Bending of a Curved Beam

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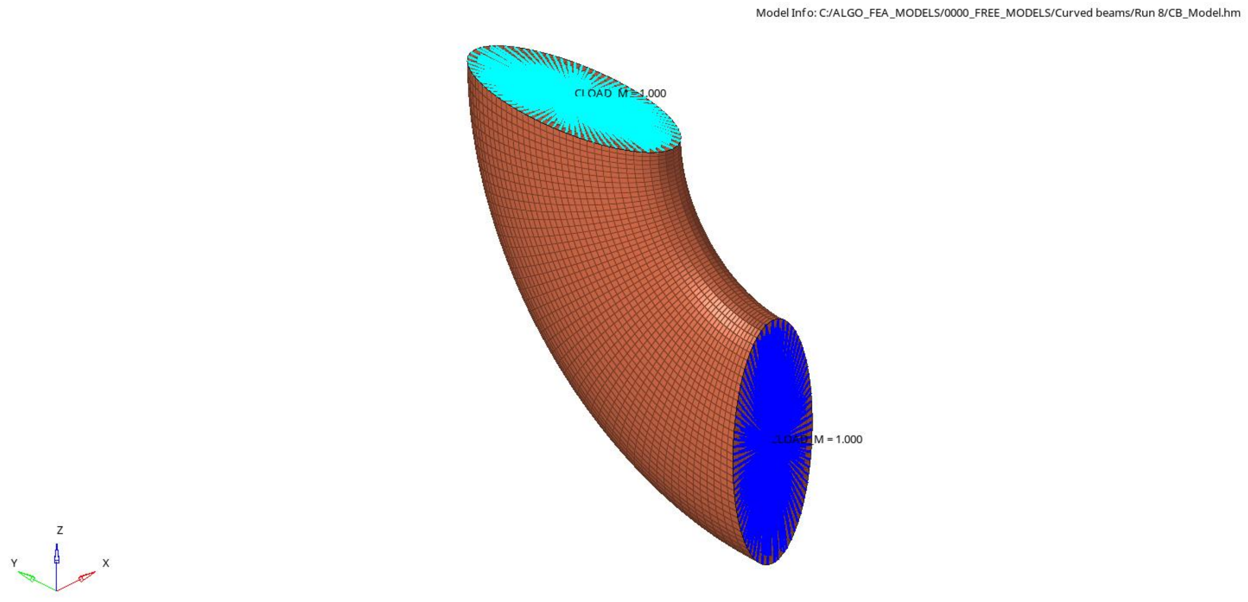
For questions, please fill out contact form

ALGO Engineering
Simplifying FEA

Model Description

- Bending analysis of a curved beam based on example question 1 documented in page 272 of the following book :
  - J. Souza, *Roark's Formulas For Stress And Strain-.pdf*. Accessed: Nov. 06, 2022. [Online]. Available: https://www.academia.edu/37205286/Roarks_Formulas_For_Stress_And_Strain_pdf



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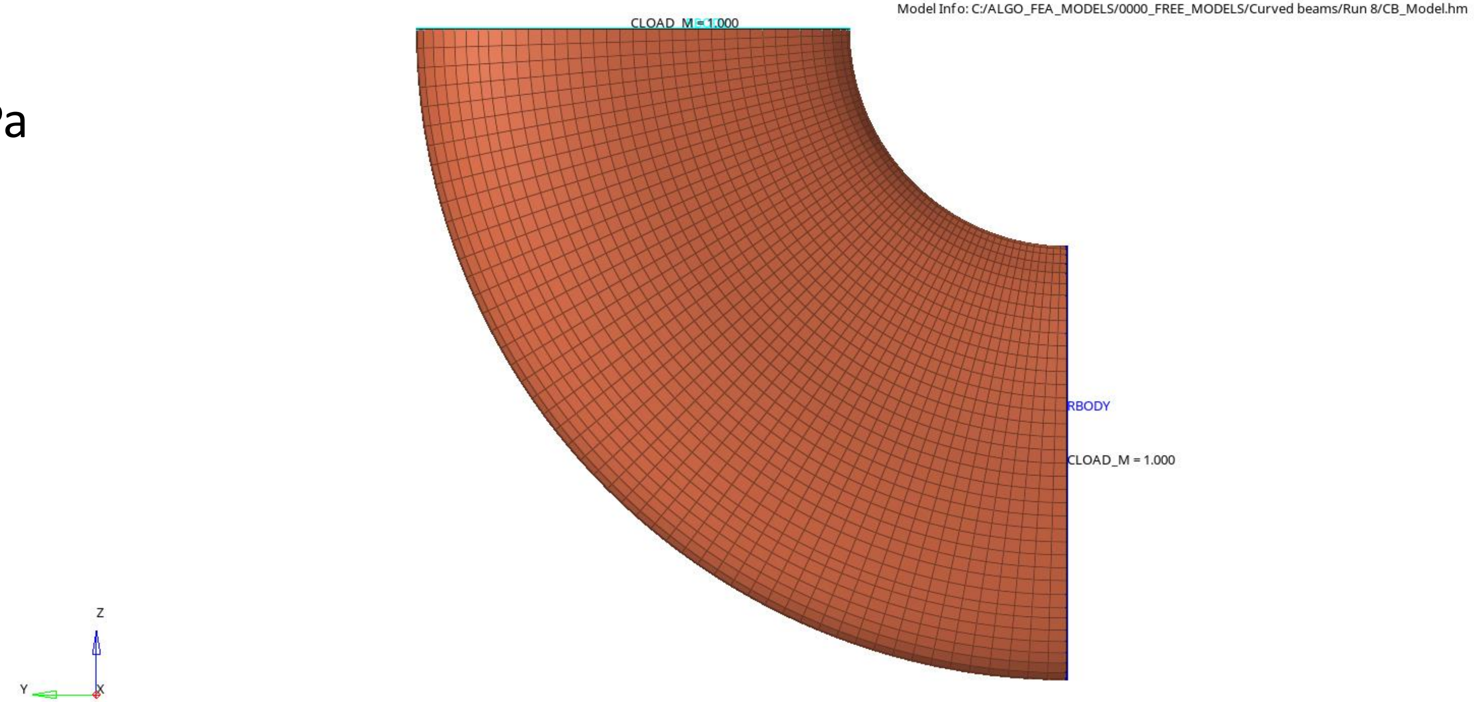
Model Description

Young's modulus – 206.8427184 GPa

Density – 7850 kg/m3

Poison's ratio – 0.3

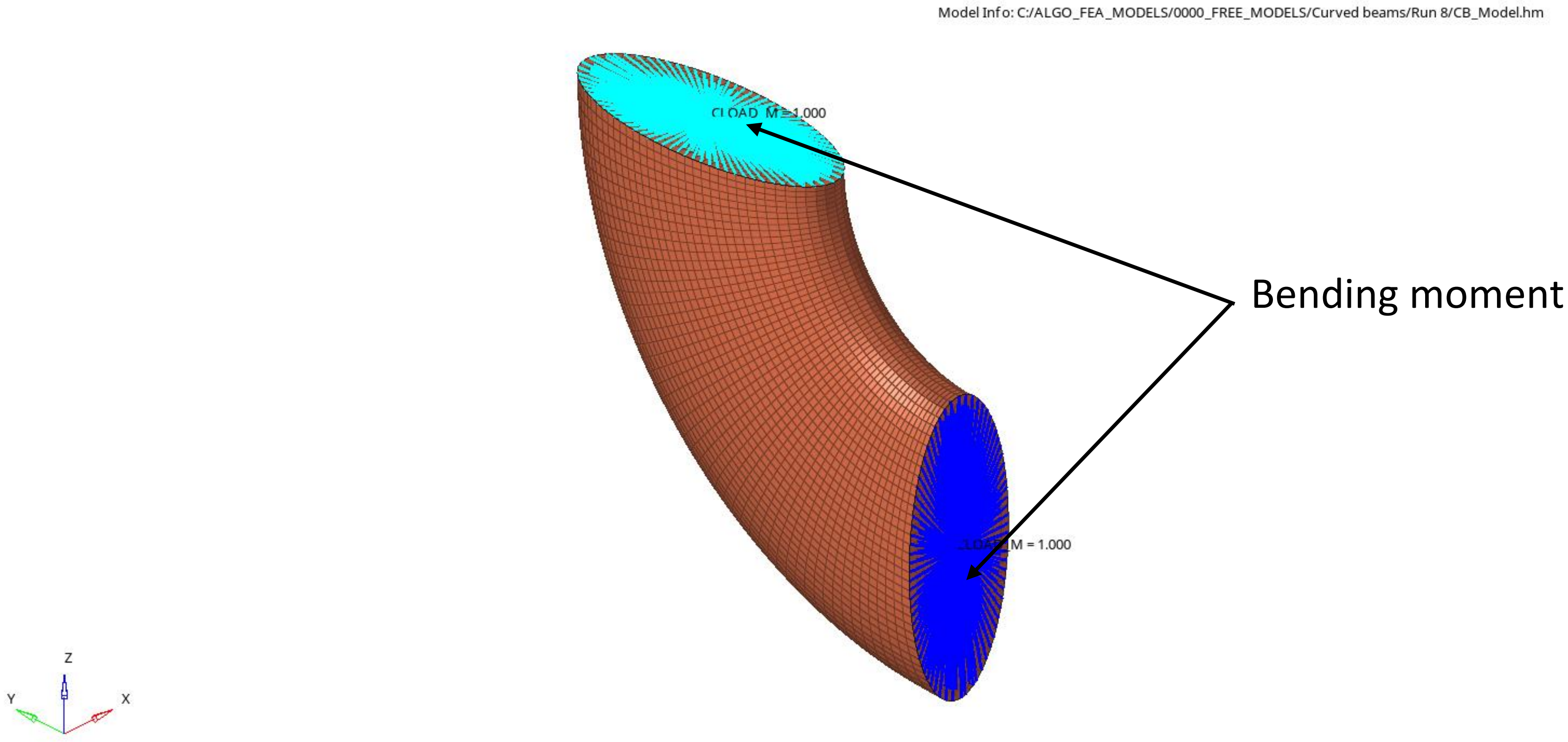


Model Parameters

Entity	Type
Solver	Altair Radioss
Version	2021.2.1
Processors	2
Threads	2
CPU	Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz
Total run time	0.1 sec

FEA Entities	Type
Analysis Type	Dynamic Explicit
Unit System	kg, mm, ms
Element Type	HEXA8N
Material Type	M1_ELAST
Property Type	P14_SOLID

Analysis Setup



Analysis Assumptions and Limitations

- Angle of curvature of the beam was not mentioned in the question and is thus assumed as 90deg.
- Material of the beam was also not mentioned in the question and is thus assumed as steel.

Hand Calculations

$R - Radius\ of\ curvature\ measured\ to\ centroid\ of\ section$
$c\ - distance\ from\ centroidal\ axis\ to\ extreme\ fiber\ on\ concave\ side\ of\ beam$
$A - Area\ of\ section$
$e - distance\ from\ centroidal\ axis\ to\ neutral\ axis\ measured\ toward\ center\ of\ curvature$
$M - moment$

$$R = 100\ mm, c = 50\ mm, b = 40\ mm$$

$$A = \pi c \frac{b}{2} = 3142\ mm^4$$

$$\frac{e}{c} = \frac{R}{c} - \frac{2}{ln\left(\frac{\frac{R}{c}+1}{\frac{R}{c}-1}\right)} = 0.1340$$

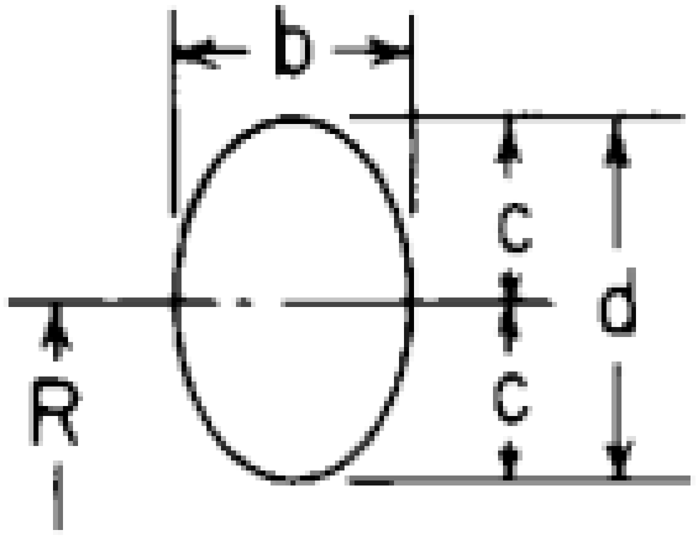


Figure – from above book

Hand Calculations

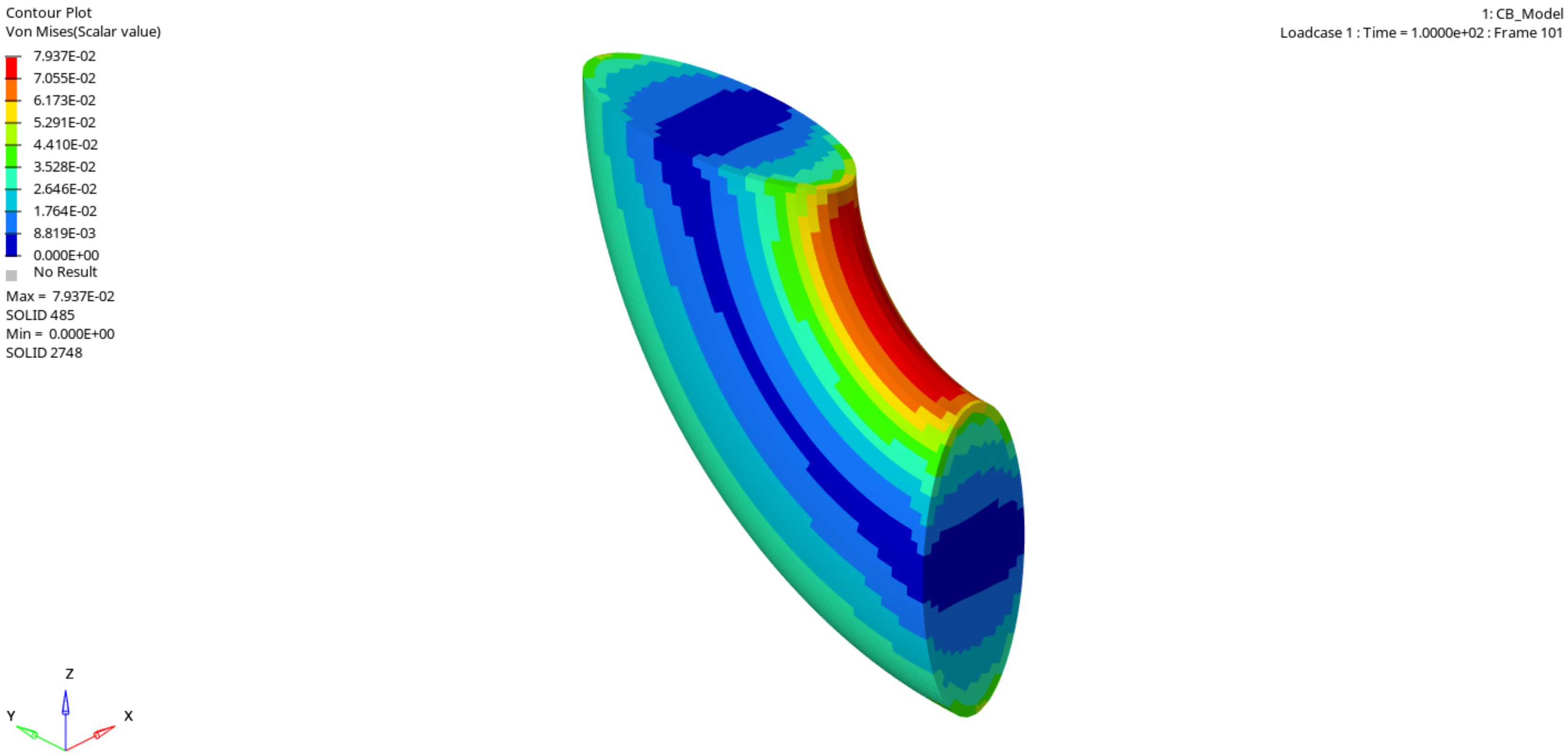
$$r_n = R - e = 93.3\, mm$$

Therefore,

$$\sigma_{max} = \frac{M(r_n - c)}{Aec} = 82.3\ N/mm^2$$

Analysis Results

Units – GPa



Analysis Results

- Maximum stress,

  Based on hand calculations – 82.3 N/mm2

  From the simulation – 79.37 N/mm2

Conclusions

- Bending analysis of a curved beam conducted using Altair Radioss based on the book listed in slide 2.
- Results of the simulation correlate well to the expected hand calculation value.