K-Solutions for Through Cracks Under Biaxial Loading

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for

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BACKGROUND

There have been several inquiries from AFGROW Users and Training Class Attendees over the years about the development of a K-solution for cracked holes under biaxial loading. Nothing has been done to date since it has not been considered to be a priority. Also, there are issues related to crack growth rate data in multiple directions and existence of biaxial loading data.

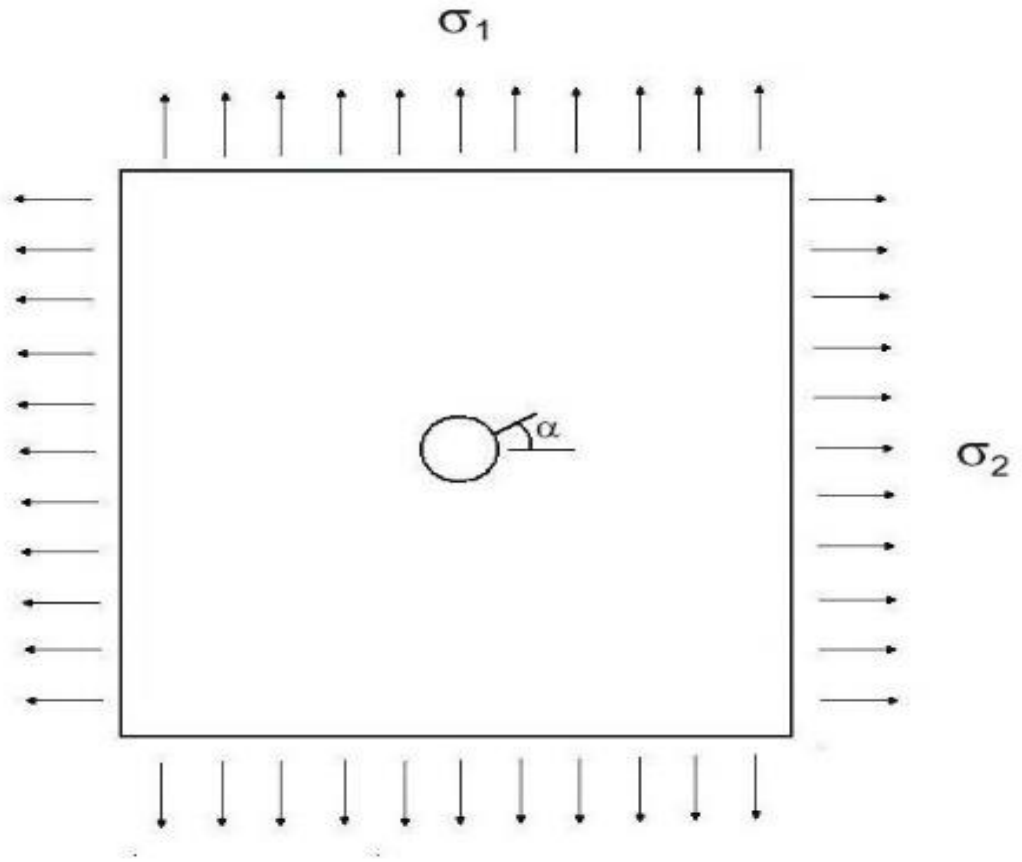
This subject came up again at the AFGROW European Workshop this year while discussing our new capability to use crack growth rate data in two growth directions.

Preliminary Study
(Through Crack)

Plate Width: 4 inches

Plate Height: 4 inches

Diameter: 0.25 inches



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Load Cases

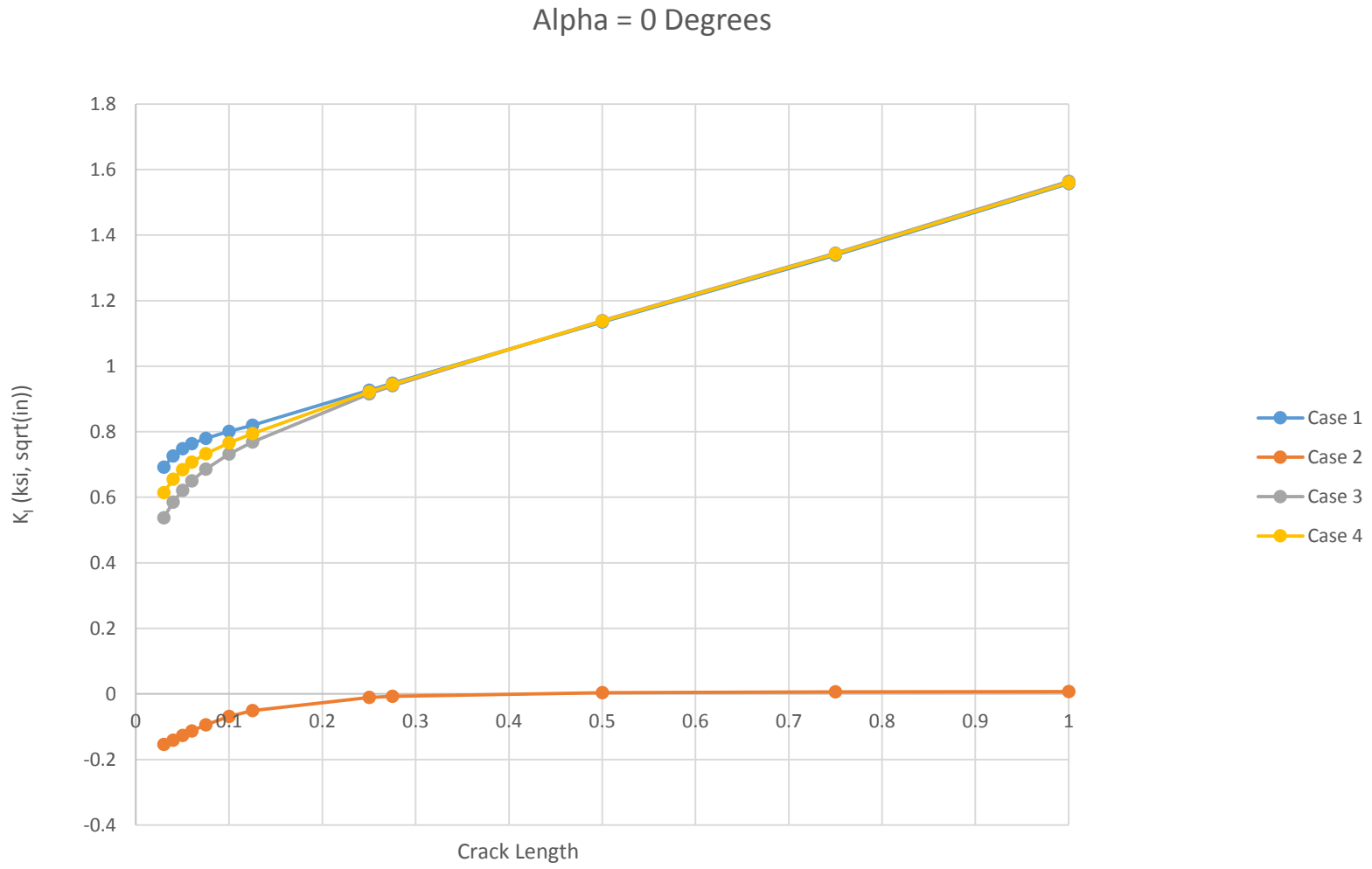
Case 1: $\sigma_1 = 1, \sigma_2 = 0$

Case 2: $\sigma_1 = 0, \sigma_2 = 1$

Case 3: $\sigma_1 = 1, \sigma_2 = 1$

Case 4: $\sigma_1 = 1, \sigma_2 = 0.5$

Results



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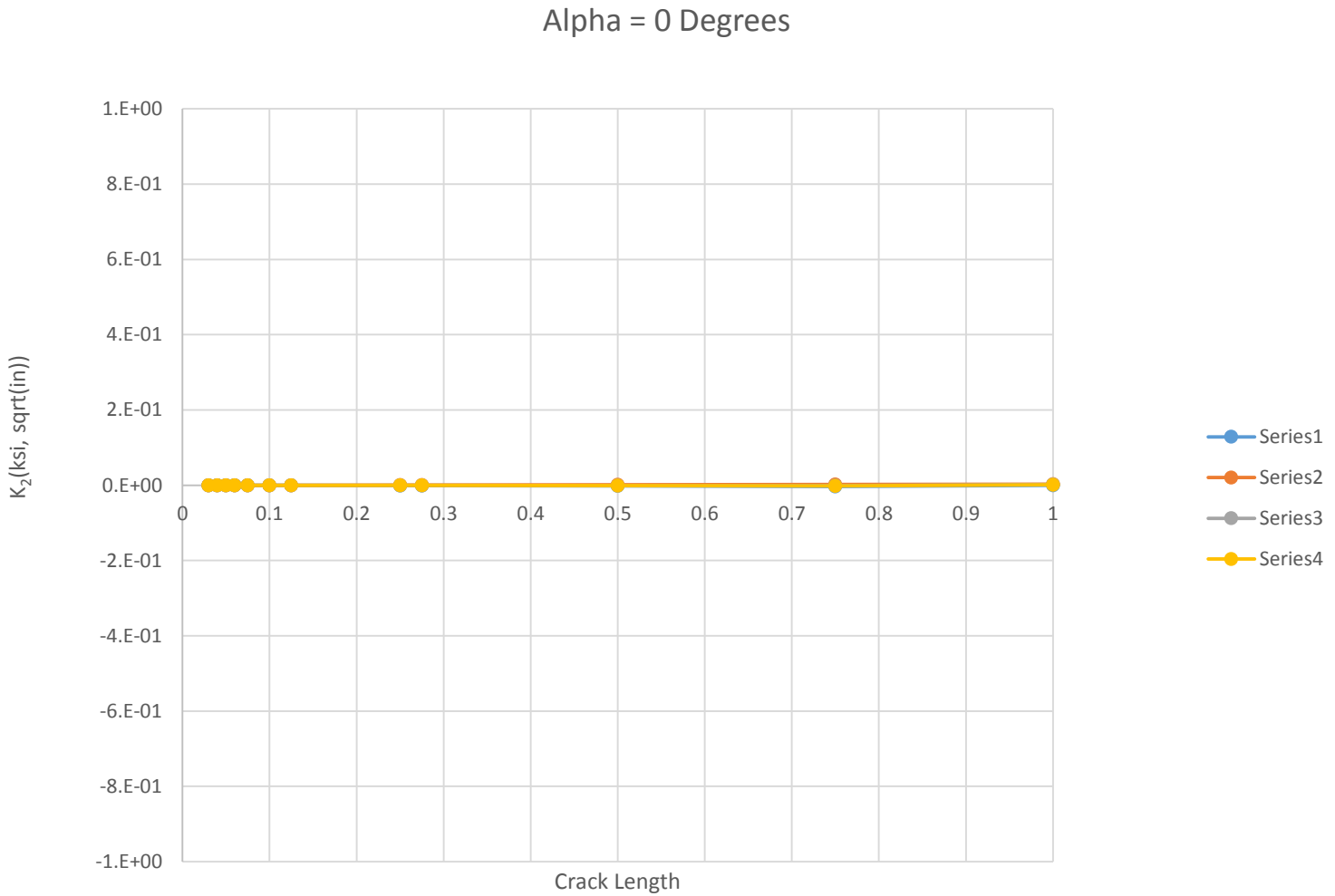

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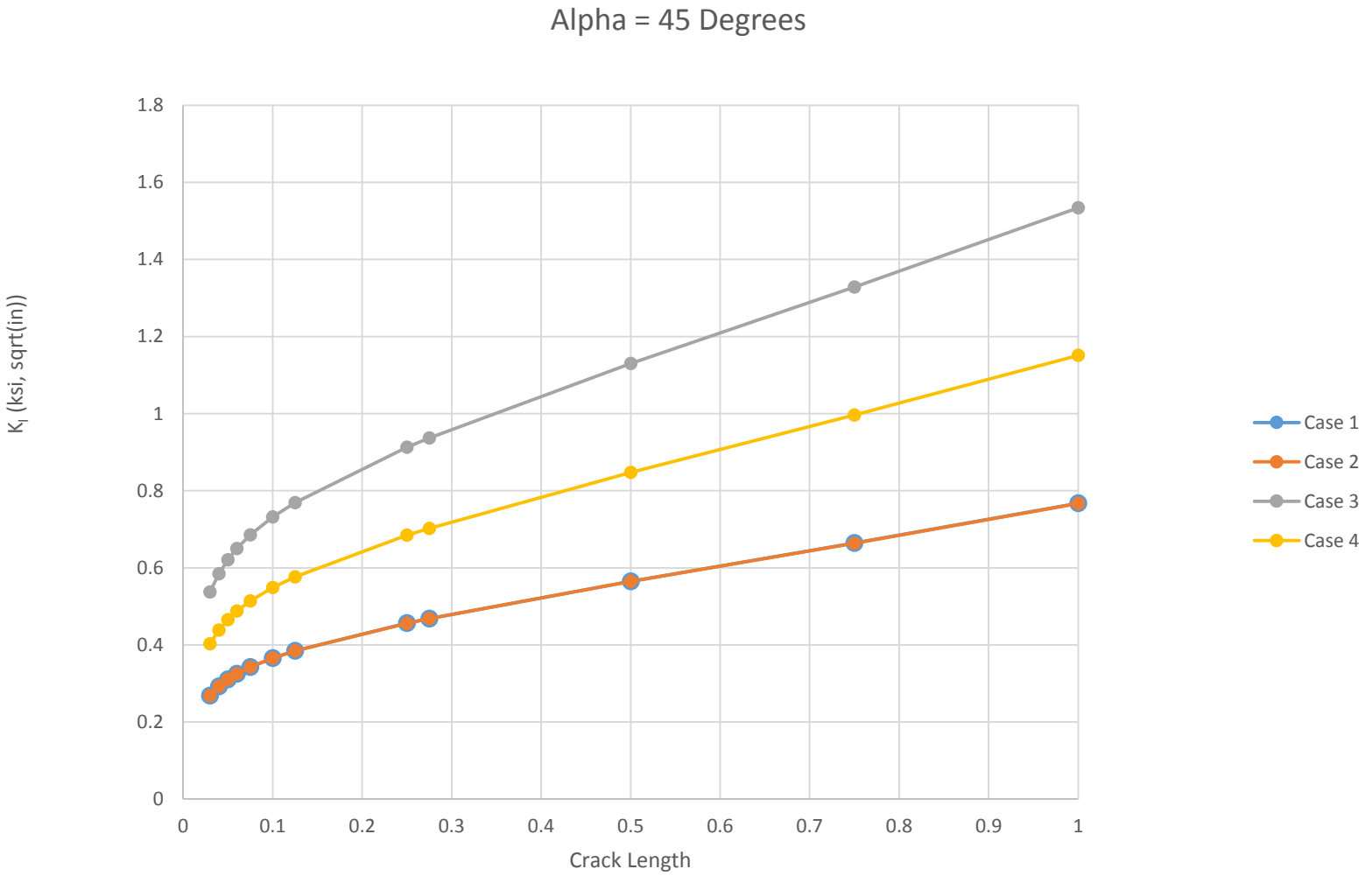

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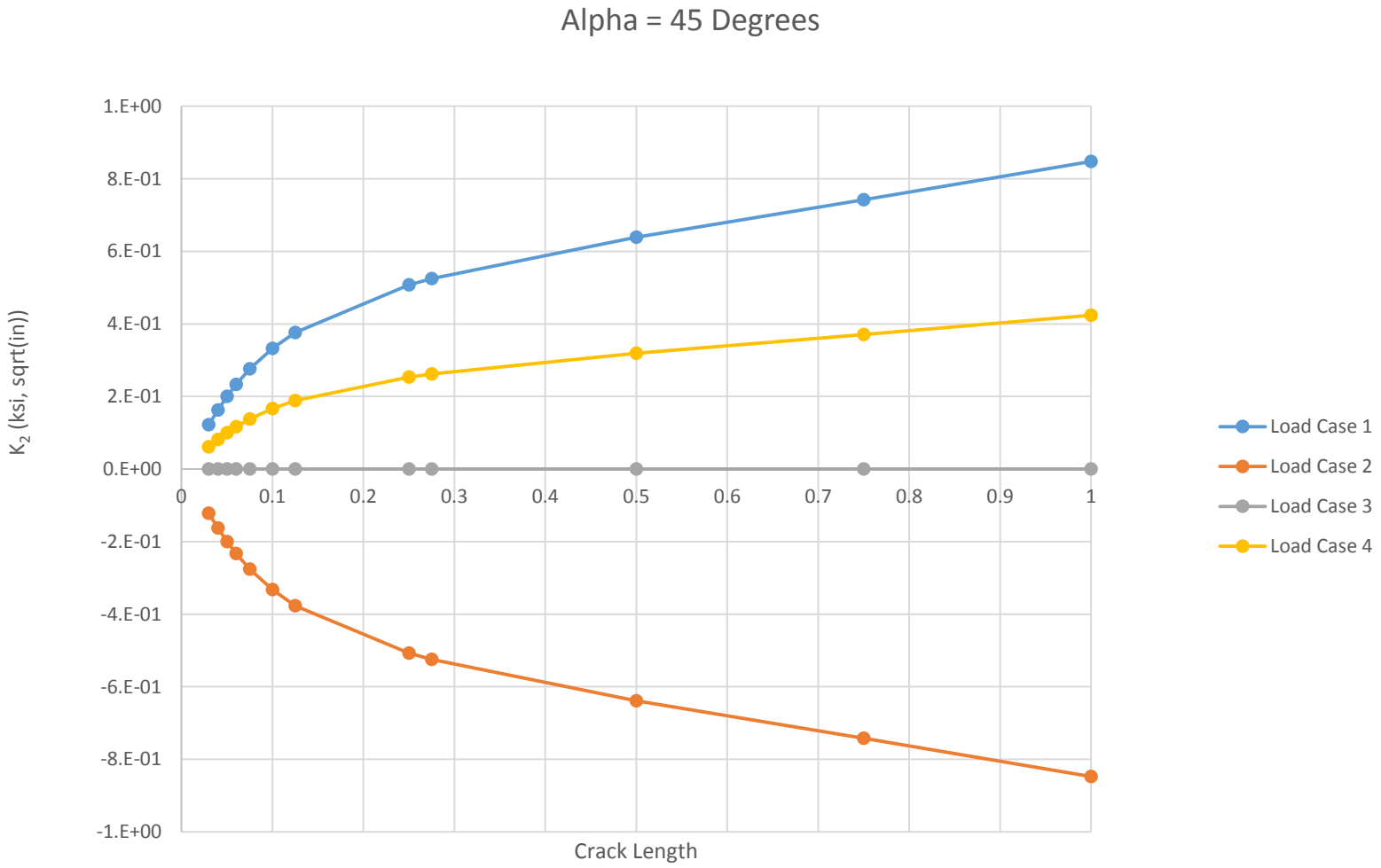

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Observations

- For α = 0 degrees, there is a potential life increase due to biaxial loading for shorter crack lengths (< 1 hole diameter)
- For α = 0 degrees, K_2 is relatively small for all crack lengths (indicating little/no tendency for crack turning)
- For α = 45 degrees, biaxial loading has a significant effect
- For α = 45 degrees, the K_2 results also indicate a strong tendency for the crack to turn to become normal to the dominate loading direction
- It also appears that developing a curve fit solution for any α and combination of geometric parameters would be extremely difficult.
- This solution would be a great candidate for a real-time, FEM based model

Questions for the Workshop

Existence of Biaxial Loading Data?

Would this solution be helpful?

Plug-In Modules for Real Time FEM Solutions?