Demonstration of Normalized Stress Correction Factor to Compute the Stress Intensity Factors

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Agenda

- Why? AFGROW versatile, but can’t cover every possible crack scenario
- Steps to stress correction process
- Process and results demonstrated on “elliptic surface crack in a stepped flat tension bar”
- Conclusions

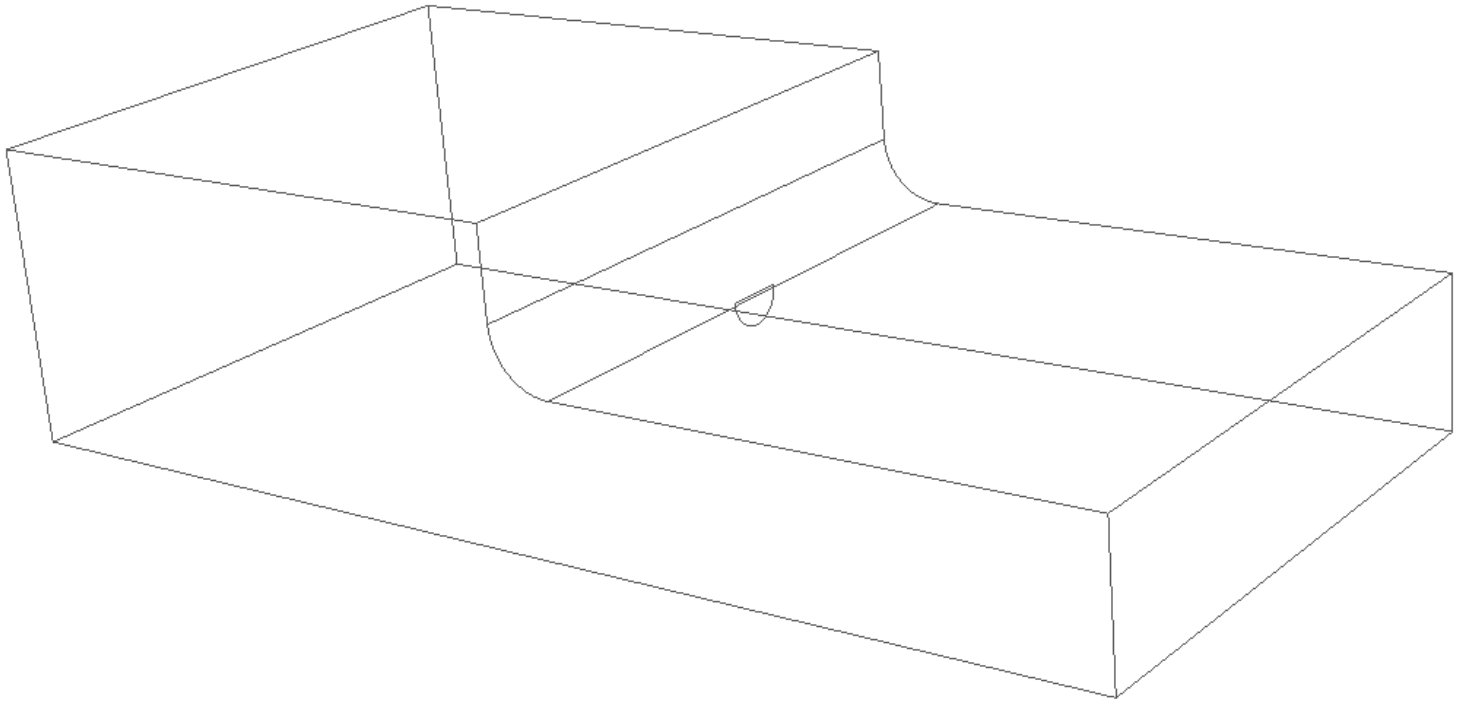
Steps for Using Stress Correction in AFGROW

- Pick reference crack scenario—as close as possible to ***YOUR*** crack scenario. With the reference crack scenario comes a reference uncracked stress state ***at the plane where crack will be located***
- Compute stress for your geometry (no crack)
- Shift coordinate system of your stresses to reference crack origin
- Ratio your uncracked stress to reference uncracked stress

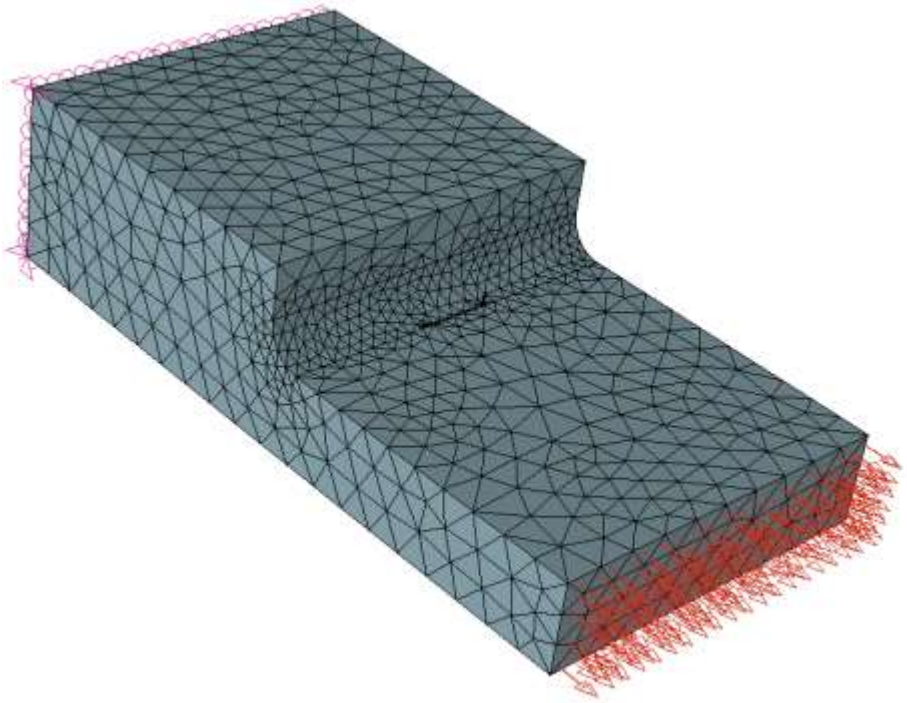
Steps for Using Stress Correction in AFGROW (continued)

- Normalize the ratioed stresses to the stress at the ‘First Point’—keep this value handy, you’re going to need it later
- Create .sd2 file with the normalized stresses
- Read into AFGROW with reference crack scenario model
- Multiply SMF by this “First Point” value

Crack Scenario in Stepped Flat Tension Bar

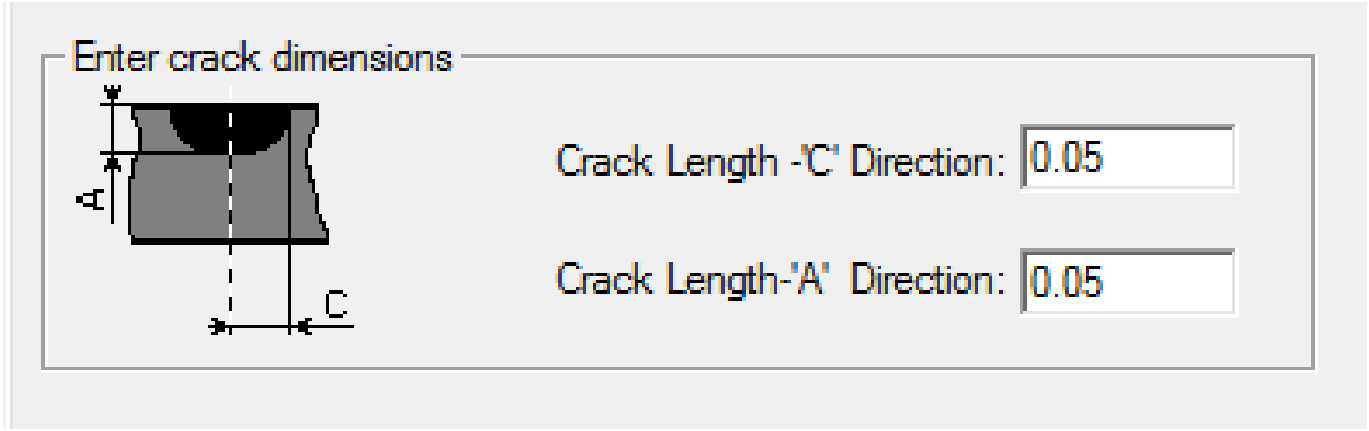


Stepped Flat Tension Bar Mesh

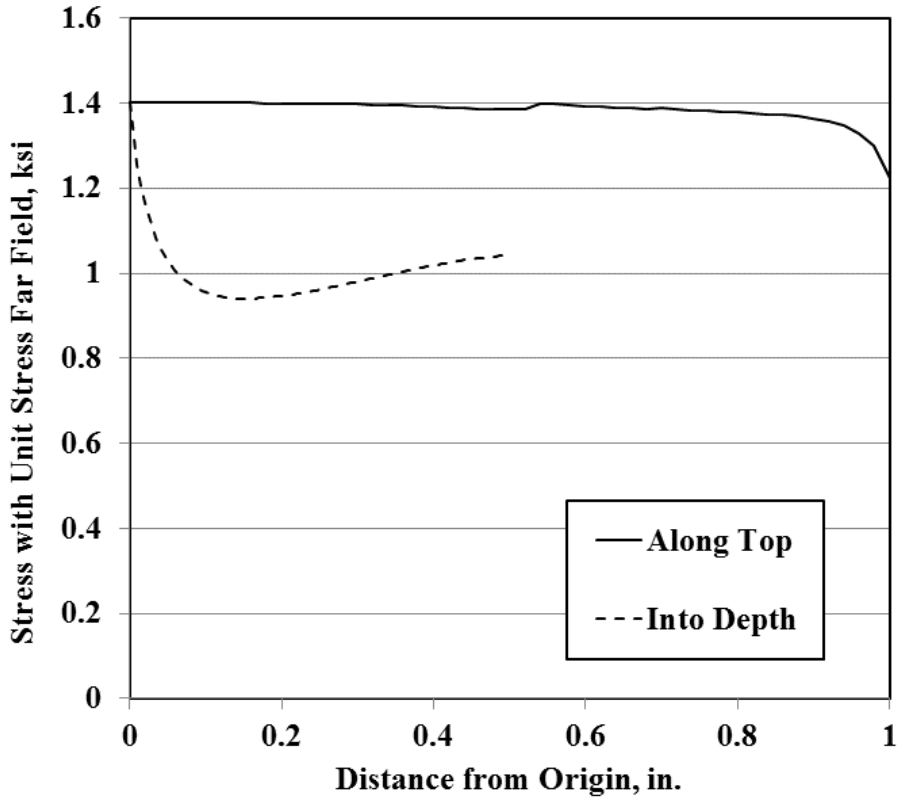


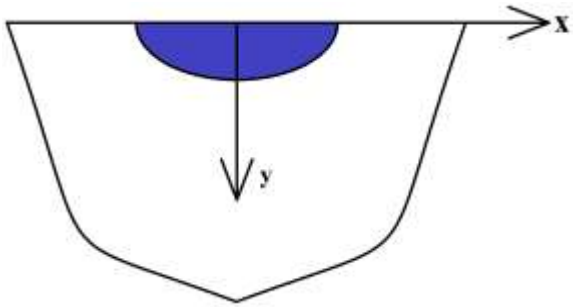
- Stepped flat tension bar in 3D
- Dimensions: W=2 in., h_1=0.5 in., h_2=1.0 in., fillet=0.2 in.
- Constant tension on one face; symmetry on opposite face

Reference Crack Scenario is Center Semi-elliptic Surface Flaw

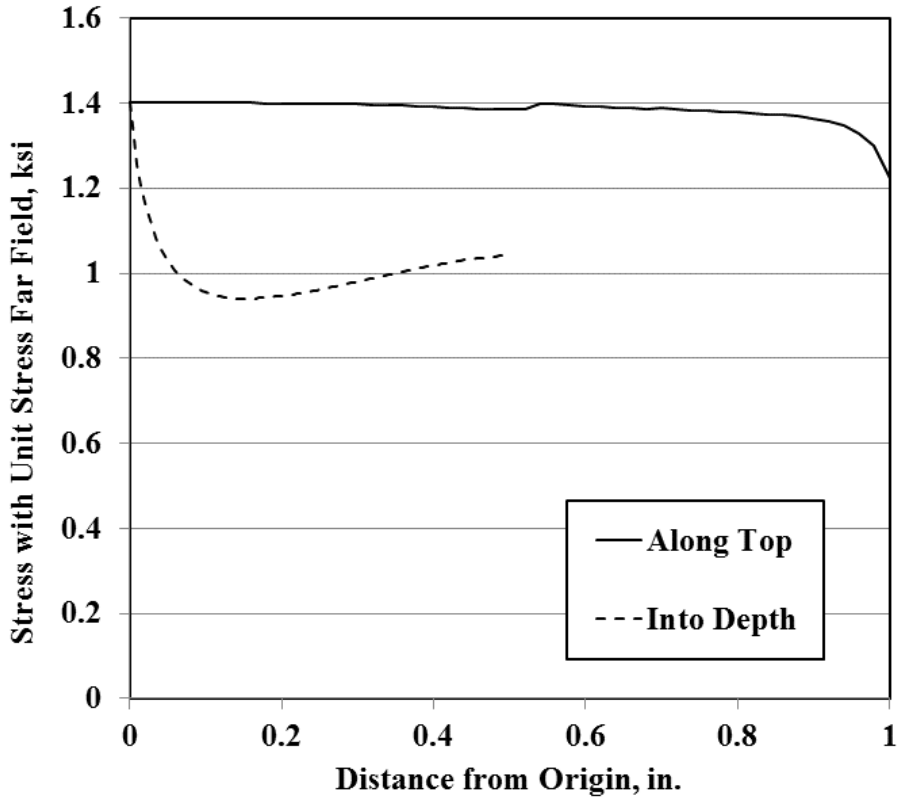


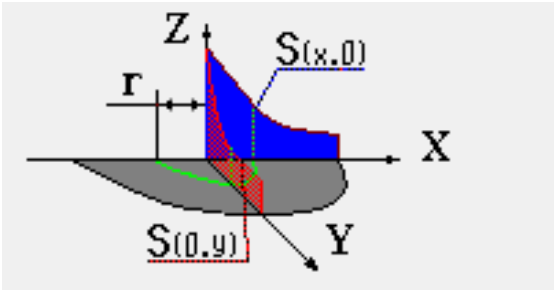
Uncracked Stress in Stepped Flat Tension Bar





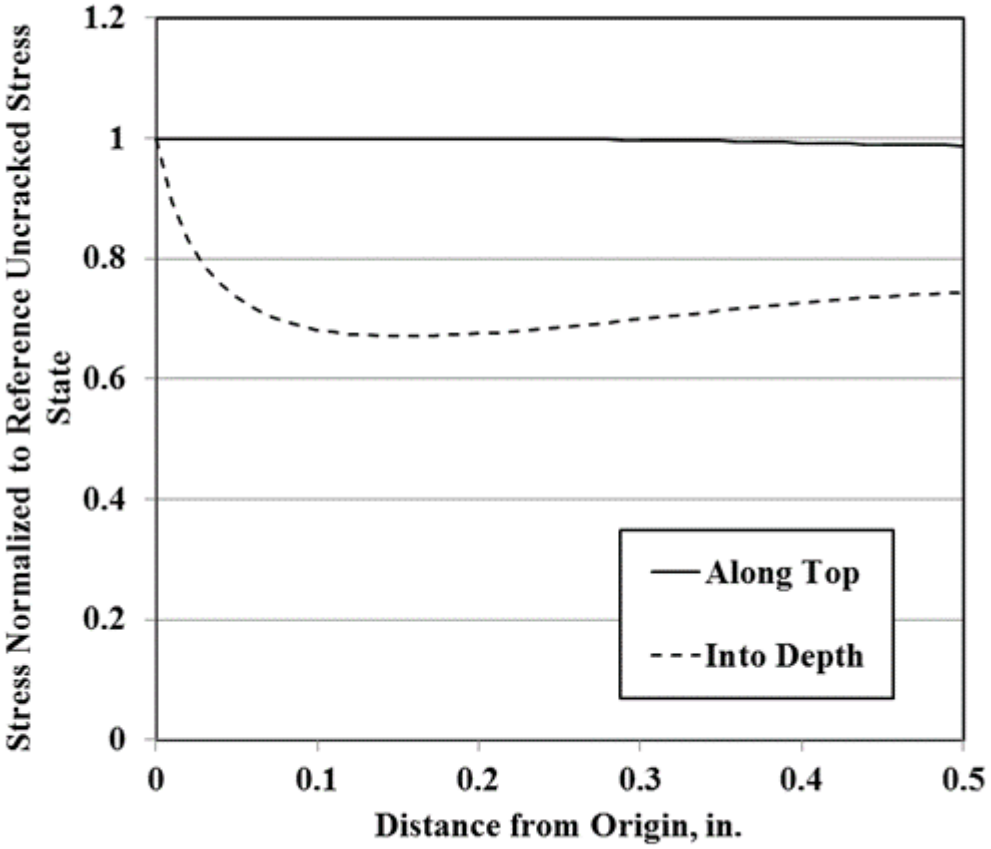
Normalized to Reference Stress State

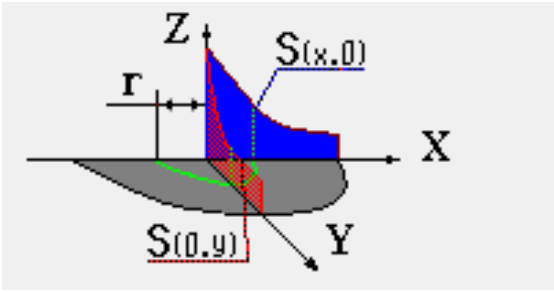




Reference Uncracked Stress is 1 ksi

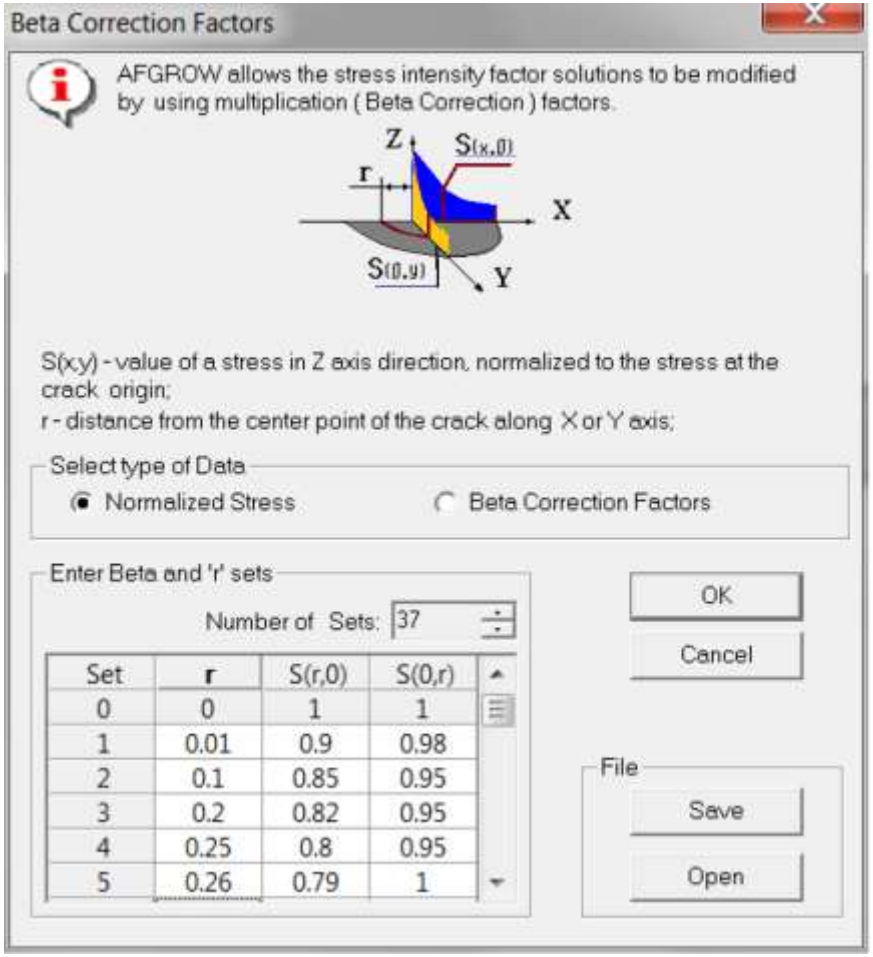
Normalized to “First Point”





SAVE “1.402” for SMF later

AFGROW Stress Correction



Set	r	S(r,0)	S(0,r)
0	0	1	1
1	0.01	0.9	0.98
2	0.1	0.85	0.95
3	0.2	0.82	0.95
4	0.25	0.8	0.95
5	0.26	0.79	1

For this study…

S(x,0)=S(r,0)

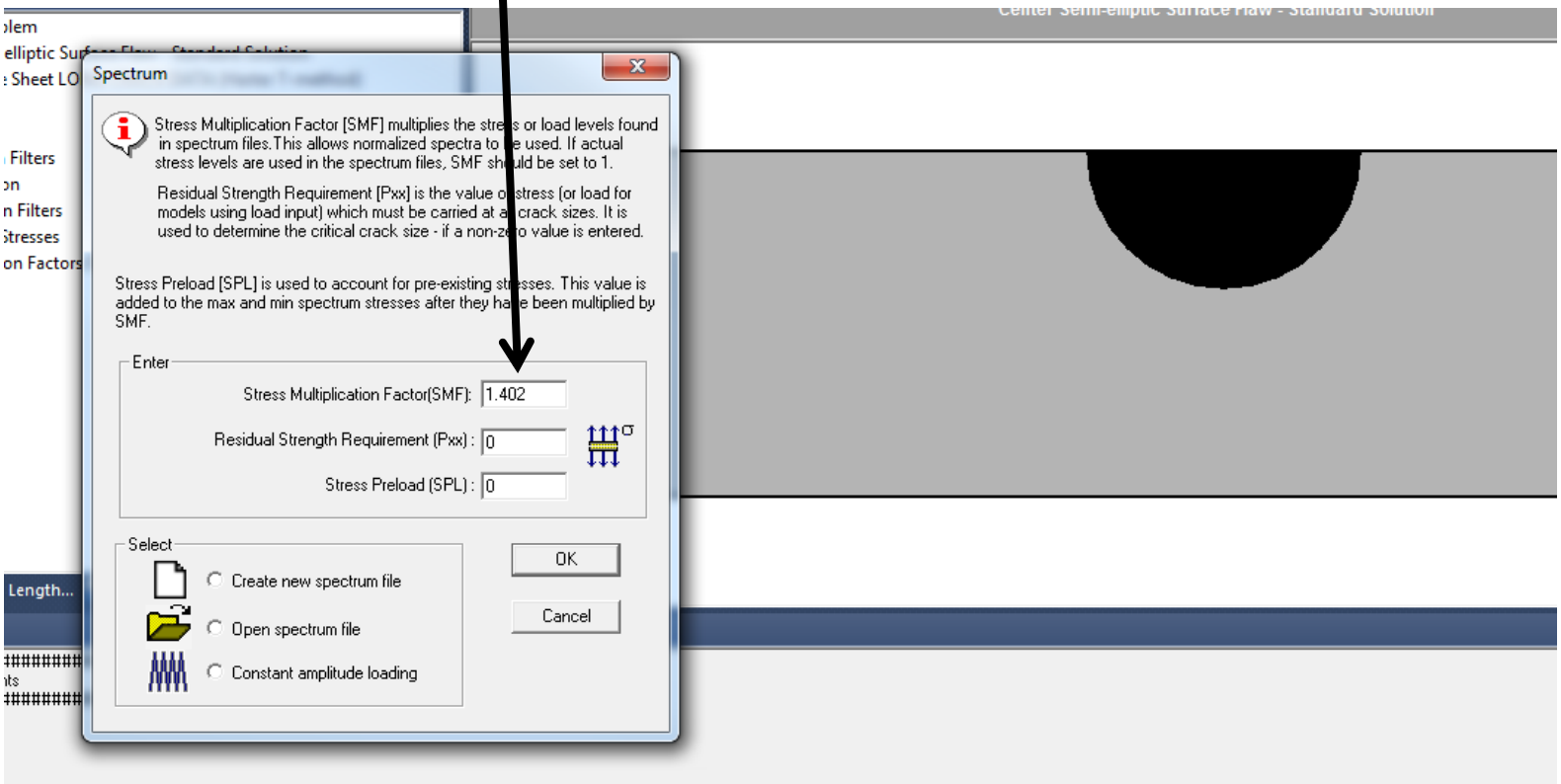
S(0,y)=S(0,r)

50		
0.01	1.000004811	0.894619325
0.02	1.000002504	0.831424341
0.03	0.999986126	0.788611297
0.04	0.999949392	0.75789559
0.05	0.999889946	0.735283373
0.06	0.999820494	0.718071035
0.07	0.999760346	0.705059486
0.08	0.999740164	0.695194296
0.09	0.999771885	0.687978784
0.1	0.999781213	0.681464713
0.11	0.9996999	0.677623746
.	.	.
.	.	.
.	.	.

Note: Because you have normalized all stresses to the r=0 (origin) AFGROW assumes S(r=0,0) and S(0,r=0) are 1.0; thus no need to put the r=0 data.

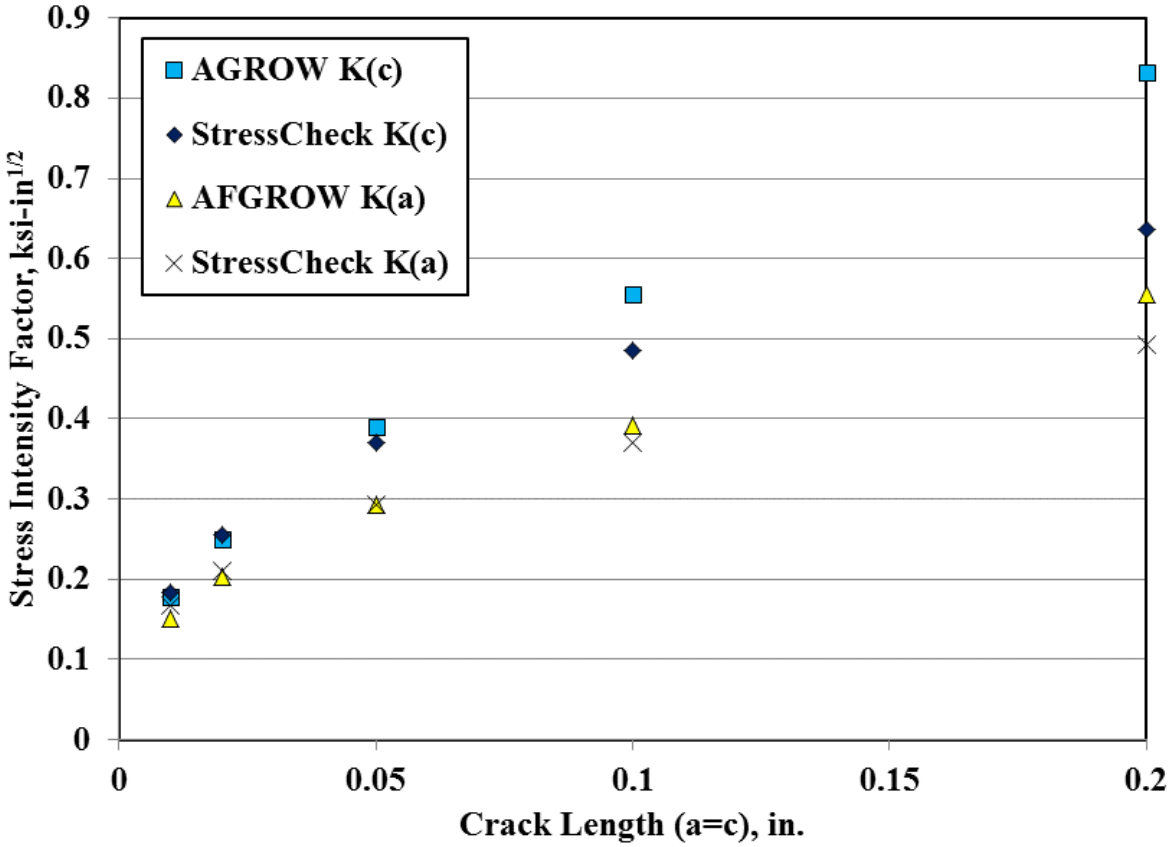
Adjust the SMF

Multiply SMF by "1.402"



Note: My, original non stress corrected SMF was "1.0".

Difference is Larger as Crack Dimensions Increase



Conclusions

- AFGROW's stress correction allows you to greatly increase the crack scenarios you can analyze
- Stress correction method may not be as accurate as you need