Stress Analysis Of Spiral Guide Train On A SPJ Rod

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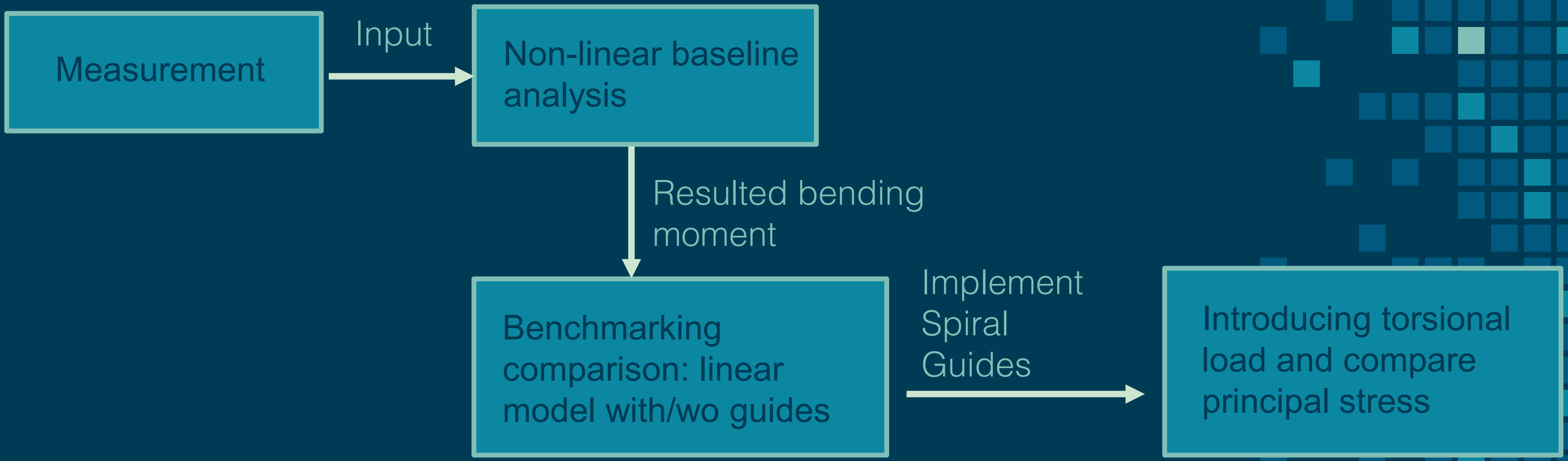
Objective

- To carry out stress analysis of the effect of spiral guide train on an SPJ blank
- To understand SPJ blank behavior when subjected to loading with spiral guide setting

Methodology

- Computer simulation with Finite Element Method using an existing SPJ blank specimen as baseline.



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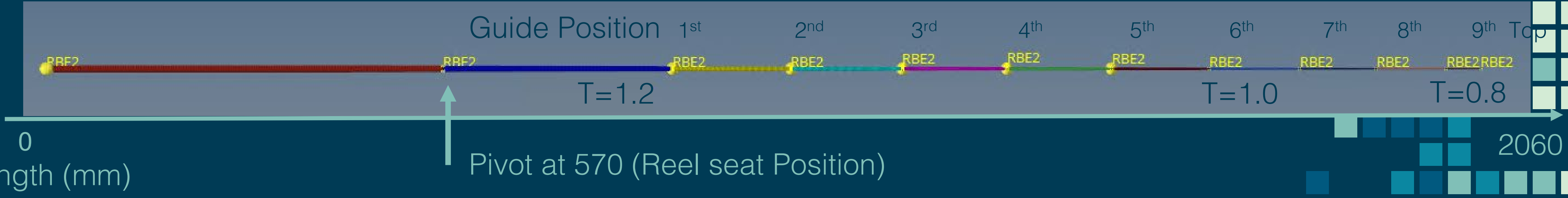
Geometry measurement

- Baseline geometry is created according to measured length and OD of SPJ blank specimen in average.
- Thickness was assumed and assigned to model:
  T 1.2 mm (0-900 mm)
  T 1mm (900-1800 mm)
  T 0.8 mm (1800-2060 mm)
- Loading 10 kg
- Typical carbon fiber composite material

Length (mm)	Guide frames (GF) positions	Outer dimension
0	No Guides, Bottom end	10.35
570	No Guides, Reel Seat Position	9.68
900	1st Guide	7.98
1070	2nd Guide	7.10
1230	3rd Guide	6.28
1380	4th Guide	5.50
1530	5th Guide	4.73
1670	6th Guide	4.00
1800	7th Guide	3.34
1910	8th Guide	2.77
2010	9th Guide	2.26
2060	10th Tip Top	2.00



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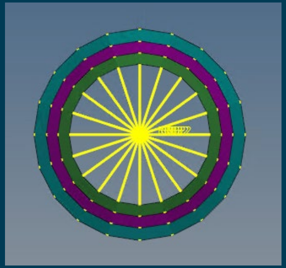
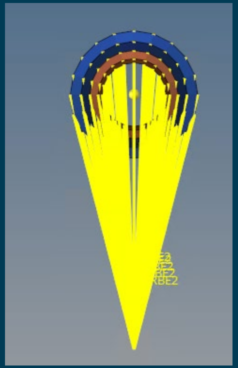
Guide/Position

- Guide position is located with a RBE2 element
- Guides are assumed to be rigid
- Moment applied to RBE2 elements

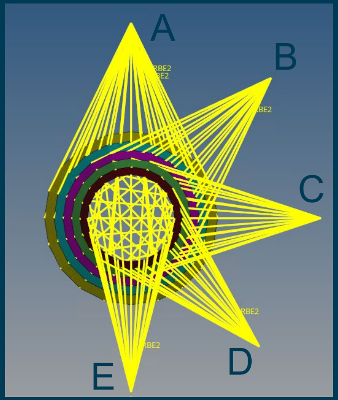
Length (mm)	Guide (GF) positions
900	1st GF, A
1070	2nd GF, A
1230	3rd GF, B, angle AoB 45°
1380	4th GF, C, angle AoC 90°
1530	5th GF, D, Angle AoD 135°
1670	6th GF, E
1800	7th GF, E
1910	8th GF, E
2010	9th GF, E
2060	10th GF, E

Case 1 : Bare blank without guides

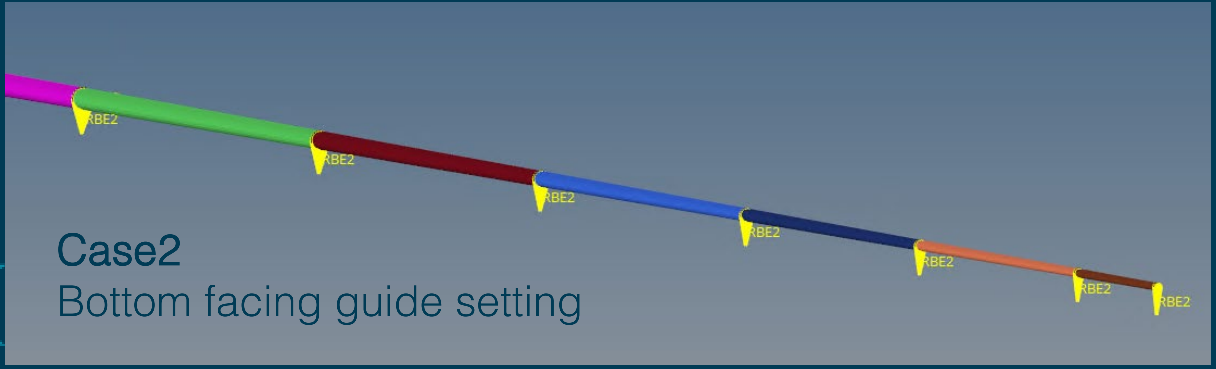




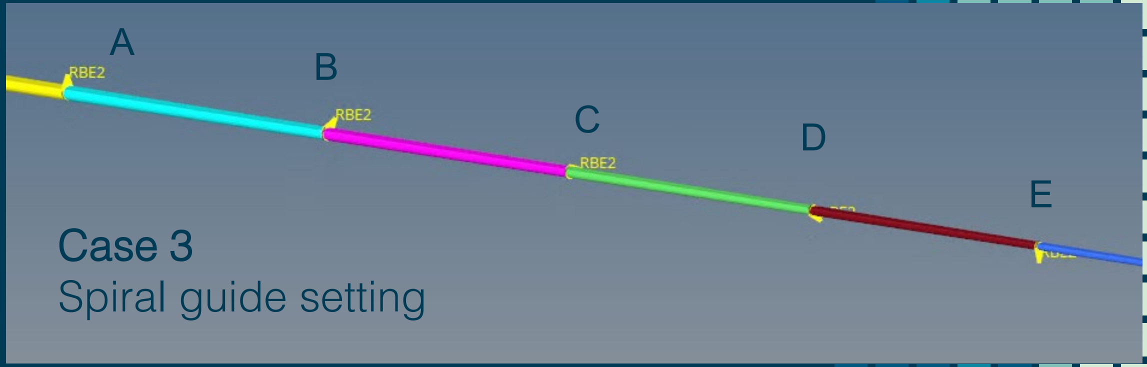
Case 2: Lower middle guide position



Case 3: Spiral position



Case2
Bottom facing guide setting



Case 3
Spiral guide setting

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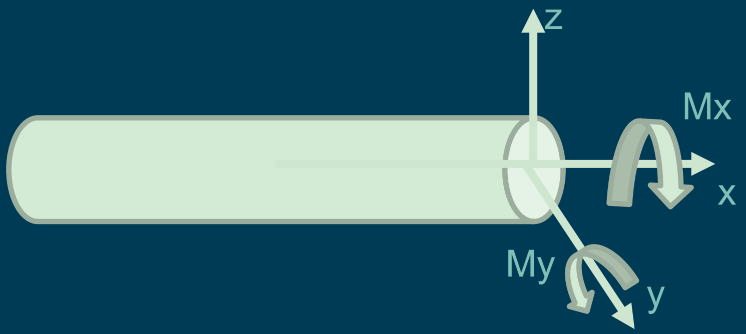
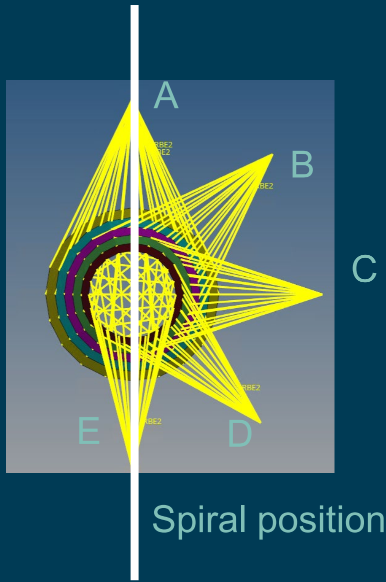
Bending moment

- Bending moment Mx results in torsional load and My results in bending in XZ plane.
- Resulted bending moment My is extracted from nonlinear baseline model.
- Bending moment Mx is calculated from distance between axis and guide frame B C D. There is no torsional load at A and E.

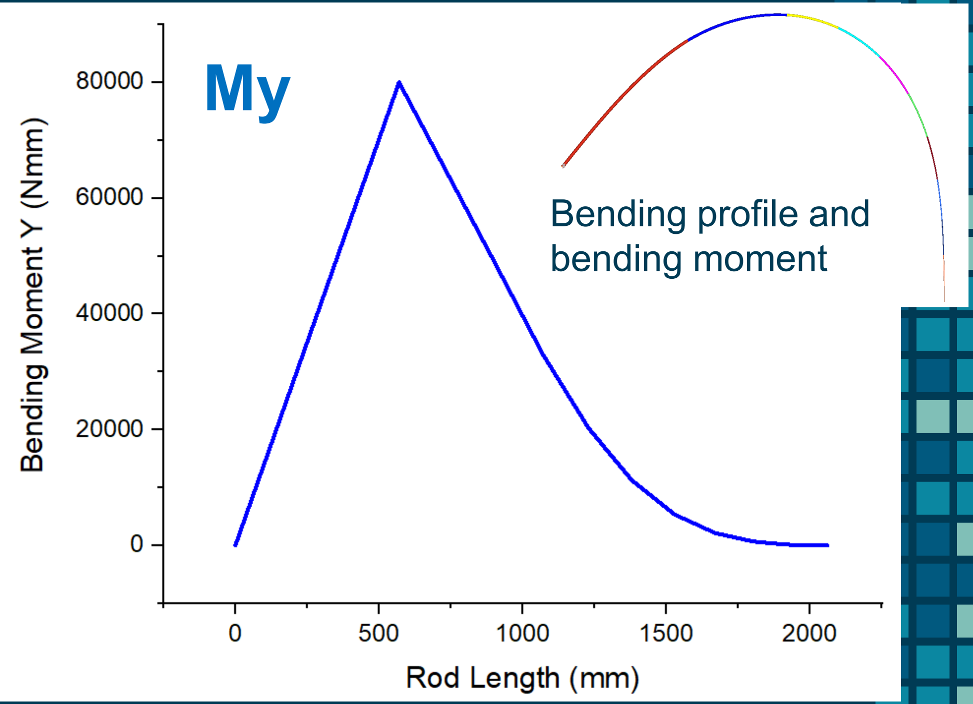


Mx



Spiral position

Length (mm)	Guide frames (GF) positions	Dy (mm)
1230	3rd GF, B	6.46
1380	4th GF, C	8.75
1530	5th GF, D	5.92



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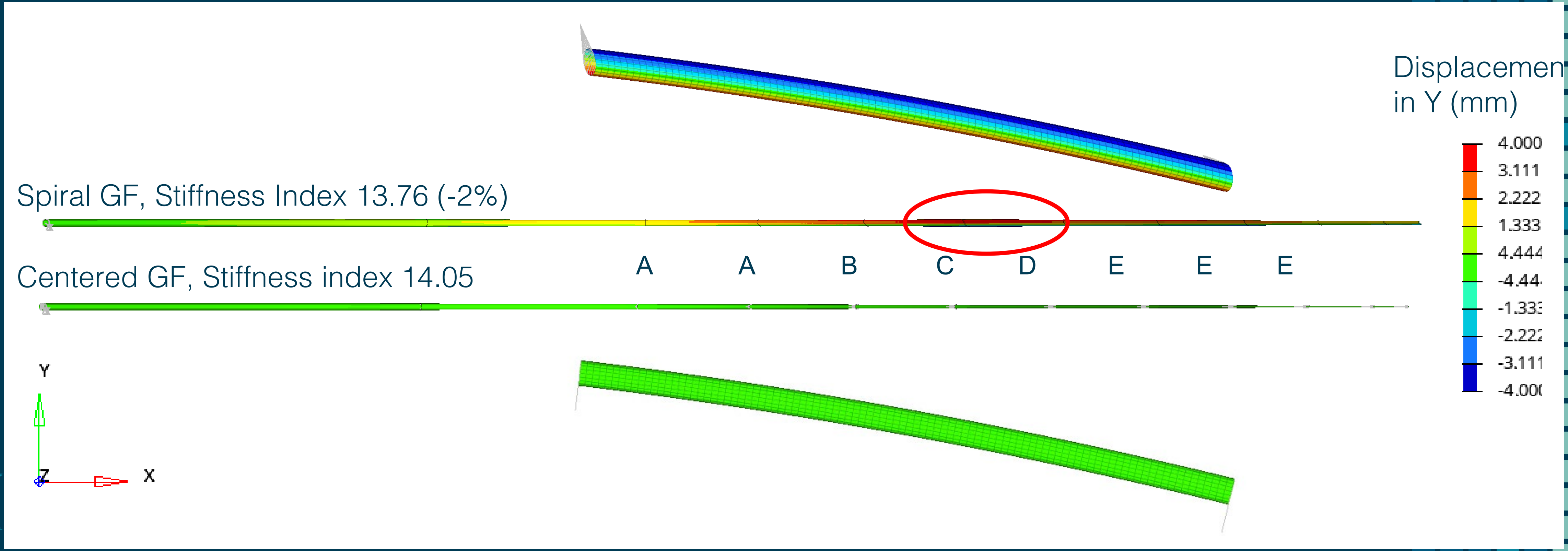
Results (1)

- Comparing cases 1 and 2, with and without guides, no changes because of no additional bending.
- Comparing cases 2 and 3, with the spiral guide setting, there is a slight reduction in the stiffness index due to twists under torsional load.



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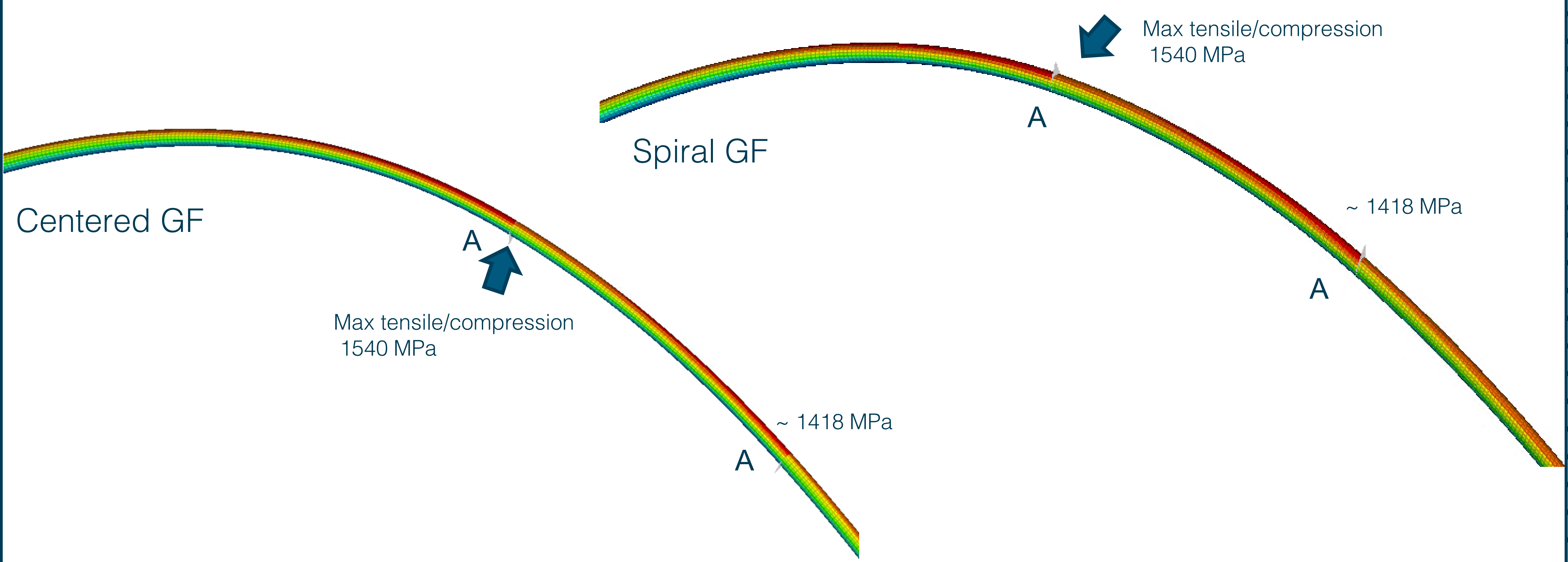
Results (2)

- Comparing cases 2 and 3, rod with spiral guide setting did not change averaging max. principal stress.
- Max stress located at first guide frame (~900mm)



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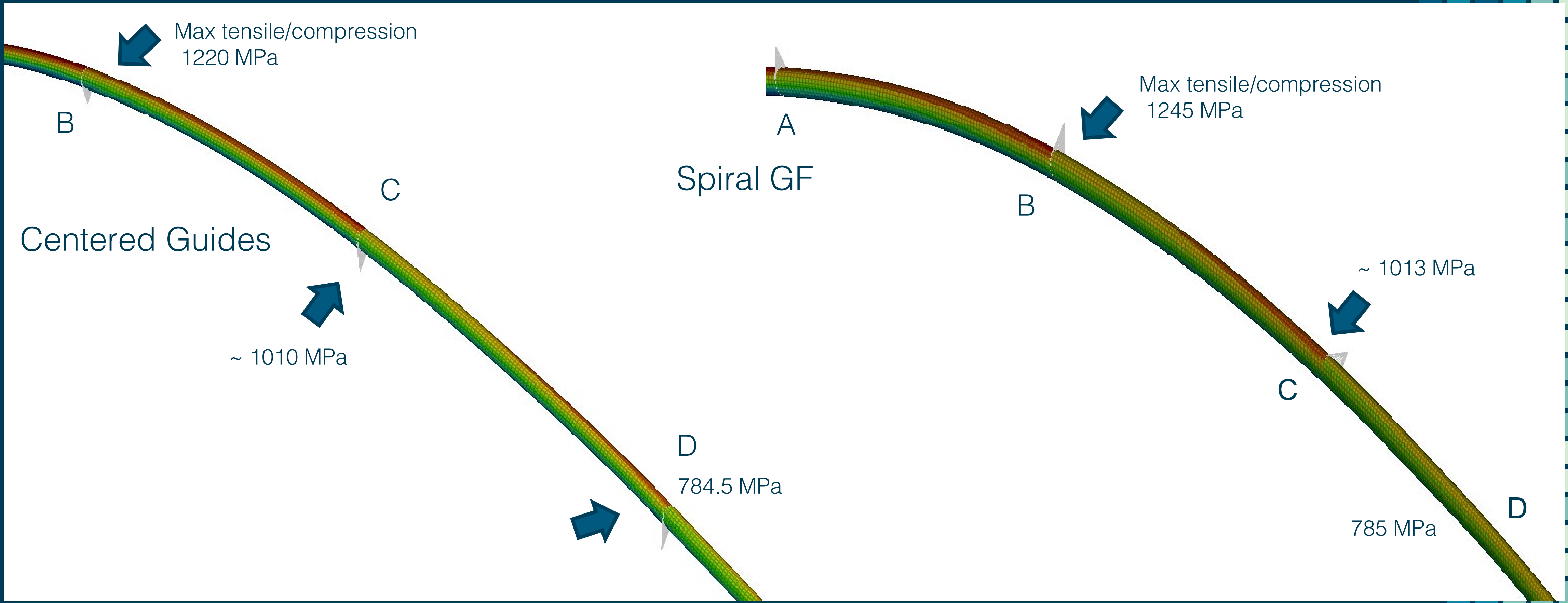
Results (3)

- Averaging max principal stress with spiral guide setting increased slightly.



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Conclusion

- In a linear model, spiral guide setting on a SPJ blank decreased stiffness by ~2%.
- Max stress level which is located at the first guide did not change.
- Stress at guide transition area, position B, C and D, increased by only 2%, meaning there is minimal torsional load in contrast to conventional guide settings.

Benefits of spiral guide setting

On a conventional setup under load, the natural tendency is for the rod to twist or turn. Relocating the front guides to the bottom in a spiral guide setting will counter torsional force, giving the angler better leverage without spending energy to keep the rod upright.

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