Solving fatigue problems

Like static failure theories, fatigue failure requires that you provide the following two critical pieces of information.

Strength properties

Applied Stresses

Computing the strength of the material requires that you know the answers to the following questions

What material is being used

Sut Sy

What kinds of surface finish is on the component

k_{surface}

What reliability needs to be designed into the component

k_{reliablity}

What impact will sizing have on the strength

 \mathbf{k}_{size}

What effects will temperature and environment have on the strength

 \mathbf{k}_{temp}

Are there other strength reducing conditions present?

 $\mathbf{k}_{\mathsf{misc}}$

Is the design supposed to be for infinite life?

Most steels .5 * Sut @ E6 cylces

Aluminum Sut @ 5E8 cycles

Compute **fatigue strength** using the above mentioned information

Plot Goodman Diagram

Stress information

Compute **geometric properties** using nominal dimensions

Area, I Polar Moment of Inerta, J 2nd Moment of Area, I

Compute alternating and mean components of all modes of loading

M mean and M alternating (bending moments) T mean and T alternating (torques) P mean and P alternating (axial loading)

Compute alternating and mean components of all stresses using nominal geometric information

Compute Kt and q for all modes of loading; Compute Kf for all modes of loading

alternating components of all stresses get the full value of Kf mean components get varying amounts of Kf based on the following

$$if K_{f} |\mathbf{s}_{omax}| < S_{y}, K_{fm} = K_{f}$$
$$if K_{f} |\mathbf{s}_{omax}| > S_{y}, K_{fm} = \frac{S_{y} - K_{f} \mathbf{s}_{oa}}{|\mathbf{s}_{omax}|}$$
$$if K_{f} |\mathbf{s}_{omax} - \mathbf{s}_{omin}| > 2S_{y}, K_{fm} = 0$$

Compute stresses considering effects of fatigue due to stress risers

Compute von Mises alternating and mean stresses

Plot load line on Goodman Diagram and compute factors of safety

Load line mean stress remains constant, alternating stress increases alternating stress remains constant, mean stress increases

Report lowest factor of safety