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RamSeries - Validation Case 9

Roll-up of clamped beam

Version
15.1.0

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November 2018

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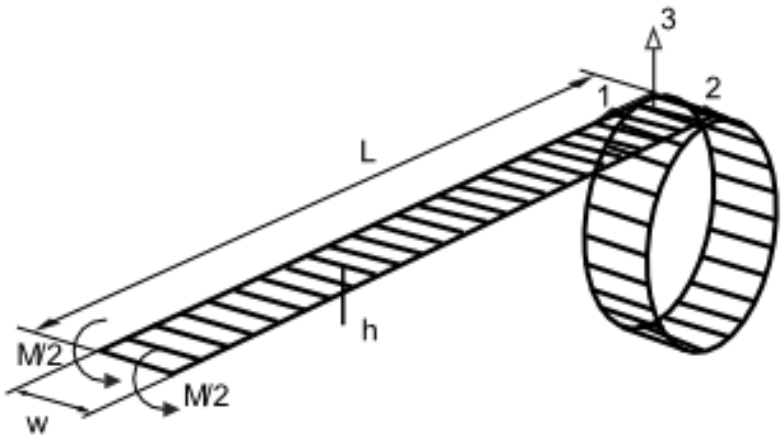
1 Validation Case 9 - Roll-up of clamped beam

Model Description

This test case is based on the Non-Linear test "Roll-up of a clamped beam", described in Ref. [1],and is used for testing finite rotations. In statics, this test is indispensable.

The planar straight beam is clamped at one end and loaded by a bending moment at the other end, As shown in the following image:



With:

L = 10 m

w = 1 m

h = 0.1 m

The concentrated tip load is applied into the Z direction.

The material is assumed to be linear elastic:

E = $12e10^{6}$ Pa

μ = 0

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:

Loads:

A bending moment is applied at the free end:

$$M = 2 \cdot \pi \cdot E \cdot I / L = 628.319 \text{ N} \cdot \text{m}$$

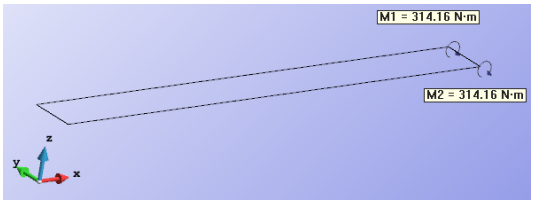
The load corresponds to the reference load (Ref. [1], page 438 for results comparing and validation.

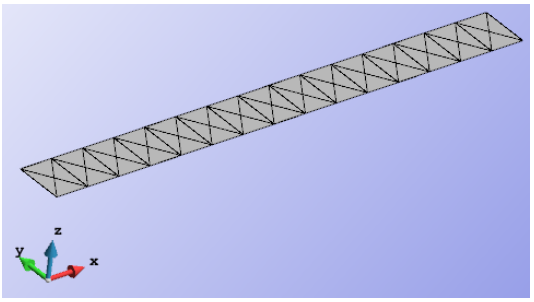
The simulation has been performed using a non-linear solver, with 100 equal load steps/increments.

Mesh:

A mesh of 60 linear triangles (DKT) beam elements has been used (total of 47 nodes.

In the following images, the applied bending moment (left) and the used mesh can be seen:



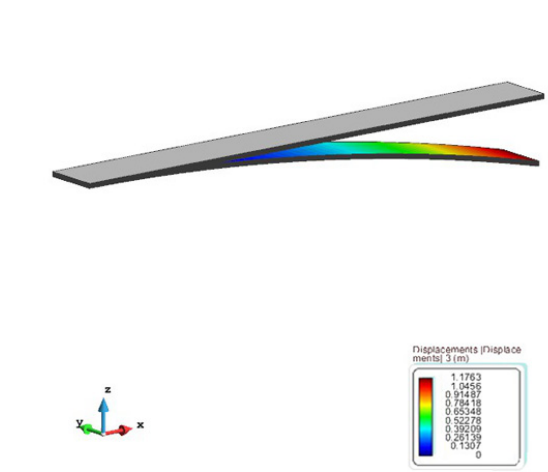


Displacements results:

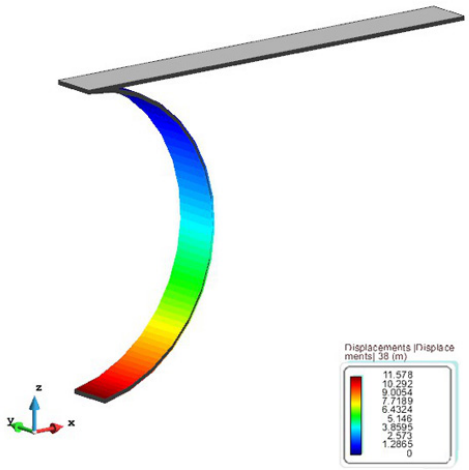
The results obtained in RamSeries and the error with respect to the reference solution (exact Timoshenko beam solution) are shown next:

	u_x (m)	u_z (m)	w_y (rad)
RamSeries	-10.012	-0.0003	6.2852
Exact	-10	0	6.2832

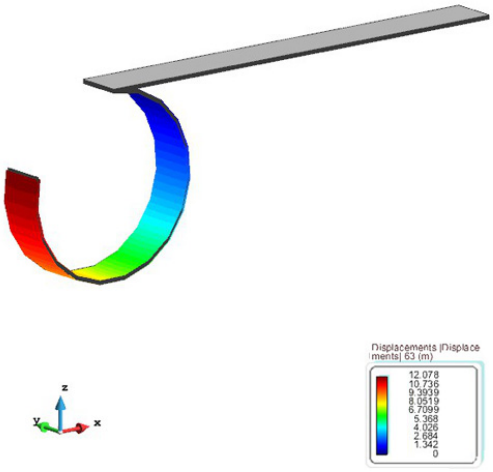
The following images show four steps of the evolution of the rolling-up process:



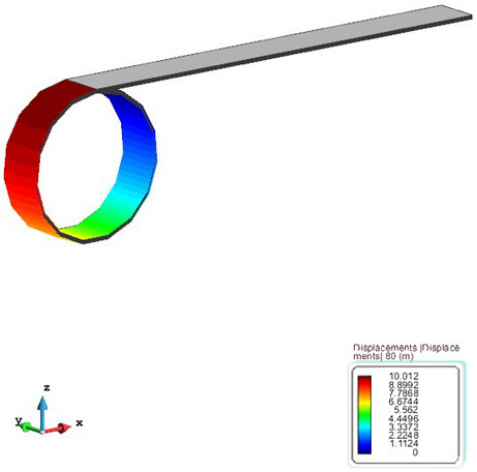
1



2



3



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References

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

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