



U.S. AIR FORCE



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BAMF Discussion

Lessons Learned

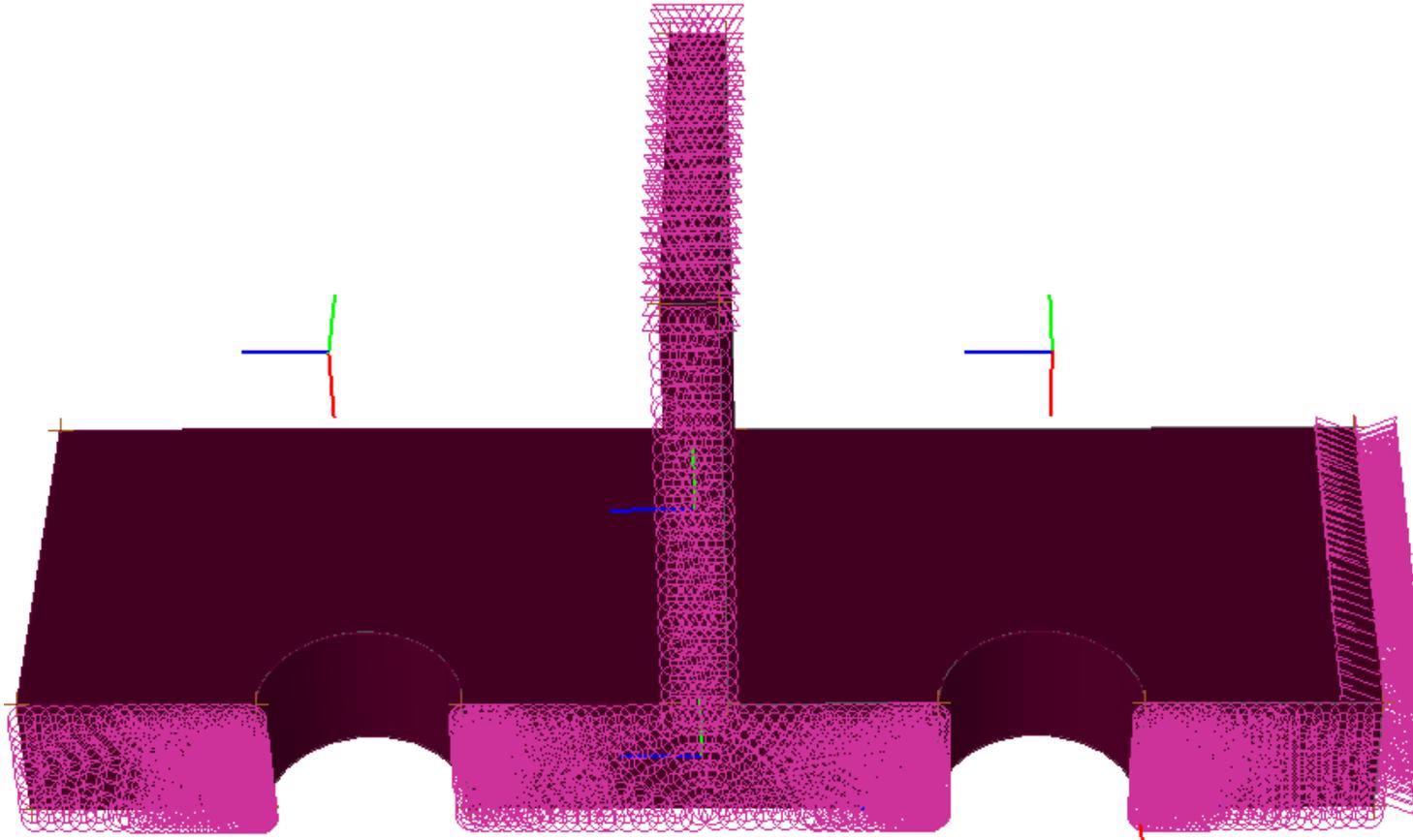
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StressCheck Model



■ Initial constraint approach:

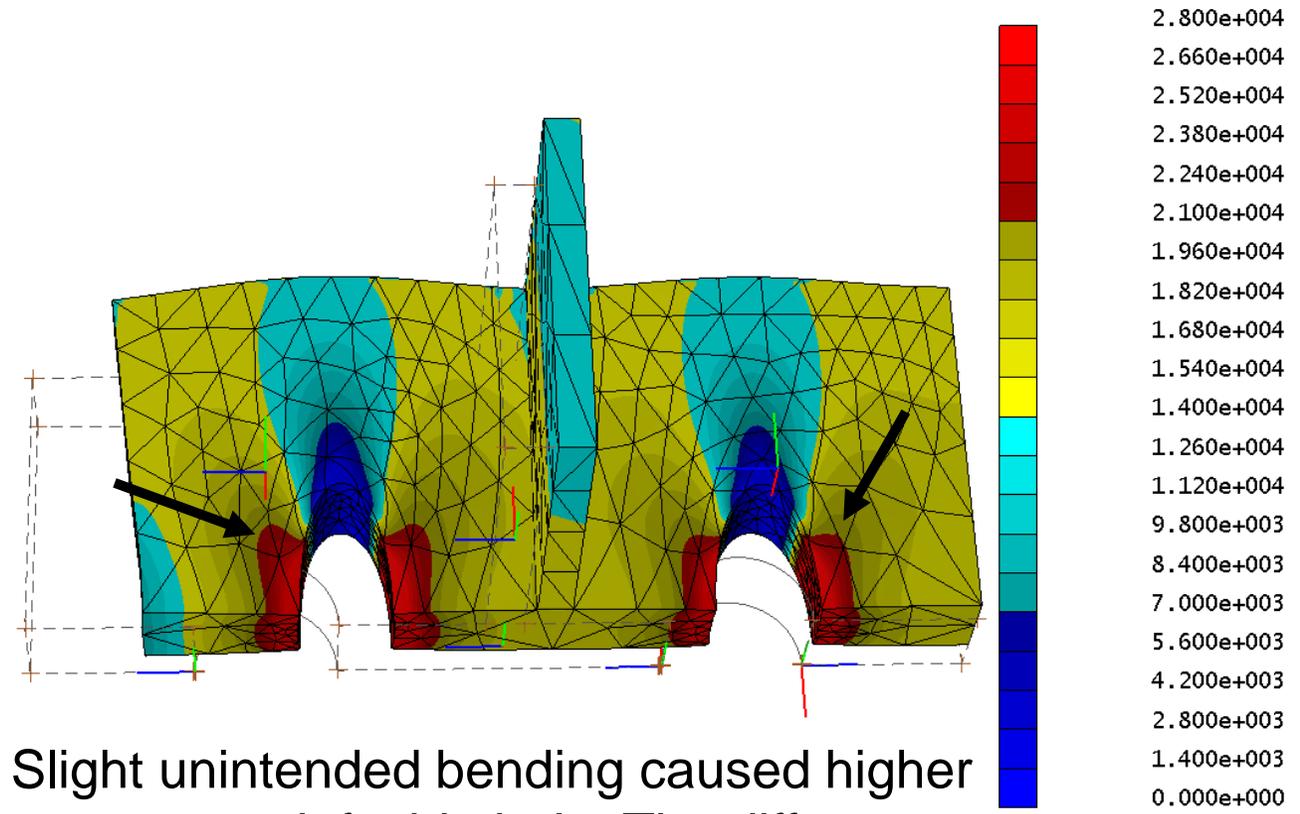
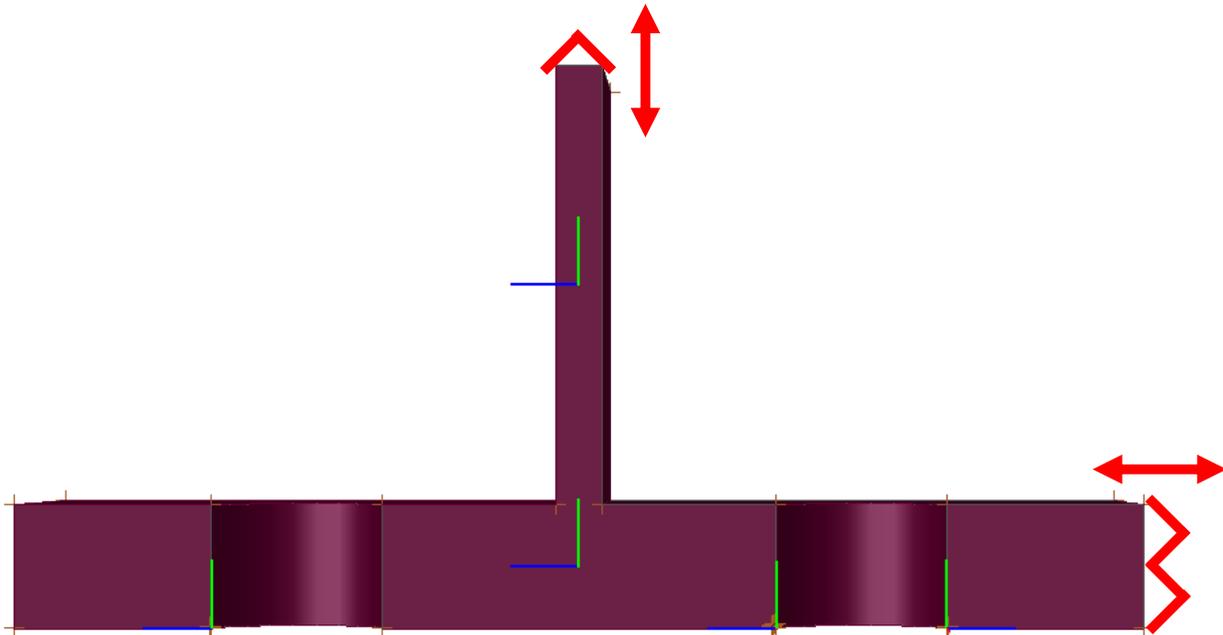




StressCheck Model Initial Constraint



■ Initial constraint approach



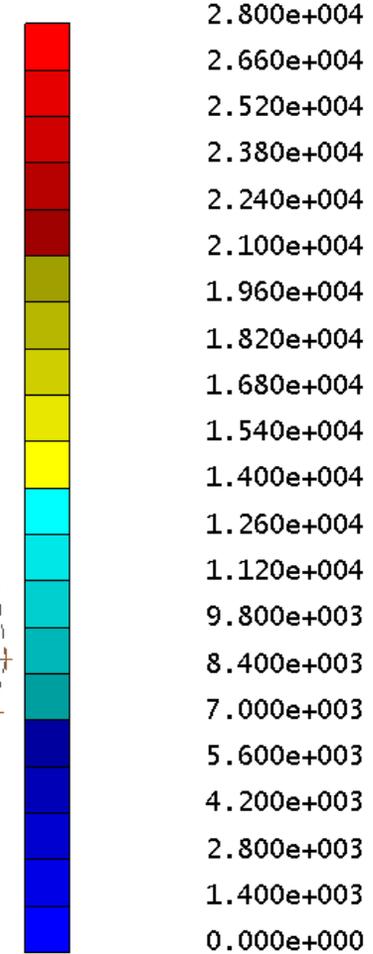
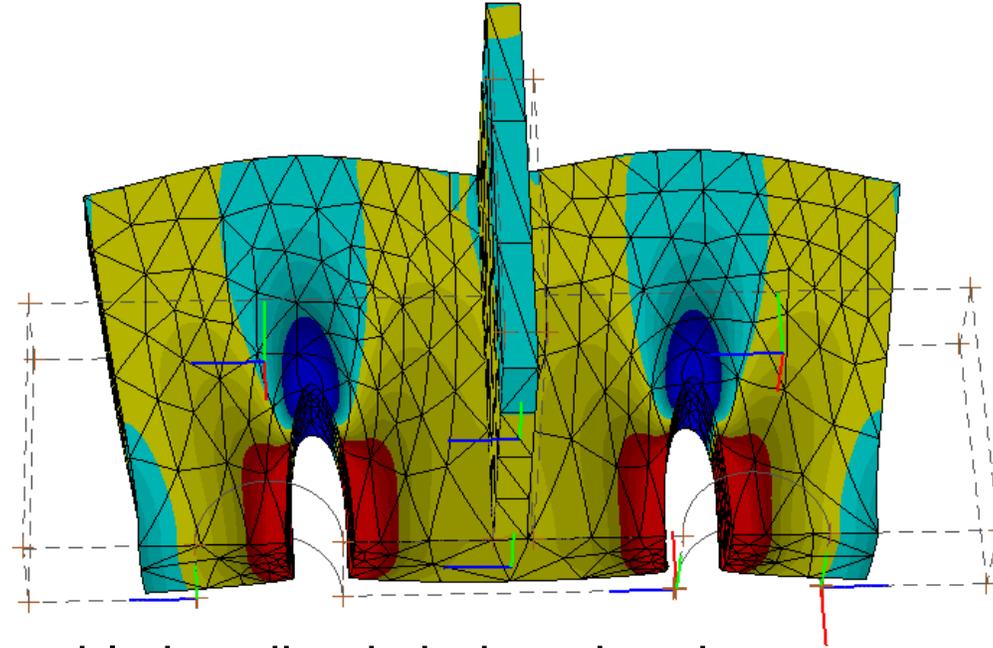
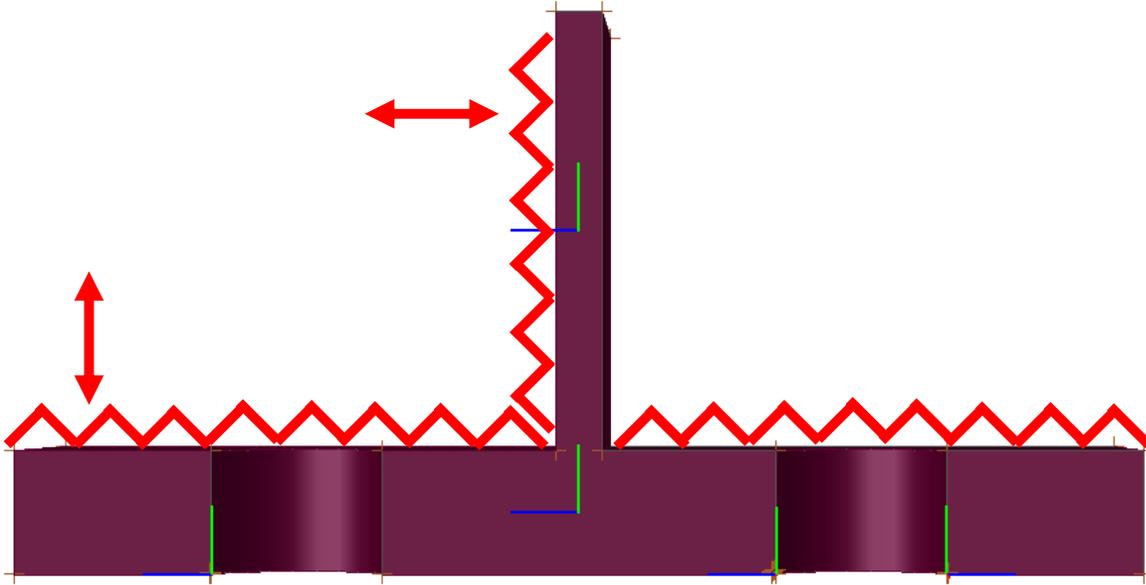
Slight unintended bending caused higher stresses on left side hole. The difference caused cracks to not grow analytically on the side closest to the constraint.



StressCheck Model Final Constraint



Final constraint approach



No noticeable bending is induced and stress/deformation around holes are symmetric.

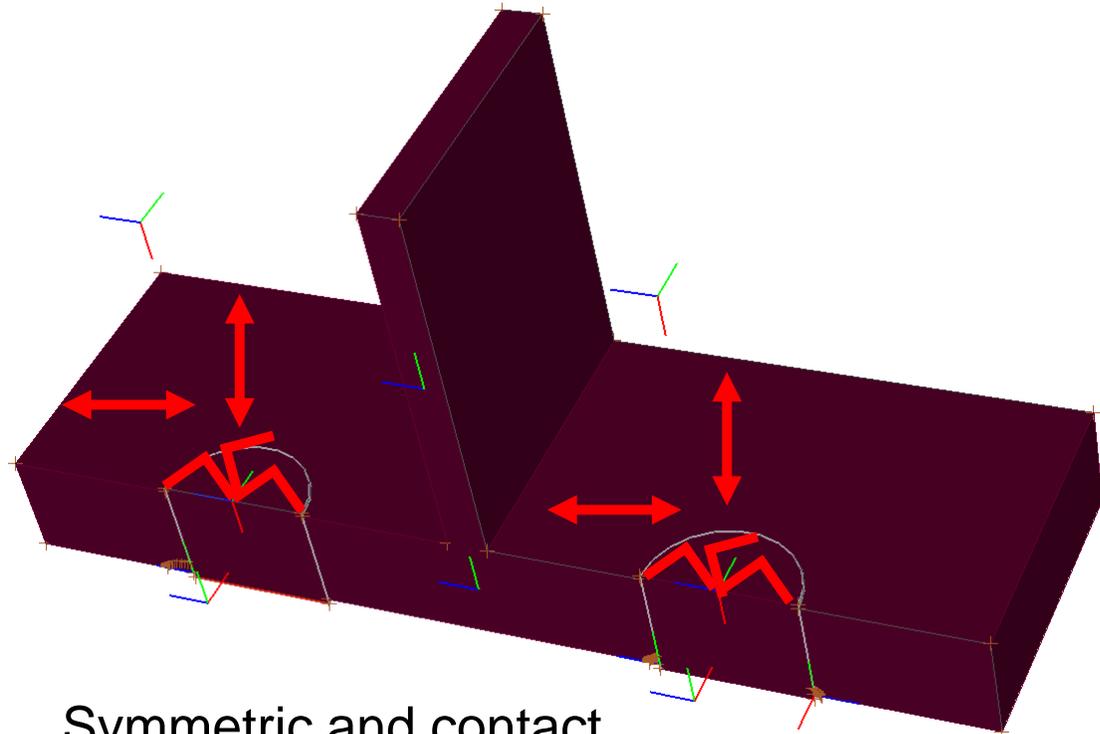
Take away: apply constraints near the neutral axis



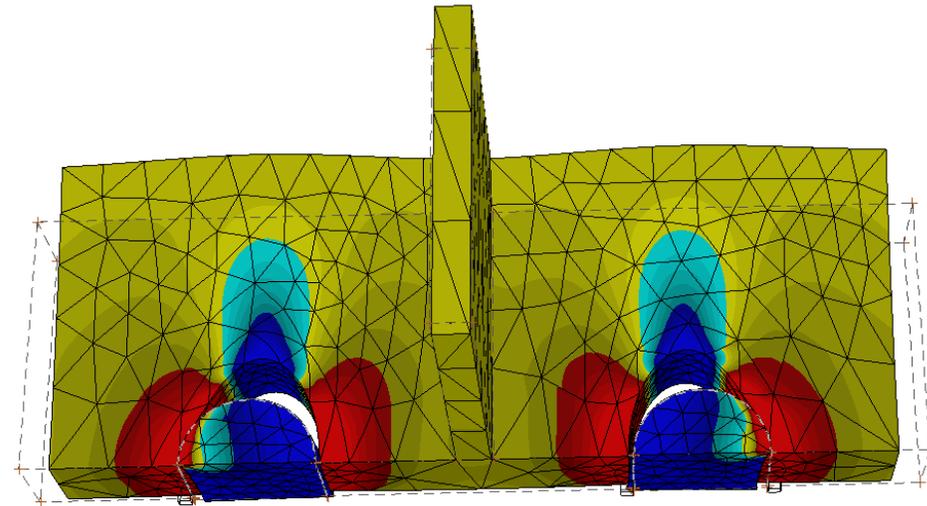
StressCheck Symmetric Pin Model



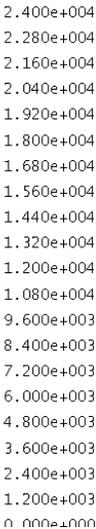
- This was the first analysis attempted using fastener contact in BAMF
- Initial pin constraint restricted translation on the upper face of the pin in two directions, up-down and fore aft



Symmetric and contact constraints not depicted



StressCheck V10.3
Units = INCH/LBF/SEC/F
CONTACT ID=SOL1
Run=1, DDF=114990
Deformed (S1)
Scale:1.67e+002
Max= 6.762e+004
Min=-7.921e+003



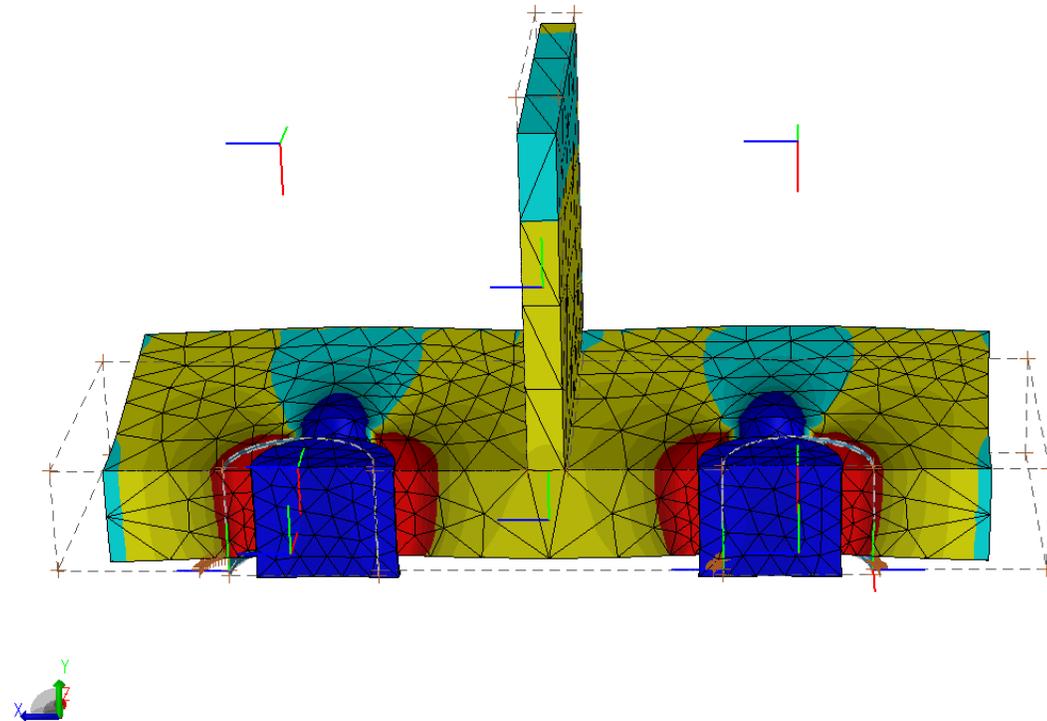
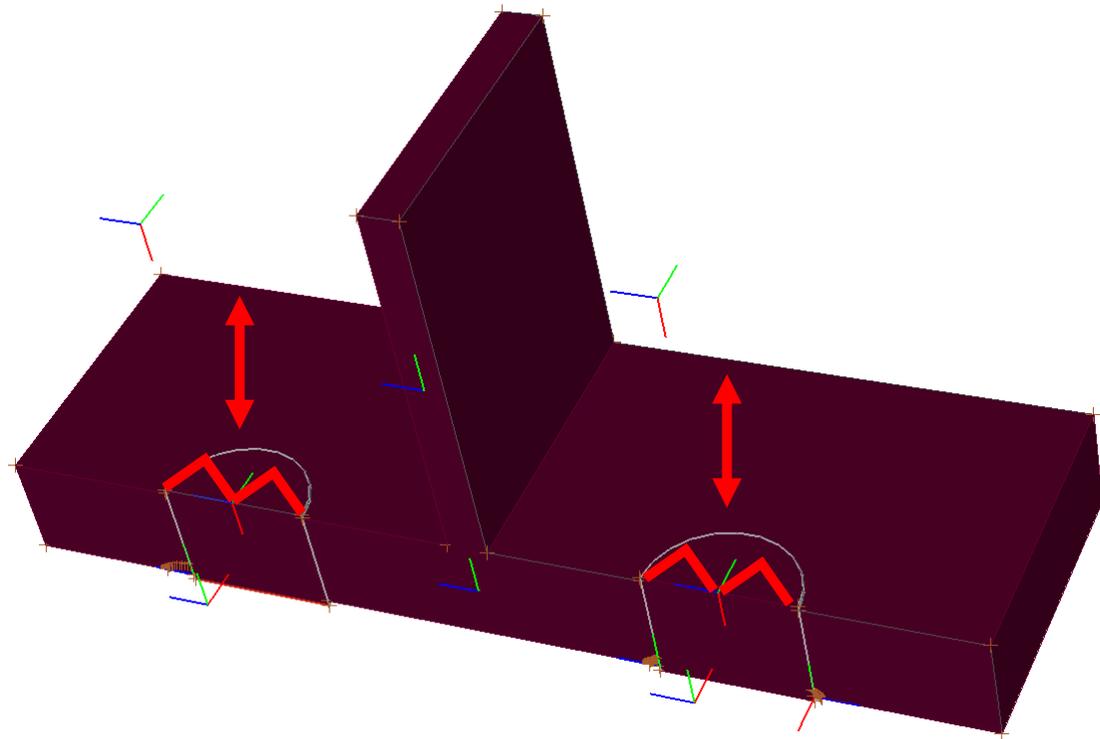
Constraining the pins laterally caused the spar to deform around the pins creating peak stresses on the outer sides and minimal contact on the inner. Furthermore, pin bending caused high stresses at the top of the pin with minimal contact at the bottom



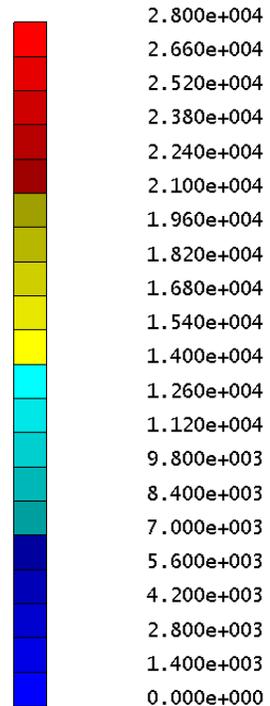
StressCheck Symmetric Pin Final



- Permitting the pin to translate laterally with spar deflection created the intended, uniform stresses through thickness at the fastener holes



StressCheck v10.3
Units = INCH/LBF/SEC/F
CONTACT ID=SOL
Run=1, DOF=114986
Deformed (S1)
Scale:2.10e+02
Max= 1.115e+005
Min=-1.195e+004

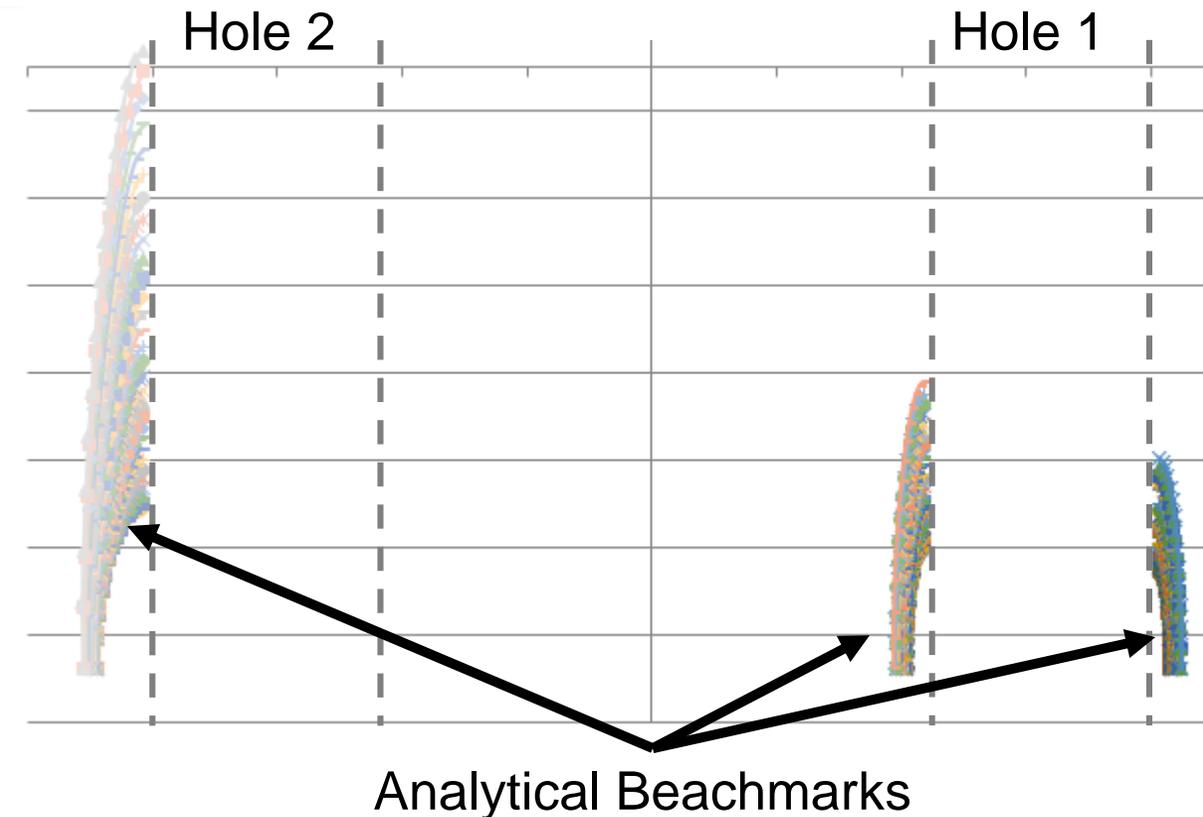
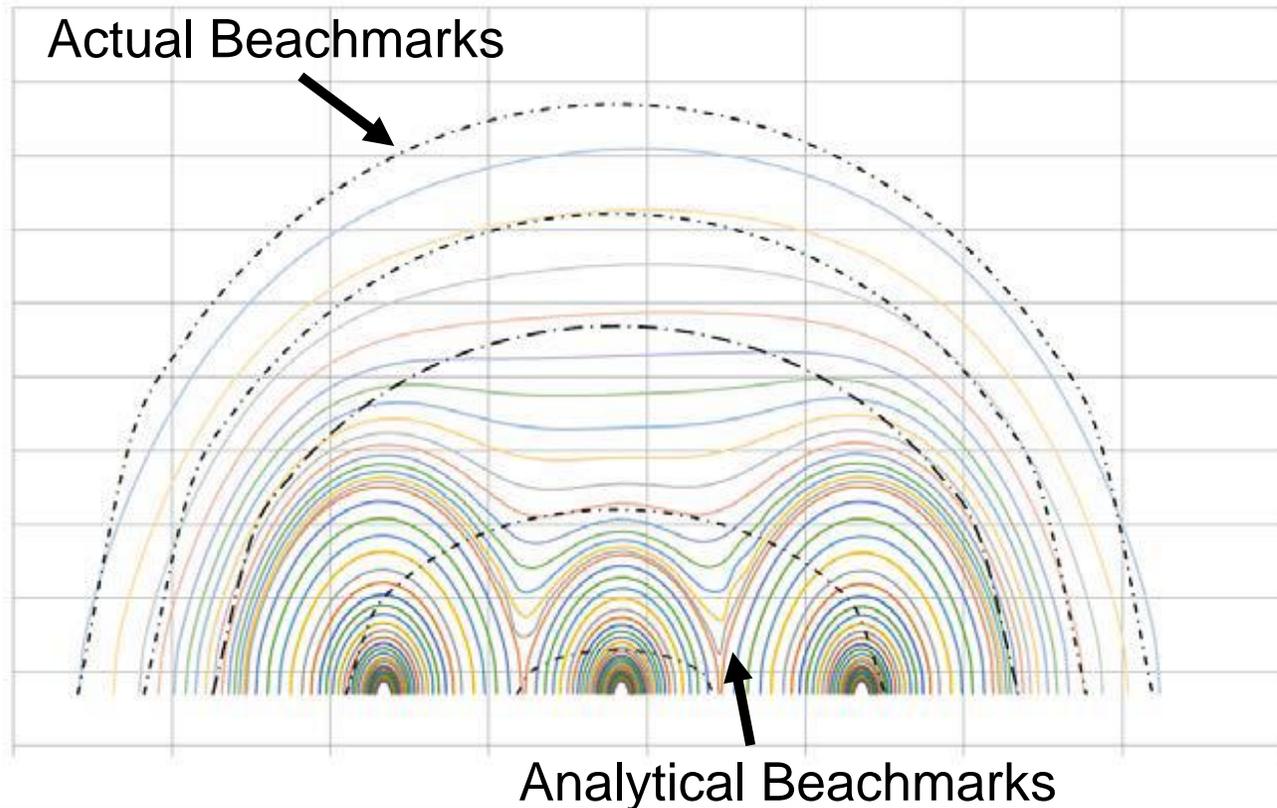




BAMF Multi-Crack Development



- Previous multi-crack analyses in BAMF used the same initial crack size for all cracks
- BAMF was enhanced to handle “small” crack growth for secondary cracks

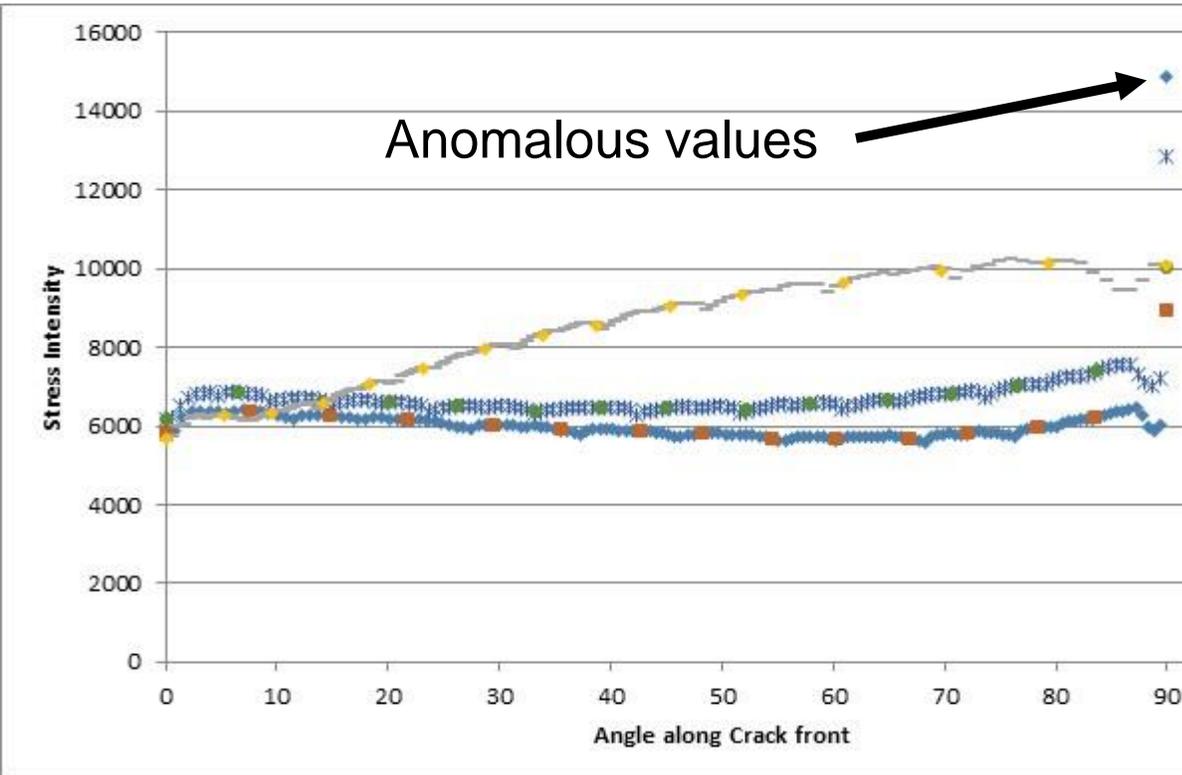




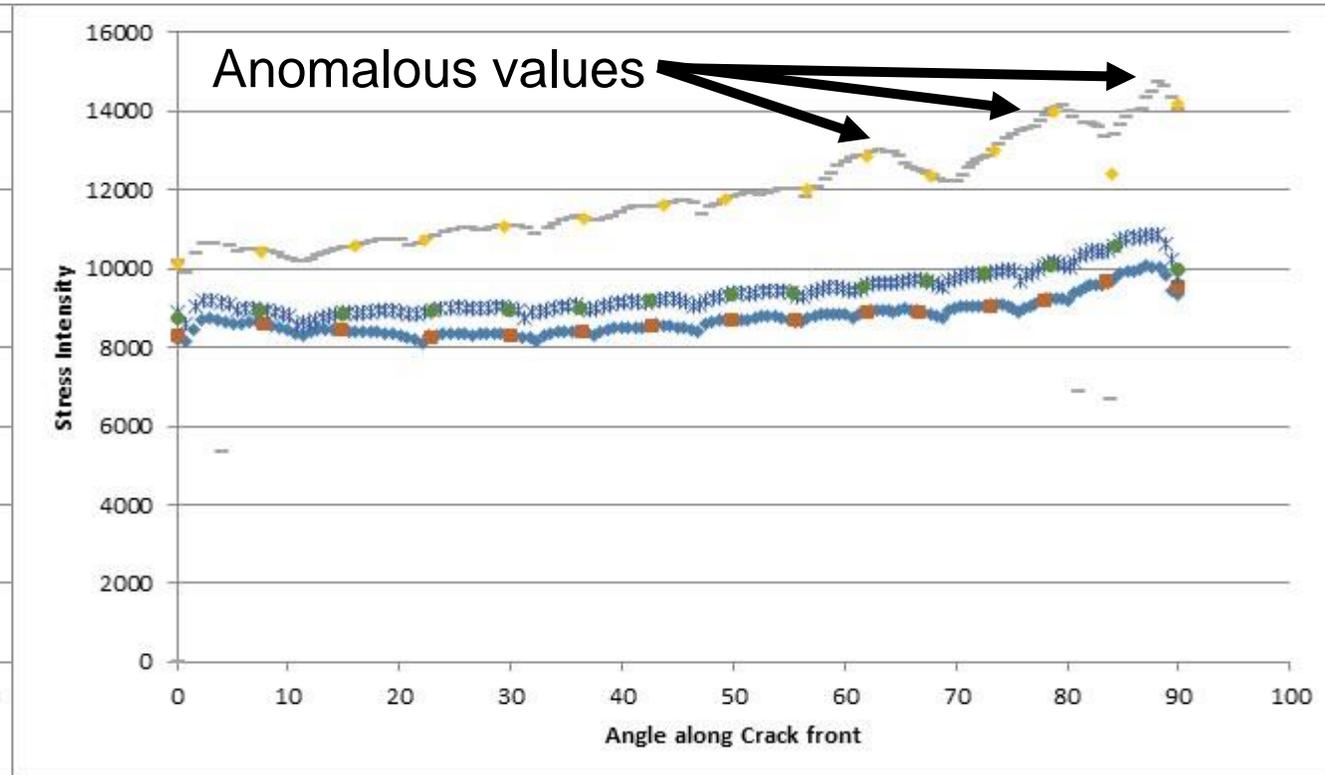
BAMF K Extraction Enhancement



- Fastener contact creates a local analytical singularity at the contact face which creates anomalies with stress intensity extraction
- BAMF updated to omit anomalous K extraction from contact model



First iteration



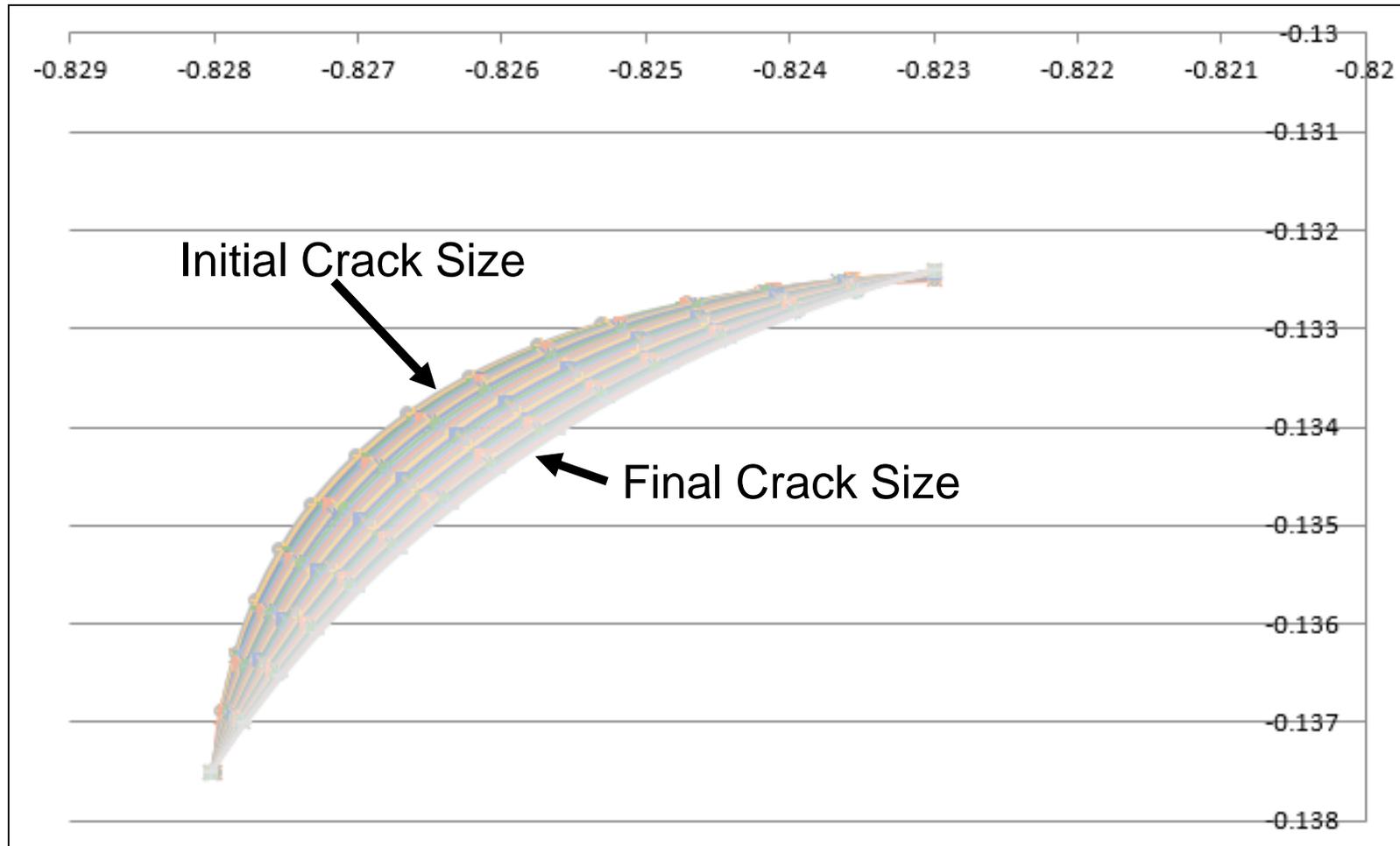
After a few iterations



BAMF Negative Crack Growth



- Negligible Crack growth created negative growth.

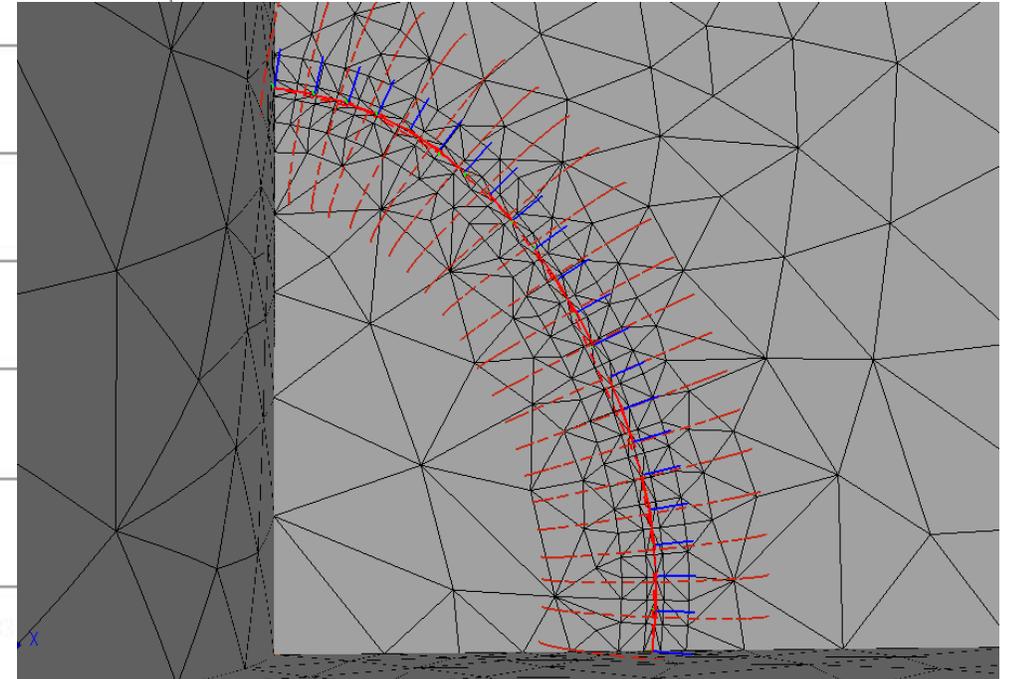
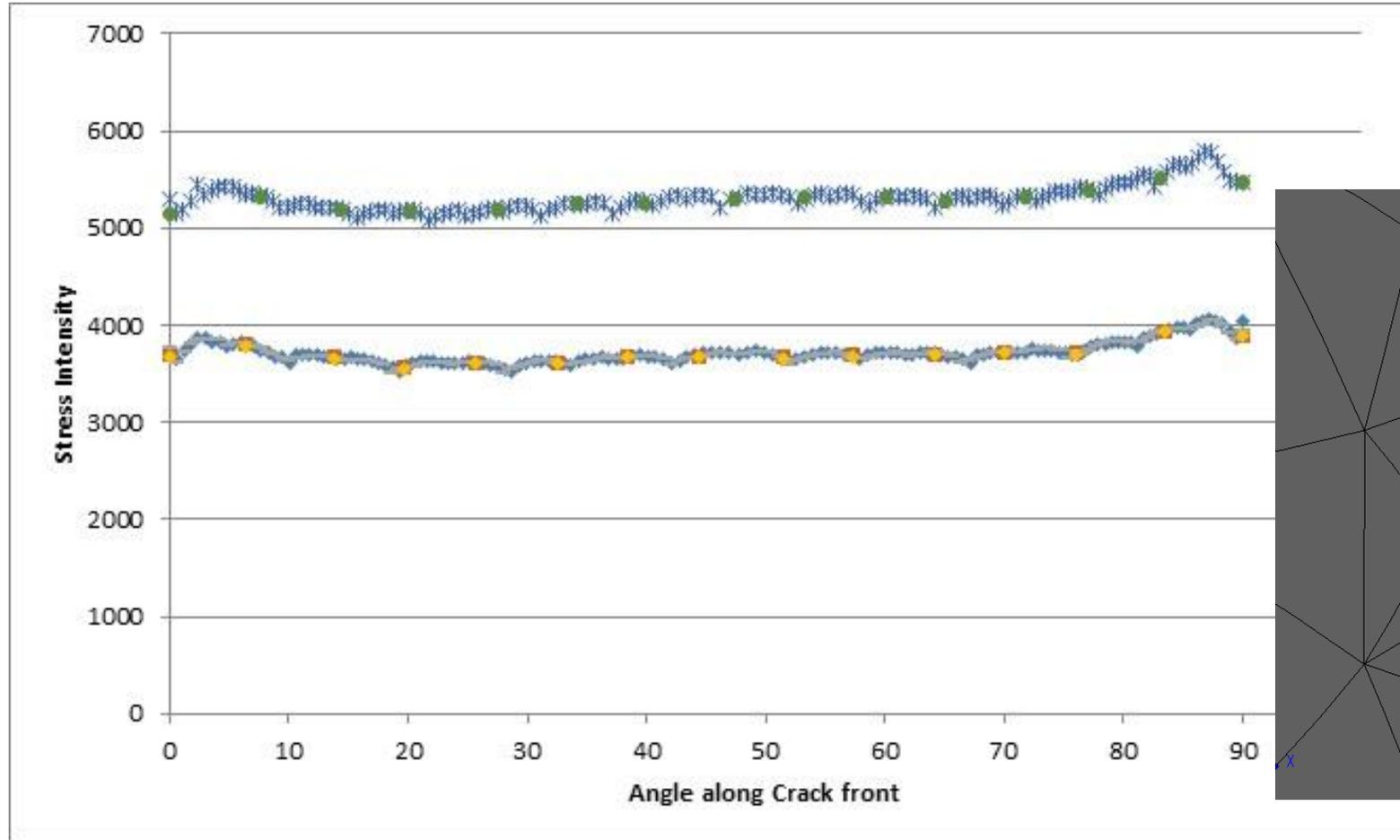




Radius of Integration for K extraction



- Radius of integration was hard coded to be the same for each crack





Input of Model Parameters



■ Far Field Stress and Thickness was switched when sent to StressCheck

BAMF Parameter Generator

Number of Cracks: 3

Far Field Stress: 14000

Thickness: .275

Em: 10800000

v: .33

Generate Parameter File

Generate StressCheck Model



StressCheck Model Information

Model Info Parameters Rules

Name	Description	Expression	Value	Limit	Class	Sort
C3PY5			2.8280e-003		General	
C3PY6			3.3399e-003		General	
C3PY7			3.8383e-003		General	
C3PY8			4.2001e-003		General	
C3PY9			4.5386e-003		General	
CrackAngle1			9.0000e+001		General	
CrackAngle2			9.0000e+001		General	
CrackAngle3			9.0000e+001		General	
Cracks			3.0000e+000		General	
Em			1.0800e+007		General	
PointsCrack1			1.5000e+001		General	
PointsCrack2			1.5000e+001		General	
PointsCrack3			1.5000e+001		General	
Stress			2.7500e-001		General	
Thickness			1.4000e+004		General	
v			3.3000e-001		General	

Accept Delete Auto Step: 0.2

Input Settings