

FATIGUE

- Fatigue Strength and Endurance**
- S-N Curves**

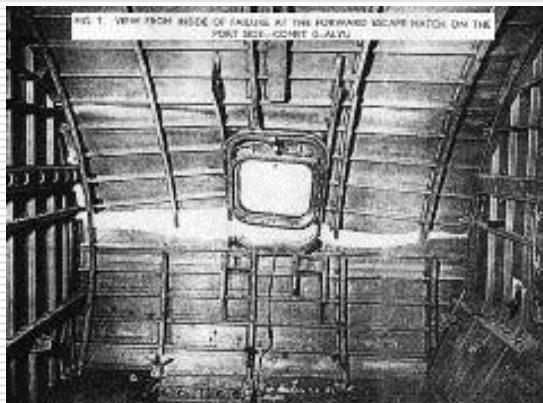
Examples of Fatigue



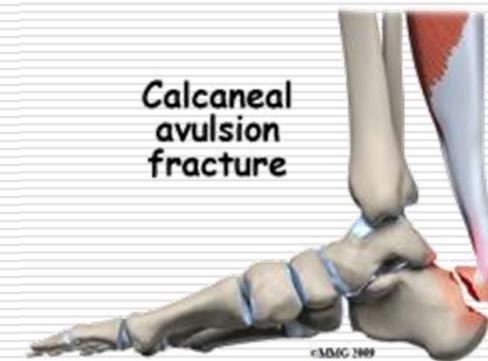
Aerospace Examples of Fatigue



Courtesy of www.aloha.net



Biomedical Examples of Fatigue



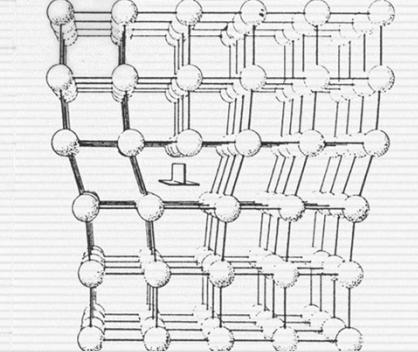
Energy Examples of Fatigue



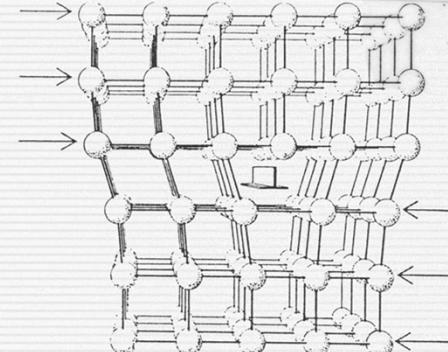
Stages of Fatigue Fracture

Initiation

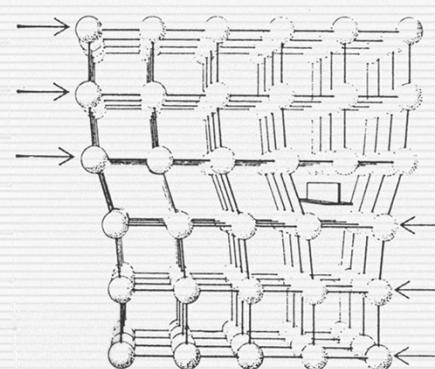
- Most Complex**
- Most Studied**
- All Materials have Flaws**



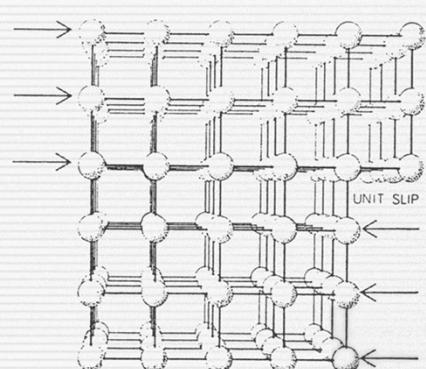
**Edge Dislocation Imperfections
In crystalline structure**



**Repetitive Shear Forces cause Flip in
Atomic bonds that make Dislocations Jump**

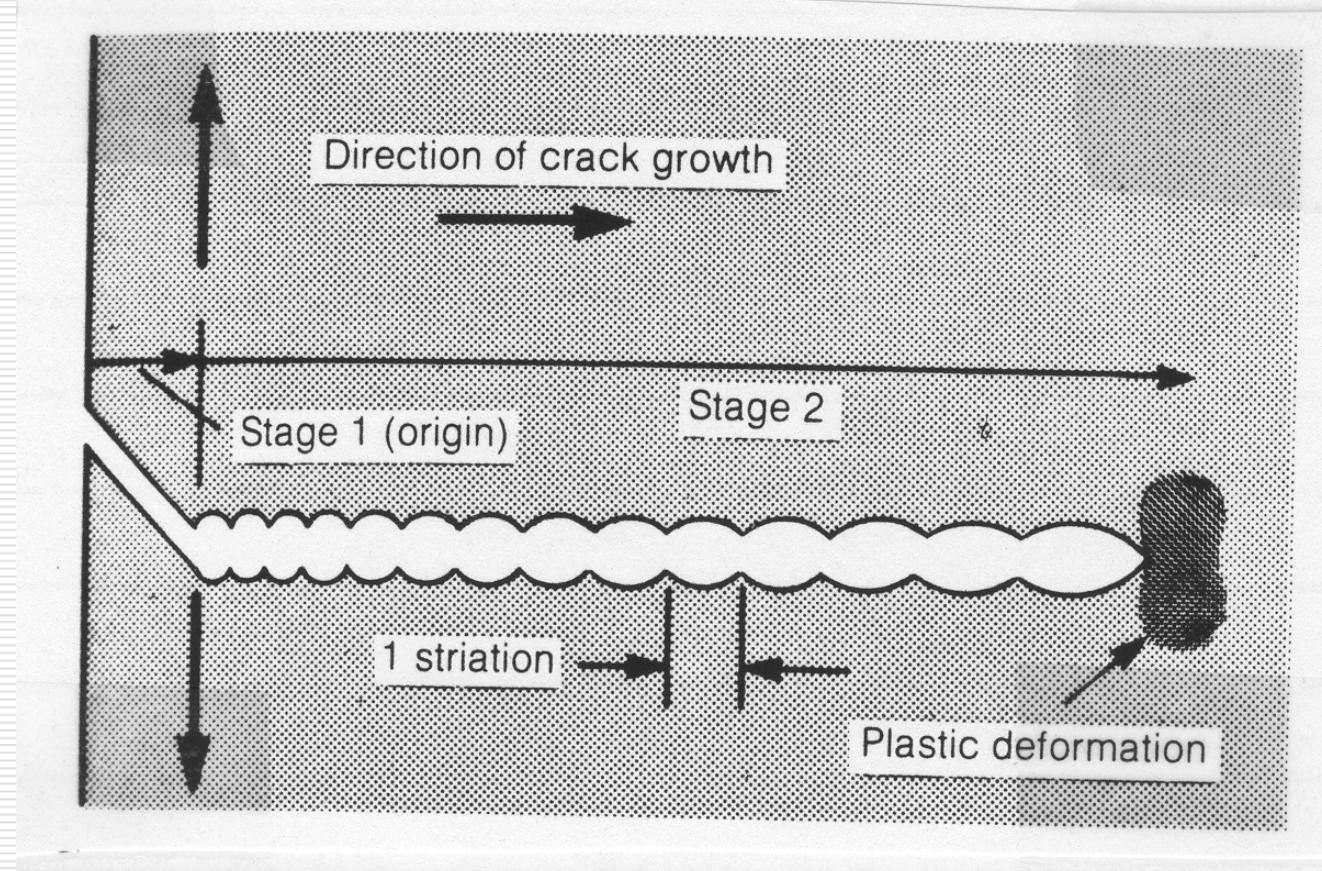


**Continued Loading Moves
Dislocations to the Edge**



**Dislocations Join
to Form Microcracks**

Stages of Fatigue Fracture Propagation



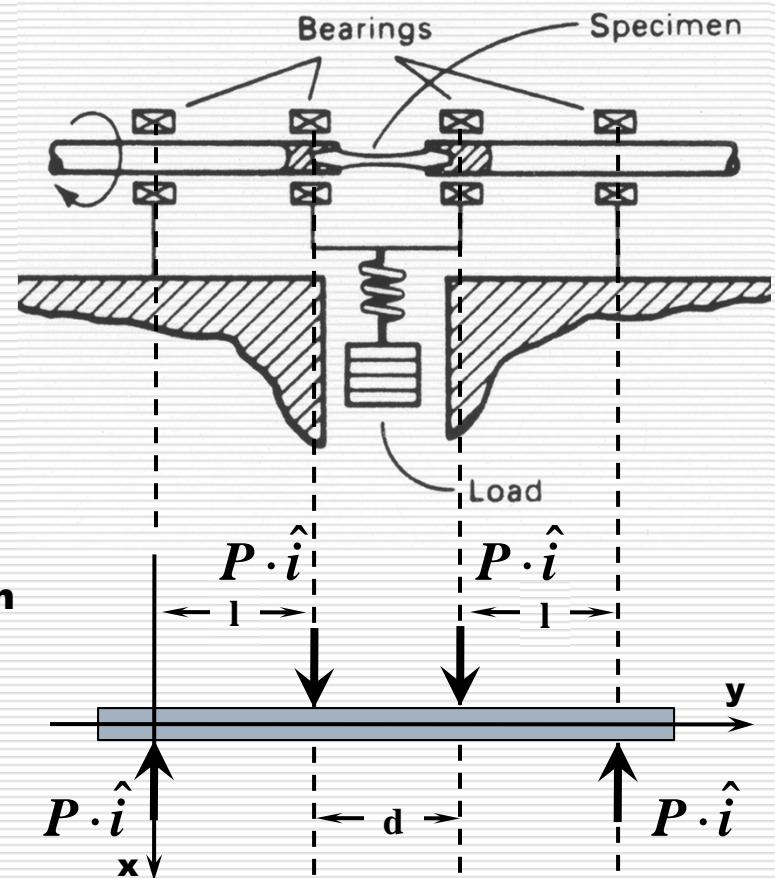
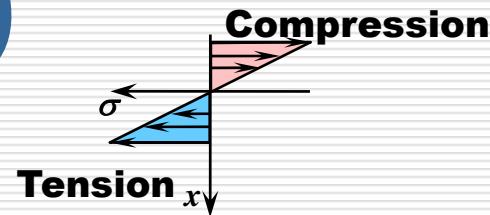
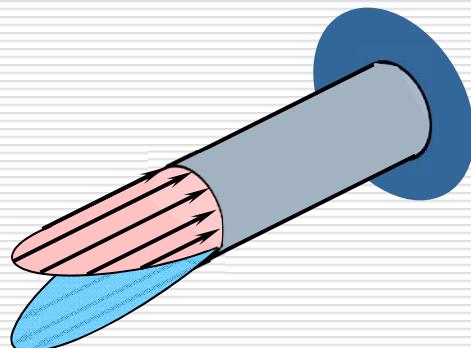
Stages of Fatigue Fracture

Rupture

- Crack Propagates to Final Failure**
- Perspectives**
 - Phenomenological**
 - Fracture Mechanics**

Fatigue Strength and Endurance Limits

- Repeated or varying loads
- Specified Magnitude
- R.R. Moore Machine

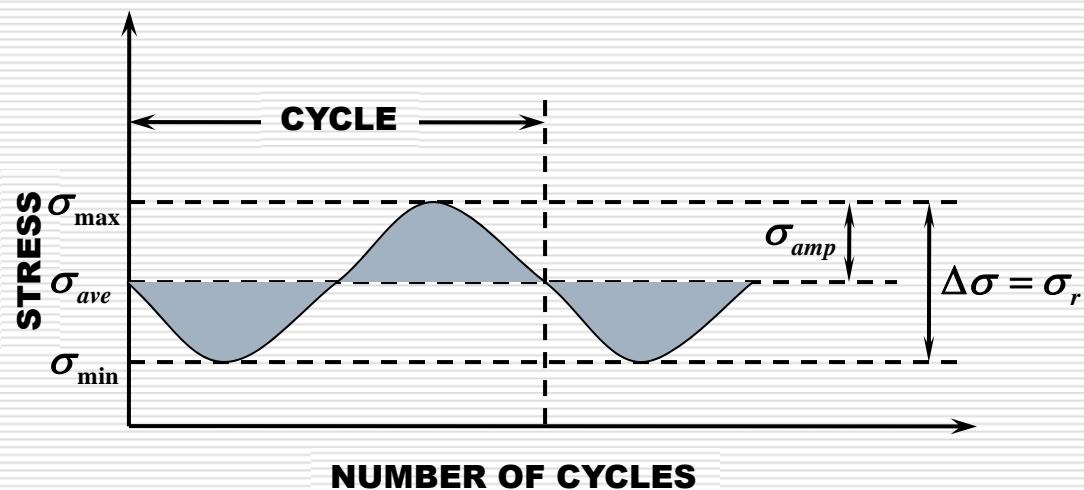


Fatigue Terminology

□ Stress Ratio

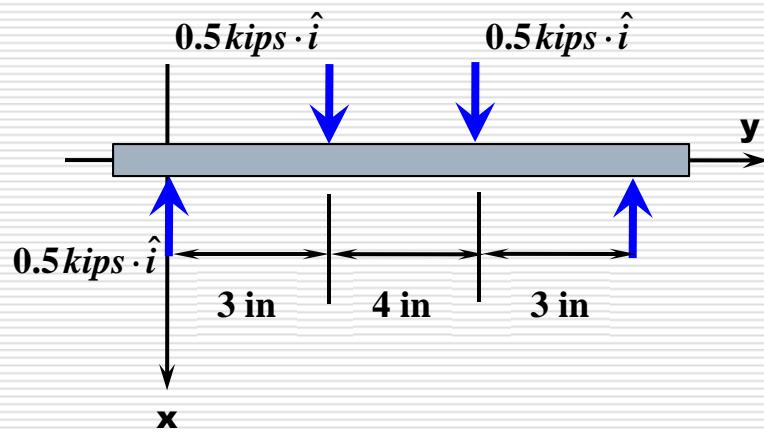
$$A = \sigma_{amp} / \sigma_{ave}$$

$$R = \sigma_{min} / \sigma_{max}$$



Example #1

- For the beam below determine
- Stress ratio
 - Mean stress
 - Stress range
 - Stress amplitude

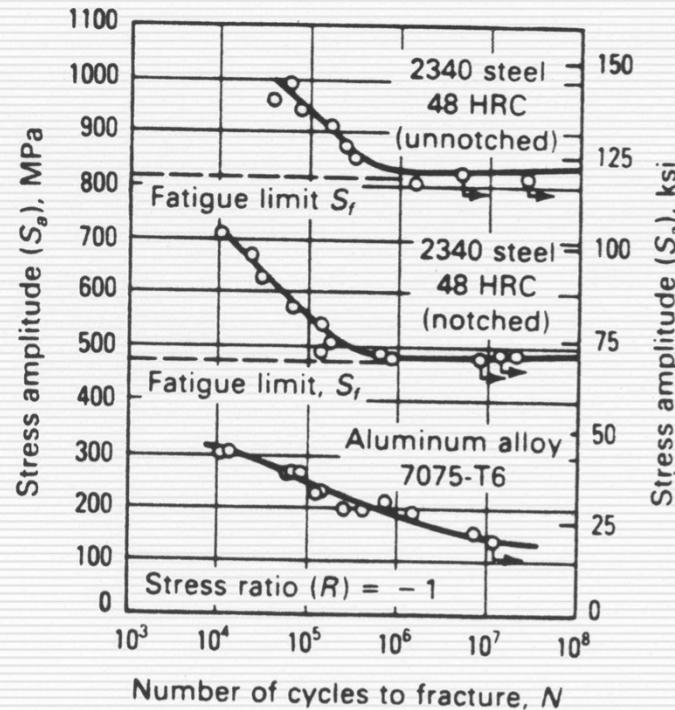


$$r = 0.564 \text{ in.}$$

$$I = \frac{\pi \cdot d^4}{64}$$

S-N Curves

□ Results of a fatigue test



Scales used

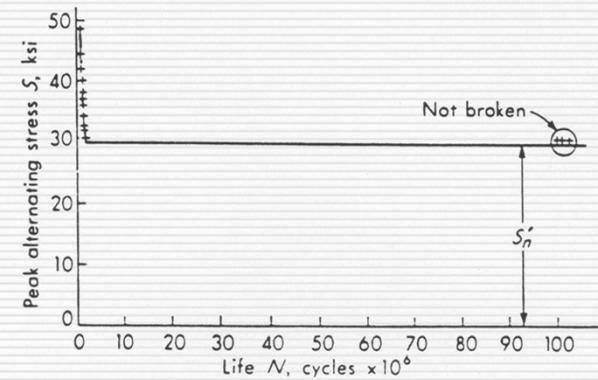


Fig. 11.4 Table 11.1 data plotted on linear coordinates.

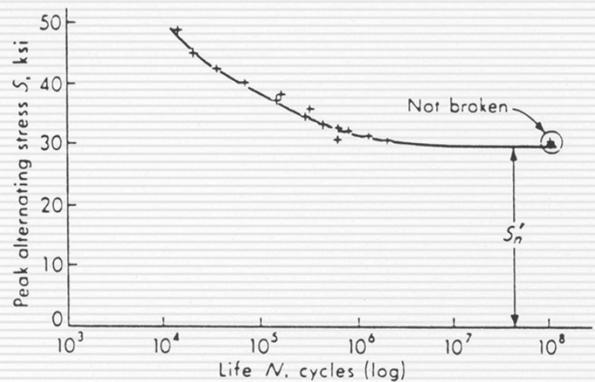


Fig. 11.5 Table 11.1 data plotted on semilog coordinates.

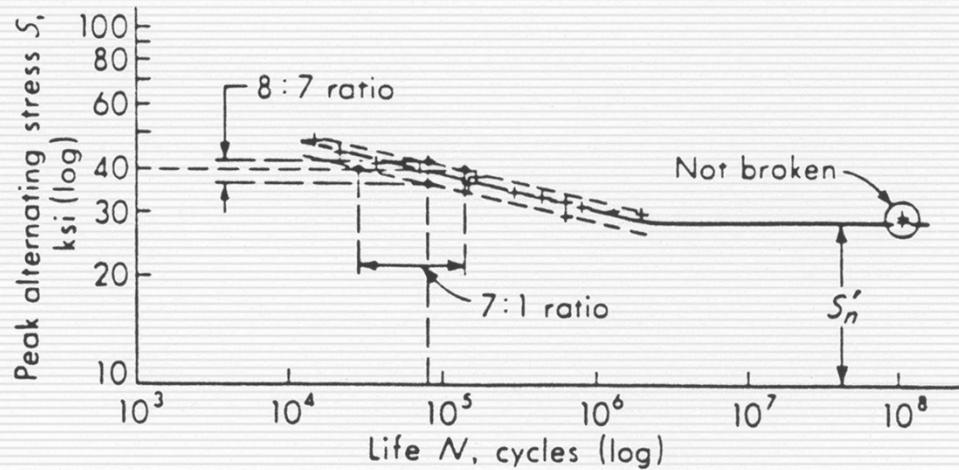
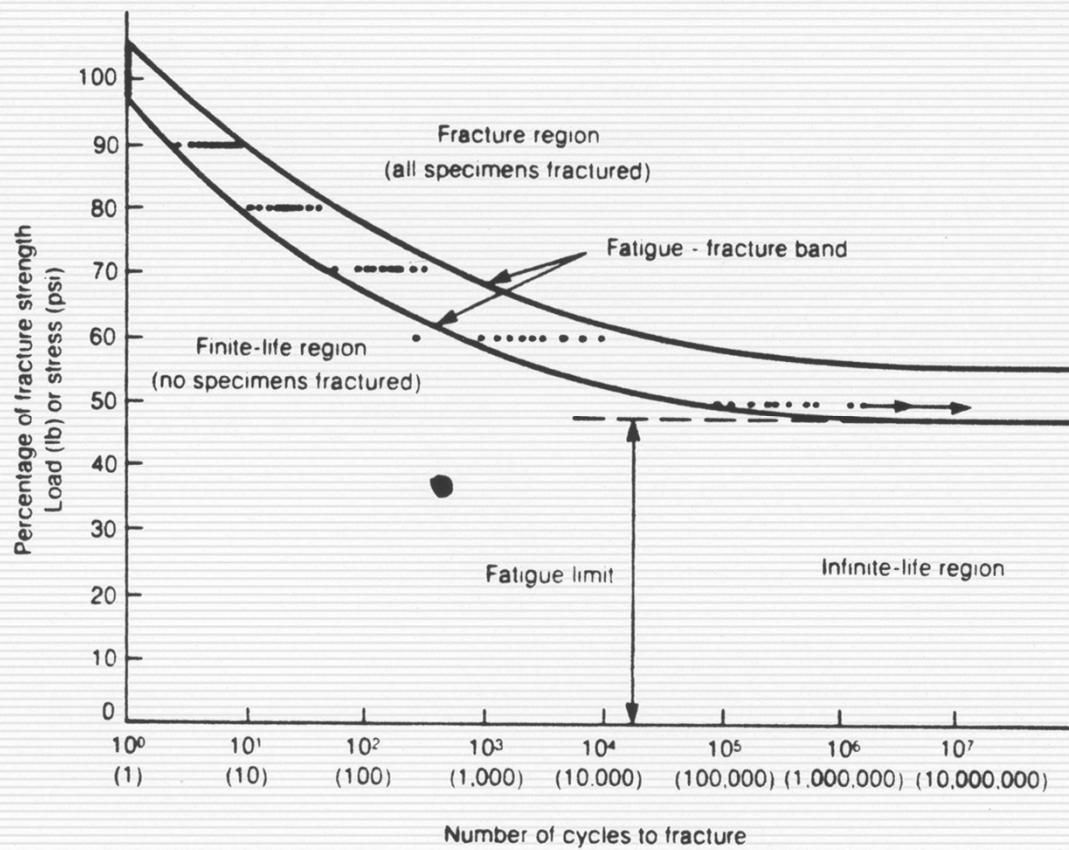


Fig. 11.6 Table 11.1 data plotted on log-log coordinates.

Fatigue Strength and Endurance Limit



Material Behavior

