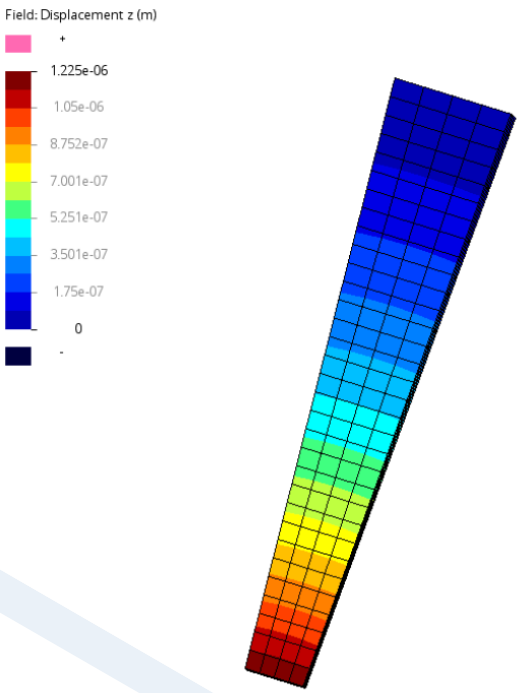
AKSELOS



ELONGATION OF A SOLID BEAM

Application Note

Objectives:

- Create an Akselos model using Solid elements.
- Define materials, loads and boundary conditions.
- Determine the maximum axial deflection and the axial stress.
- Solve with both FEA and RB-FEA solver types.
- Compare with theory results.

Reference: C. O. Harris, ***Introduction to Stress Analysis***, The Macmillan Co., New York, NY, 1959, pg. 237, problem 4.

Model Description:

The model below is a finite element representation of a tapered aluminum alloy bar of square cross-section. Dimensions of this beam are shown in Figure 1 and Table 1.

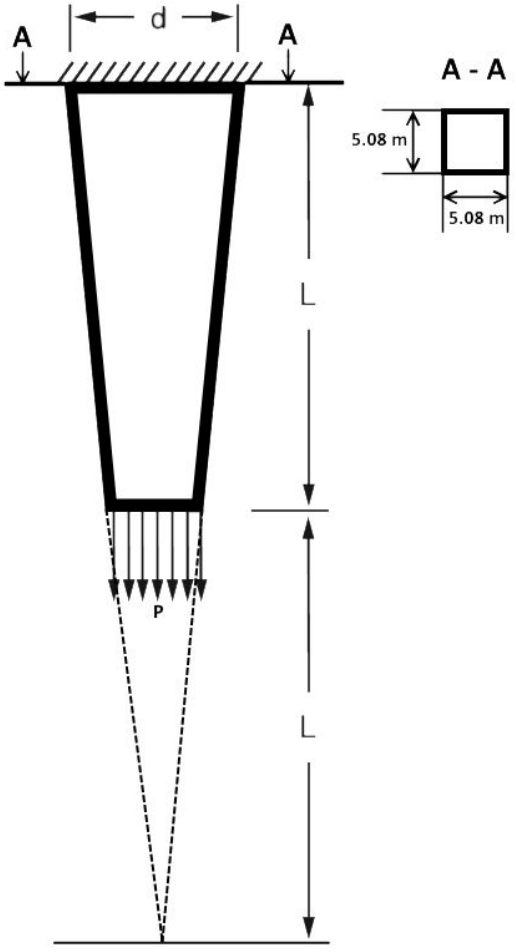


Figure 1: Model schematic

Model Properties:

Material Properties	Elastic Modulus	71.7055 GPa
	Poisson Ratio	0.3
Geometric Properties	L	25.4 m
	d	5.08 m
Loading	P	6.8974 kPa (*)

Table 1: Model Properties. (*) Positive pressure value means tensile pressure, while negative value means compressive pressure.

We plan to use Solid 8-node HEX element for this case.

Suggested Exercise Steps

- Create Tapered beam component in Akselos Modeler with a port (at clamped position) and a normal load surface. ***(Refer to the Component Editor tutorials in the Akselos User Manuals to learn how to create components.)***
- Define material properties.
- Apply boundary conditions and loads.
- Upload model to Akselos server.
- Solve model with FEA solver type.
- Do component training process with Akselos Server.
- Review the results and compare with theory.

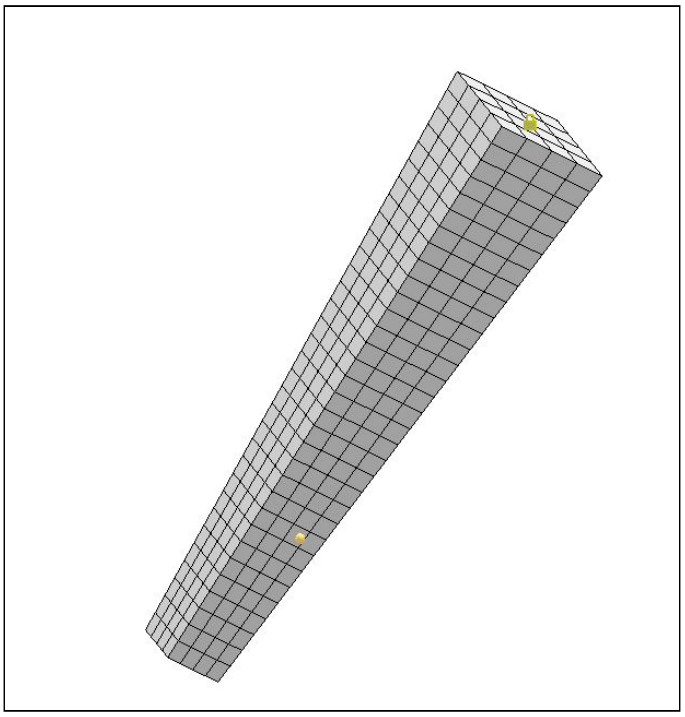


Figure 2: Model in Akselos Assembler (512 elements with 825 nodes)

Results:

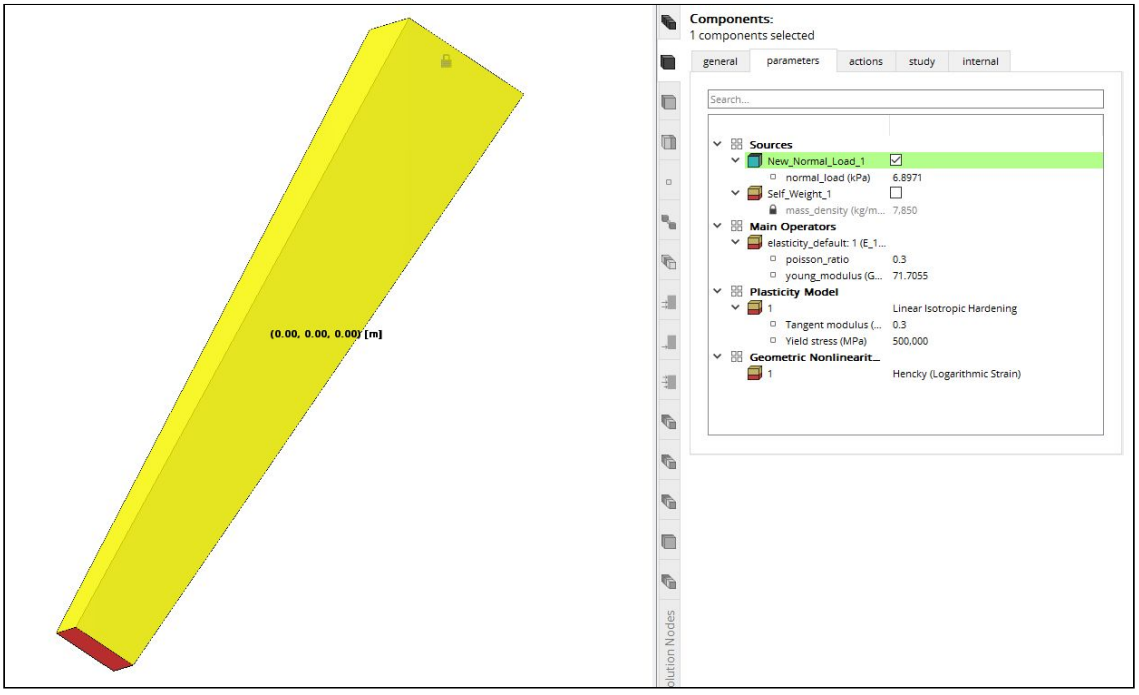


Figure 2: Model in Akselos Modeler with properties

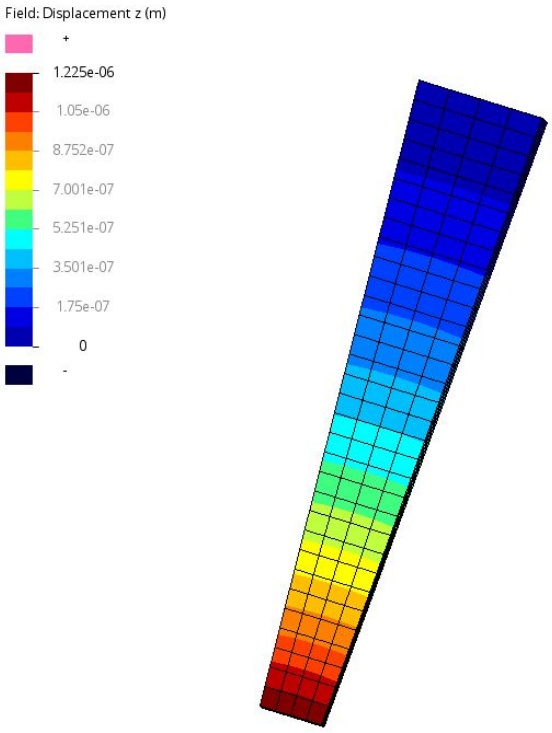


Figure 3: RB-FEA result in Vertical Displacement

	Theory	FEA	RB-FEA
Vertical displacement (m)	1.221×10^{-6}	1.225×10^{-6}	1.225×10^{-6}
Axial stress at mid-length (Pa)	3064.03	3043.33	3043.33
Solving time (s)		0.066	0.0012

Note that the RB-FEA vs. FEA speedup in this case is 0.066 / 0.0012 = 55. The FEA model in this case is very simple (only 512 elements), and we typically observe much larger speedup for more complex models.

About Akselos

Akselos is a digital technology company headquartered in Switzerland, with operations in Europe, the USA and South East Asia. The company has created the world's most advanced engineering modeling, and fastest simulation technology, to protect the world's critical infrastructure today and tomorrow. The technology has the power to revolutionize how we build and manage our critical infrastructure, and pushes the boundaries of what modern engineering and data analytics can achieve. Developed by some of the world's best minds, the MIT-licensed technology builds something far beyond the capability of a conventional digital twin – a digital guardian that allows operators to not only monitor an asset's condition in real time, but helps them to see the future.

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