Deflection of a beam

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For questions, please fill out contact form

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Model Description

- Deflection analysis based on example question 2 documented in page 133 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, spruce is used as the material in this model.

Model Info: C:/ALGO_FEA_MODELS/0000_FREE_MODELS/Deflection of a beam/Run_CZ2/model.hm

Model Description

- Length – 180 in

- Width – 2 in

- Thickness – 4 in

- Young's modulus – 1300000 lb/in2

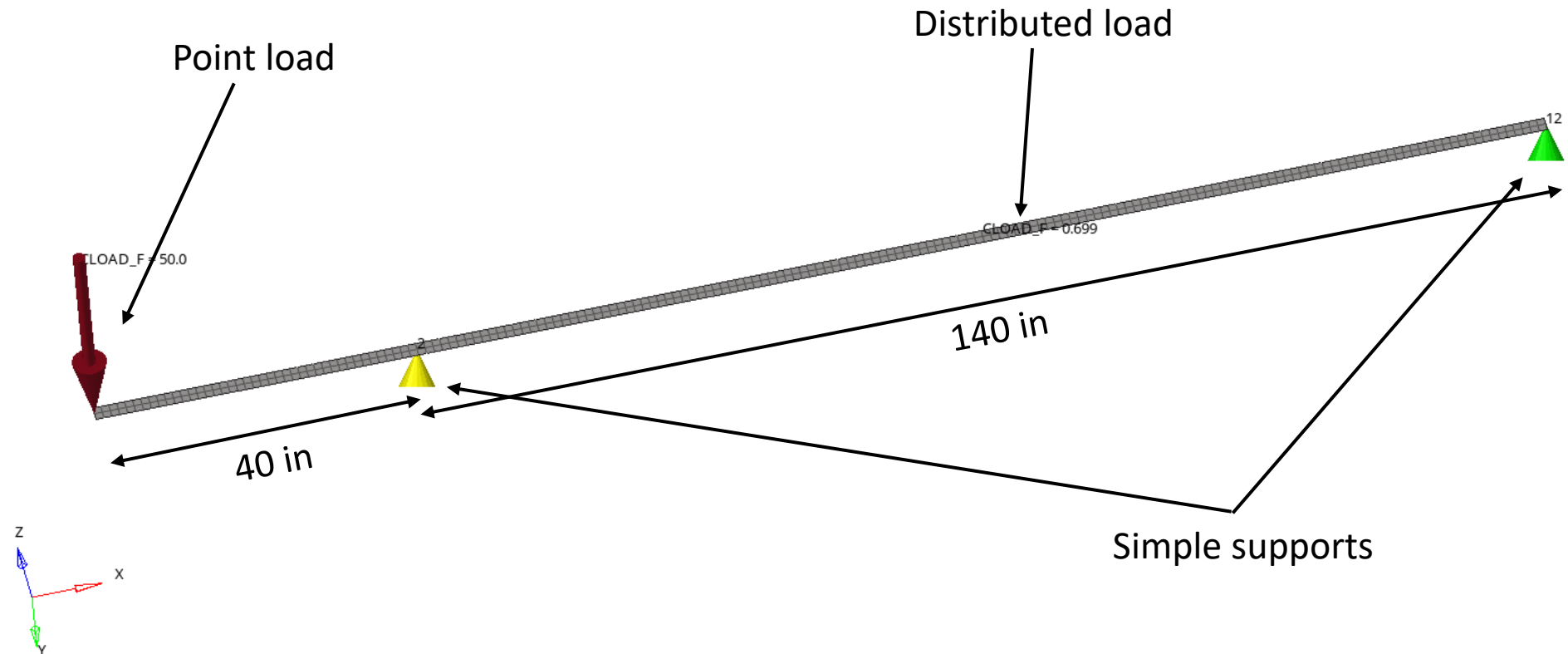- Poison's ratio – 0.3

- Density – 0.018 lb/in3 (assumed)

Model Info: C:/ALGO_FEA_MODELS/0000_FREE_MODELS/Deflection of a beam/Run_CZ2/model.hm

12

CLOAD_F = 0.699

2

Z

Y   X

CLOAD_F = 50.0
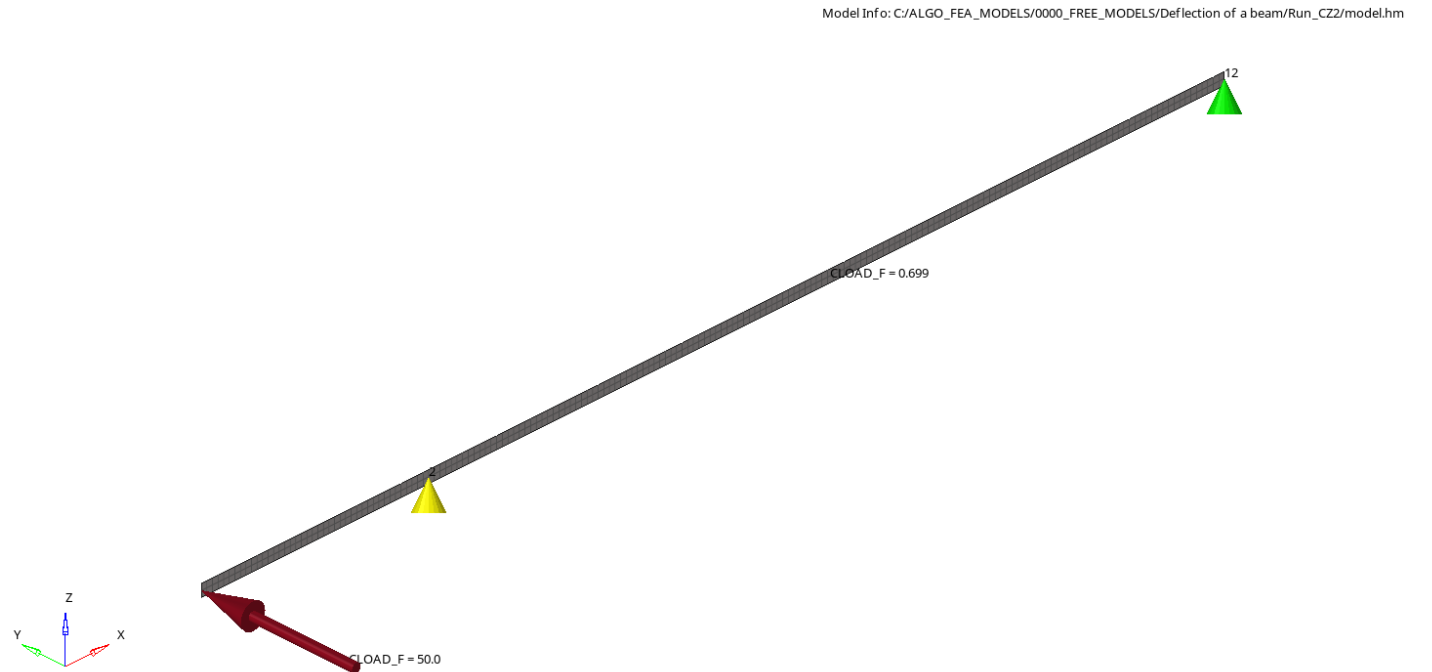
Model Parameters

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	3.62 sec

FEA Entities	Type
Analysis Type	Dynamic Explicit
Unit System	lb, in, s
Element Type	SHELL4N
Material Type	M1_ELAST
Property Type	P1_SHELL

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Analysis Setup

Units - in

Model Info: C:/ALGO_FEA_MODELS/0000_FREE_MODELS/Deflection of a beam/Run_CZ2/model.hm

Point load

Distributed load

CLOAD_F = 50.0

GLOAD_F = 0.699

140 in

40 in

Simple supports

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Analysis Assumptions and Limitations

- Standard density value of spruce is assumed.
- The FEA analysis is performed dynamically since we are using the explicit Radioss solver.

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Hand Calculations

Superposition of deflection by each load is assumed as the total deflection

w_a − *distributed load* l_1 − *length of the distributed load*
l_2 − *overhanging length* E − *Young's modulus* I − *second moment of area*
W − *point load*

$$Deflection\ by\ distributed\ load = (-40)\frac{w_a {l_1}^3}{24EI} = \frac{9800000}{E}$$
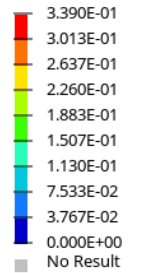
$$Deflection\ by\ point\ load = -\frac{W{l_2}^3}{3EI} + (-40)\left[-\frac{1}{3}\frac{W l_2 l_1}{EI}\right] = -\frac{14400000}{E}$$

$$Total\ deflection = \frac{9800000}{E} - \frac{14400000}{E} = -\frac{4600000}{E} = 0.33\ in\ (downward)$$

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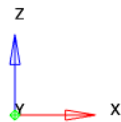
Analysis Results

Units - in

Contour Plot
Displacement(Mag)
Analysis system

	3.390E-01
	3.013E-01
	2.637E-01
	2.260E-01
	1.883E-01
	1.507E-01
	1.130E-01
	7.533E-02
	3.767E-02
	0.000E+00
	No Result

Max = 3.390E-01
Node 5040
Min = 0.000E+00
Node 5226

1: model
Loadcase 1 : Time = 5.0000e+00 : Frame 6

2/21/2023

Conclusions

- Deflection analysis of a 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.

    Deflection based on hand calculations – 0.33 in

    Deflection from the simulation - 0.339 in

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