COMSOL MULTIPHYSICS®

Eigenfrequency Analysis of a Free Cylinder

SOLVED WITH COMSOL MULTIPHYSICS 3.5a

© COPYRIGHT 2008. All right reserved. No part of this documentation may be photocopied or reproduced in any form without prior written consent from COMSOL AB. COMSOL, COMSOL Multiphysics, COMSOL Reaction Engineering Lab, and FEMLAB are registered trademarks of COMSOL AB. Other product or brand names are trademarks or registered trademarks of their respective holders.



Eigenfrequency Analysis of a Free Cylinder

Introduction

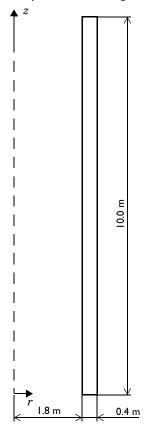
In the following example you will build and solve an axial symmetric model using the Axial Symmetry, Stress-Strain application mode.

This model calculates the eigenfrequencies and mode shapes of an axisymmetric free cylinder. The model is taken from NAFEMS *Free Vibration Benchmarks* (Ref. 1). The eigenfrequencies are compared with the values given in the benchmark report.

Model Definition

The model is NAFEMS Test No 41, "Free Cylinder" described on page 41 in NAFEMS *Free Vibration Benchmarks, Volume 3* (Ref. 1). The Benchmark tests the capability to handle rigid body modes and close eigenfrequencies.

The cylinder is 10 m high with an inner radius of 1.8 m and a thickness of 0.4 m.



MATERIAL

Isotropic material with $E = 2.0 \cdot 10^{11}$ Pa and v = 0.3.

LOADS

In an eigenfrequency analysis loads are not needed.

CONSTRAINTS

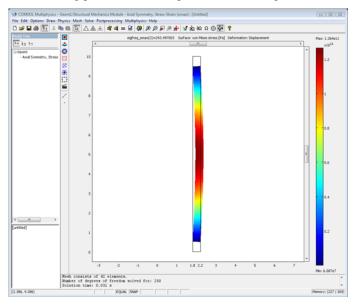
No constraints are applied because the cylinder is free.

Results

The rigid body mode with an eigenvalue close to zero is found. The eigenfrequencies are in close agreement with the target values from the NAFEMS Free Vibration Benchmarks (Ref. 1).

EIGENFREQUENCY	COMSOL	TARGET (REF. I)
f_1	0 Hz	0 Hz
f_2	243.50 Hz	243.53 Hz
f_3	377.44 Hz	377.41 Hz
f_4	394.30 Hz	394.11 Hz
f_5	398.00 Hz	397.72 Hz
f_6	405.75 Hz	405.28 Hz

The following plot shows the shape of the second eigenmode:



Reference

1. F. Abassian, D.J. Dawswell, and N.C. Knowles, *Free Vibration Benchmarks, Volume 3*, NAFEMS, Glasgow, 1987.