Stress Analysis of a Solid Homogeneous Circular Disc

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For questions, please fill out contact form

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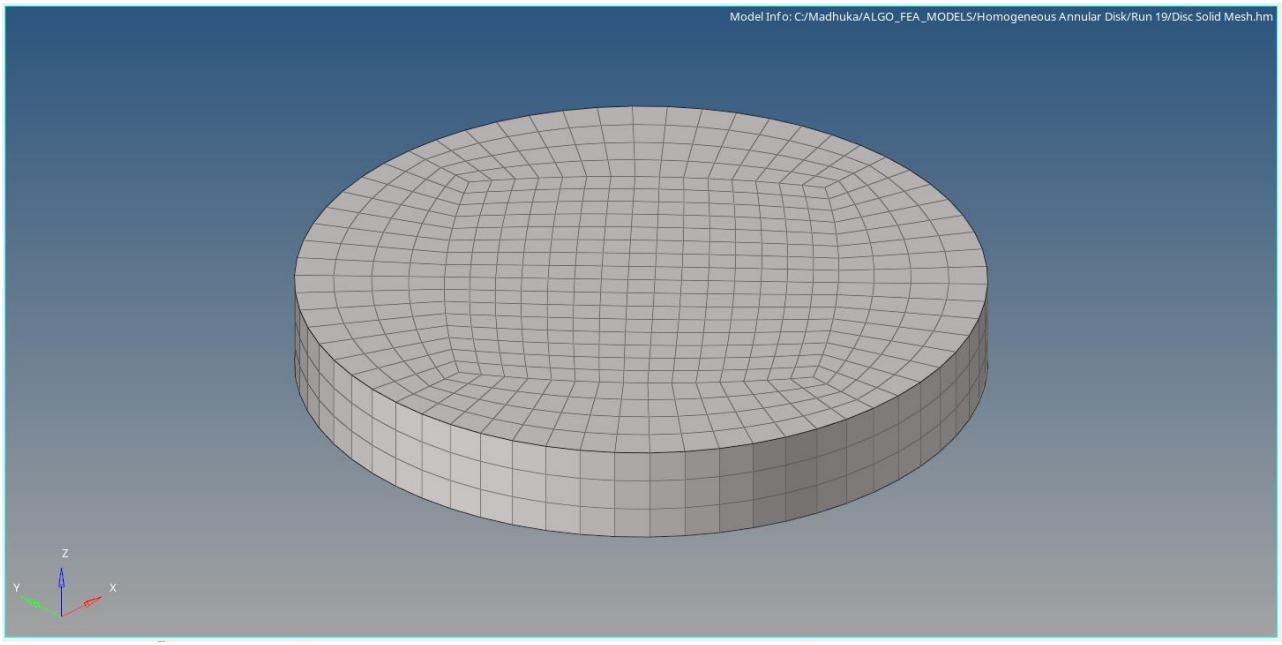
Model Description

- Stress Analysis of a Solid Homogeneous Circular Disc rotating about its own axis based on example question 7 documented in page 750 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

- Steel is selected as the material for the disc.



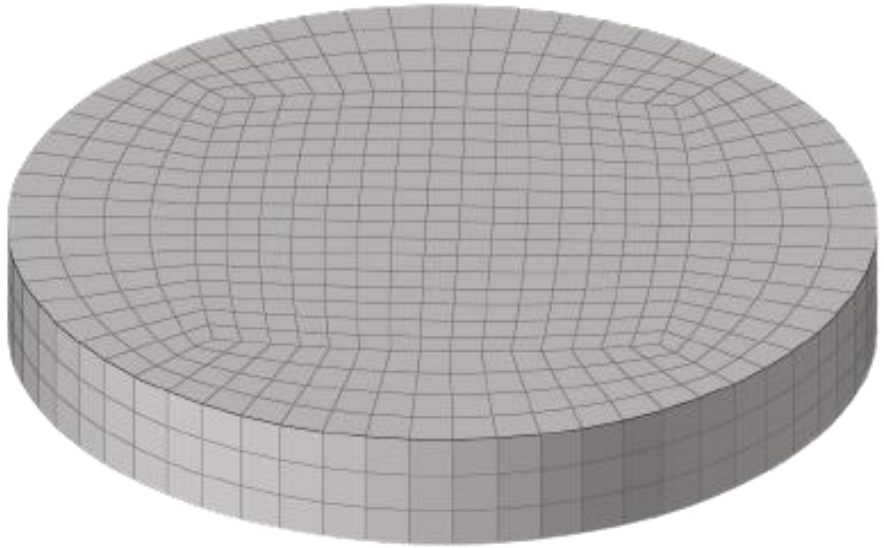
Model Description

Diameter – 100 mm

Thickness – 14 mm

Young’s modulus – 206.8427184 GPa

Poison’s ratio – 0.285



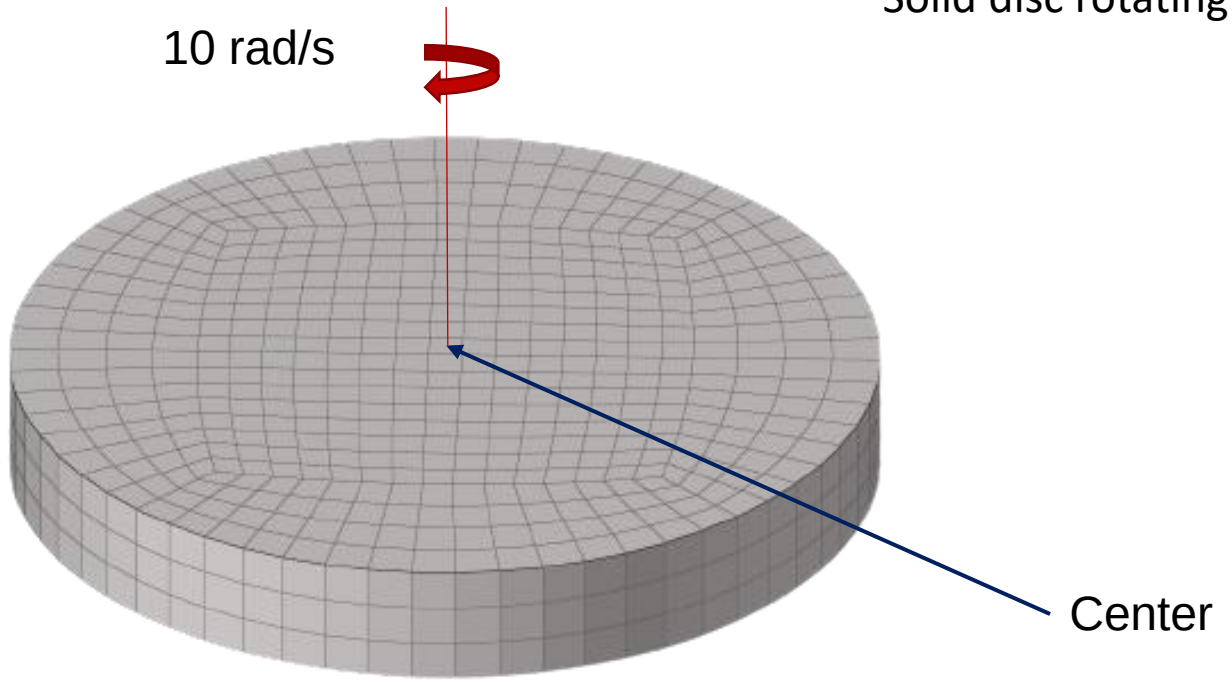
Model Parameters

Entity	Type
Solver	Altair Radioss
Version	2022.1
Processors	2
Threads	2
CPU	Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz
Total run time	5.93 sec

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

Analysis Setup

Solid disc rotating about its own axis



Analysis Assumptions and Limitations

- Standard material properties of steel is assumed.

Hand Calculations

R – *Radius of the disc*

ν – *Poisson's Ratio*

δ – *Density*

σ_r – *Radial Stress*

σ_t – *Tangential Stress*

$$(\sigma_r)_{max} = (\sigma_t)_{max} = \frac{\rho\omega^2 (3+\nu) R^2}{8}$$

$$= \frac{7.85 * 10^{-6} * (0.01)^2 * (3+0.285) * 50^2}{8}$$

$$= 8.0585 * 10^{-7}\ kgmm^{-1}ms^{-2}$$

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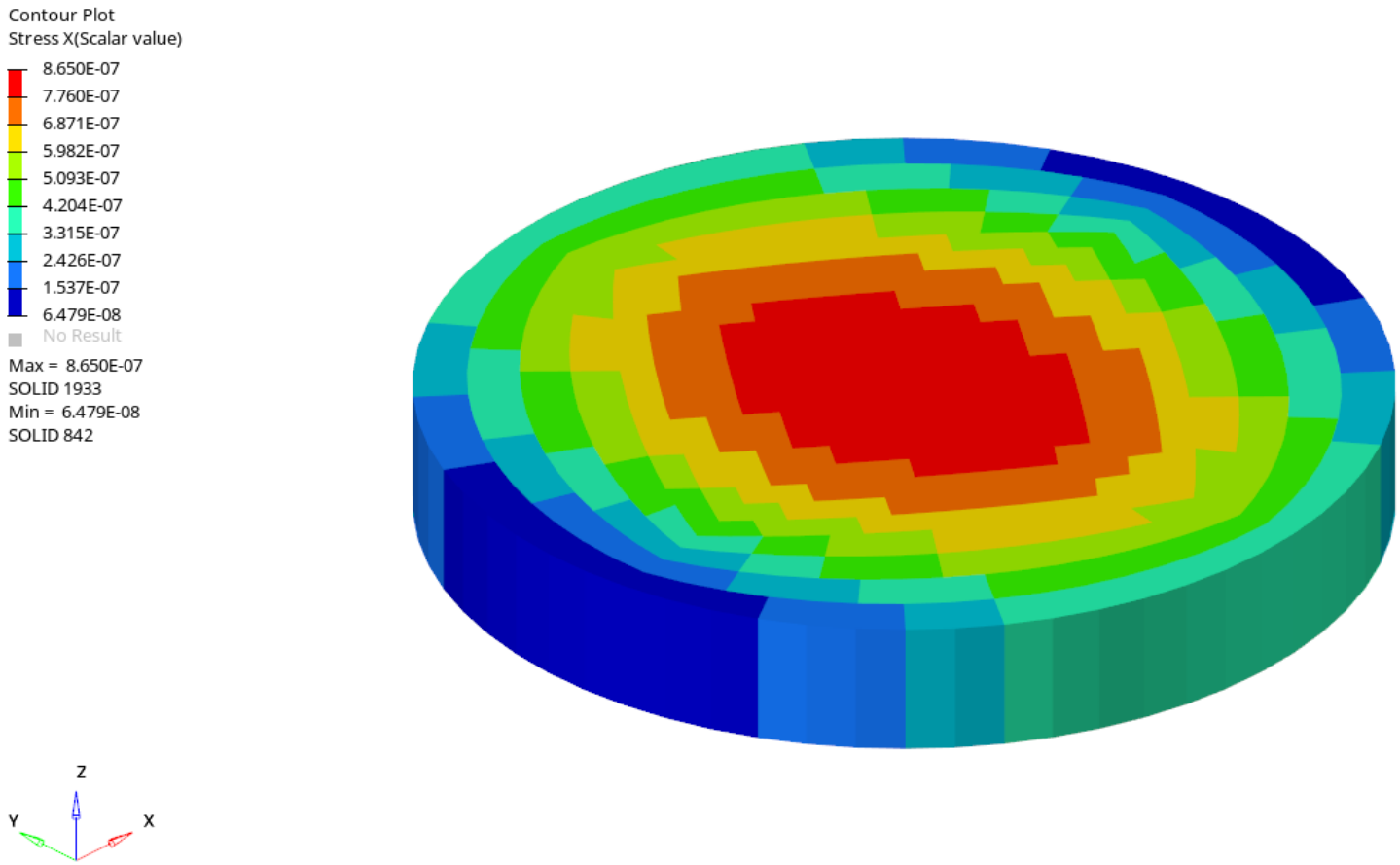
Analysis Results – Stresses

Units - GPa



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Analysis Results

- Maximum Radial and Tangential inertial stress occur at the center of the disc,

  Based on hand calculations – $8.06 * 10^{-7}\ kgmm^{-1}ms^{-2}$

  From the simulation - $8.65 * 10^{-7}\ kgmm^{-1}ms^{-2}$

- Error percentage = $\frac{(8.06 * 10^{-7} - 8.65 * 10^{-7})}{8.06 * 10^{-7}} * 100\%$

  $= 7.34\%$

Conclusions

- Stress analysis of a homogeneous circular disc conducted using Altair Radioss based on the book listed in slide 2.
- Results of the simulation correlate well to the expected hand calculation value.