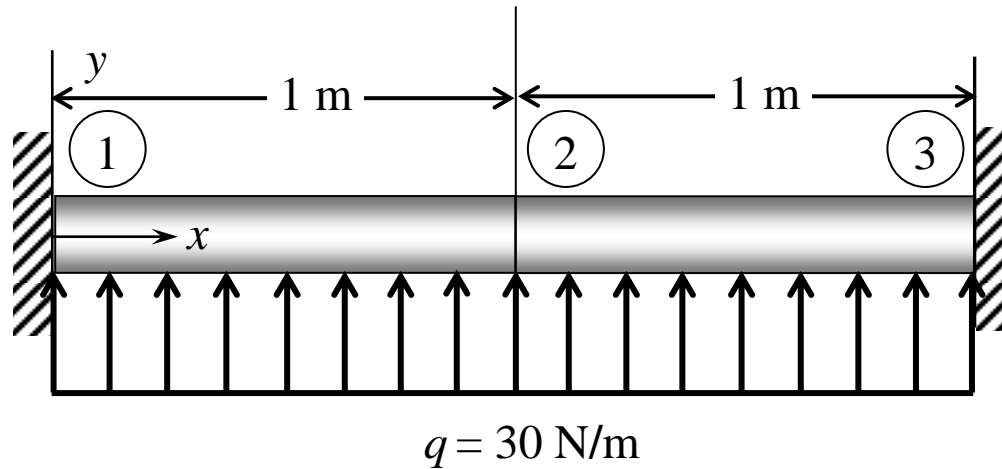


Tutorial 3:

Plane Beam

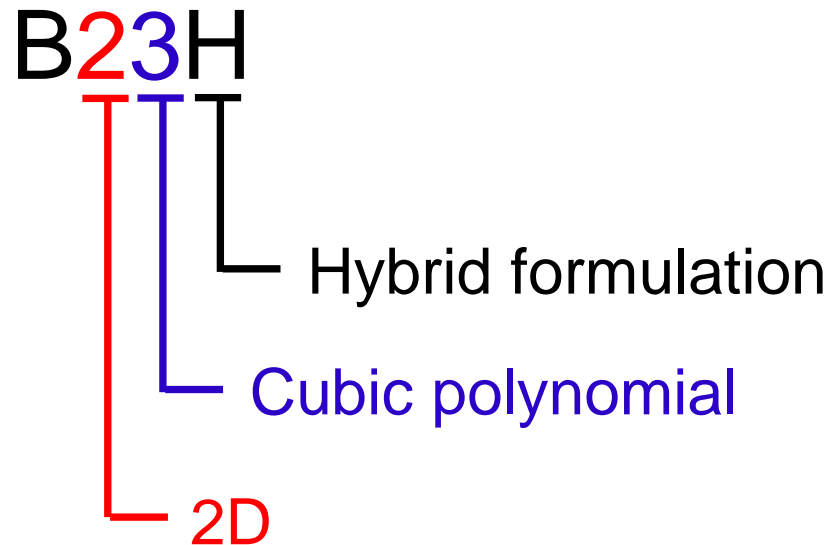
CLAMPED-CLAMPED BEAM

- $E = 100 \text{ MPa}$,
- Circular section with $r = 20\text{mm}$
- Plot bending moment and shear force diagrams



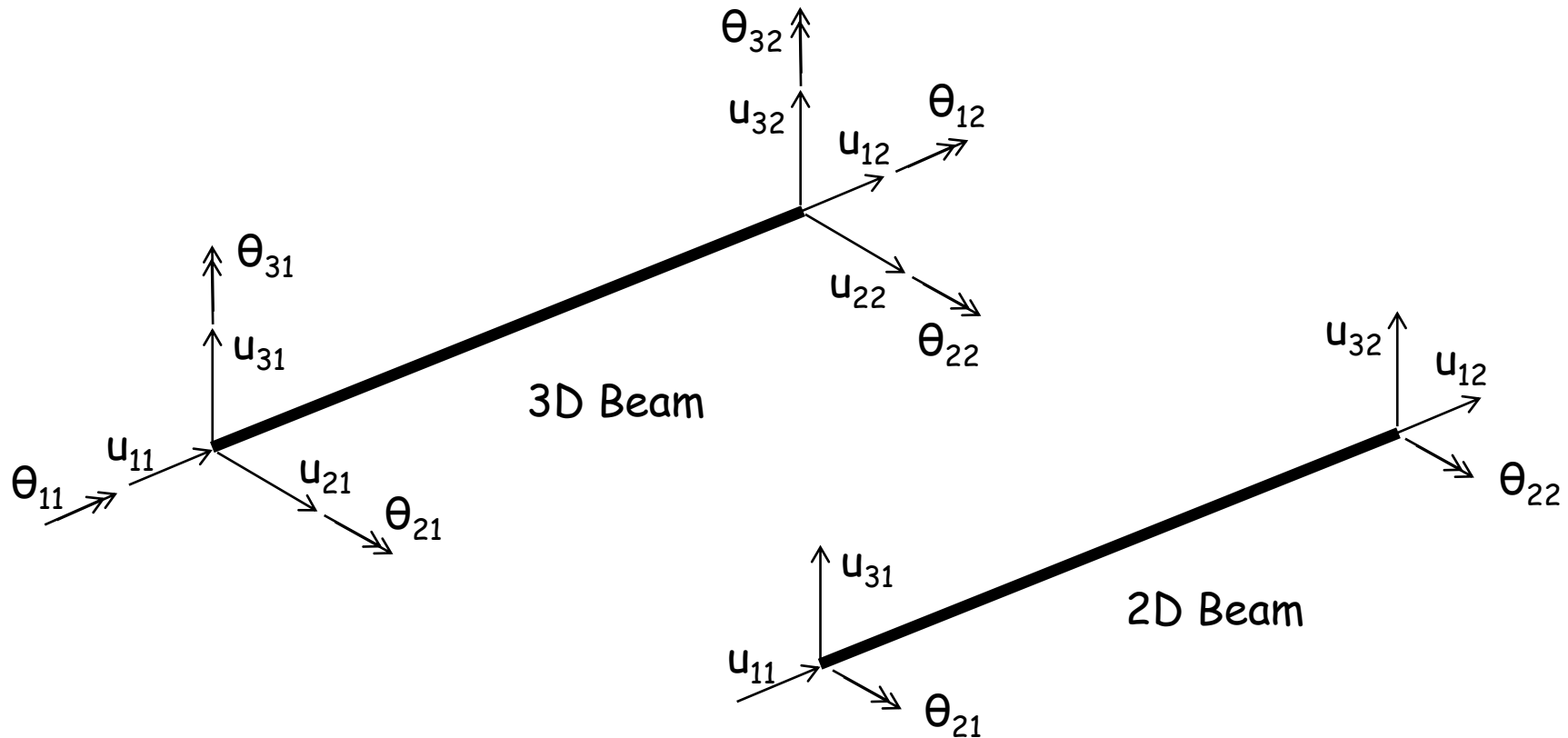
CLAMPED-CLAMPED BEAM

- Classification of Beam Elements
 - Dimension (2D / 3D)
 - Formulation type (Mindlin-2node / Mindlin-3node / Euler)
 - Additional information (OS (open section) / H (hybrid) / OSH)



CLAMPED-CLAMPED BEAM

- Degree of freedoms for a beam element
 - 2D/3D (2D beam is a special case of the 3D beam)
 - With translation (from the truss element)
 - Do not confuse sign convention for displacements and forces

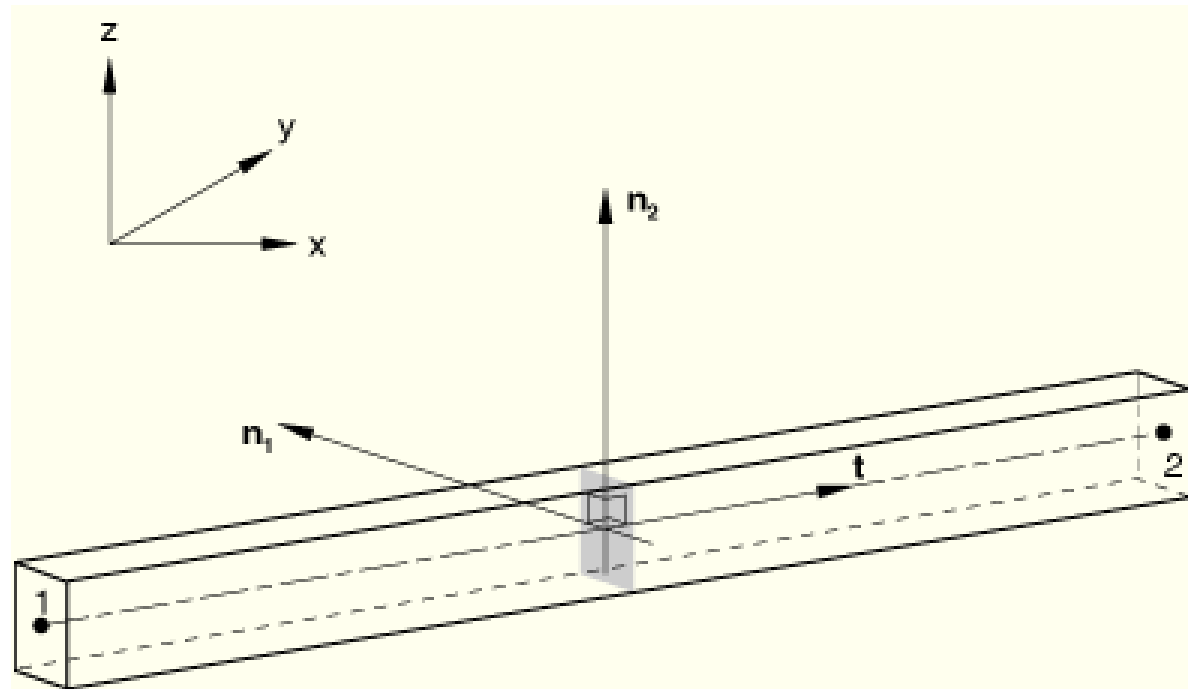


CLAMPED-CLAMPED BEAM

- Parts
 - 2D Planar, Deformable, Wire, App Size = 4
 - Create lines: $(-1, 0)$, $(1, 0)$
- Materials
 - Mechanical, Elasticity, Elastic
 - Young's modulus = $100E6$, Poisson's ratio = 0.3
- Profiles
 - Circular, $r = 0.02$
- Sections
 - Beam
- Assign the section "Beam" to the part

CLAMPED-CLAMPED BEAM

- Beam cross section needs orientation (ex. Second moment of inertia)
- n_1 vector is $(0, 0, -1)$ for plane beam (may not be modified for plane beam)
- Tangent direction vector t is dependent to the direction of wire geometry



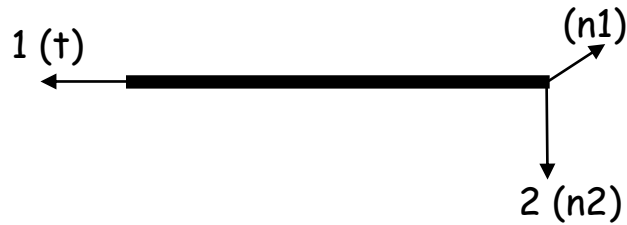
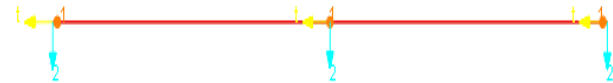
CLAMPED-CLAMPED BEAM

CASE 1

Direction of wire geometry (\dagger)



Assigned beam orientation

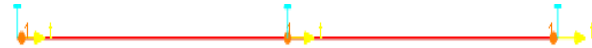


CASE 2

Direction of wire geometry (\dagger)



Assigned beam orientation

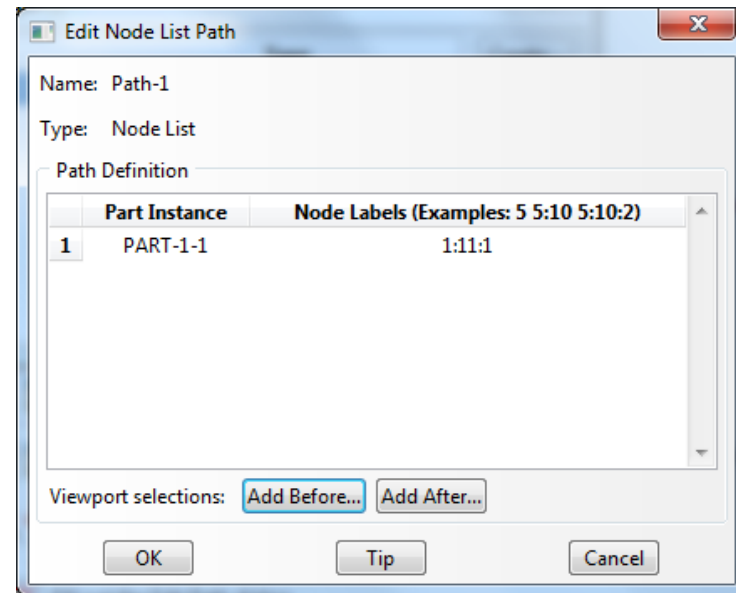


CLAMPED-CLAMPED BEAM

- Assembly, Instance
- Steps
 - Linear perturbation, Static
- Field output request
 - Check SF, Section forces and moments
- BCs
 - Initial, Encastre (clamped)
- Loads
 - Mechanical, Pressure (force/length for beam) or Line load (force/length), select upward, Uniform, 30
- Mesh
 - Element type, "Classical beam theory" or Euler beam theory, Cubic polynomial, (B23), Global element size = 0.2

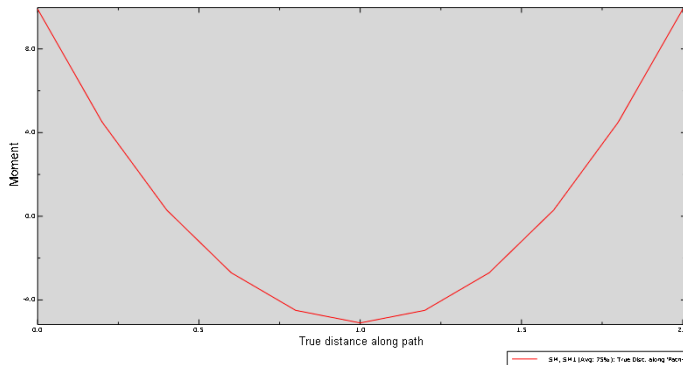
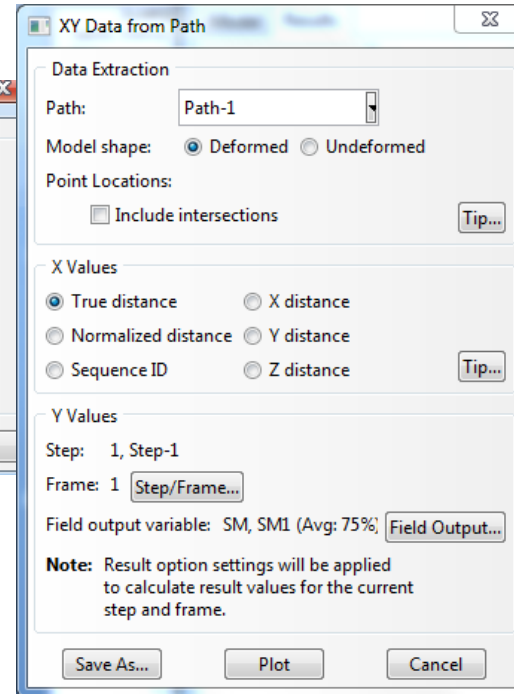
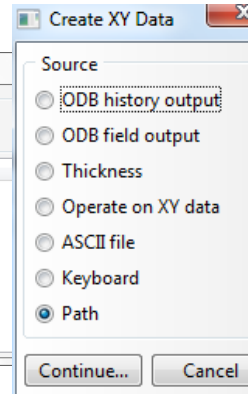
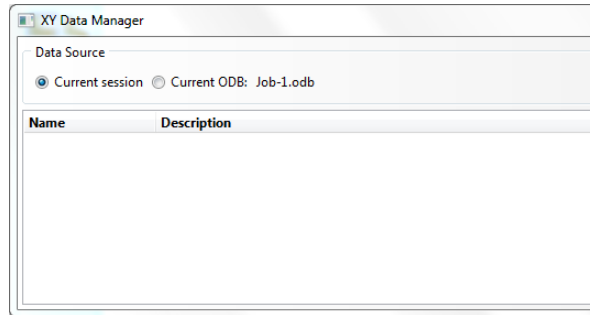
CLAMPED-CLAMPED BEAM

- Analysis, Create Job, Data Check, Submit
- Results
- Deformed plot, Stress plots
 - Field output, Section points, Top or Bottom
- Paths, Node list (first node #, last node #, inc)



CLAMPED-CLAMPED BEAM

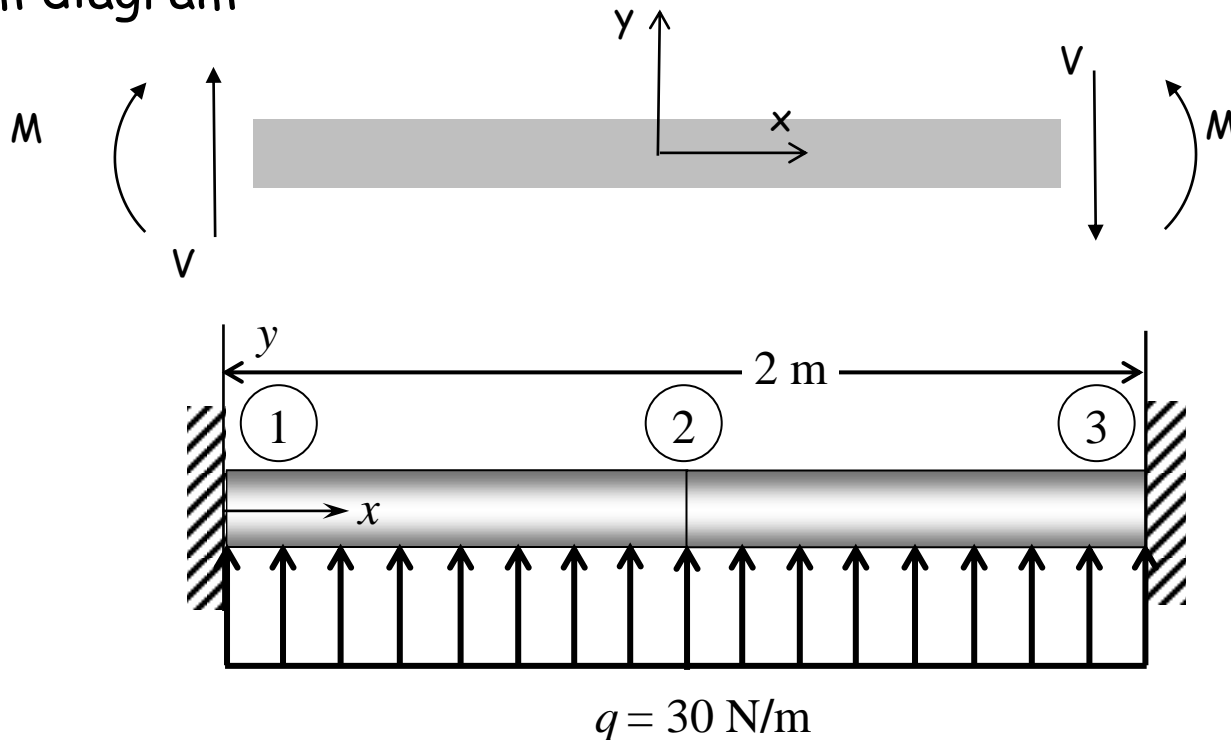
- XYData, path, X Values = Sequence ID
 - Field output, SM1



- To adjust font size of the XYData plot
 - Double click object to open a dialog box to adjust its properties (ex: double click the legend box to enlarge its font size)

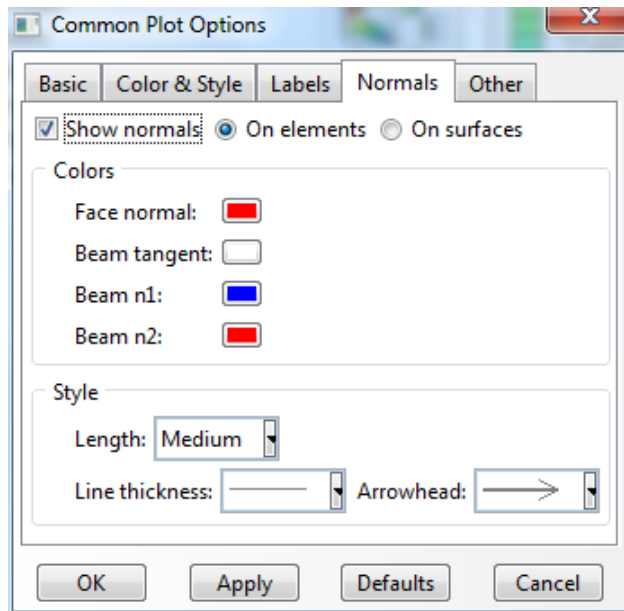
CLAMPED-CLAMPED BEAM

- Sign Convention for force and moment
 - Must not be confused with sign convention for displacements
 - Users must make sure which sign convention is used in a FEA software
 - Shear force and bending moment sign convention of ABAQUS for beam diagram

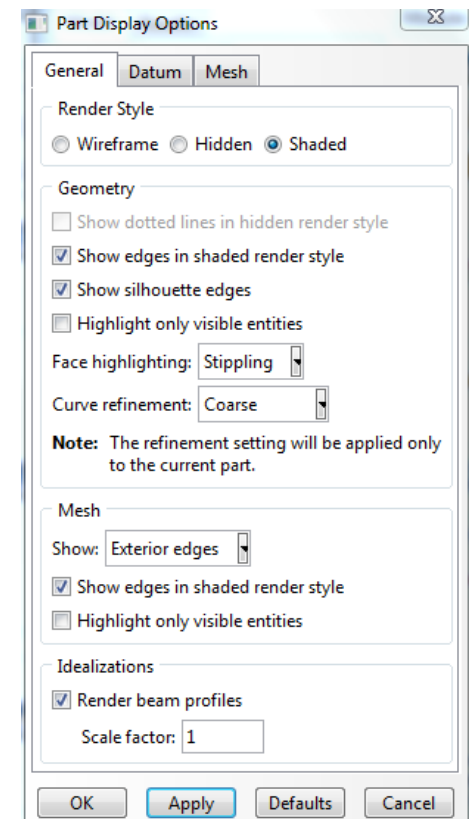


CLAMPED-CLAMPED BEAM

- Common Plot Options
 - Normals, check "Show normals", "On element"

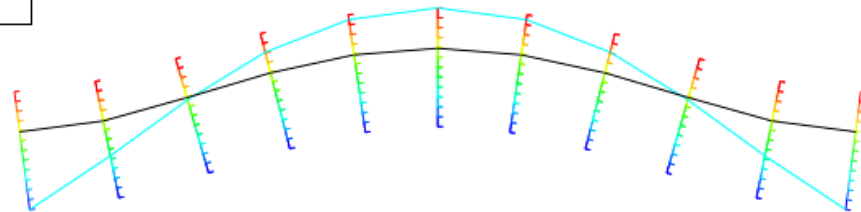
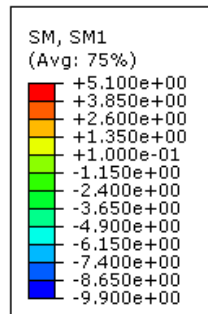
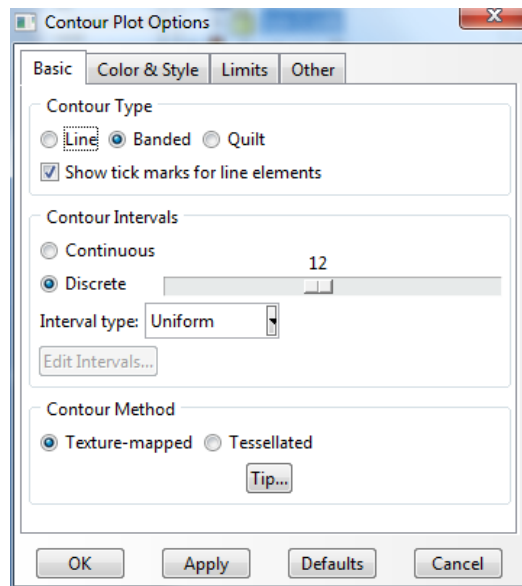


- Module part, View, Part Display Options
 - check "Render Beam Profile"



CLAMPED-CLAMPED BEAM

- Result
 - Field output, SM1
 - Shear force output (SF2) is not available for B23 element
- Contour Plot Options
 - Check "Show tick marks for line elements"



ODB: Job-1.odb Abaqus/Standard 6.9-1 Sat Oct 15 20:36:14 Eastern Daylight Time 2011

Step: Step-1
Increment 1: Step Time = 1.000
Primary Var: SM, SM1
Deformed Var: U Deformation Scale Factor: +2.011e+00

CLAMPED-CLAMPED BEAM

- Change element type
 - Element type, "Timoshenko beam theory" or Mindling beam theory, Shear flexible, (B21), Global element size = 0.2
- Field Output
 - Shear force output (SF2) is available

