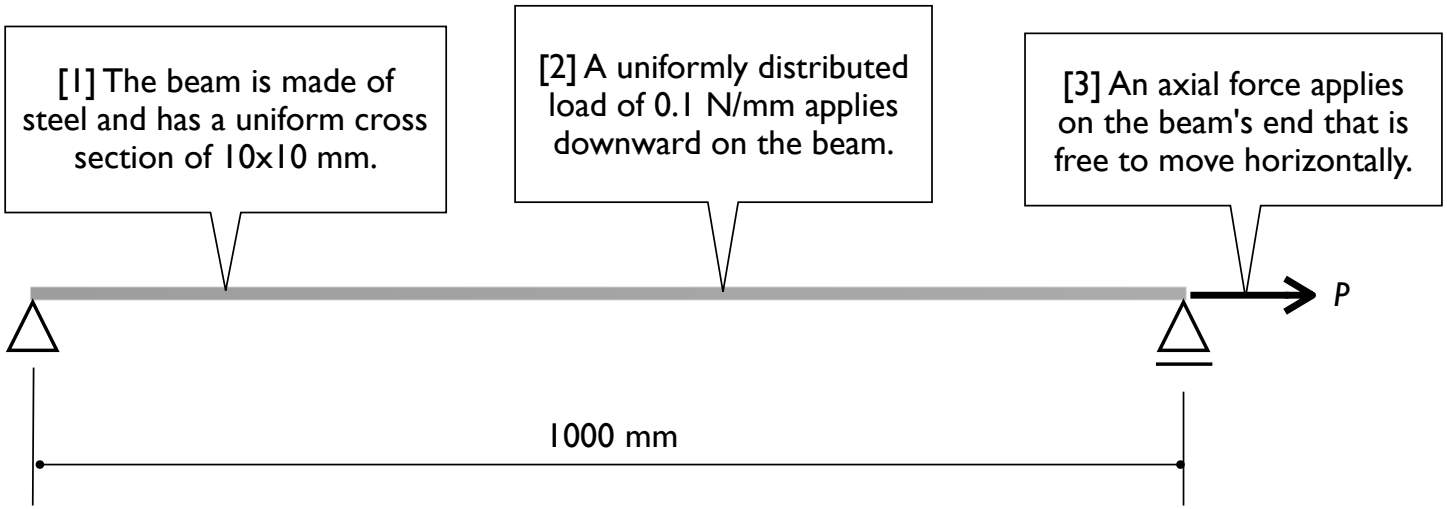
Chapter 10

Buckling and Stress Stiffening

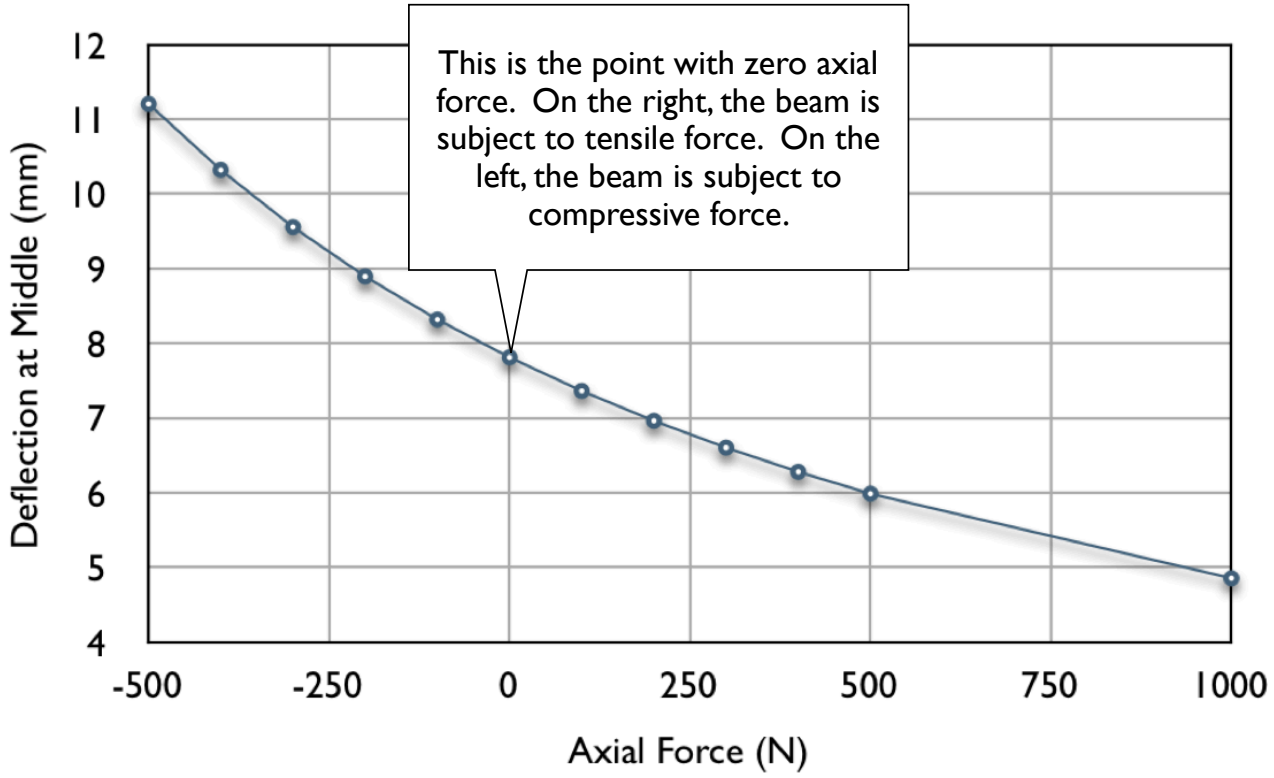
Section 10.1

Stress Stiffening

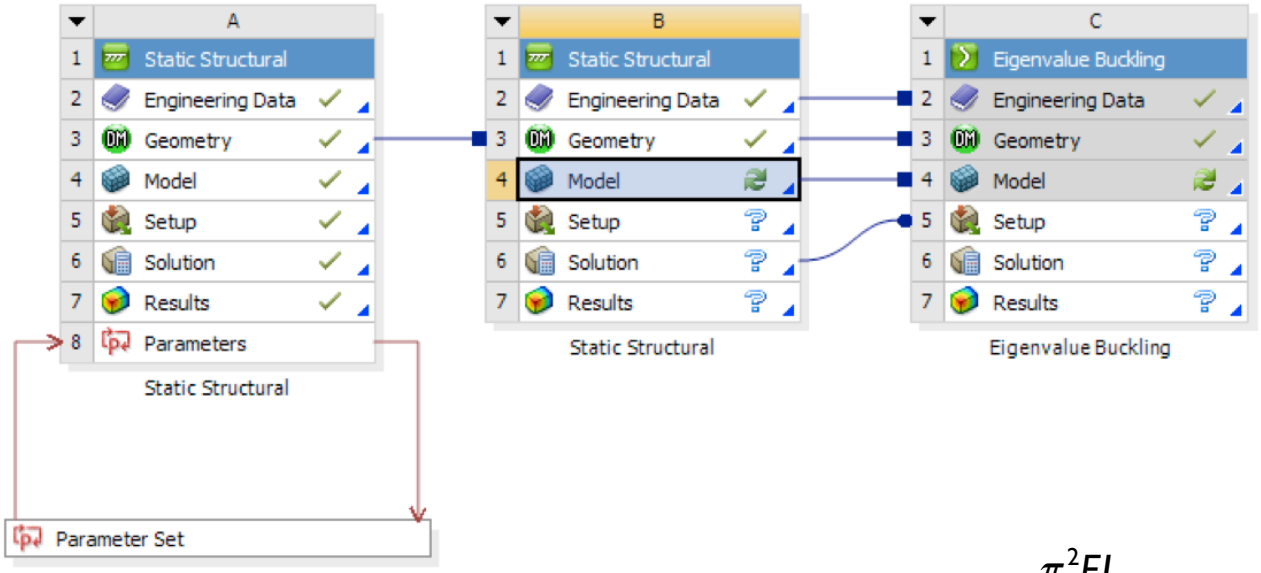
Problem Description



Stress Stiffening Effects

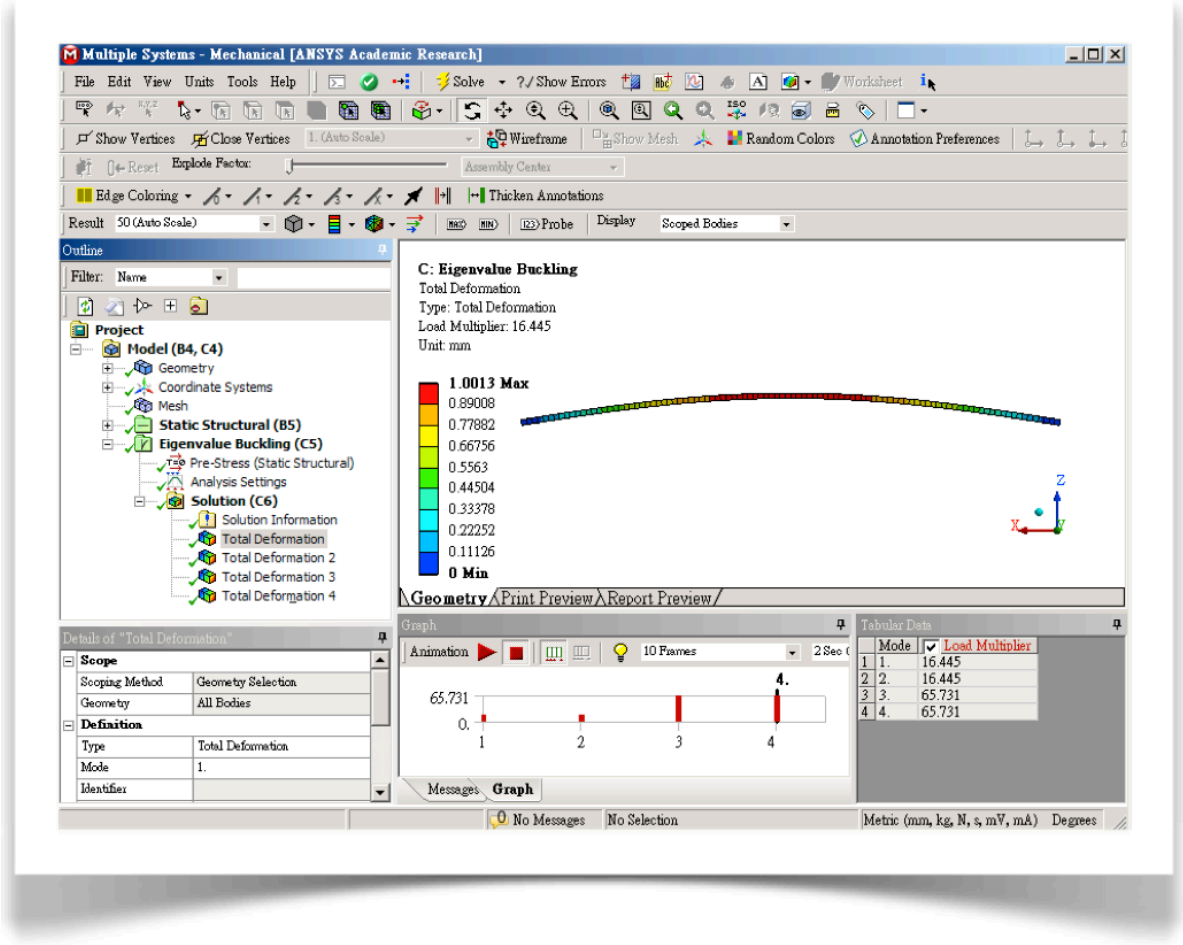


Linear Buckling Analysis



$$P_{buckling} = \frac{\pi^2 EI}{L^2} = 1644.5 \text{ N}$$

Results

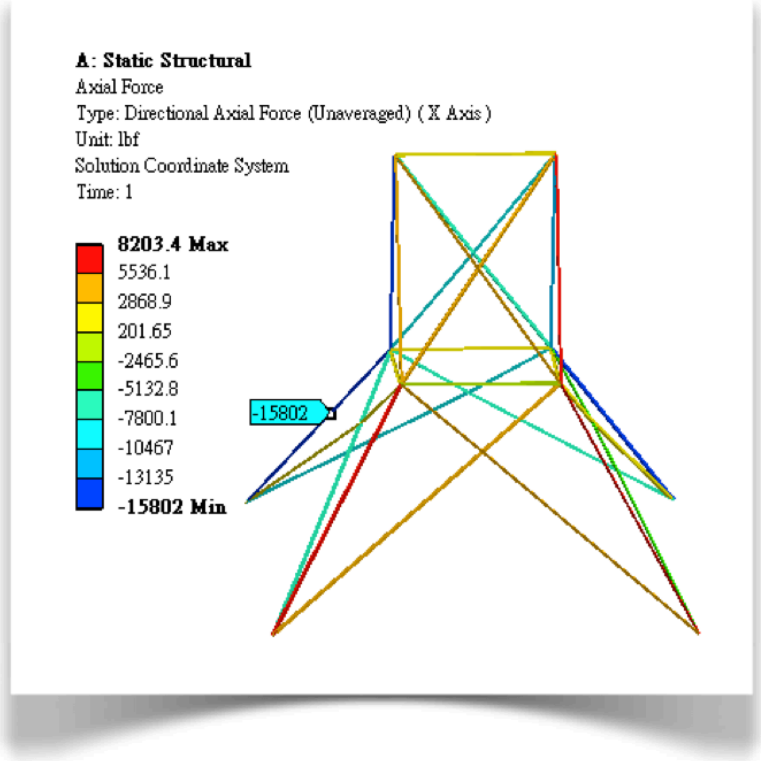

Multiple Systems - Mechanical [ANSYS Academic Research]
File Edit View Units Tools Help
Solve
Show Errors
Worksheet
Show Vertices
Close Vertices
Wireframe
Show Mesh
Random Colors
Annotation Preferences
Reset
Explode Factor:
Edge Coloring
Thicken Annotations
Result
50 (Auto Scale)
Probe
Display
Scoped Bodies
Outline
Filter:
Name
Project
Model (B4, C4)
Geometry
Coordinate Systems
Mesh
Static Structural (B5)
Eigenvalue Buckling (C5)
Pre-Stress (Static Structural)
Analysis Settings
Solution (C6)
Solution Information
Total Deformation
Total Deformation 2
Total Deformation 3
Total Deformation 4
C: Eigenvalue Buckling
Total Deformation
Type: Total Deformation
Load Multiplier: 16.445
Unit: mm
1.0013 Max
0.89008
0.77882
0.66756
0.5563
0.44504
0.33378
0.22252
0.11126
0 Min
Geometry
Print Preview
Report Preview
Details of "Total Deformation"
Scope
Scoping Method
Geometry Selection
Geometry
All Bodies
Definition
Type
Total Deformation
Mode
1.
Identifier
Graph
Animation
10 Frames
65.731
0.
1
2
3
4
Tabular Data
Mode
Load Multiplier
1 1. 16.445
2 2. 16.445
3 3. 65.731
4 4. 65.731
Messages
Graph
No Messages
No Selection
Metric (mm, kg, N, s, mV, mA)
Degrees

Section 10.2

3D Truss

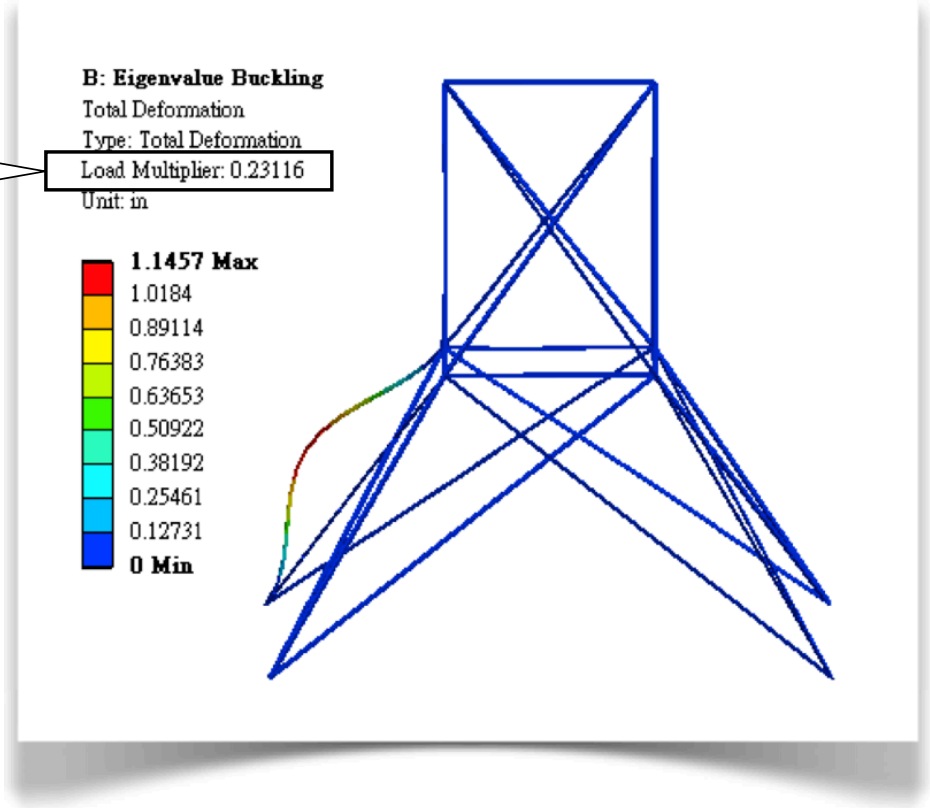
Problem Description

$$P_{buckling} = \frac{\pi^2 EI}{L^2} = \frac{\pi^2 (29,000,000)(0.13852)}{(133.46)^2} = 2,226 \text{ lb} = 0.14P$$



Results

Buckling will occur when 23% of design loads apply on the structure. The multiplier can be viewed as safety factor. The structure is not safe.

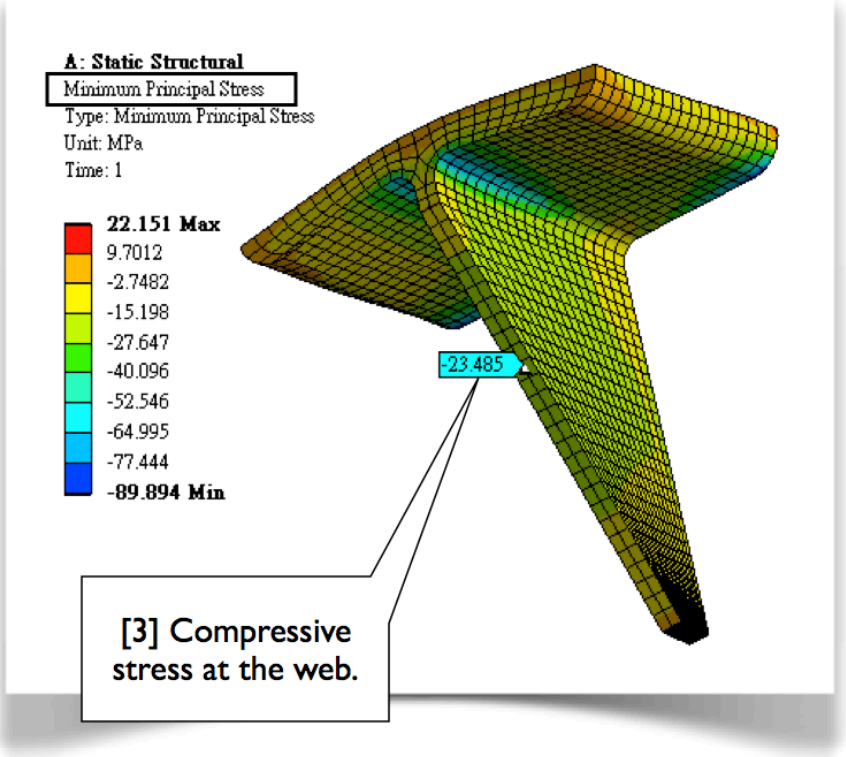


Section 10.3

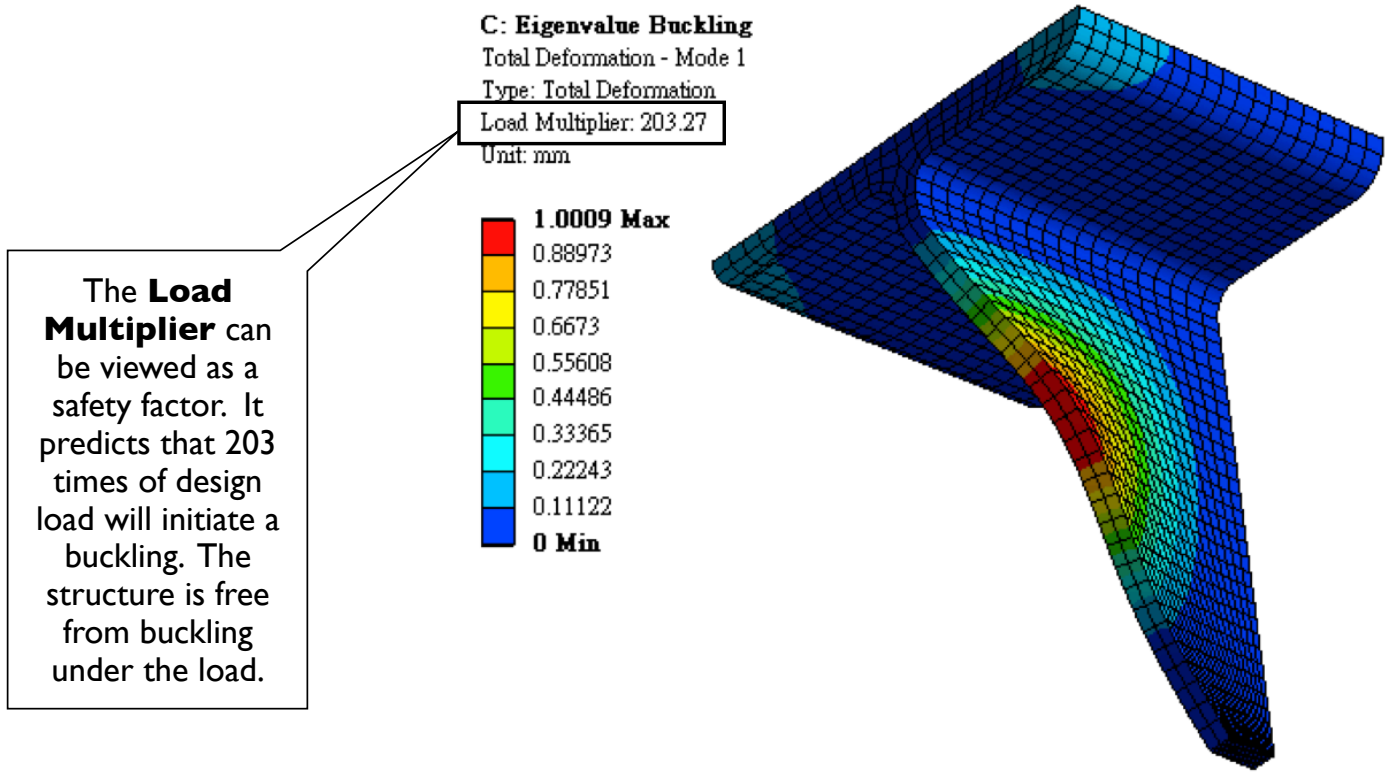
Beam Bracket

Problem Description

- It is a good practice that an engineer always checks the structural stability whenever compressive stresses exist.



Results



The **Load Multiplier** can be viewed as a safety factor. It predicts that 203 times of design load will initiate a buckling. The structure is free from buckling under the load.