Nonlinear Contact FEA of A Couple Driveshaft

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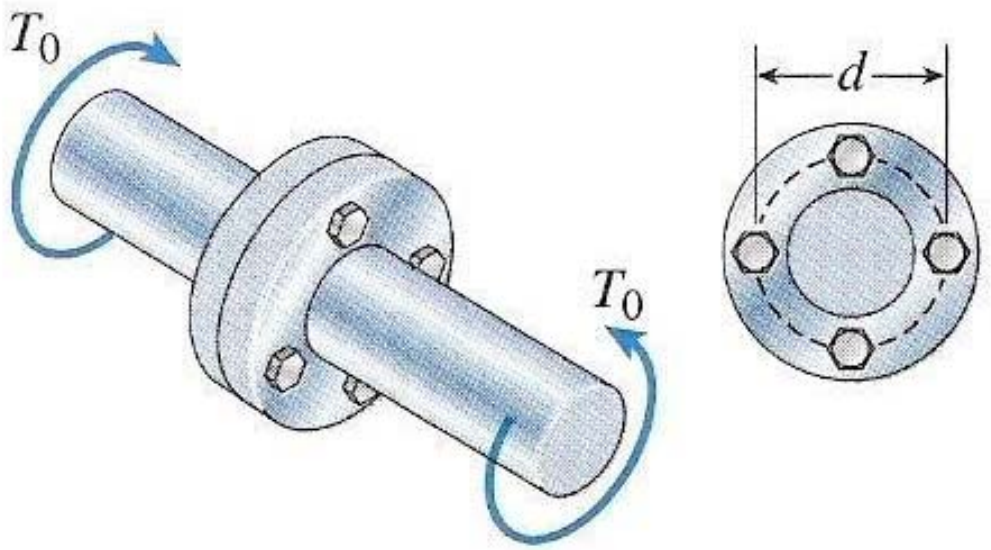
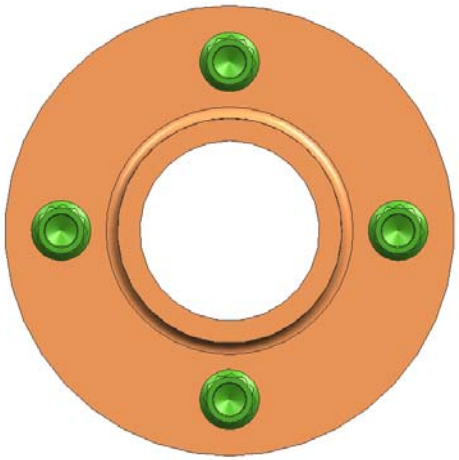
Problem

No Friction
d = 6 inch
4 ¾ in Bolts
τ_{allow} = 14 ksi

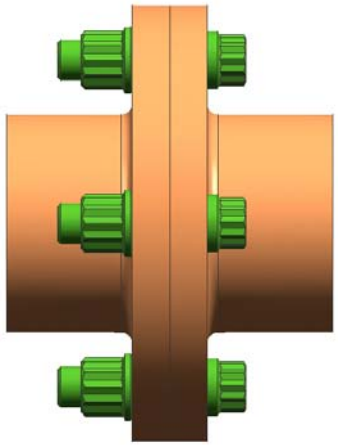
To = ?



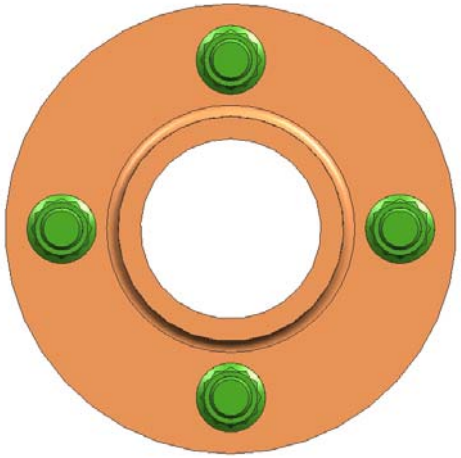
Complex Solid Model Creation



Front



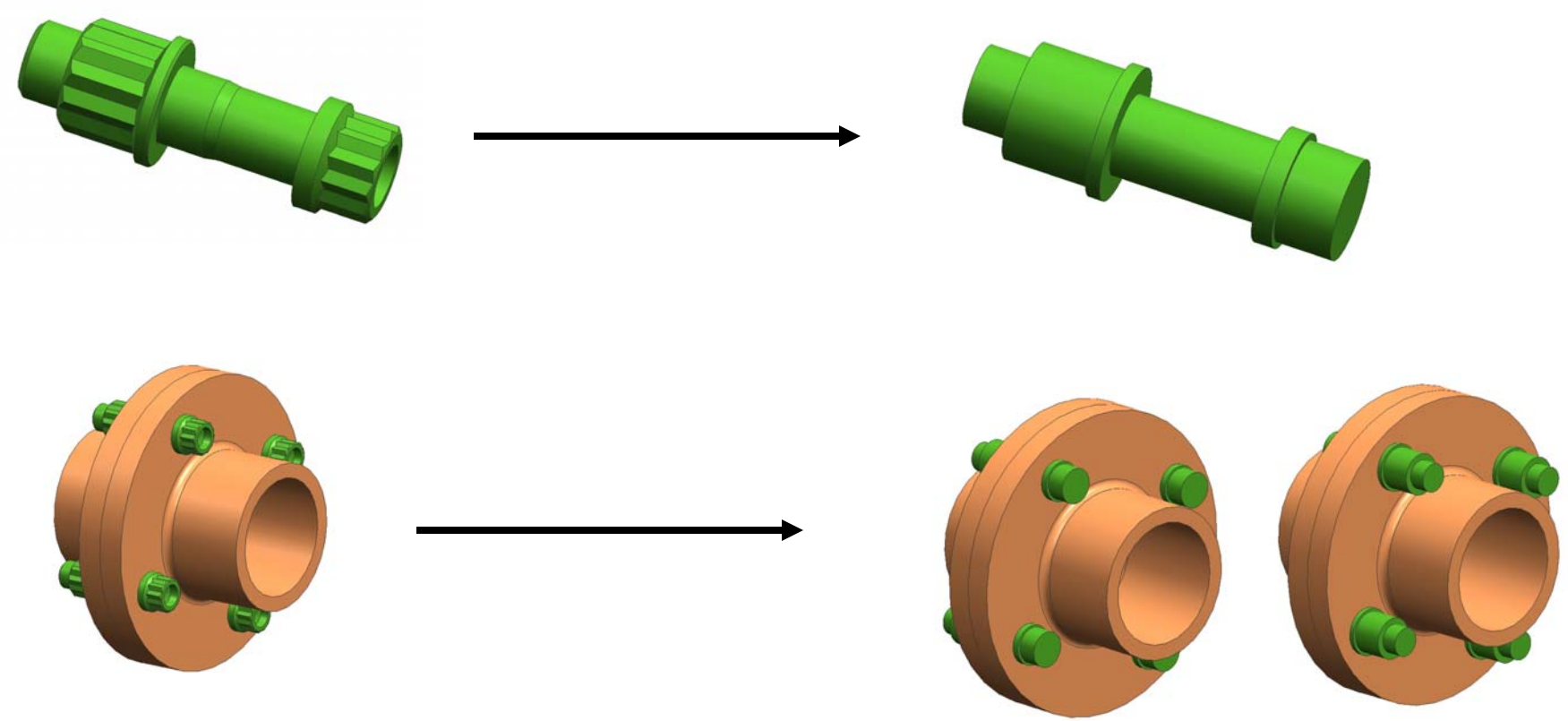
Side



Back

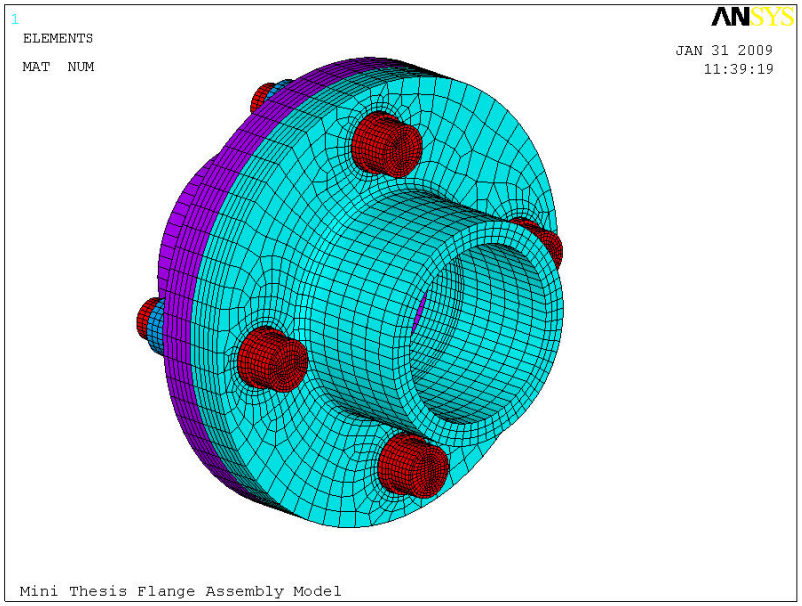
- Flanges created use sketcher
- Fasteners are standard AS series, existing models

Defeatured Solid Model

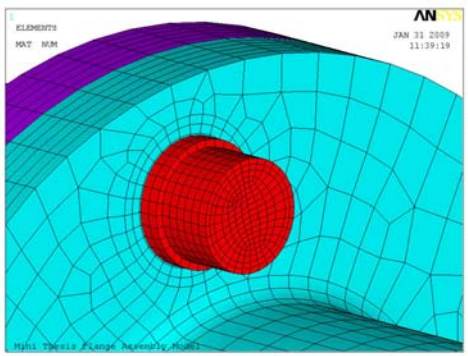


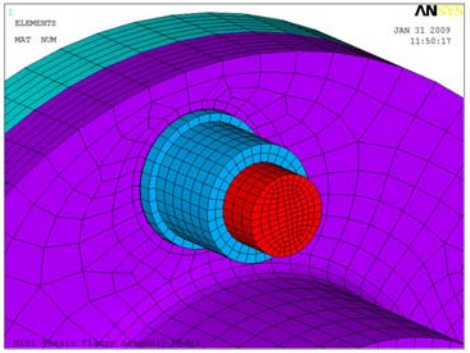
Fasteners defeatured in regions not of interest to simplify mesh

Finite Element Model

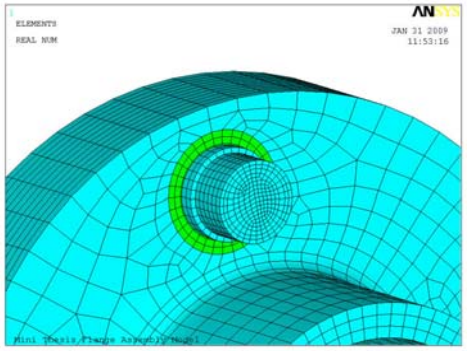


- Solid 45 Elements
- 48,548 elements
- 40,079 nodes
- E = 30x10^6 psi
- v = 0.3
- T = 70F



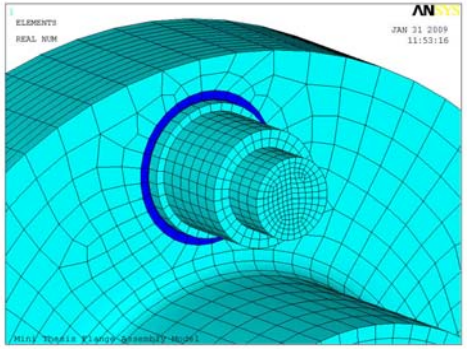


Finite Element Model Contact Regions

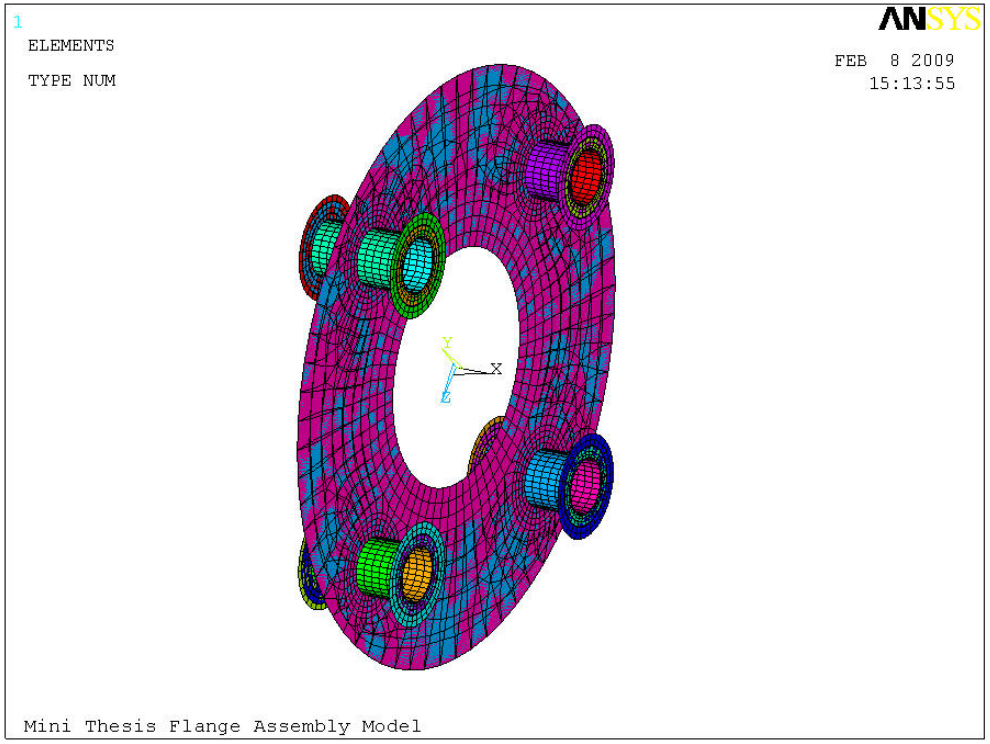


Bolt Face

- Target 170
- Contact 174 Elements
- 13 pairs total
- Standard, Penalty Method

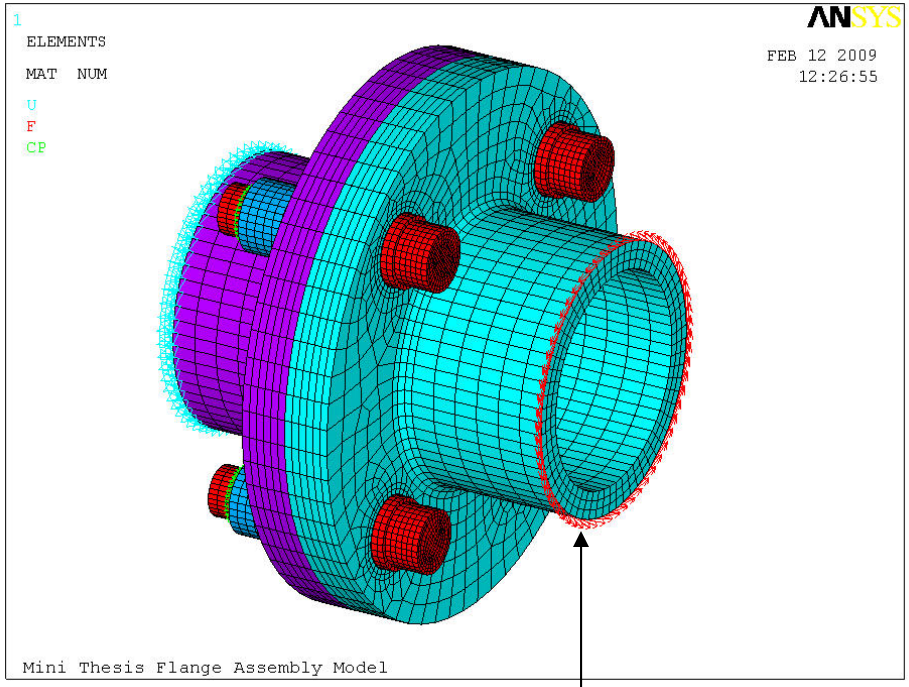


Nut Face

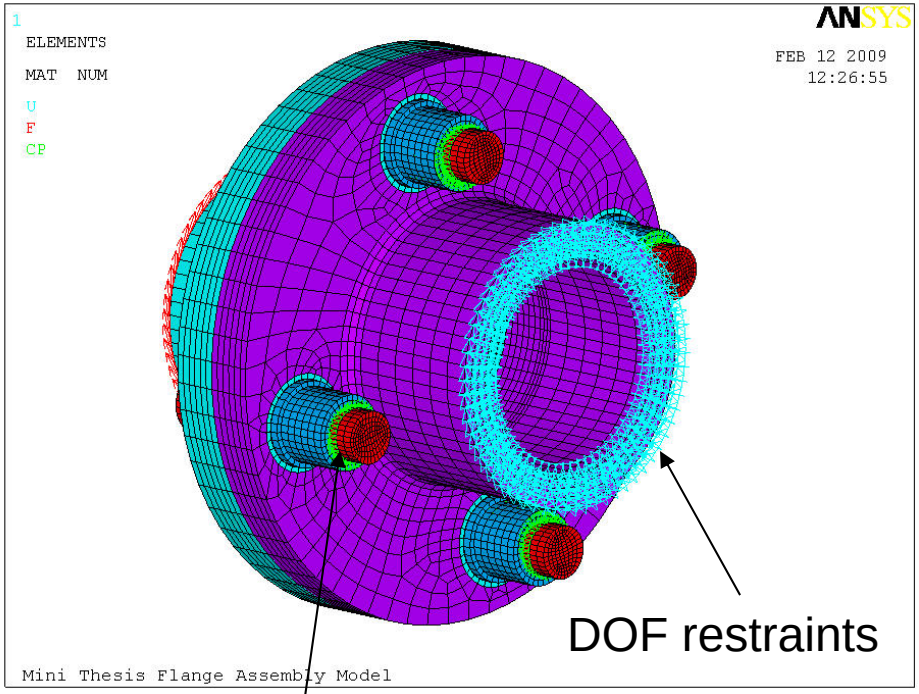


All Pairs

Finite Element Model Boundary Conditions

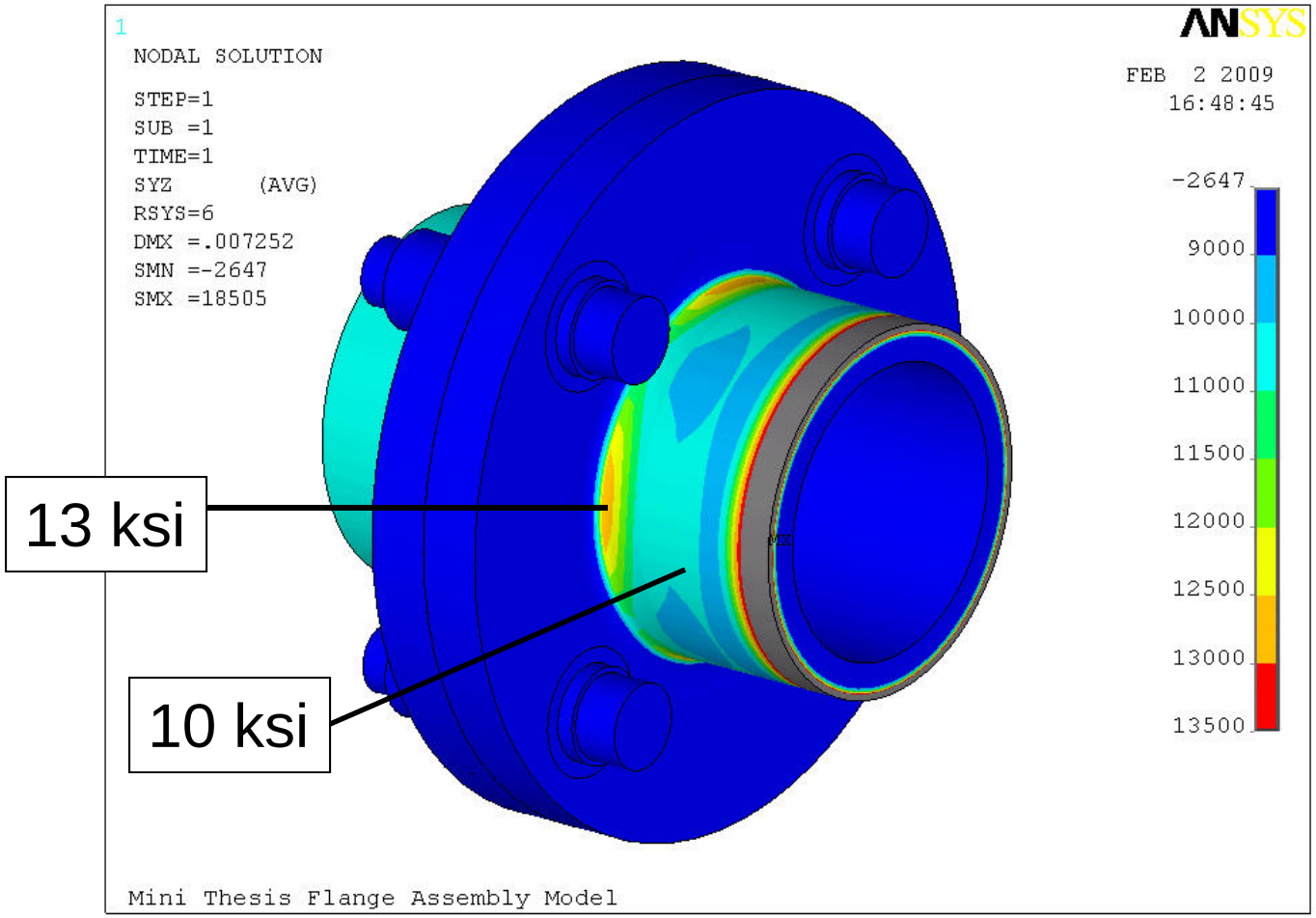


Torque applied as Tangential Forces



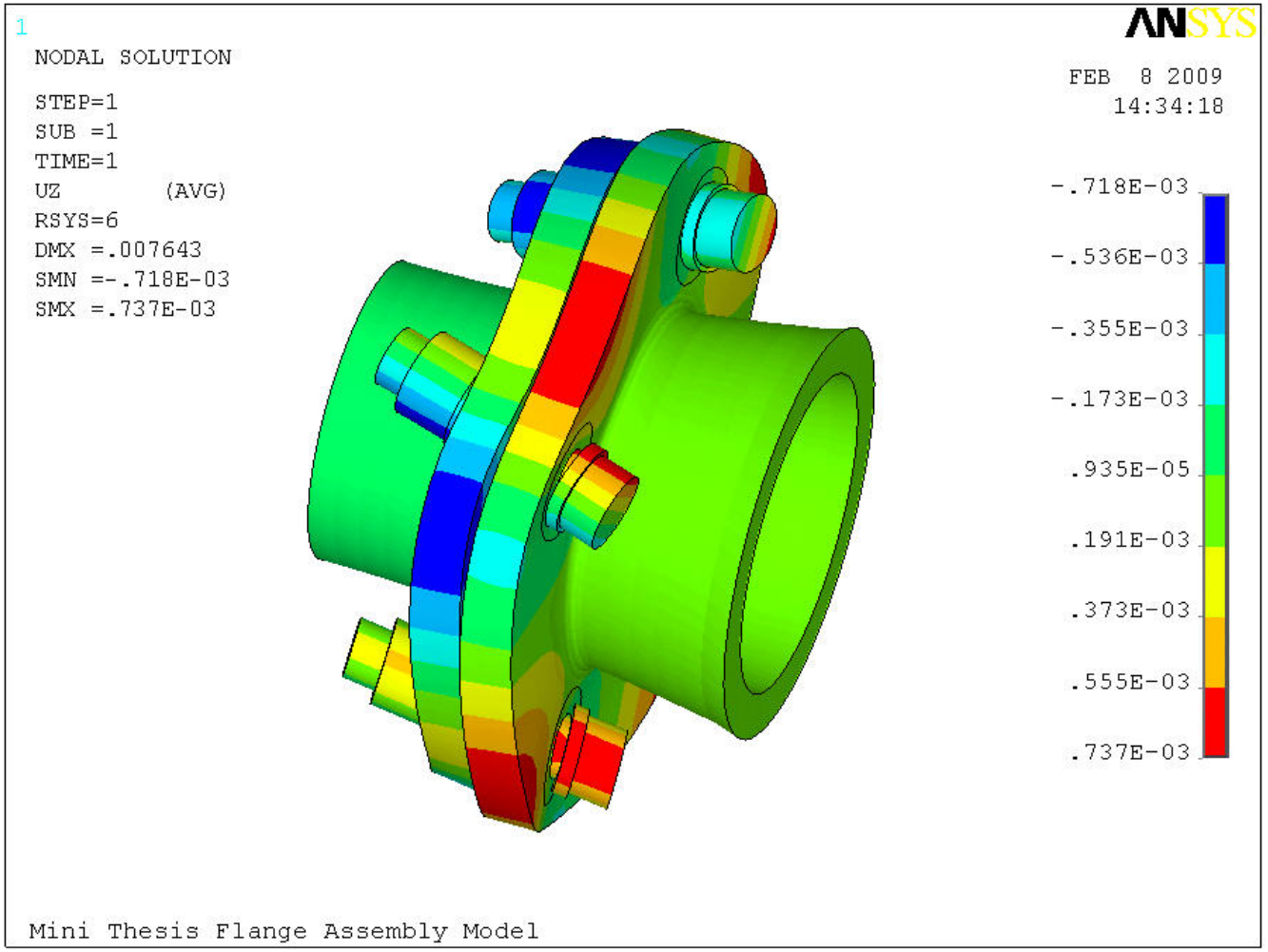
Coincident Nodal Couples

Shear Connection Von Mises Stress



Model results match hand solution, Kt ~ 1.30

Shear Connection Axial Deflection



- Bolt shank deforms under loading
- Contact regions not uniform….does not match hand solution

Conclusions

- Hand solution….initial sizing
- FE model:
  - Shear Joint
  - Tensile Joint
  - Either could be used
- FE model revealed behavior differences
- Many decisions required to complete design
- Many additional analyses required