AE 737 - MECHANICS OF DAMAGE TOLERANCE

Lecture 26

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Wichita State University, Department of Aerospace Engineering

SCHEDULE

- 5 May - Repair, NDT
- 10 May - Final Project Due by 5:00 pm

SKUNK WORKS TALK

- Friday, May 6
- 12:00 - 1:00 pm
- Shocker Hall Multipurpose Room - Honors College
- Pizza (first-come first-served)

Figure 1: LASRE on top of SR-71 Blackbird

OUTLINE

1. repairing cracked structures

2. group problems

REPAIRING CRACKED STRUCTURES

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- Some new techniques attempt to change direction of crack growth

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- Adhesives add less weight, do not introduce new damage, but it can be difficult to ensure the integrity of the bond in-service

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- Fastener is replaced with a larger fastener, appropriate to the drilled hole

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- After years of life, more advanced analysis is usually available
- Sometimes repair and load reduction are not necessary if initial design is found to be overly conservative

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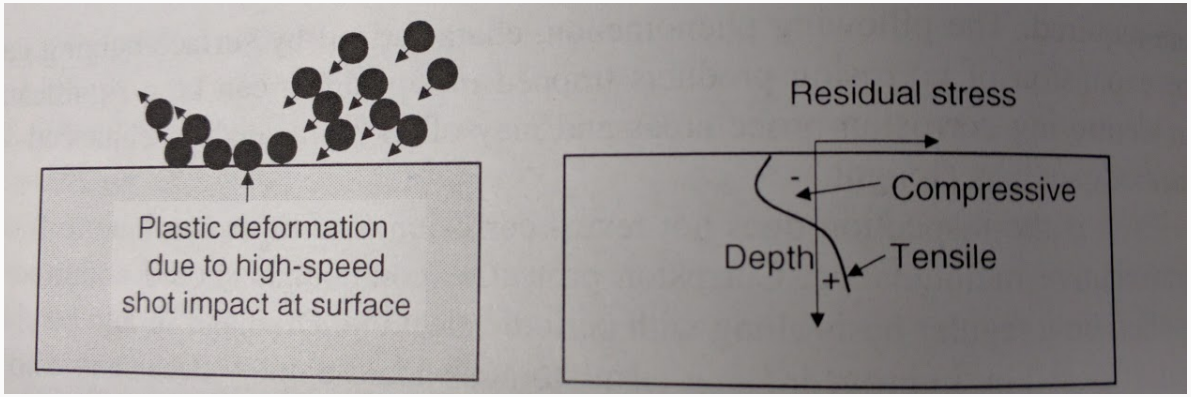
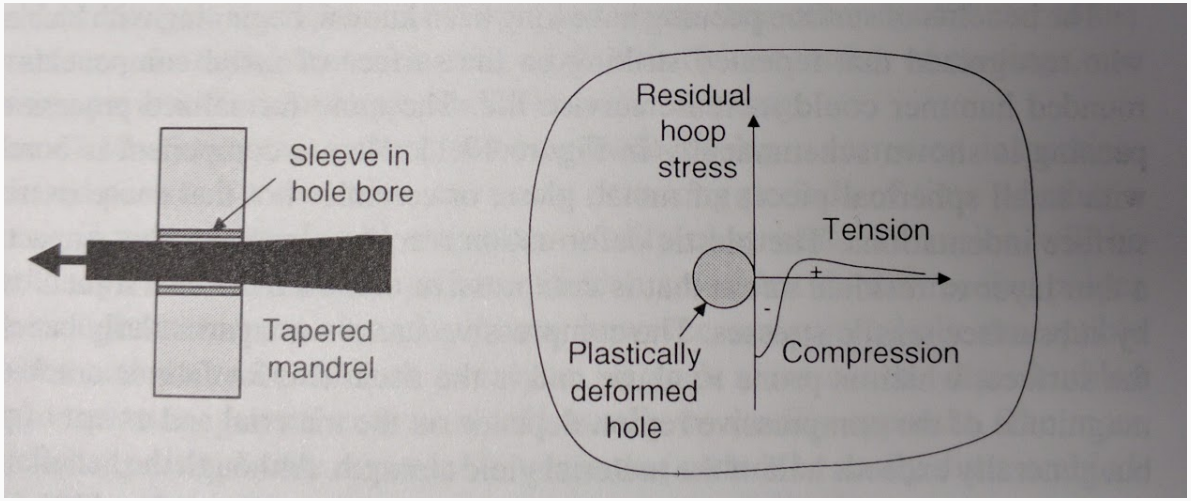
- Laser shock peening
- Hole cold-working

SHOT PEENING



HOLE COLD WORKING



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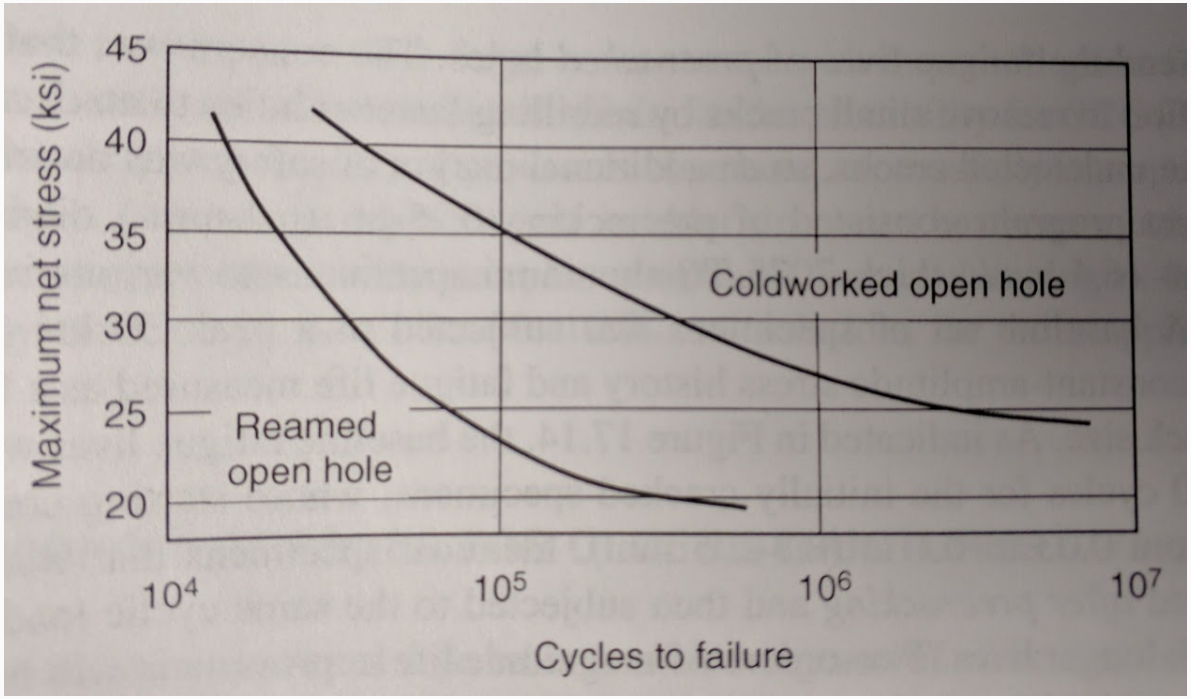

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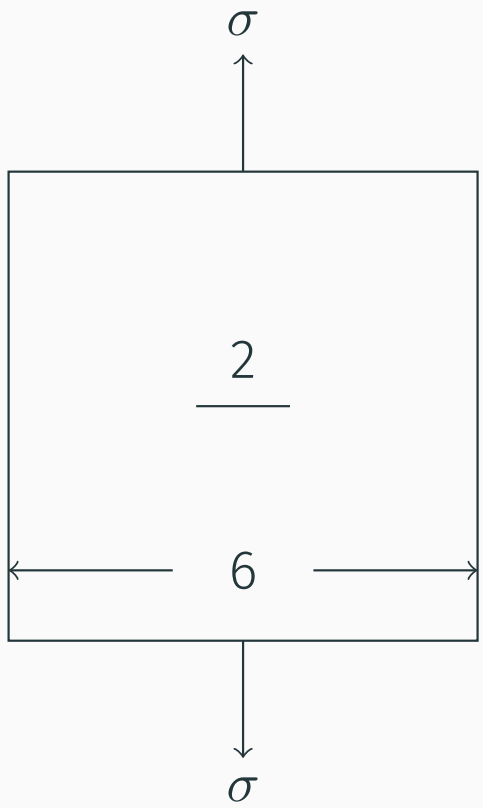
- Is multiple site damage a concern?
- Fracture vs. net section yield
- Can we reduce K_{max} below K_{th} with residual stresses?

GROUP PROBLEMS

GROUP 1

- Compare the effectiveness of stop drilling in 2024 and 7075 for the following panel.
- For 2024 use $K_c = 125\ \text{ksi}\sqrt{\text{in}}$ and $\sigma_{YS} = 50$ ksi
- For 7075 use $K_c = 60\ \text{ksi}\sqrt{\text{in}}$ and $\sigma_{YS} = 70$ ksi
- Recall $\beta = \sqrt{\sec(\pi a/W)}$



GROUP 2

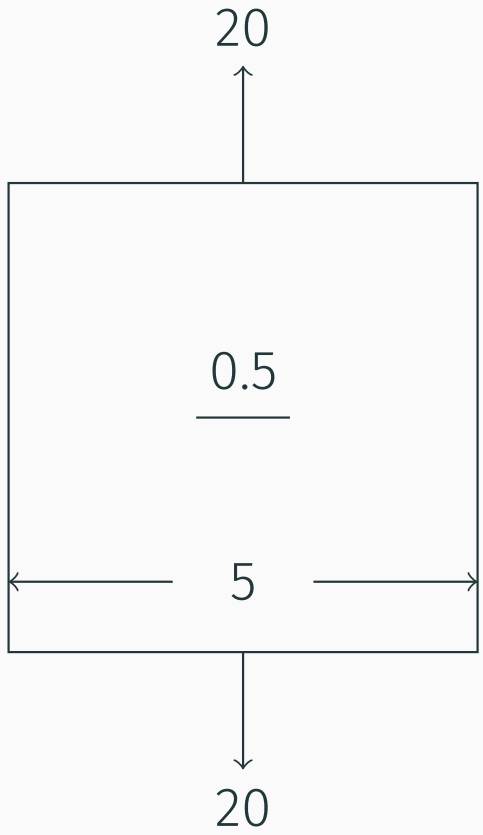
- Due to MSD concerns, we would like to alter a crack path by 15°.
- What stresses would need to be added to a 15 ksi tensile load to accomplish this?
- Note: Assume for this problem that $\beta' = \beta$
- Recall

$$K_{II} = \tau\sqrt{\pi a}\beta'$$

$$K_I \sin\theta_p + K_{II}\left(3\cos\theta_p - 1\right) = 0$$

GROUP 3

- Compare the amount of residual compressive stress needed stop crack growth for Al 2024 and Al 7075 in the following panel.
- Assume $K_{th} = 4$ ksi$\sqrt{\text{in}}$ for Al 2024
- And $K_{th} = 7$ ksi$\sqrt{\text{in}}$ for Al 7075



GROUP 4

- Due to damage, an airline decides to move an aircraft to a less strenuous flight cycle.
- Find the effective load for a flight cycle that will last at least 1000 flights for the following cracked panel.
- Note: use $p = 4$ and $M_t = 25.8$
- Assume $K_c = 60$ ksi$\sqrt{\text{in}}$ and $\sigma_{YS} = 70$ ksi
- The largest load of 20 ksi occurs during takeoff and will not change with flight cycle.