AE 737 - MECHANICS OF DAMAGE TOLERANCE

Lecture 23

Dr. Nicholas Smith

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Wichita State University, Department of Aerospace Engineering

SCHEDULE

- 19 Apr - Damage Tolerance, Homework 8 Due
- 21 Apr - Exam 2
- 26 Apr - Exam Solutions, Damage Tolerance
- 28 Apr - SPTE, AFGROW, Finite Elements
- 3 May - Finite Elements
- 5 May - Non-Destructive Testing, Composites, Final Project Due May 10

1. special topics
2. damage tolerance
3. inpsection cycle

SPECIAL TOPICS

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- Damage in composite materials
- AFGROW
- Composite certification
- Other questions?

DAMAGE TOLERANCE

DEFINITIONS

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    - Inspection cycles are set such that we can be sure crack will not become critical during regular operation

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- **Operating load** stress spectrum (used for crack propagation/fatigue)

- Single load path - safe life

STRUCTURAL CATEGORIES

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- Multiple load path - externally inspectable
- Multiple load path - inspectable prior to failure

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SINGLE LOAD PATH - SAFE LIFE

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- This often requires replacing parts pre-maturely

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- Many times this damage can be repaired to avoid replacing the part entirely
- Ideal for large, expensive parts that are easy to access (inspection and repair)

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- Secondary structure can be inspected to observe damage in primary structure

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- Otherwise same as externally inspectable structure

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  1. Determine loading cycle (or equivalent load cycle using Boeing method)
  2. Determine maximum crack length
  3. Determine initial assumed crack length (minimum detectable crack)
  4. Calculate number of cycles/flights until crack grows to maximum allowable size

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$$\sum_i (z\sigma_{max})_i^p N_i = (S)^p \tag{23.1}$$

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- Crack growth becomes unstable in Region III

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- Radiographic (X-Ray, nearly any material)

CALCULATE CYCLES

- We can integrate (analytically or numerically) to find the number of cycles it will take for a crack to grow to critical length

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- ΔN should be small enough to give converged solution

EXAMPLE