Modal Analysis of a Cantilever beam

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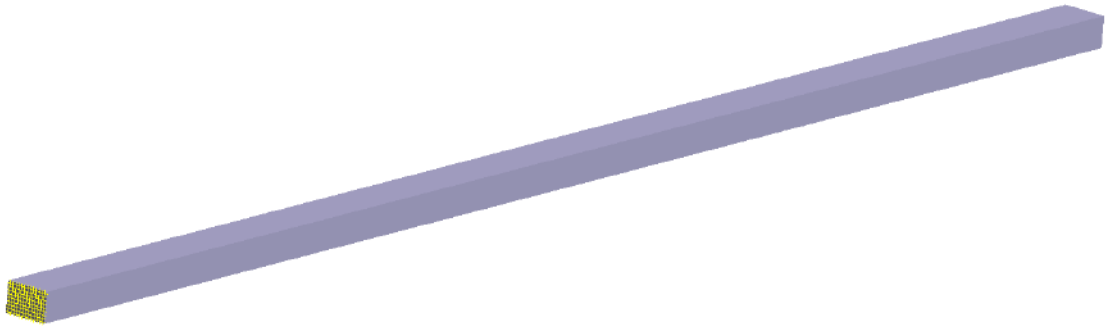
Model Description

- Modal analysis of a Cantilever beam was conducted to evaluate mode shapes and frequencies:
- Modal frequencies are compared to hand calculations.
- Note: This analysis does not model material failure.



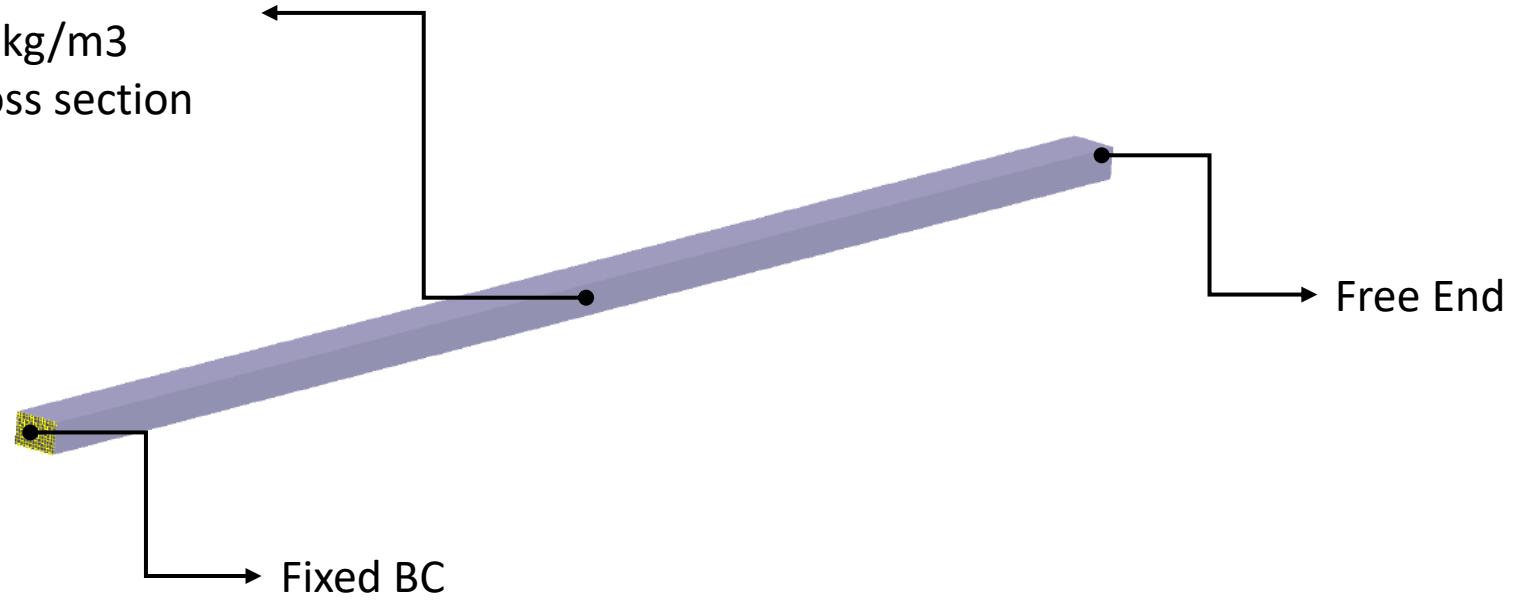
Model Parameters

Entity	Type
Solver	Altair SIMSOLID
Version	2022.2.1
CPU	Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz

FEA Entities	Type
Analysis Type	Structural non-linear
Unit System	kg, m, s

Analysis Setup

Steel Beam
- Young's modulus – 206 GPa
- Density – 7800 kg/m3
- Rectangular cross section



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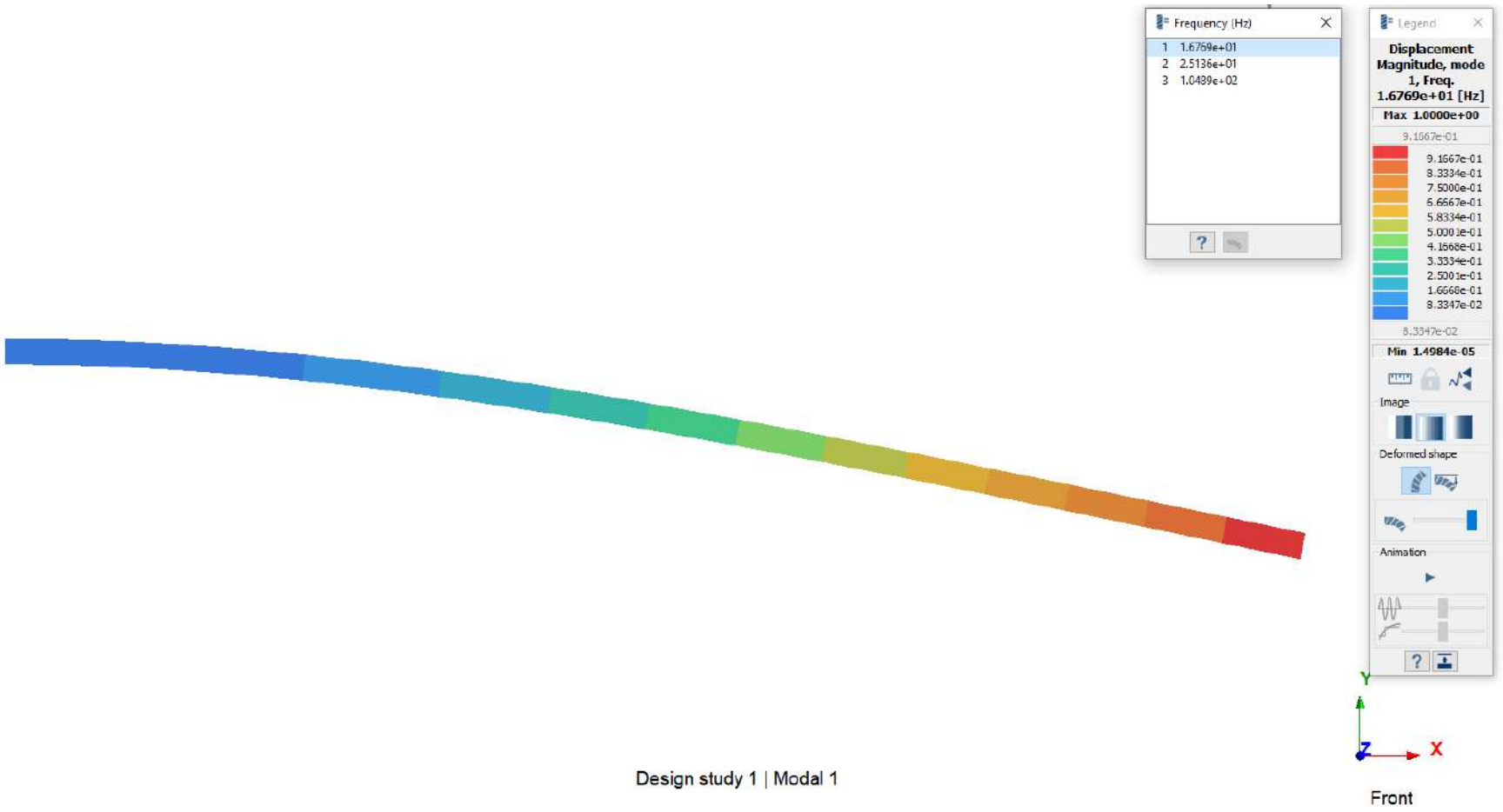
Analysis Assumptions and Limitations

- Mode Shape function calculations are omitted.

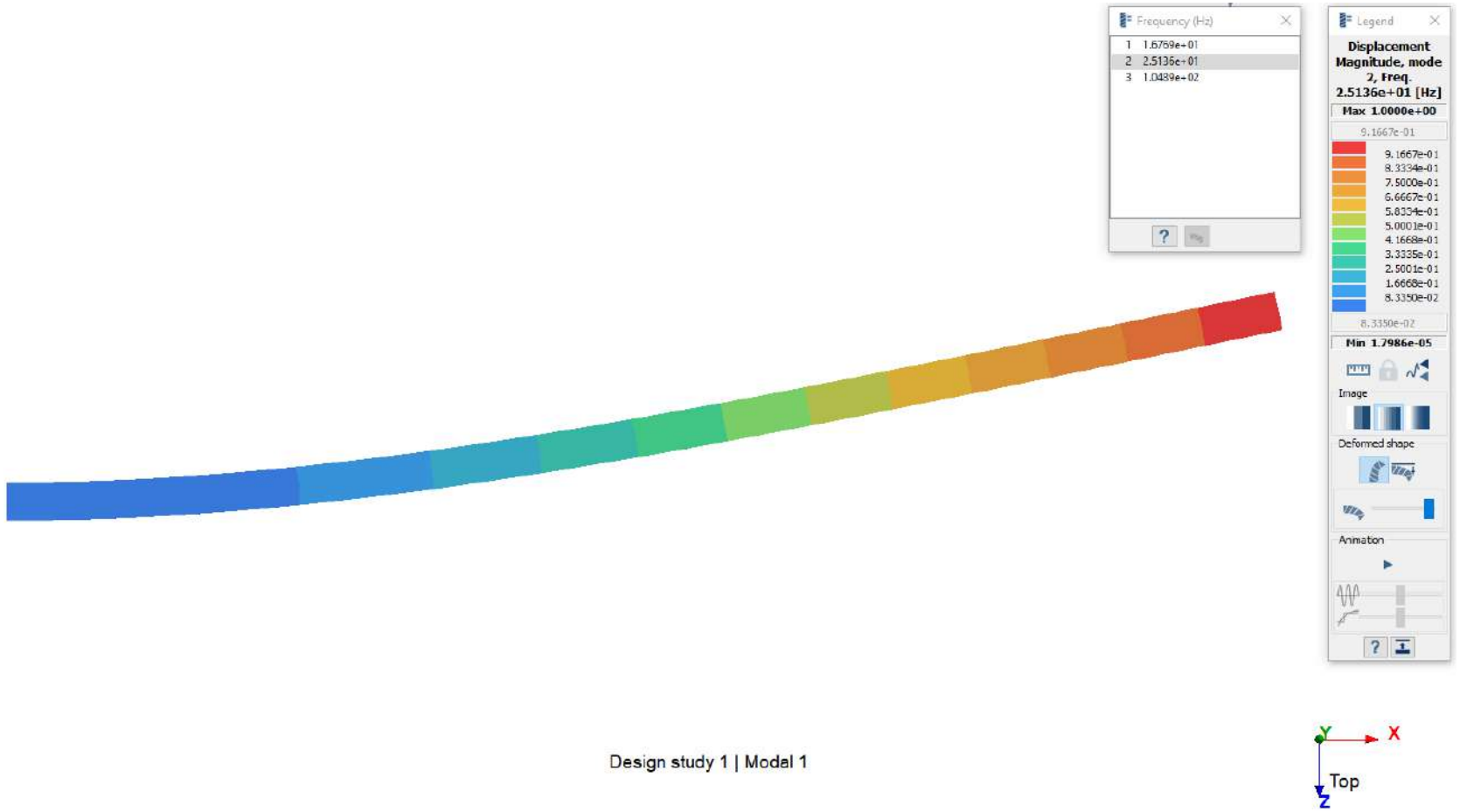
Analysis Results

1st Mode Shape



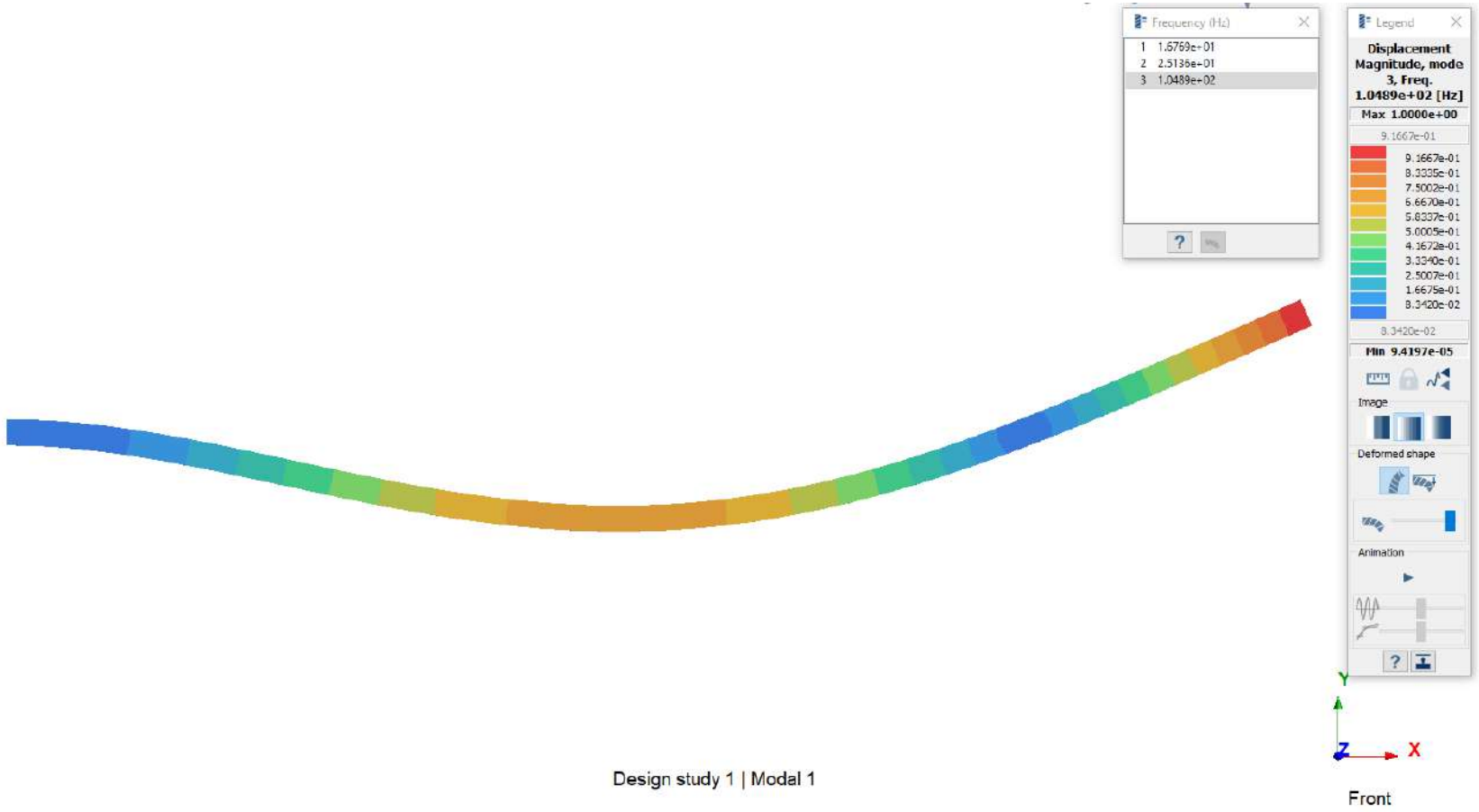
Analysis Results

2nd Mode Shape



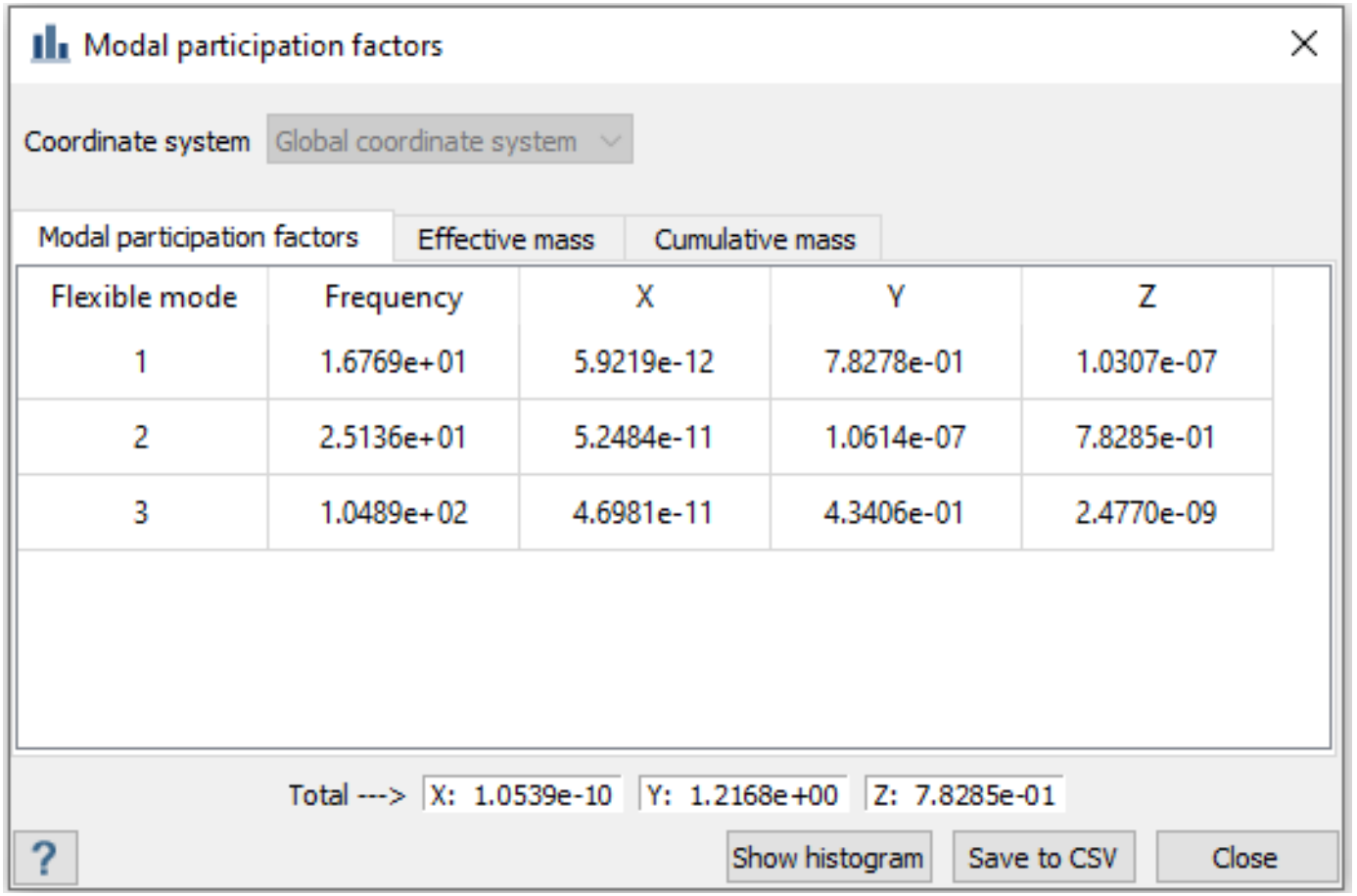
Analysis Results

3rd Mode Shape



Analysis Results

Frequencies



Hand Calculations

- 1st Mode Shape

$$f = \frac{1.875^2}{2\pi}\sqrt{\frac{EI}{\rho A}} = \frac{1.875^2}{2\pi}\sqrt{\frac{(206\times10^9)\times\left(\frac{1}{12}\times0.03\times0.02^3\right)}{7800\times(0.02\times0.03)}} = 16.6\ Hz$$

- 2nd Mode Shape

$$f = \frac{1.875^2}{2\pi}\sqrt{\frac{EI}{\rho A}} = \frac{1.875^2}{2\pi}\sqrt{\frac{(206\times10^9)\times\left(\frac{1}{12}\times0.02\times0.03^3\right)}{7800\times(0.02\times0.03)}} = 24.9\ Hz$$

- 3rd Mode Shape

$$f = \frac{4.6941^2}{2\pi}\sqrt{\frac{EI}{\rho A}} = \frac{4.6941^2}{2\pi}\sqrt{\frac{(206\times10^9)\times\left(\frac{1}{12}\times0.03\times0.02^3\right)}{7800\times(0.02\times0.03)}} = 104.1\ Hz$$

Comparison of Results

Hand Calculations (Hz)	Simulations (Hz)	Error Percentage (%)
16.6	16.8	1.2
24.9	25.1	0.8
104.1	104.9	0.76

Conclusions

- Modal analysis of a cantilever beam was conducted using Altair SIMSOLID.
- The simulation shows good correlation in mode frequencies when compared to hand calculations.
- This model provides a good starting point for modal analysis FEA and can be further utilized to model damage and failure.