Maraging Steel – SEI perspective for round-table discussions

Dennis Coyne for the Seismic Isolation group

LSC LLO March 2005

SEI Technology Demonstrator
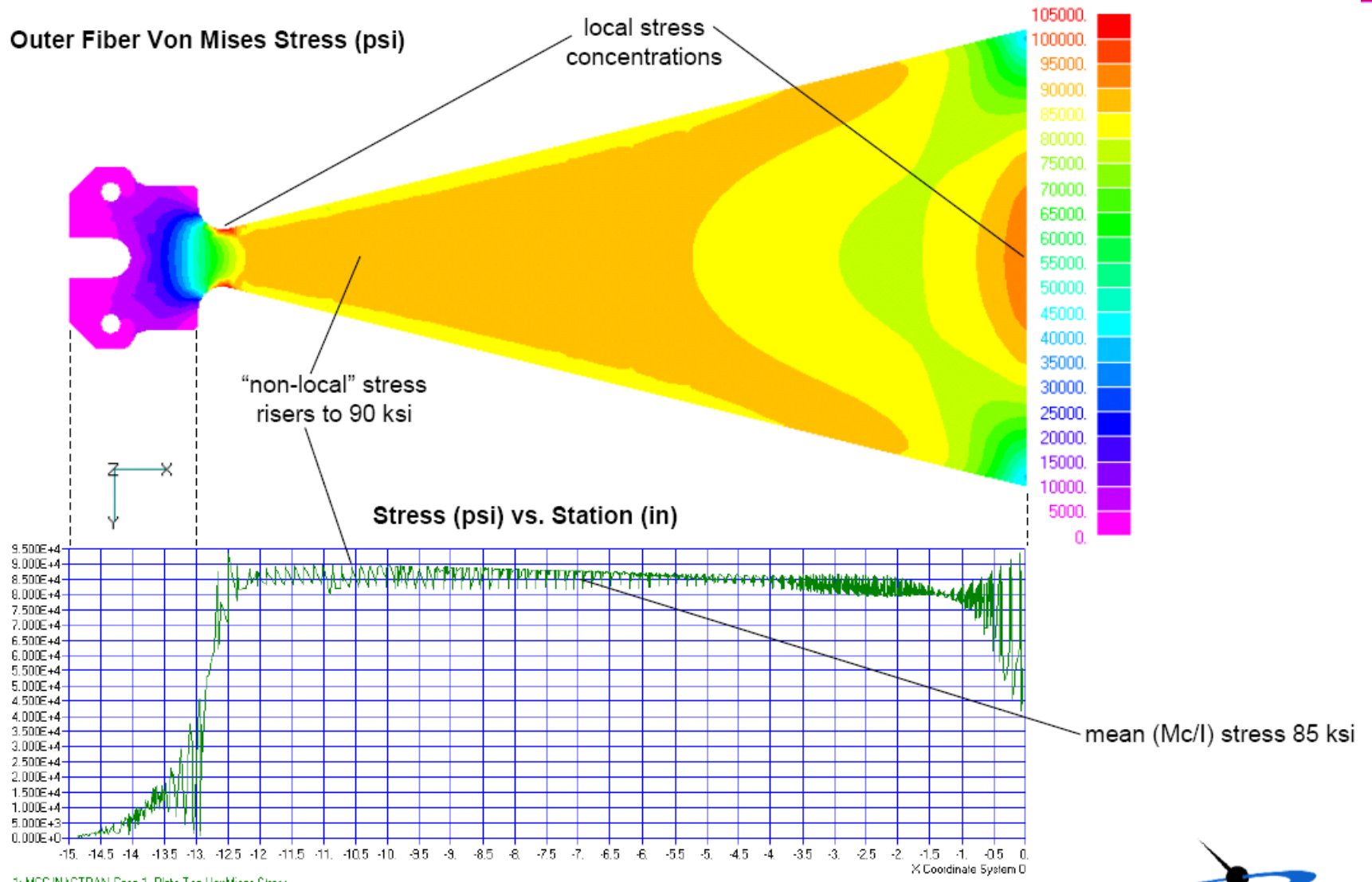## (the system at the ETF)

- The original processing sequence for the maraging steel 300 flexure was as follows:
  - » - raw stock received in a batch mill solution annealed condition after centerless grinding to the bar stock diameter
  - » - the part is machined to 5/8" dia. end, 3/8" diameter center shaft and a 0.855" end, by turning
  - » - the part is then age hardened (This results in a better surface finish after EDM and less final distortion since any residual stresses after EDM are not relieved in a subsequent age hardening)
  - » - finally the part is burned with EDM to create the 1/4" dia. flexure.
- After the age hardening step, all of the flexures (short and long flexures for the two stages) show distortion
  - » localized to the transition from the 3/8" dia. shaft to the 0.855" dia. end which interfaces to the springs
  - » The magnitude of the "runout" is 0.008" over 3" for the short (~6" long) flexure and from 0.010 to 0.040" over 8" span for the long flexures
  - » seems likely that the distortion is due to stress relief from the age hardening process. It is not clear why the distortion is localized.

BSC SEI Prototype Design (ASI)

- Spring and flexure sets, 3 each, 1 at each of 3 "corners":
  - » Maraging 300 steel; springs of trapezoidal patterndesigned for a maximum stress of 35% of yield strength, with a goal of 30%, when operating at the working load at 1 g and with the flexure laterally offset as much as 1 mm from its nominal location
  - » Exceptions for stress risers shall be proposed to the Contract Technical Manager for approval
- ASI's approach to stress risers:
  - » Set Mc/I max fiber stress in outer surface of spring or flexure to be less than 94.5 ksi (35% of minimum yield strength), with a goal of 81 ksi (30%)
  - » Verify that local stress risers do not exceed 216 ksi (80% of yield)
  - » Verify that "nonlocal" stress risers do not exceed 108 ksi (40% of yield)

Stress Distribution for Stage 0/1 Blade Under 1G

Outer Fiber Von Mises Stress (psi)

local stress concentrations

"non-local" stress risers to 90 ksi

Stress (psi) vs. Station (in)

mean (Mc/I) stress 85 ksi

1: MSC/NASTRAN Case 1, Plate Top VonMises Stress

Commonality of Design Criteria?

- Appropriate maximum stress levels for adequate factor of safety and acceptable/minimal creep?
  - » SAS uses ~67%
  - » SUS uses ~55%
  - » SEI uses 35%