures Using High Performance Finite Elements. University of Colorado (1994).

[3] R.A. Fontes Valente. On the use of an enhanced transverse shear strain shell element for problems involving large rotations. Springer (2003)

[4] Roman Vetter. Subdivision Shell Elements with Anisotropic Growth. IAS, Zurich (2012).

Validation Summary

CompassFEM version	15.1.0
Tdyn solver version	15.1.0
RamSeries solver version	15.1.0
Benchmark status	Successfull
Last validation date	27/11/2018