

RamSeries - Validation Case 16

Z-section beam under torsion (NAFEMS LE5)



RamSeries

Version
15.1.0

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1 Validation Case 16 - NAFEMS LE5

Model Description

This test case is based on the NAFEMS LE5 "Z-section beam under torsion", described in Ref. [1].

A cantilever Z-section beam with thickness t is subjected to a $1.2\text{e}6 \text{ N}\cdot\text{m}$ torque on one end.

The axial stress at point A on the mid-surface is determined.

Dimensions:

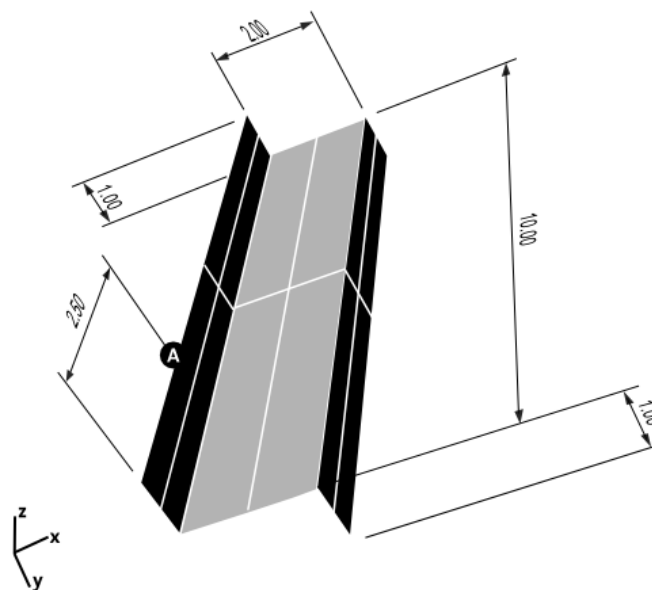
$$L=10 \text{ m}$$

$$a=c=1 \text{ m}$$

$$b=2 \text{ m}$$

$$d=2.5 \text{ m}$$

$$t=0.1 \text{ m}$$



Geometrical description (dimensions in [m])

Load value:

A pair of forces is applied so it creates the desired moment. The forces value is:

$$F=6.0\text{e}5 \text{ N}$$

Material data:

The material is assumed to be lineal elastic.

$$E = 2.1\text{e}5 \text{ MPa}$$

$$\mu = 0.3$$

$$\text{Mass density} = 7.85 \times 10^{-6} \text{ kg/mm}^3$$

$$\text{Tensile Yield Strength} = 207.0 \text{ MPa}$$

Results

For the sake of validation, various simulation were run using the properties described in the previous chapter, with different meshes (linear and parabolic quadrilaterals).

The following summary table shows the difference between RamSeries and the reference case (NAFEMS EL5), for the averaged axial stress at mid-surface (average between Top and Bottom face stresses), point A:

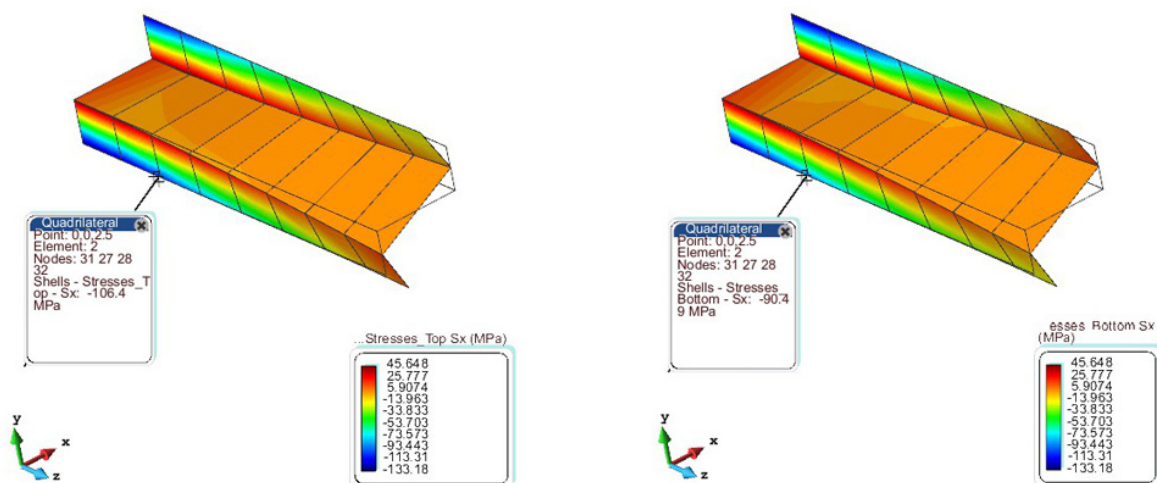
S_x NAFEMS EL5 = -108 MPa

	Ramseries S_x (MPa)	Difference (%)
Linear Quad.	-98.445	9.71
Parab. Quad.	-108.75	0.69

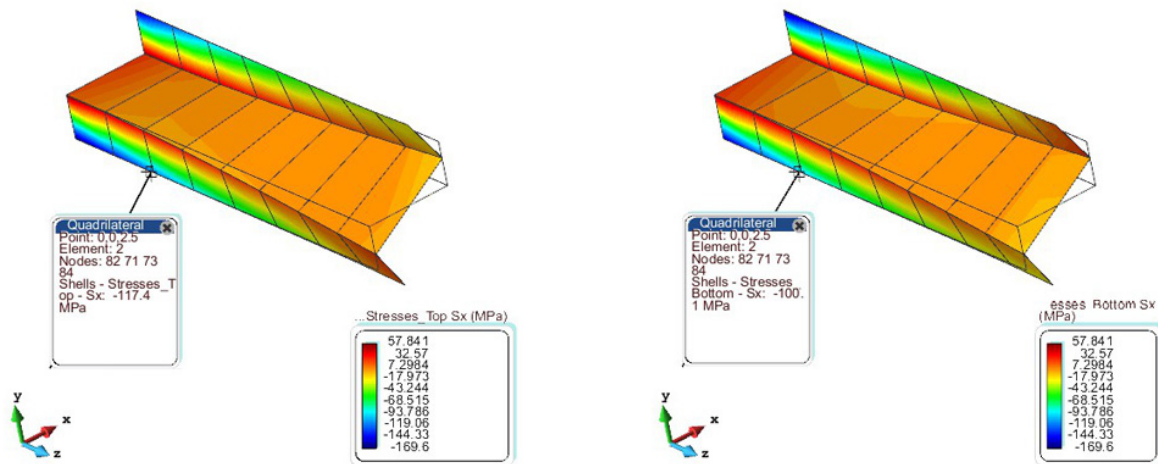
- Linear quadrilateral mesh:
A mesh of 24 elements and 37 nodes was used.
- Parabolic quadrilateral mesh:
A mesh of 24 elements and 96 nodes was used.

The results obtained for both meshes are shown next.

Linear:



Parabolic:



NASTRAN results, coming from Reference [2] are shown in the following table:

Sx NAFEMS EL5 = -108 MPa

	NX Nastran (MPa)	Difference (%)
Linear Quad.	-111	2.70
Parab. Quad.	-109.3	1.19

References

[1] NAFEMS Finite Element Methods & Standards. The Standard NAFEMS Benchmarks, Test No.LE5. Glasgow: NAFEMS, Rev.3, 1990.

[2] NX Nastran Verification Manual. UGSCorp. 2007.

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