Form 5 Multilateral System Analysis

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Sr. Project Engineer
Baker Oil Tools

Tim Theiss

FORM 5 Is a Level 5 Multilateral System.

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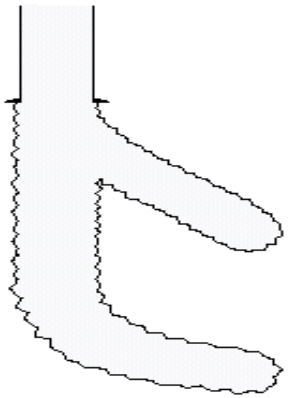

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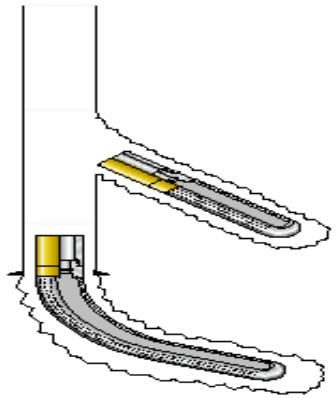

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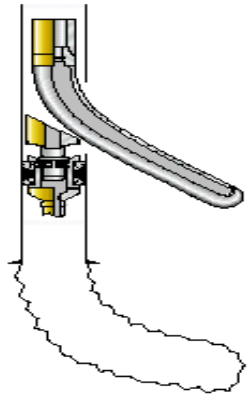

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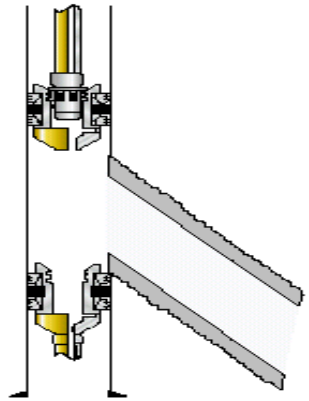

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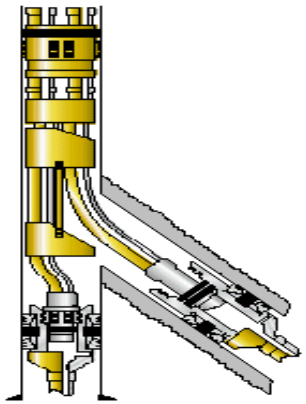

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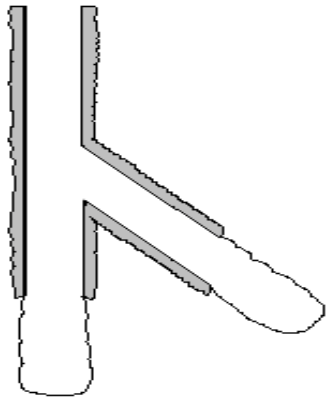

Level 6

TAML Code

Technical Advancement of Multilaterals

What is a Multilateral?

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A multilateral well is typically a well connecting two or more "standard well types"

- horizontal
- high angle
- deviated
- vertical

As such, the reservoir aspects of Multilateral wells have much in common with the reservoir aspects of horizontal and conventional wells.

What is a Multilateral?

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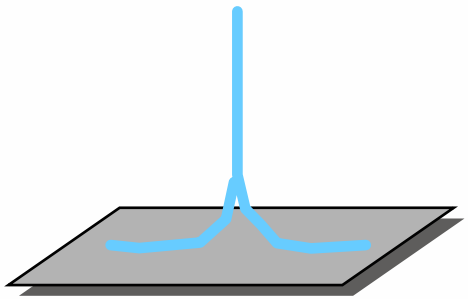
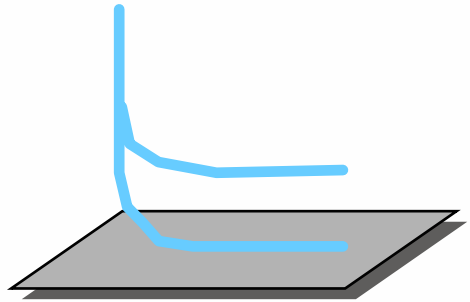
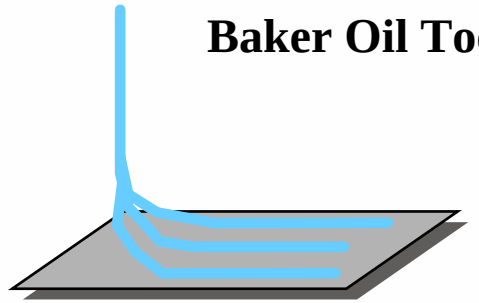


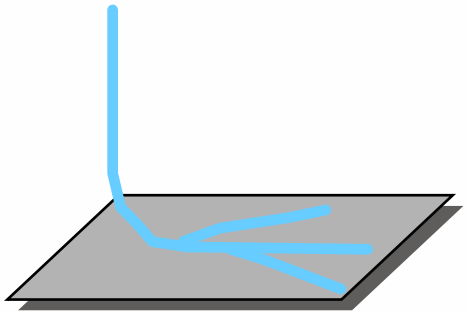
Dual



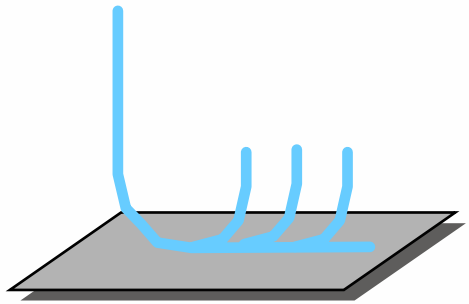
Stacked



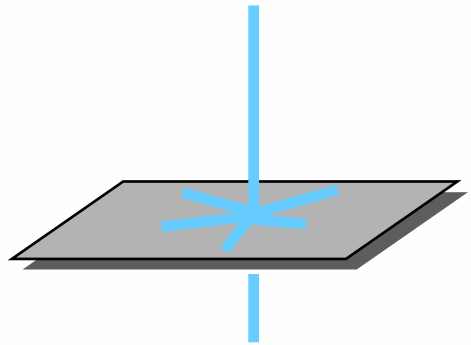
Trilateral Fork



Herringbone



Backbone and Rib



Radial

Why a Multilateral?

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Lower Costs & Increase Number of Wells per Budget

- Drill less footage
- Lower drilling fluid costs
- Fewer casing strings
- Reduced rig days
- Re-enter existing wells
- Preserve or recover slots

Why a Multilateral?

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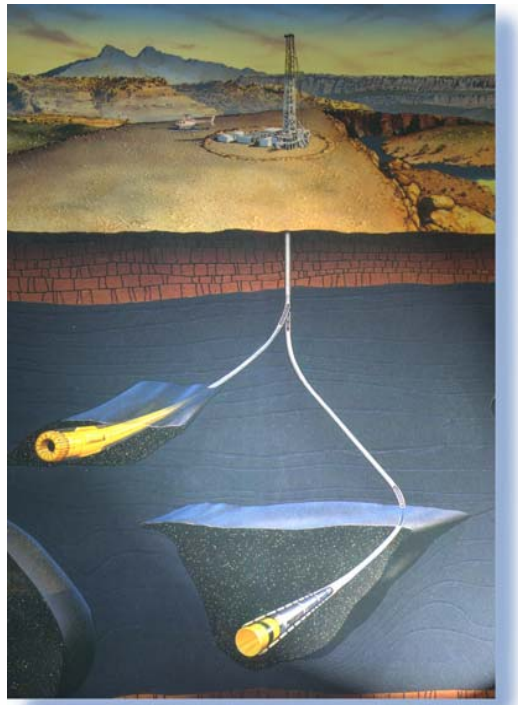
Drain The Reservoir

- Multiple Targets – intersect separate reservoirs, multiple sands, isolated fault blocks
- Drainage Patterns – more linear flow
- Improve Existing Wells – re-enter existing wells
- Production – reduce drawdown for less coning
- Injection – new & existing wells



Role of MSC.Marc in FORM 5 Development

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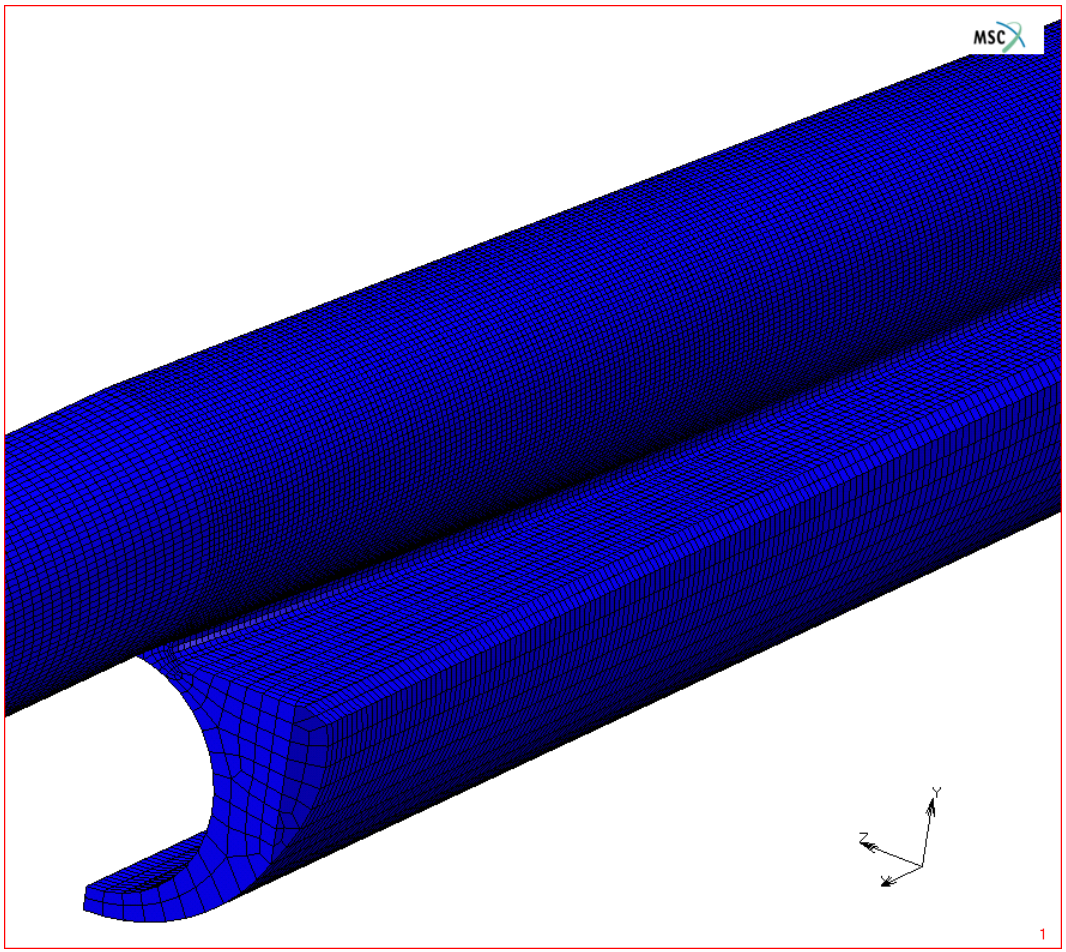
- Evaluation of Design Ideas
- Forming
- Dimensional Change of Formed Junction under Internal and External Pressure
- Swaging
- Buckling
- Collapse Pressure of Swaged Junction
- Burst Pressure of Swaged Junction

Challenge in Hex Mesh Generation



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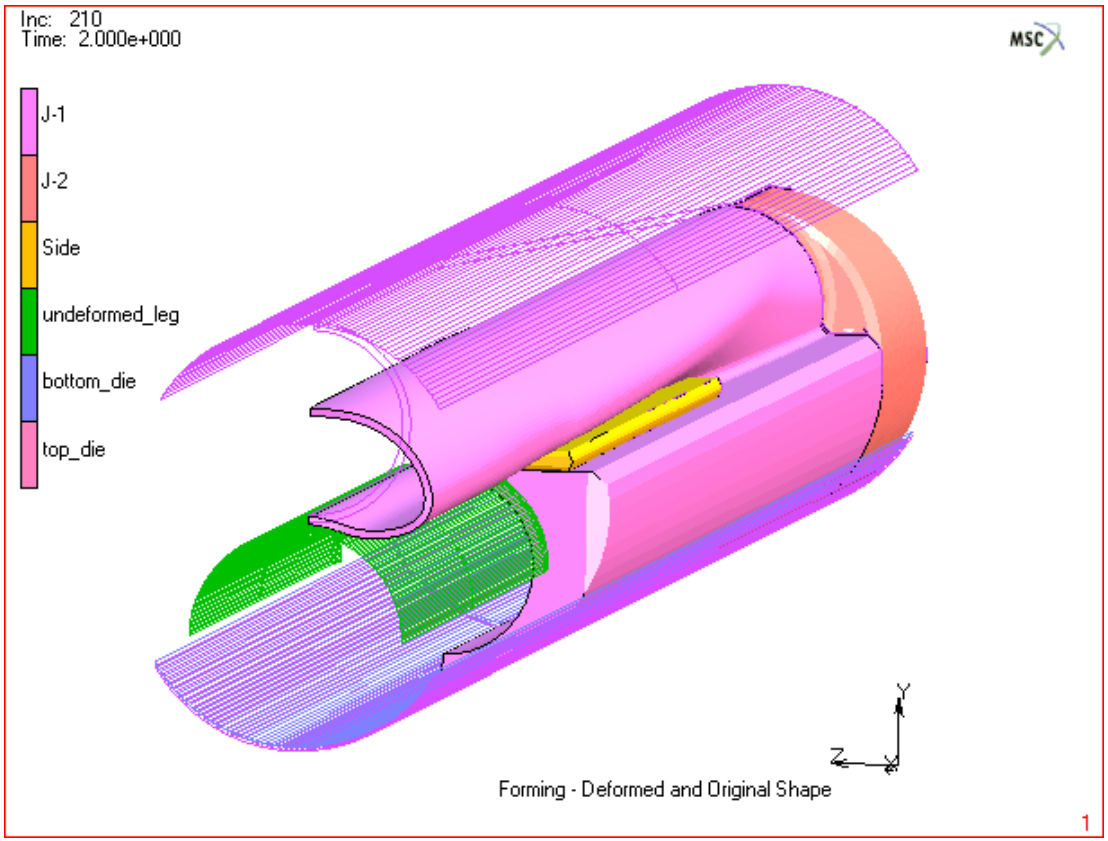
Forming Analysis



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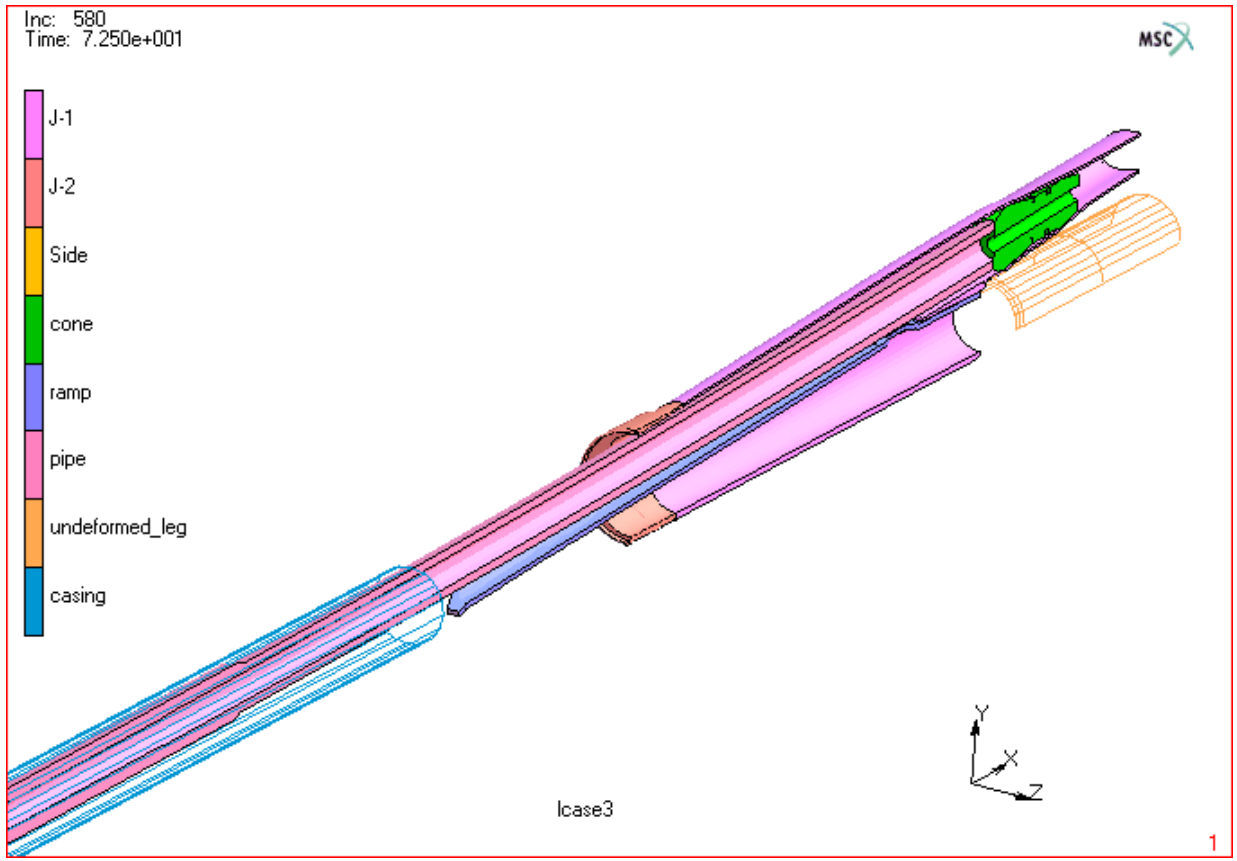
Swaging Analysis



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Swaging Test - 1

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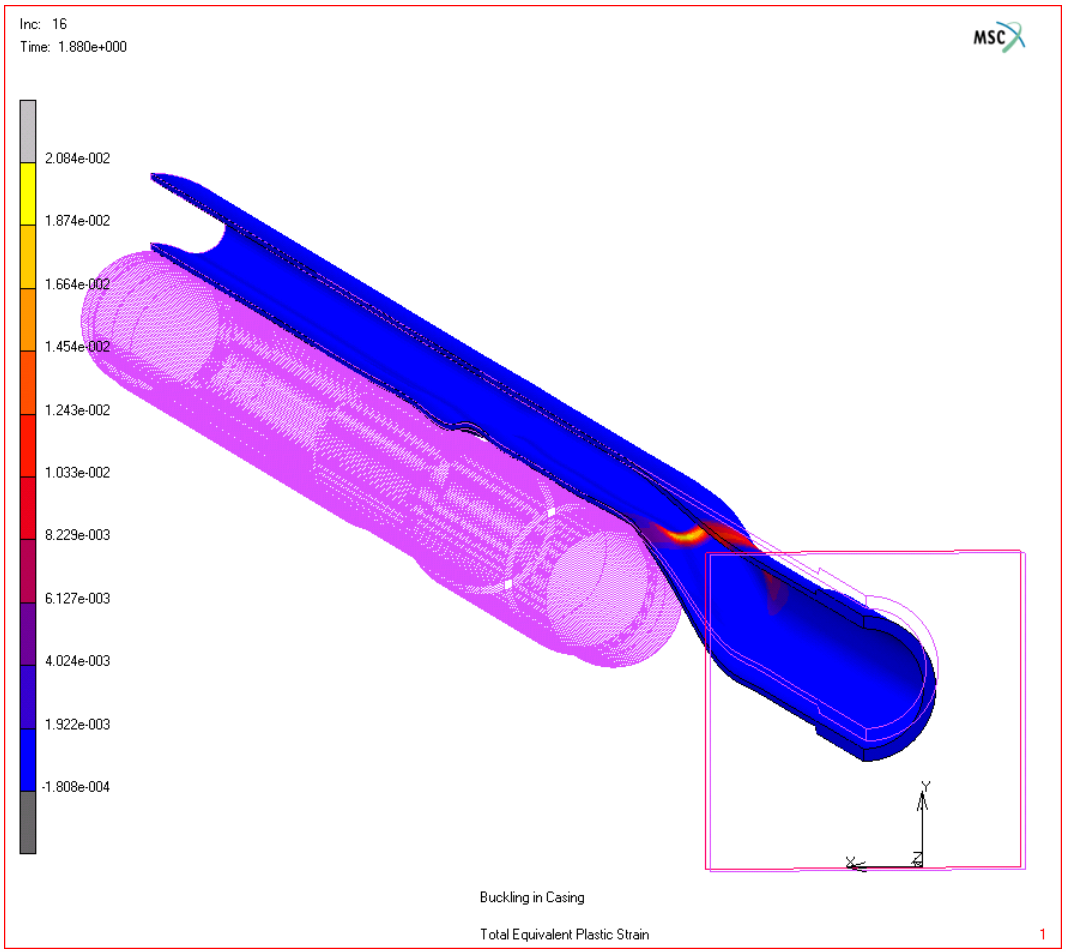
Swaging Test - 2

Buckling Analysis



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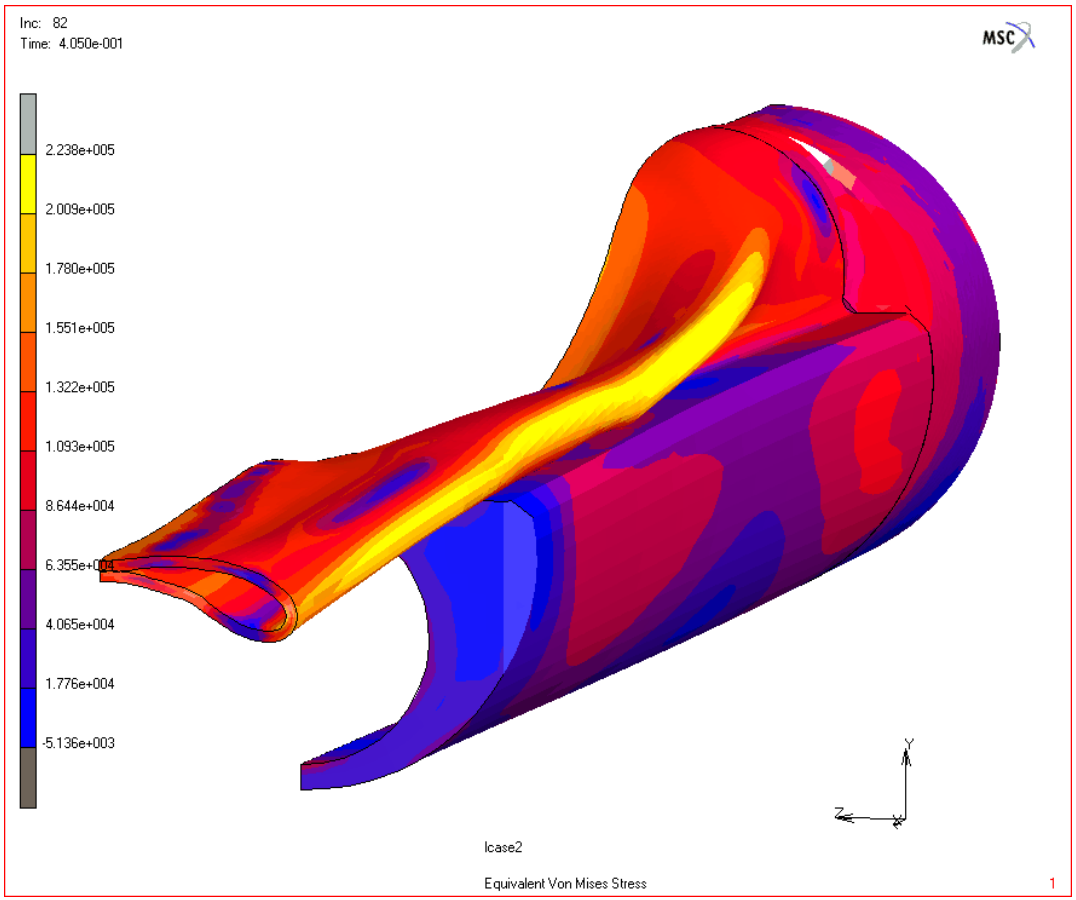
Collapse Pressure of Swaged Junction



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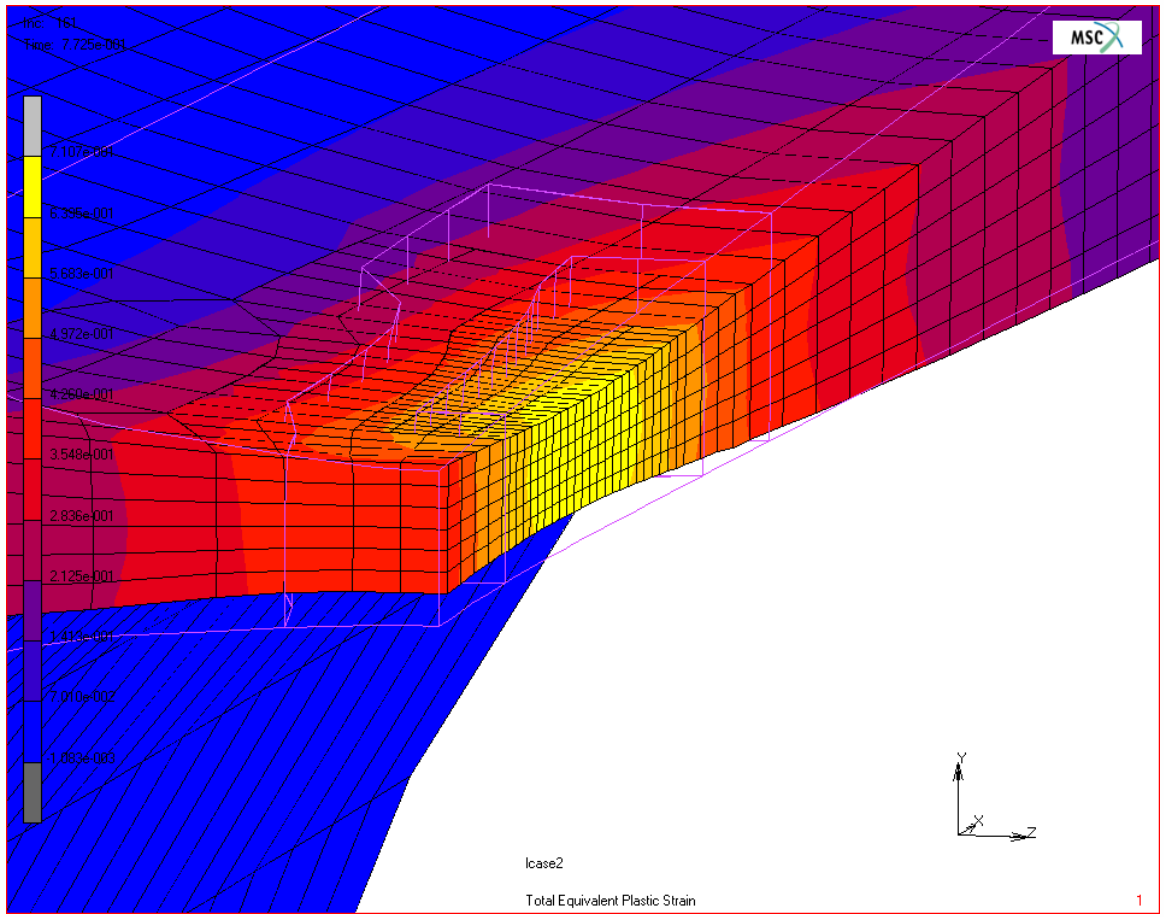
Burst Pressure of Swaged Junction



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Pressure Rating of Swaged Junction

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- Collapse Pressure:

  Collapse pressure from FEA is 10% higher than test results.

- Burst Pressure:

  Burst pressure from FEA is 15% higher than test results.

- Possible causes of deviation:

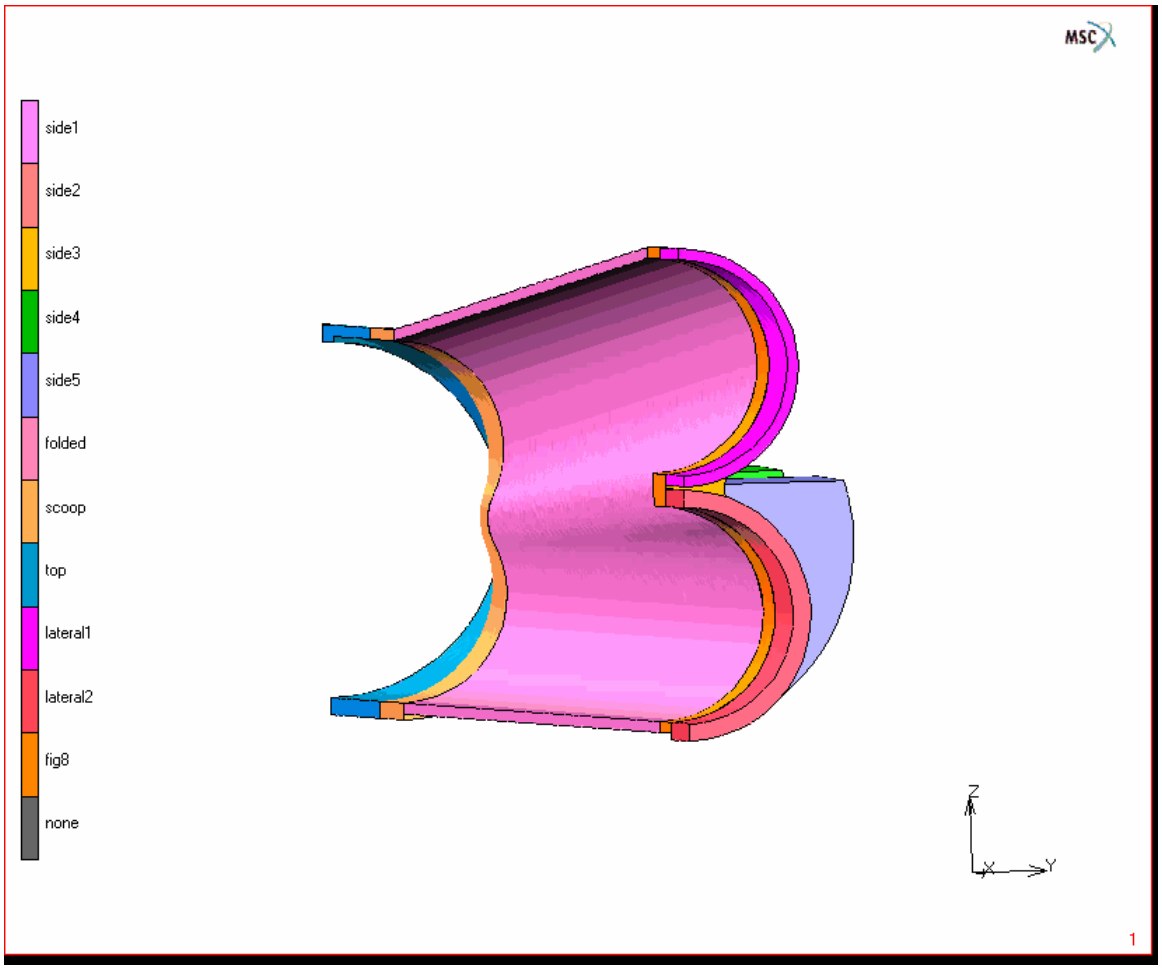
  Inaccurate material data

  Inadequate failure criteria

  Neglect of residual stresses/strains from swaging

  Rough mesh at stress concentration region

Evaluating New Ideas



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Future Improvement

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- More Accurate Stress – Strain Curve after Necking
- Damage Criteria – Lamaitre or Gurson Damage Model
- Kinematic Hardening Effects in Plasticity
- Global-Local Analysis for Stress Concentration

Conclusions

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MSC.Marc has been helpful in locating stress concentration area, modifying designs to reduce stress/strain levels, evaluating design ideas, and predicting pressure capabilities of FORM 5.

Acknowledgements

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