Deflection and Stress analysis of a Circular plate

Sanka Dasanayaka

For questions, please fill out contact form

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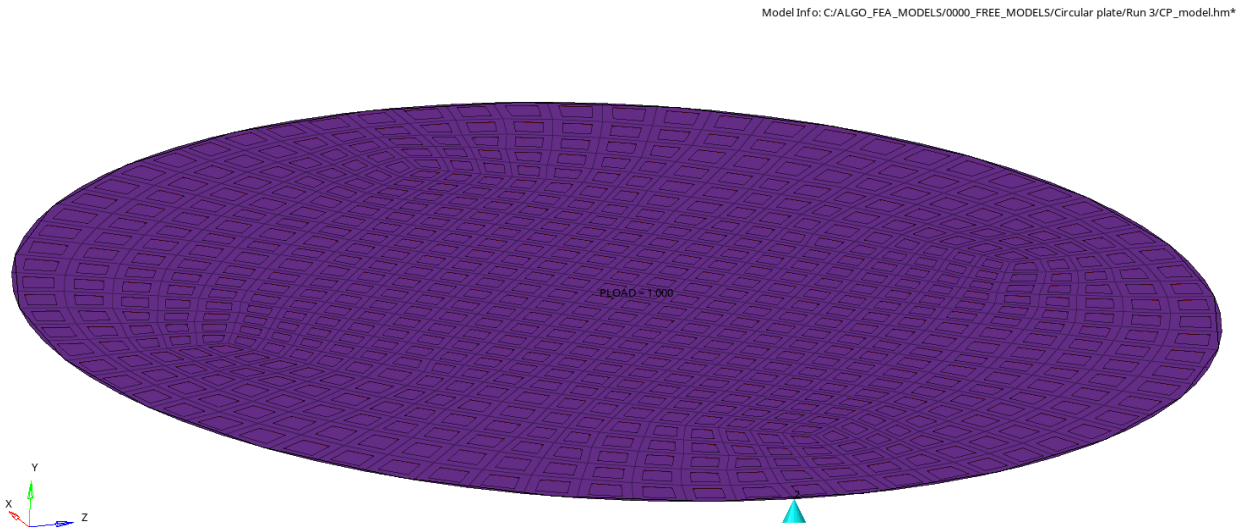
Model Description

- Deflection and stress analysis of a circular plate based on example question 1 documented in page 429 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
- As mentioned in the book, plate is steel



Model Description

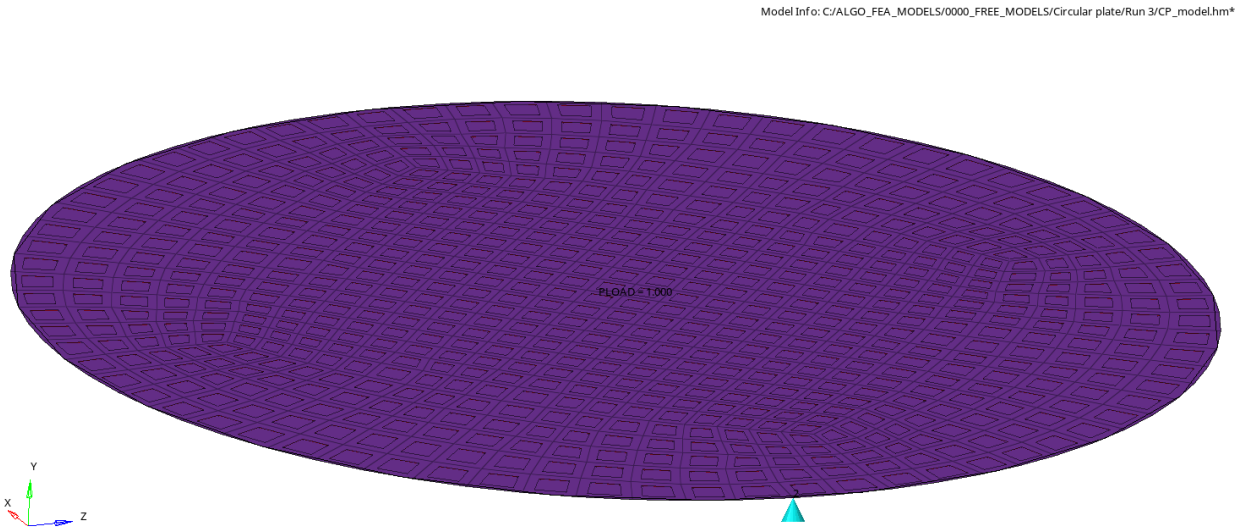
Diameter – 20 in (508 mm)

Thickness – 0.2 in (5.08 mm)

Young's modulus – 30000000 lb/in2

(206.8427184 GPa)

Poison's ratio – 0.285

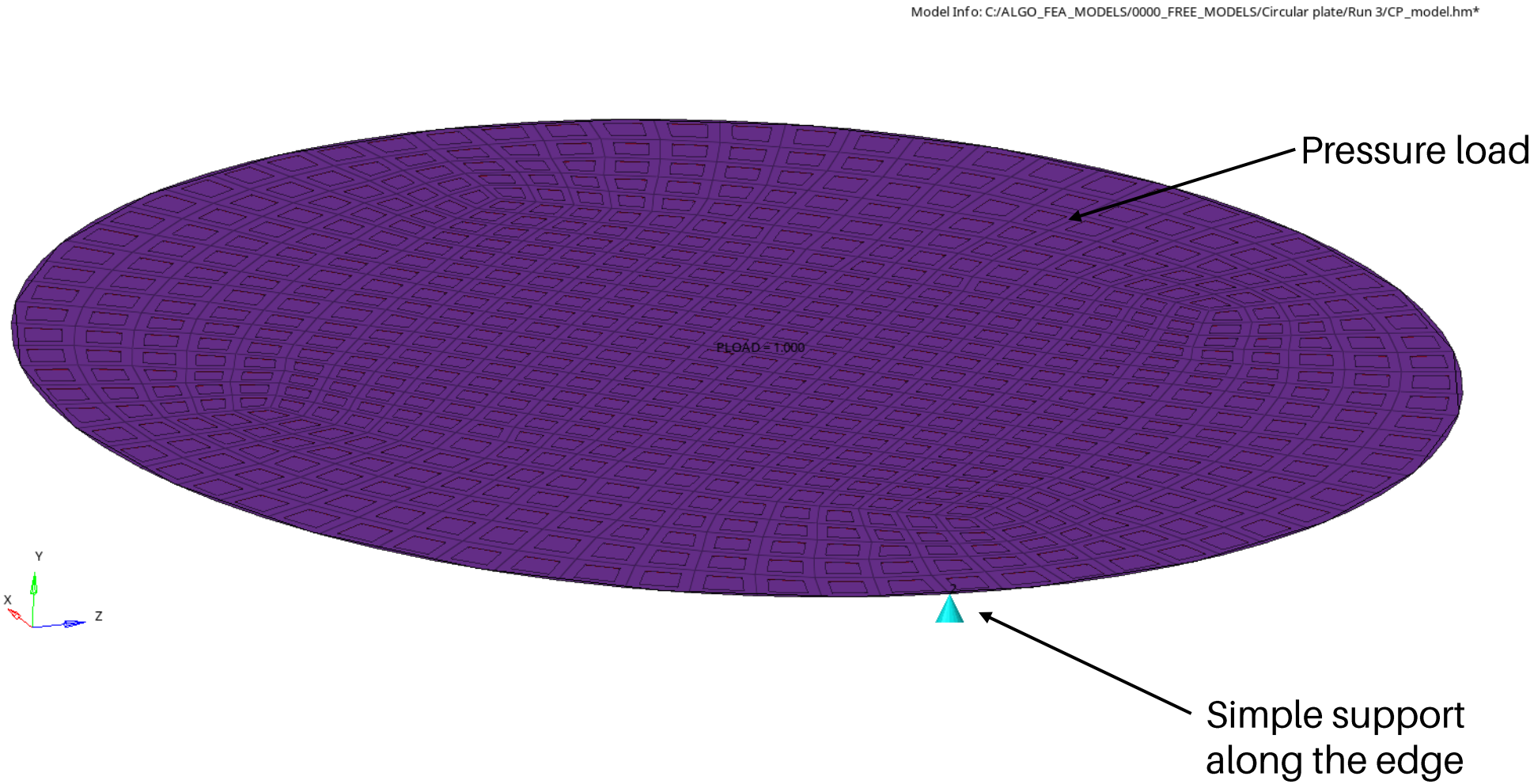


Model Parameters

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	1 sec

FEA Entities	Type
Analysis Type	Dynamic Explicit
Unit System	Kg, mm, ms
Element Type	SHELL4N
Material Type	M1_ELAST
Property Type	P1_SHELL

Analysis Setup



Analysis Assumptions and Limitations

- Standard density value of steel is assumed.
- Distributed load is assumed as a pressure load.

Hand Calculations

$\mathrm{D} - Plate\ constant \quad E - Young's\ modulus \quad \nu - Poisson's\ ratio \quad t\ - thickness$
$q - load\ per\ unit\ area \quad r_o - start\ of\ a\ distributed\ load \quad a - outer\ radius$

$$D = \frac{Et^3}{12(1-\nu^2)} = 218000 \quad then, q = 3 \quad r_o = 10$$

$$Center\ deflection = \frac{qa^4(5+\nu)}{64D(1+\nu)} = 0.0833\ in$$

$$Maximum\ bending\ moment(M) = \frac{qa^3}{16}(3+\nu) = 61.5\ lb - in/in$$

$$Maximum\ stress = \frac{6M}{t^2} = 9240\ lb/in^2$$

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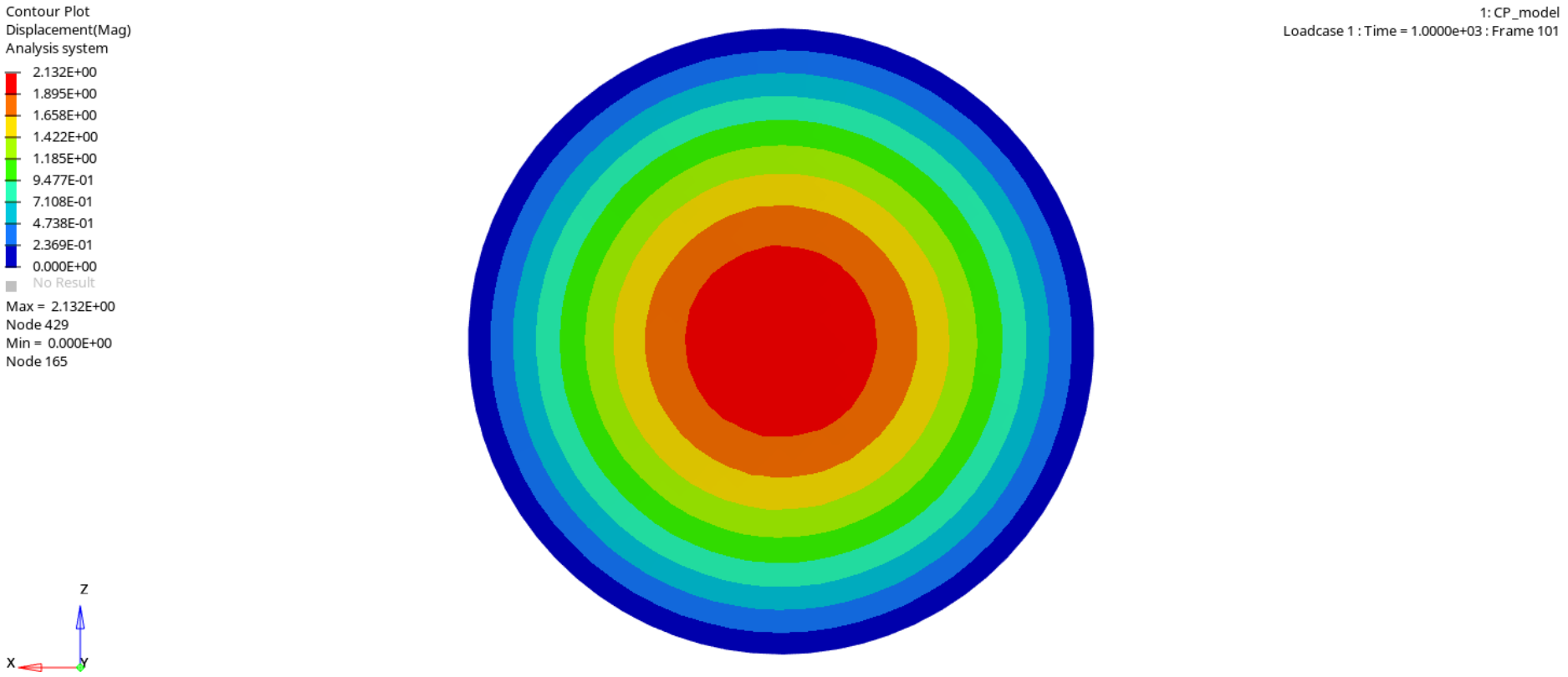
Analysis Results – Center Deflection

Units - mm



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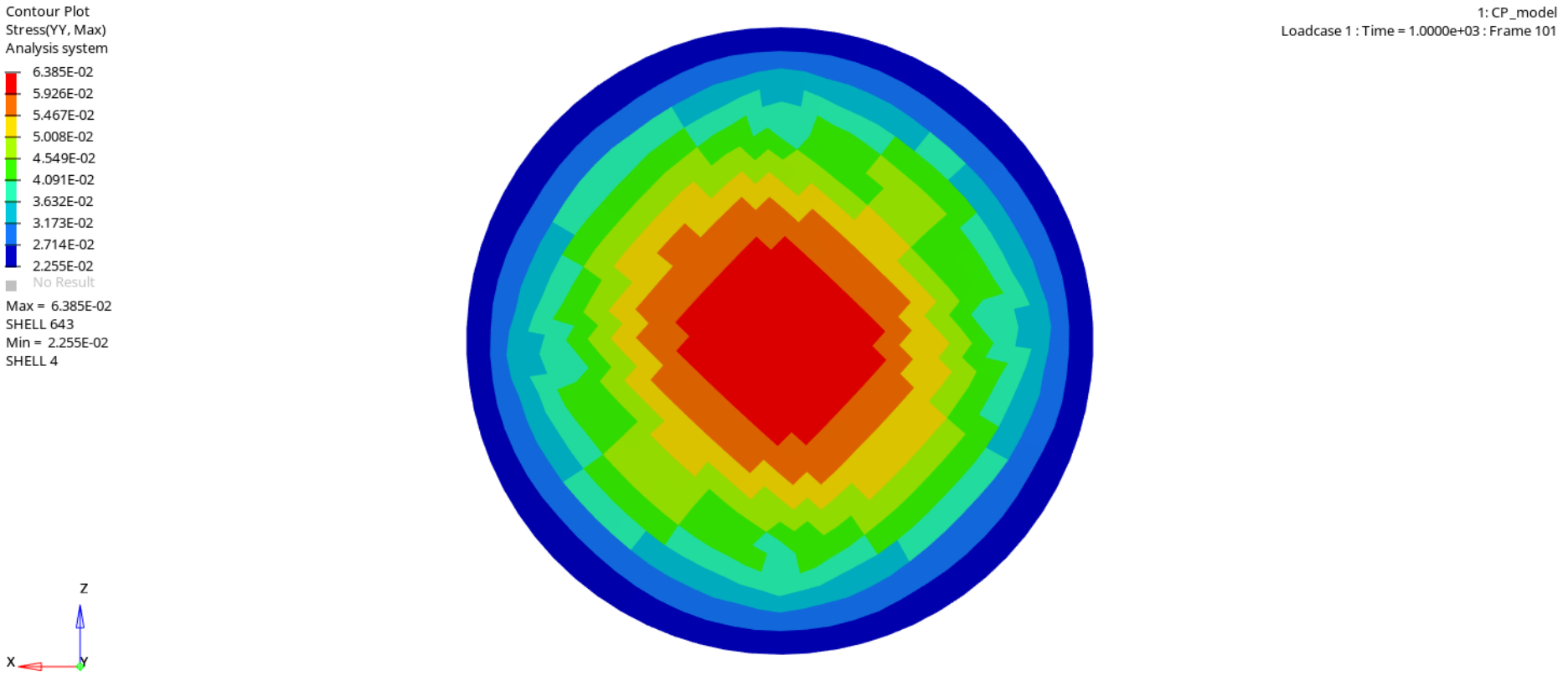
Analysis Results – Maximum Stress

Units - GPa



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Analysis Results

- Center Deflection,

  Based on hand calculations – 0.0833 in (2.1158 mm)

  From the simulation - 0.0839 in (2.132 mm)

- Maximum Stress,

  Based on hand calculations – 9240 lb/in2 (63.708 MPa)

  From the simulation - 9260.66 lb/in2 (63.85 MPa)

Conclusions

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