Fatigue Crack Growth on Several Materials under Single-Spike Overloads and Aircraft Spectra

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Mississippi State University
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Outline of Presentation

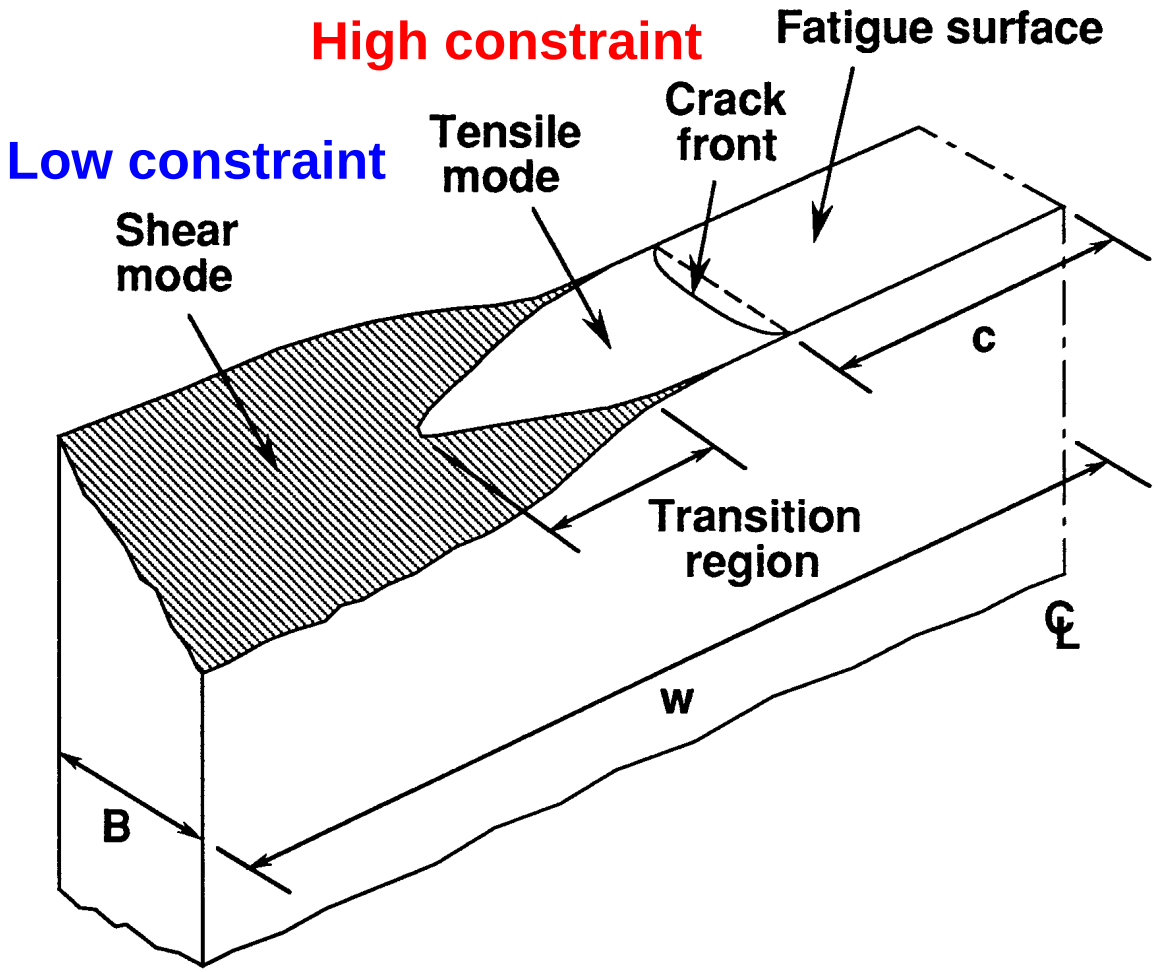
- **Plane-strain to plane-stress fatigue-crack growth behavior**

Flat-to-Slant Crack Growth and the Associated Constraint-Loss Behavior

Schijve (1966)

ASTM STP-415:

Crack-growth rate was "constant" at transition on 2024-T3 Alclad for wide range in R



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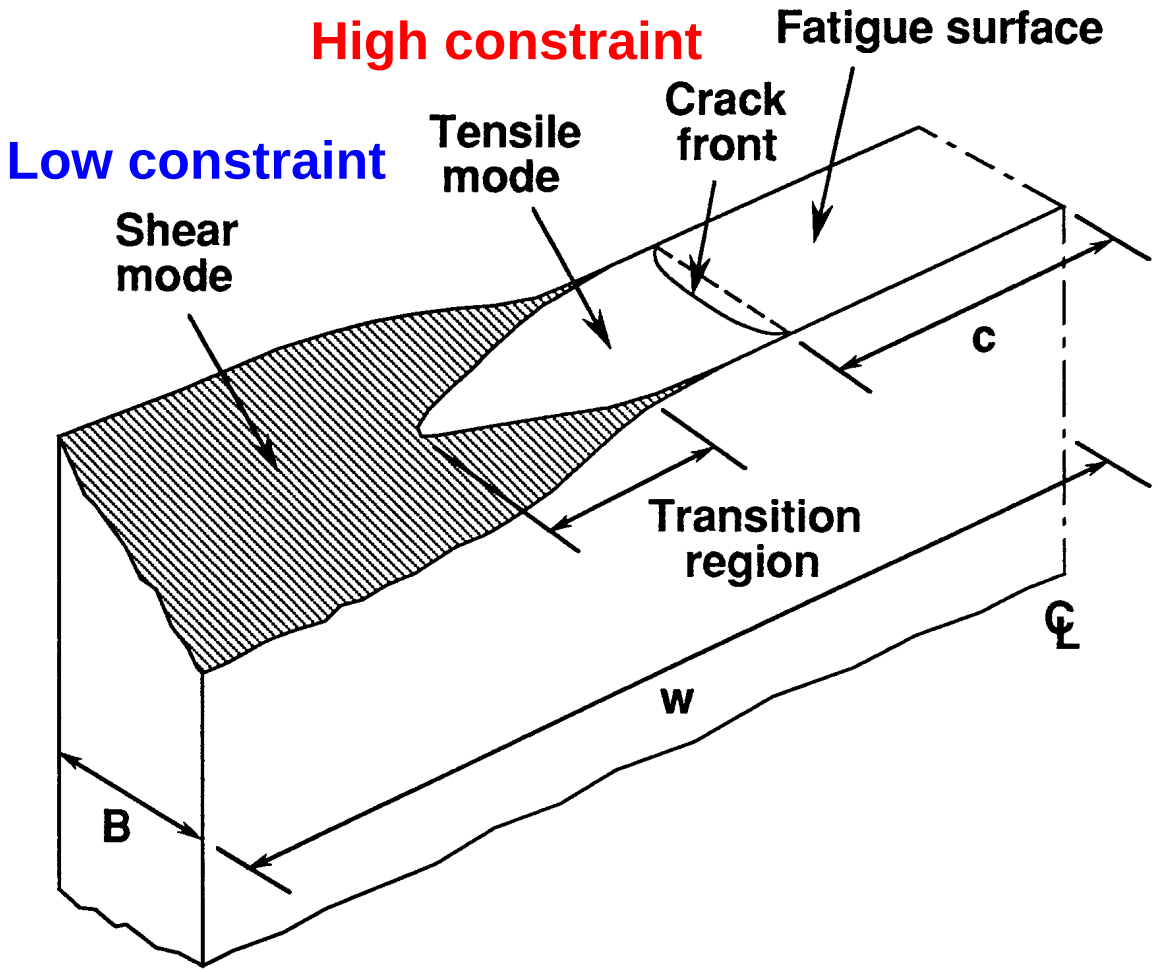

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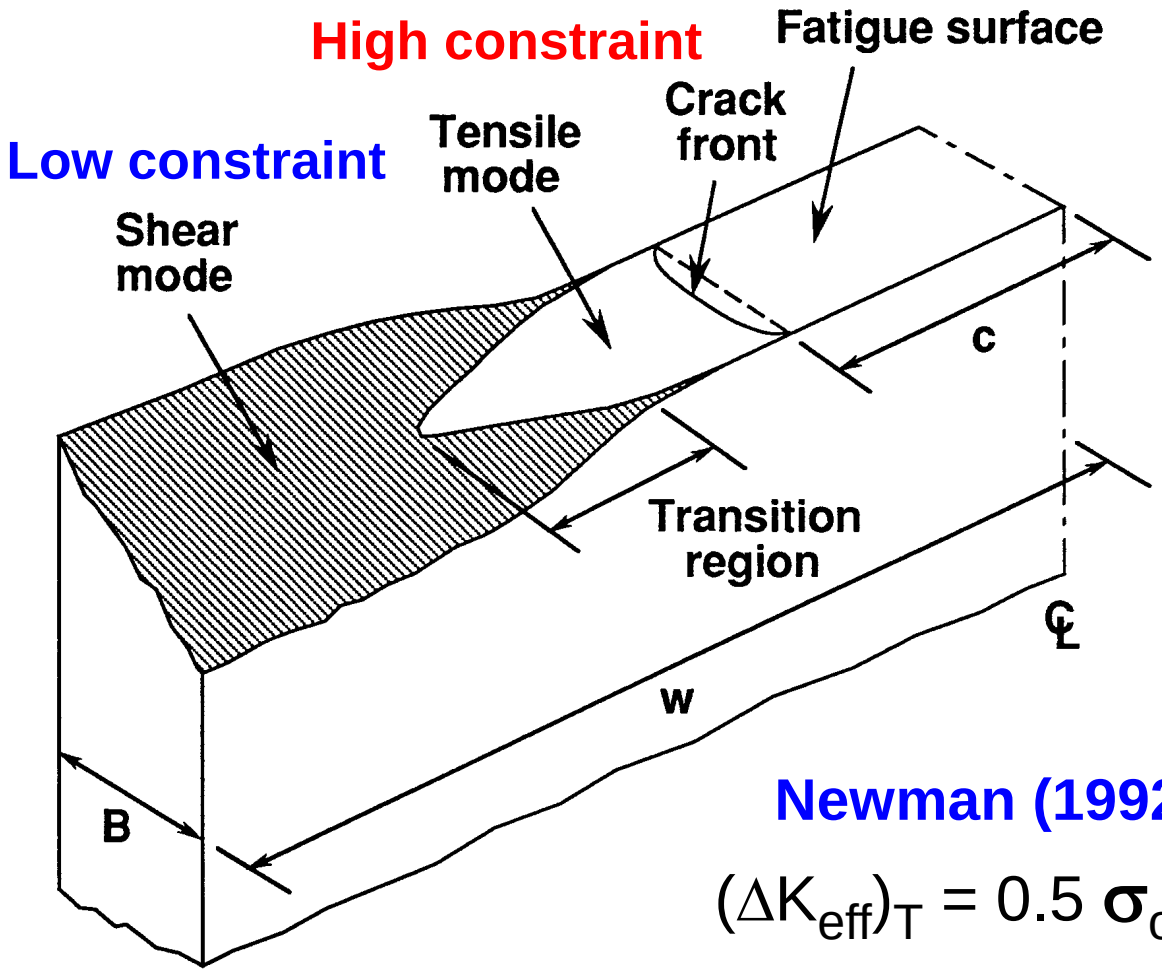

Newman (1992)

$$(\Delta K_{eff})_T = 0.5\ \sigma_o\ B^{1/2}$$

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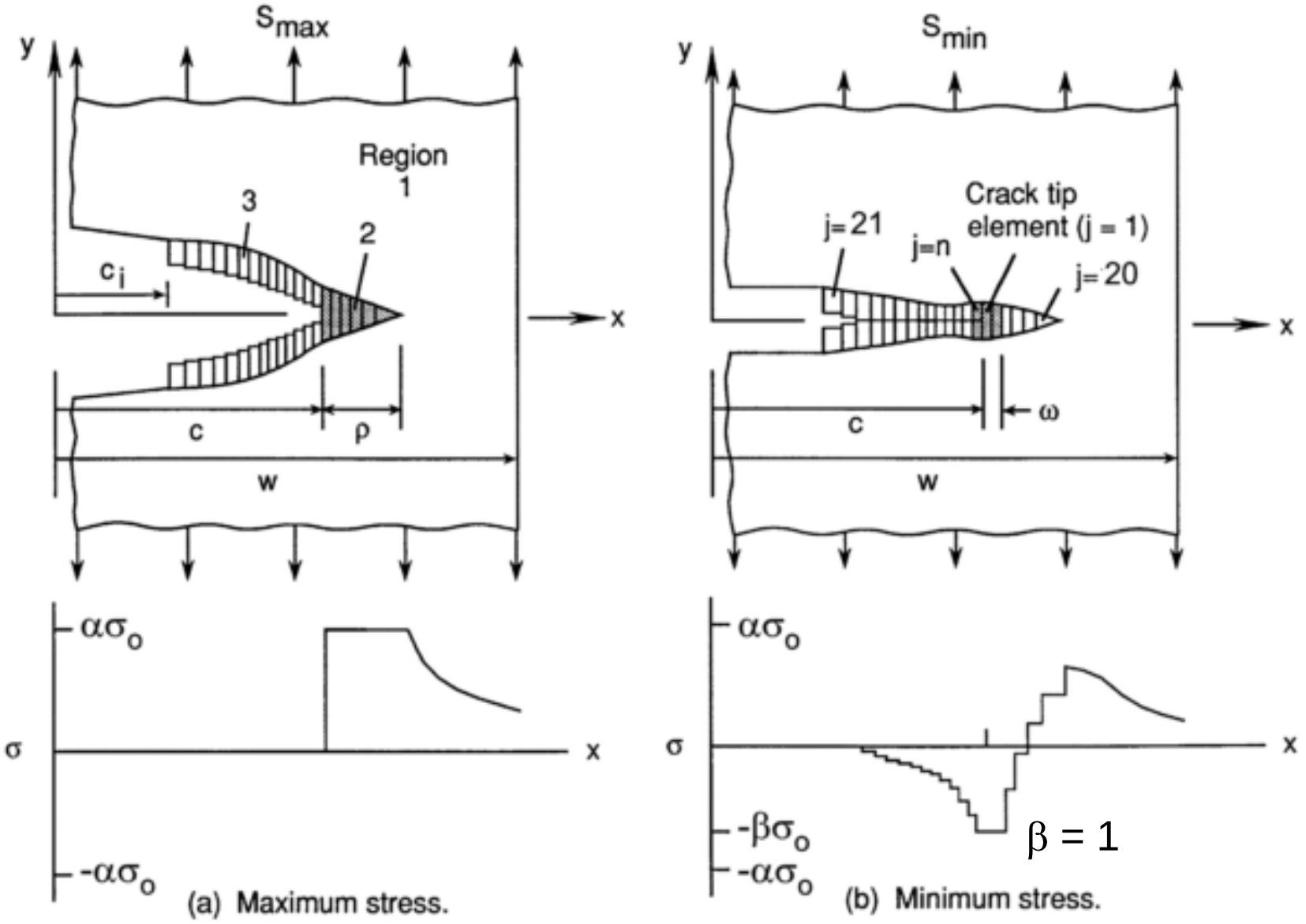
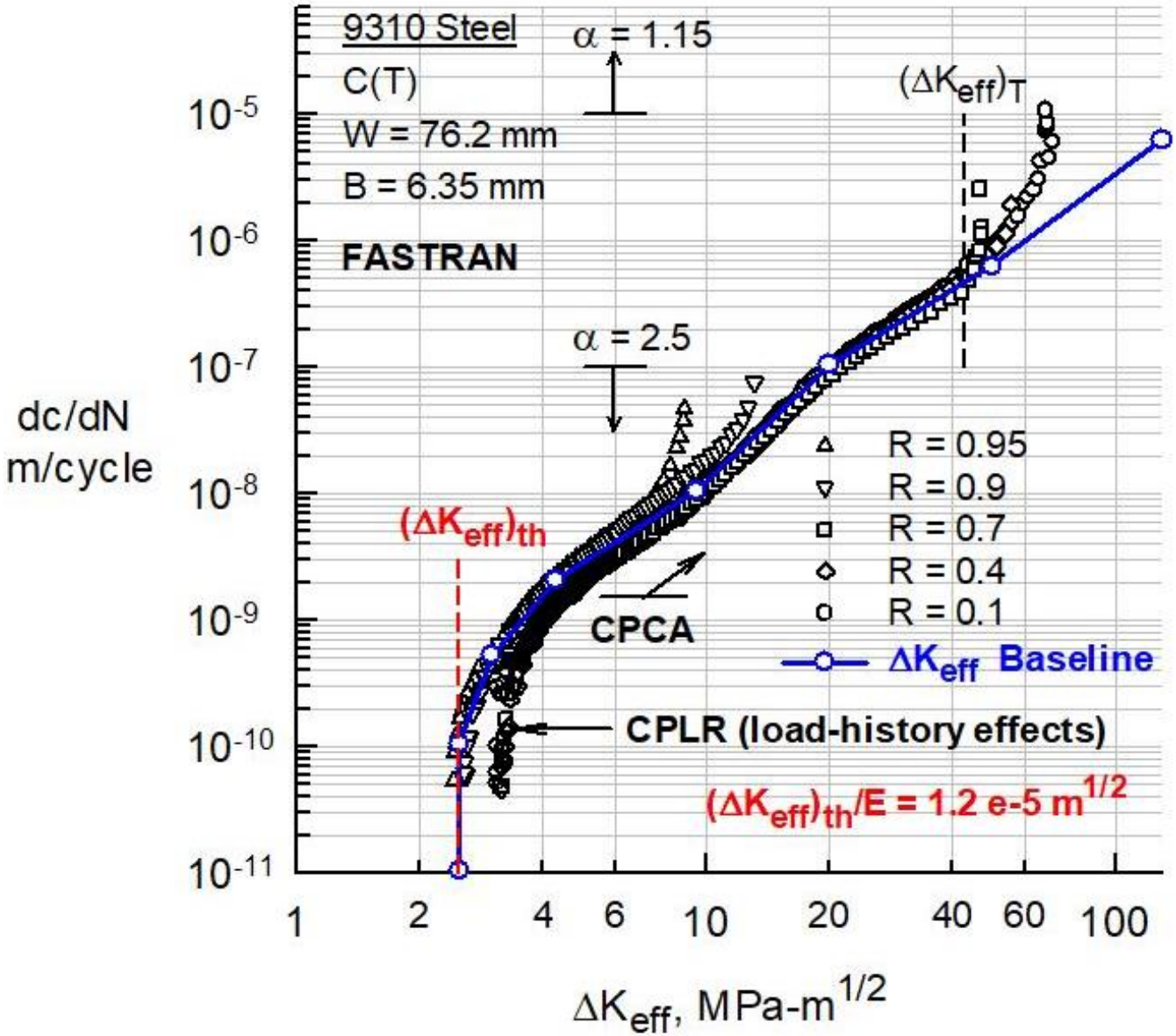
- **Fatigue-crack-growth-rate against ΔK_{eff} correlations**

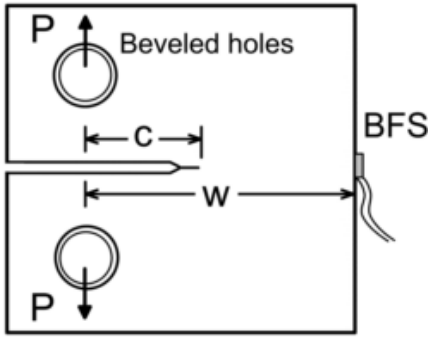
FASTRAN – Fatigue-Crack-Closure based Life-Prediction Code

1976 - Present



Effective SIF Relation for 9310 Steel Plate C(T) Specimens





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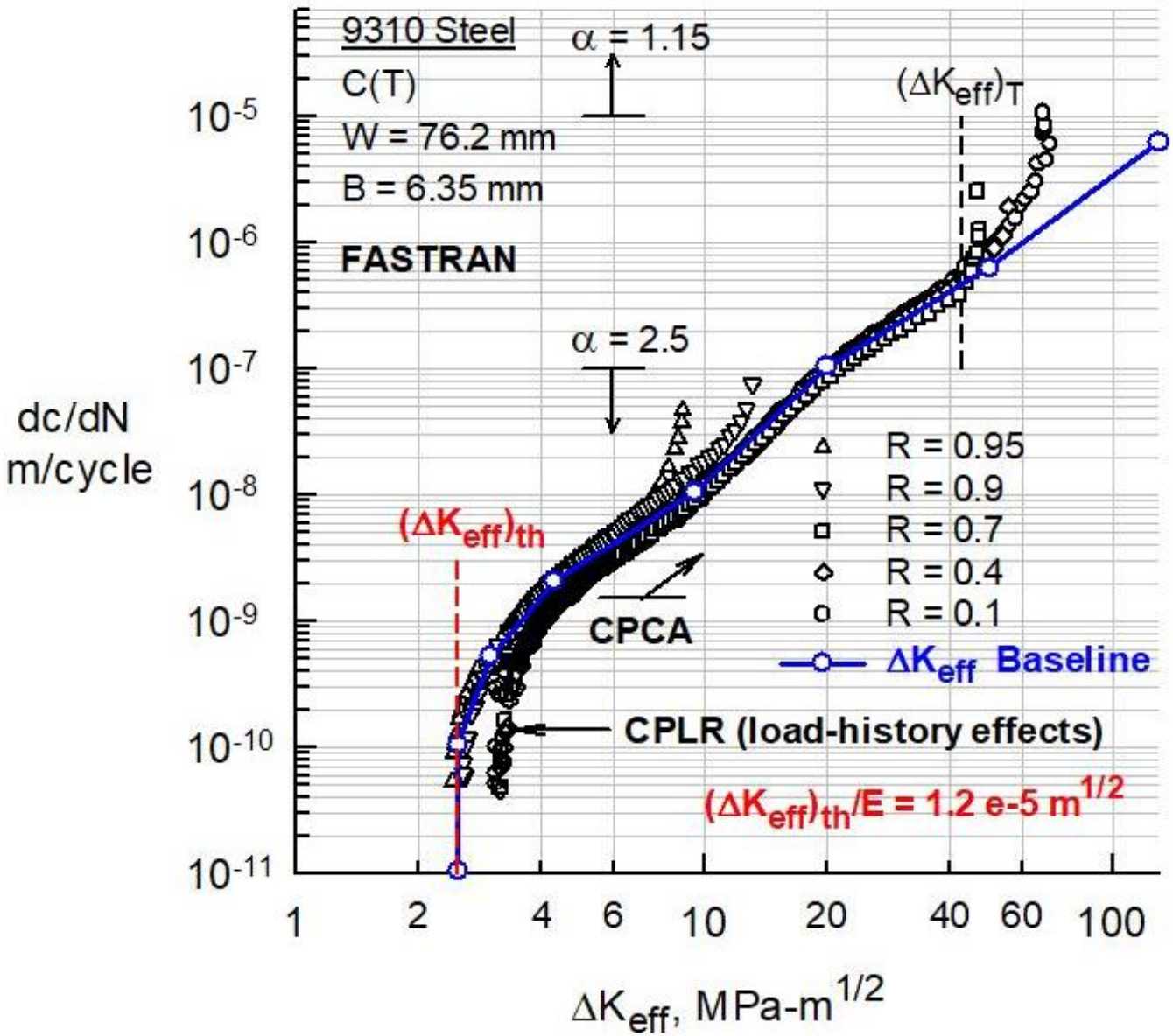
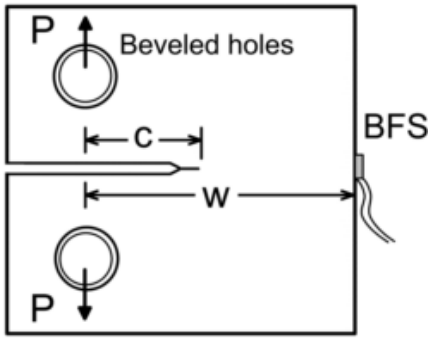


Need larger width specimens !



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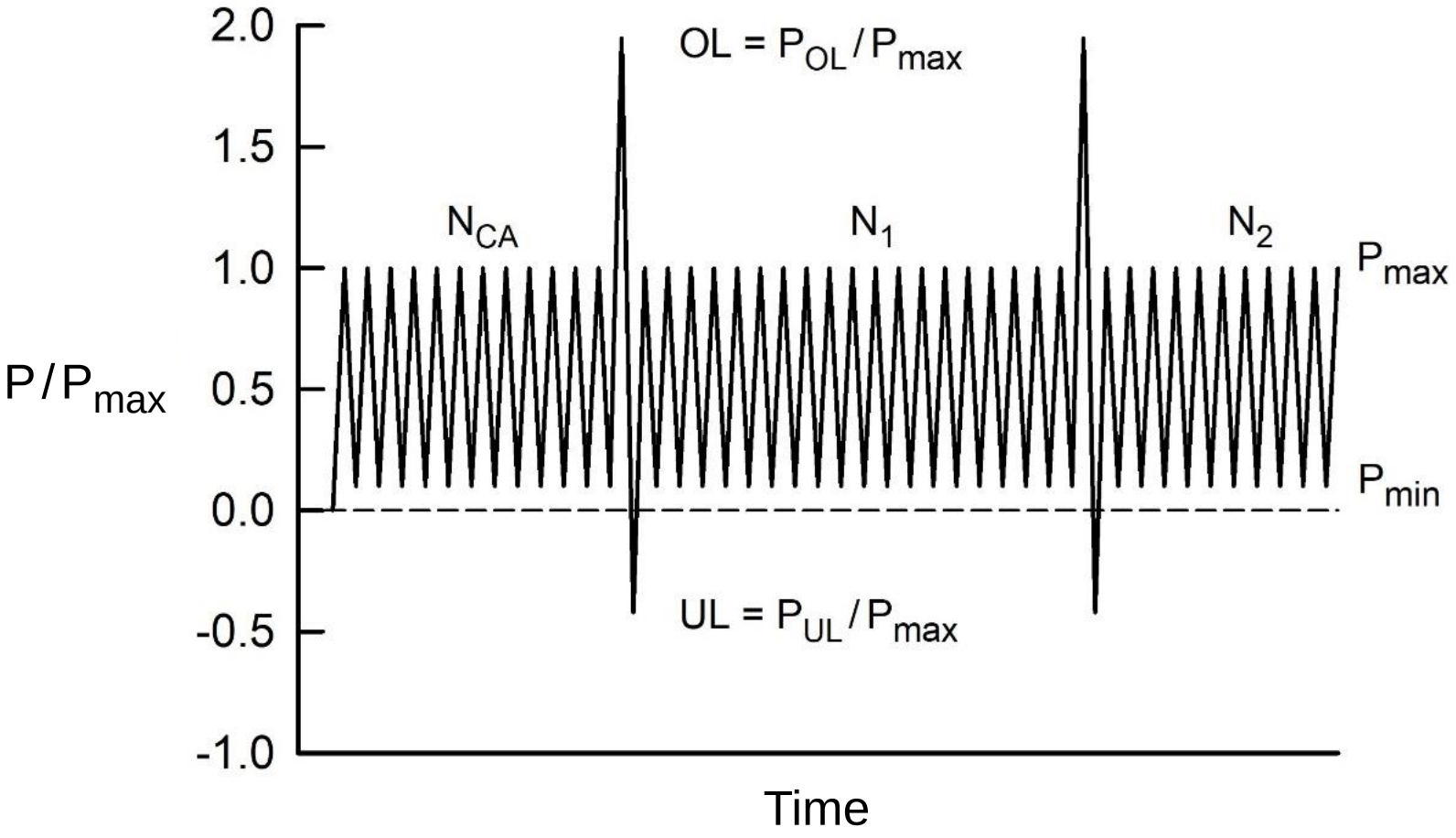
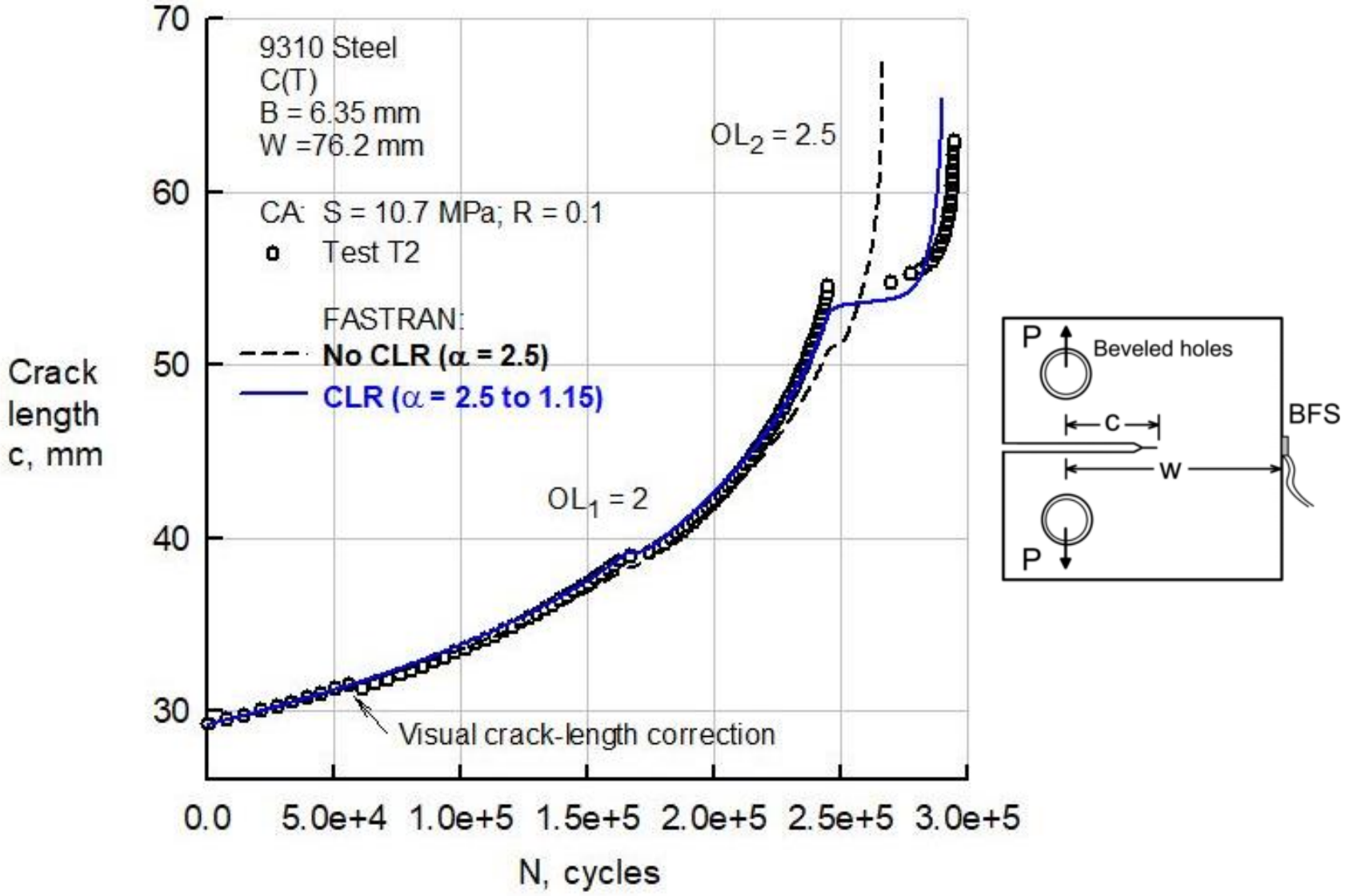
- **Single-spike overload/underload tests and analyses**
  - 9310 Steel Plate C(T) Newman et al. (2013)

Repeated Single-Spike Overload/Underload History under Constant-Amplitude Loading



Measured and Predicted Crack-Length-against-Cycles for C(T) Specimen made of 9310 Steel Plate under Repeated Single-Spike Overloads



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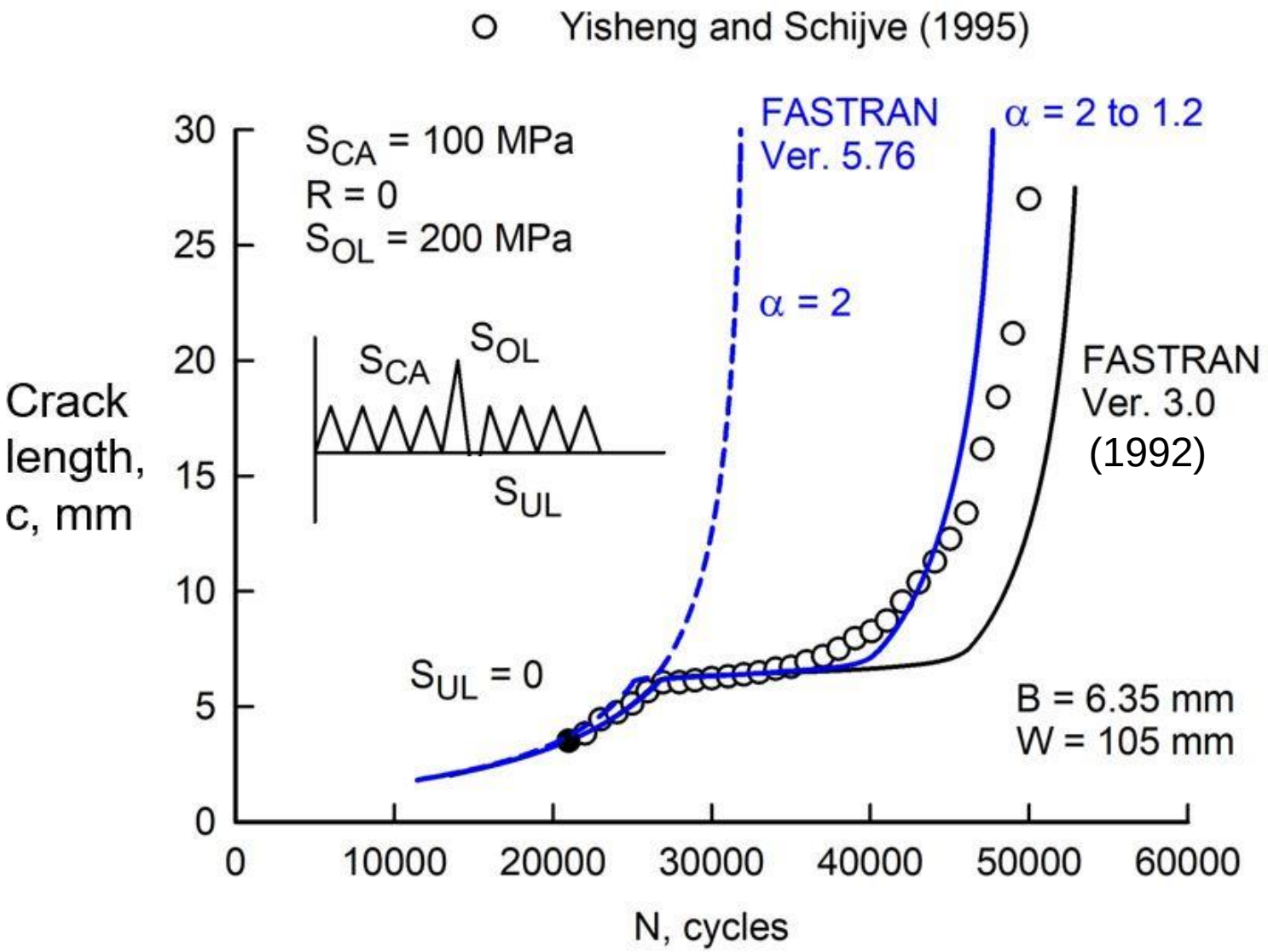
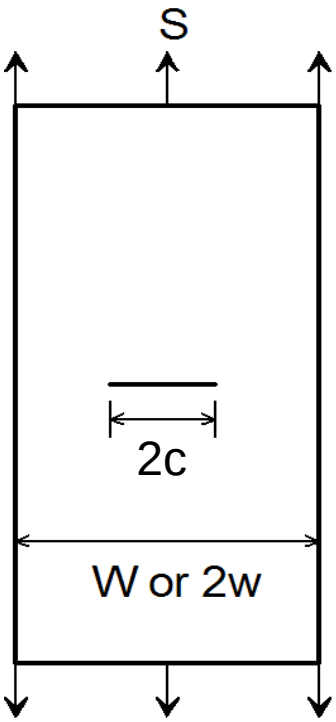
Test and Analyses of a Single-Spike Overload on 2024-T3 Plate





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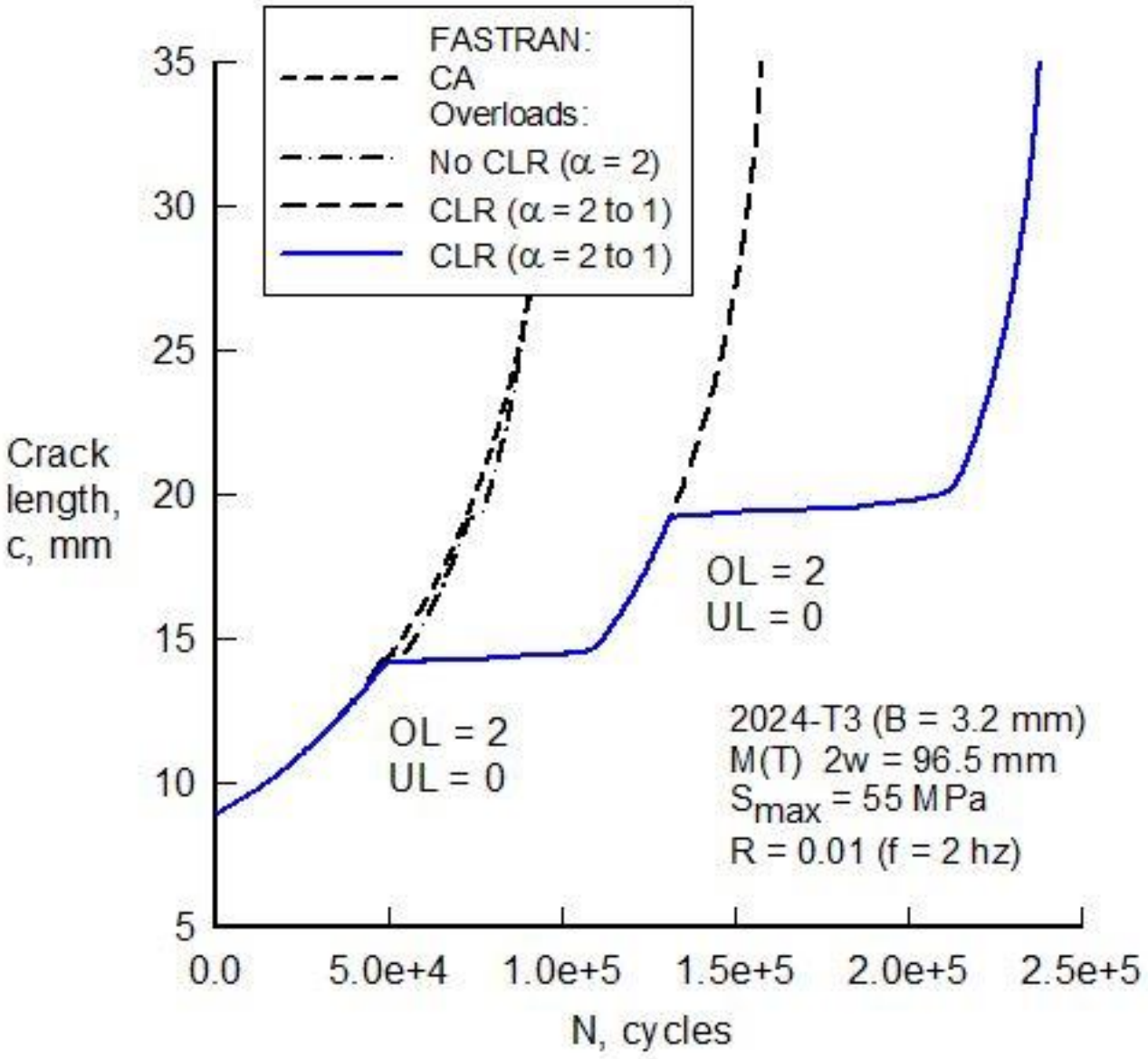
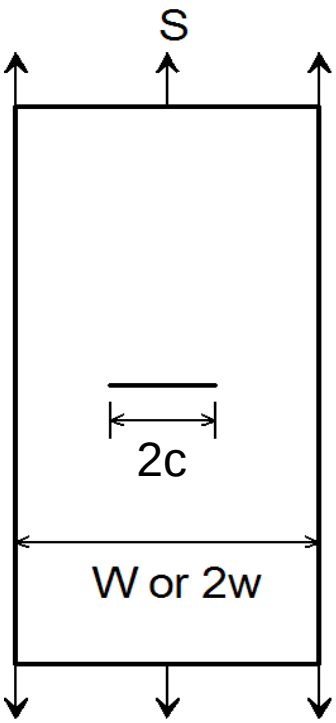
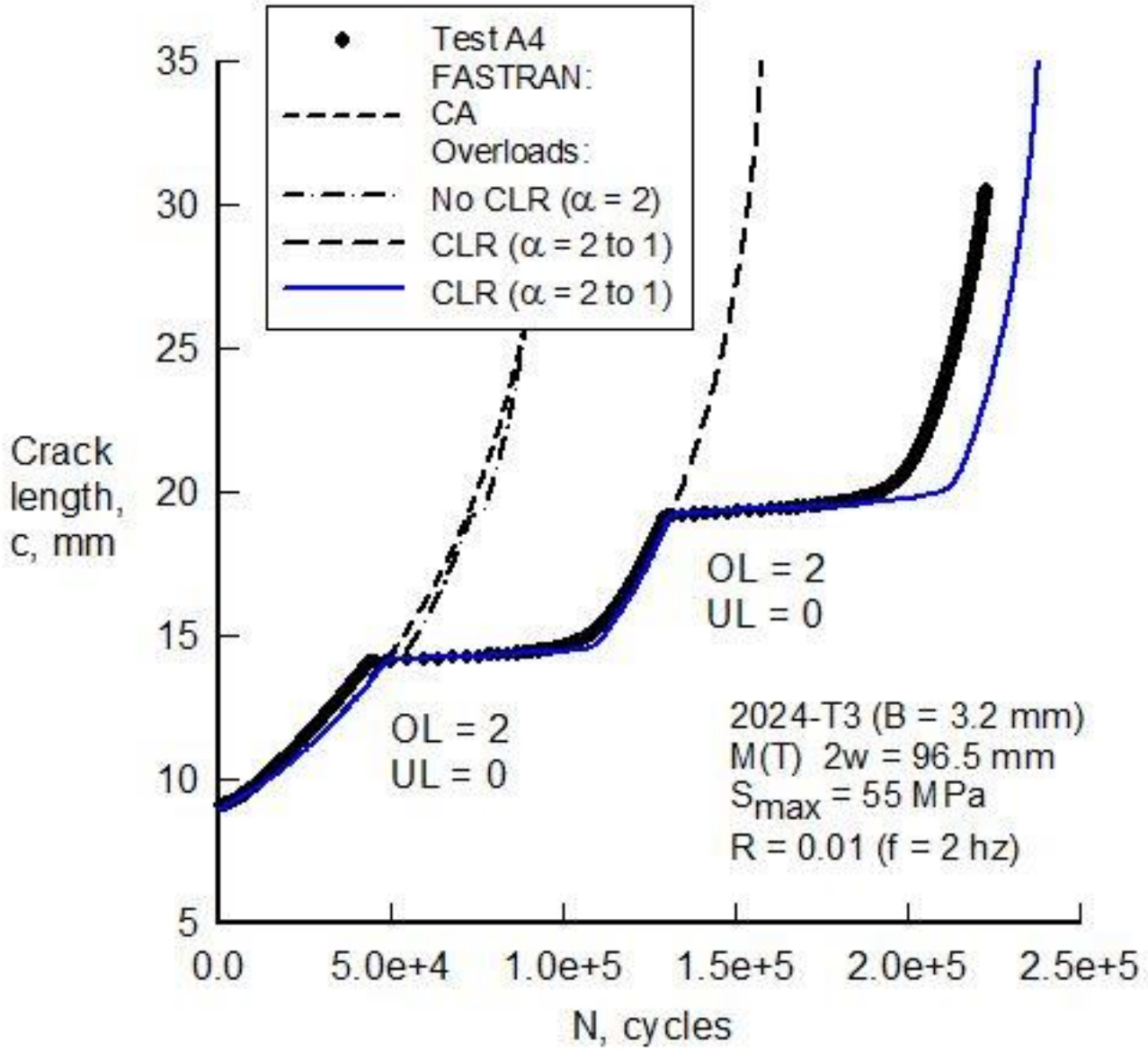
  - 2024-T3 Sheet M(T) Newman-Walker

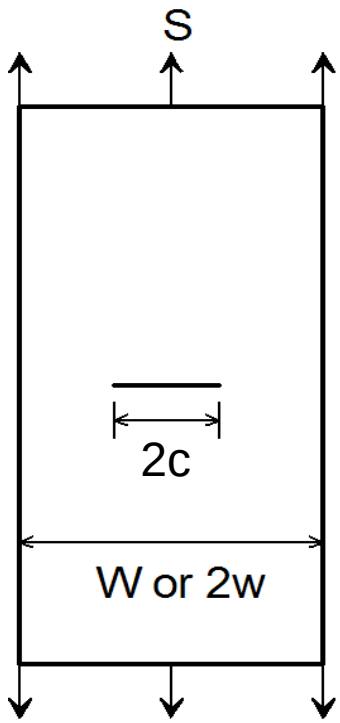
Predicted Crack-Length against Cycles under Repeated Single-Spike Overloads in 2024-T3 Sheet





Measured and Predicted Crack-Length against Cycles under Repeated Single-Spike Overloads in 2024-T3 Sheet





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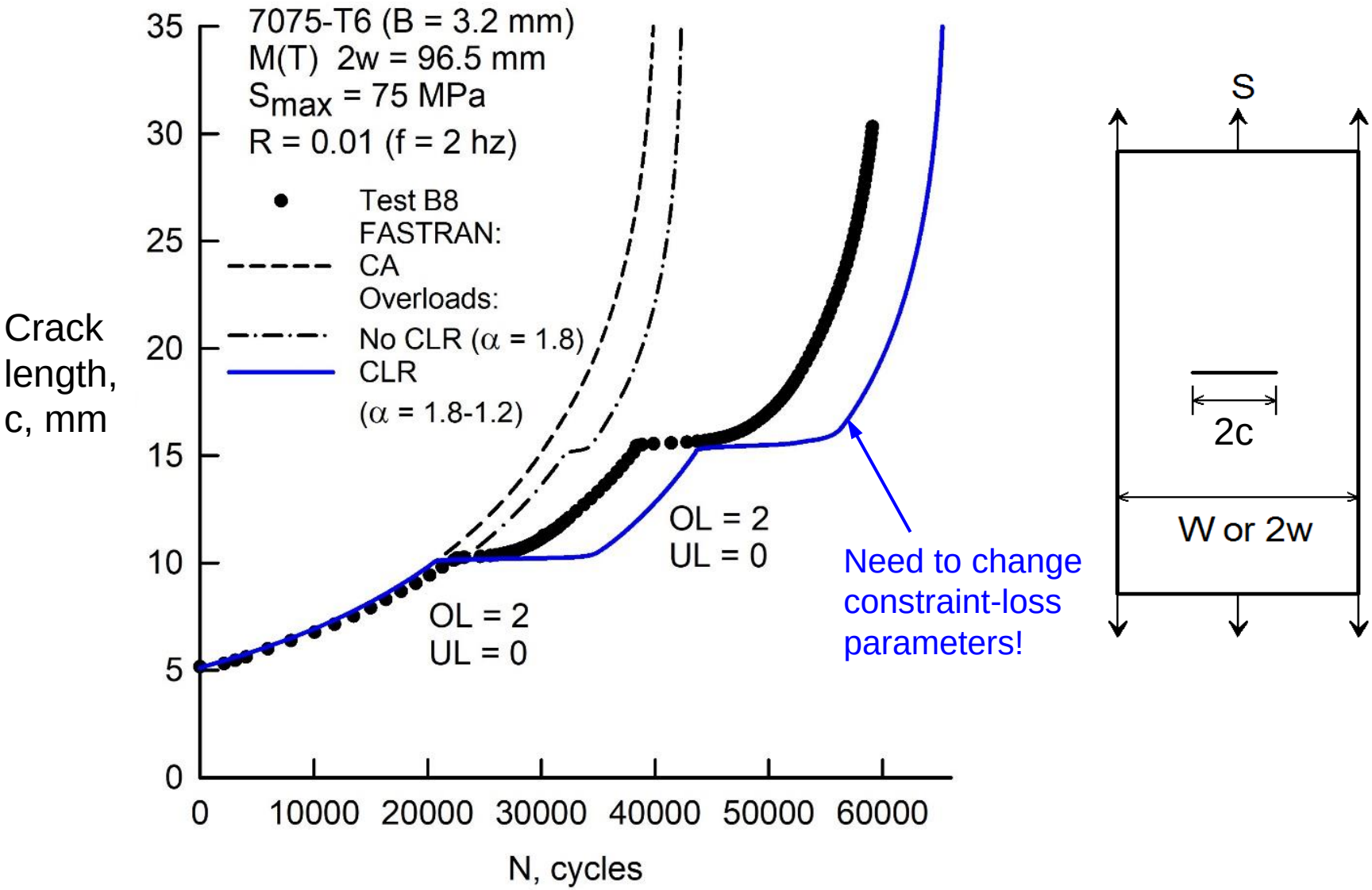
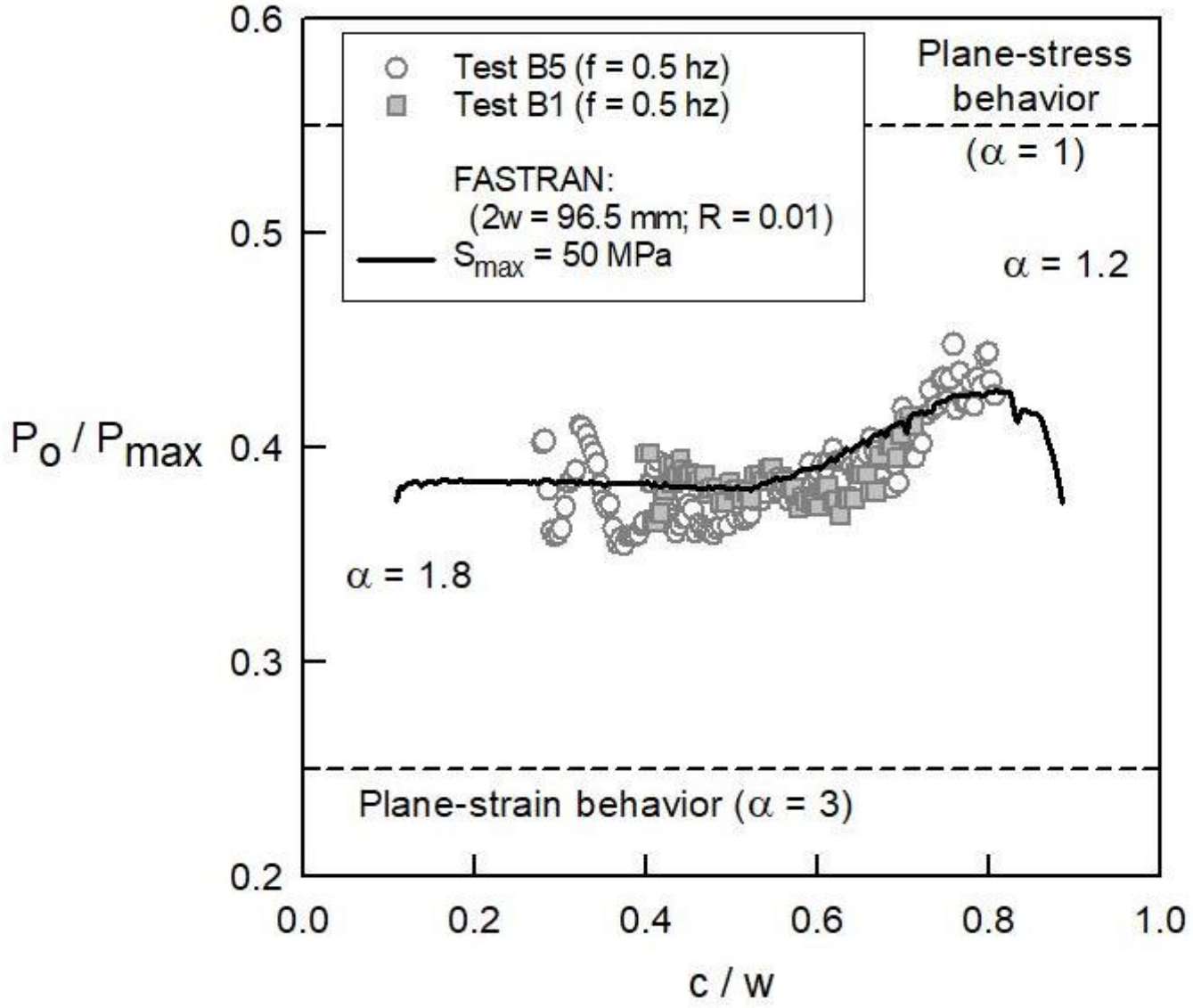
  - 2024-T3 Sheet M(T) Newman-Walker
  - 7075-T6 Sheet M(T) Newman-Walker

Measured and Predicted Crack-Length against Cycles under Repeated Single-Spike Overloads in 7075-T6 Sheet



Measured and Calculated Constraint-Loss Behavior for 7075-T6 Sheet under Constant-Amplitude Loading



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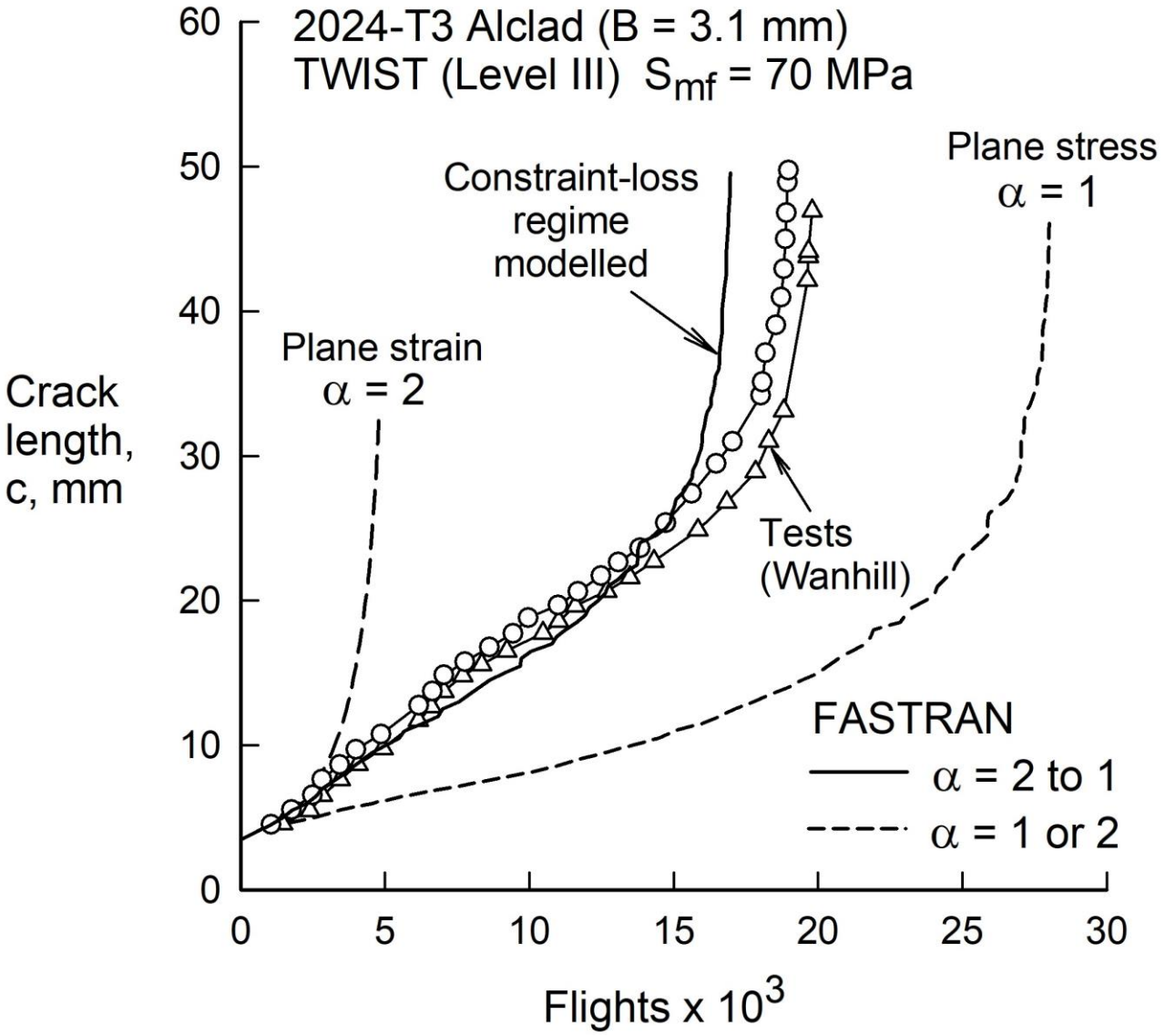
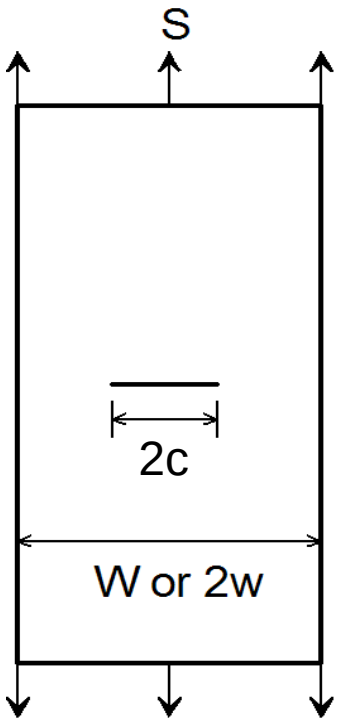
  - 7075-T6 Sheet M(T) Newman-Walker
- **TWIST spectrum crack-growth tests** (Wanhill) **and analyses**

Crack Growth under TWIST (Level III) Spectrum Loading

Wanhill (1977), Newman (1992)





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- Transition from plane-strain to plane-stress behavior (flat-to-slant crack growth) occurs at a **constant crack-growth rate** and is controlled by $\mathbf{(\Delta K_{eff})_T}$.

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Thank You, Very Much !

Questions ?