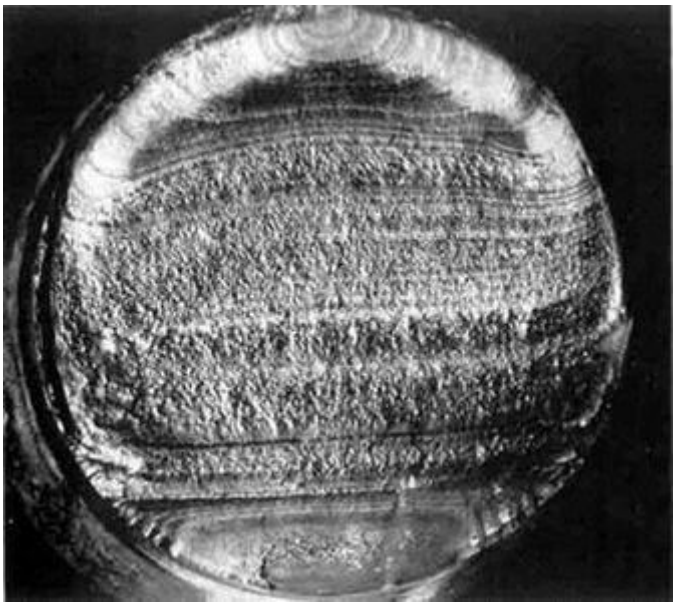
Ansys Workbench Fatigue Module

This tips & tricks article illustrates how to take into account a non-zero mean stress in an Ansys Workbench fatigue analysis.

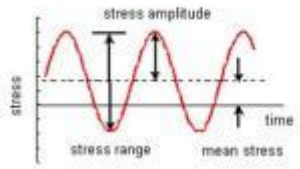


Download: Ansys Workbench Fatigue Model (*.wbpz)

Combine static and varying load in WB Fatigue Module

ANSYS WB Fatigue Module is able to solve Constant Amplitude, Non-Proportional Loading

First here are some definitions:



Stress Amplitude $S_a = \frac{S_{max\ (max)} - S_{min\ (min)}}{2}$

Mean Stress $S_m = \frac{S_{maximum} + S_{minimum}}{2} \neq 0$

Non zero mean stress loading

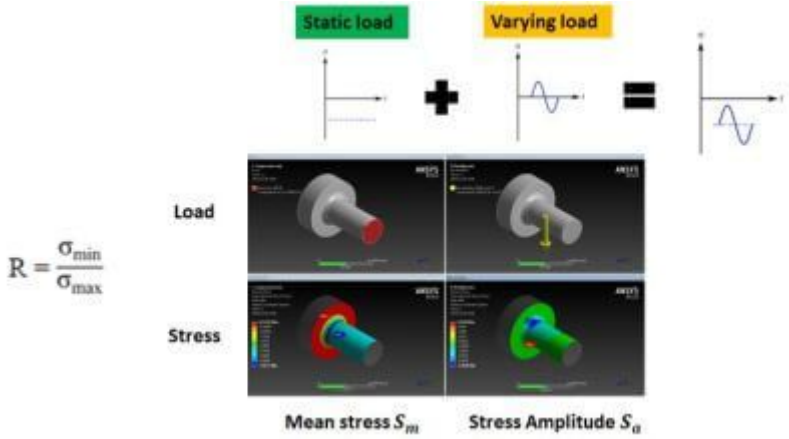
To create this fatigue solution we have to obtain the stress result for Smaximum and Sminimum

$$S_{maximum} = \frac{varying\ load}{2} + static\ load \qquad S_{minimum} = -\frac{varying\ load}{2} + static\ load$$

$$S_m = \frac{S_{maximum} + S_{minimum}}{2} \neq 0$$

Alternating bending stress R < -1

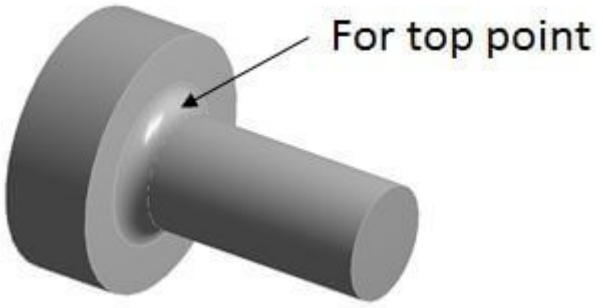
For instance we have an alternating bending stress with a mean compression stress.

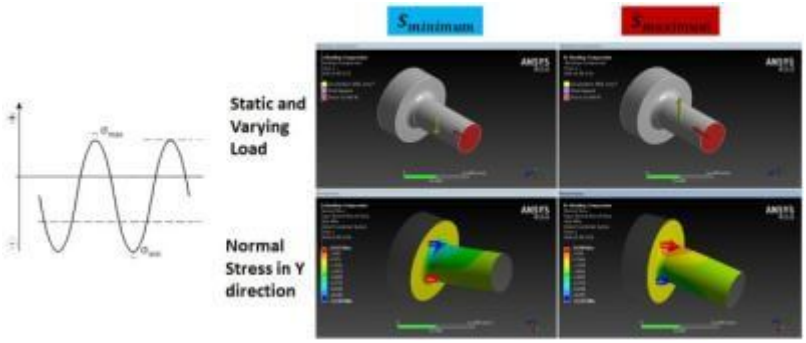


$$R = \frac{\sigma_{min}}{\sigma_{max}}$$

Smaximum and Sminimum

In Ansys Workbench we have to combine the static and alternating stress in 2 static structural solutions that will give us the Smaximum and Sminimum.





Solution Combination

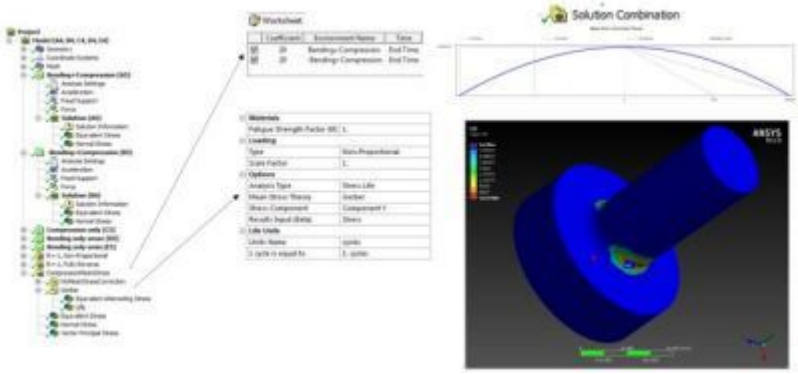
Once the maximum and minimum result is obtained we will be able to combine them into a Solution combination to allow the fatigue module calculate it.

$$S_{mean\ stress} = \frac{S_{maximum} + S_{minimum}}{2} = \frac{\left(\frac{varying\ load}{2} + static\ load\right) + \left(-\frac{varying\ load}{2} + static\ load\right)}{2} = Static\ load$$

$$S_{stress\ amplitude} = \frac{S_{maximum} - S_{minimum}}{2} = \frac{\left(\frac{varying\ load}{2} + static\ load\right) - \left(-\frac{varying\ load}{2} + static\ load\right)}{2}$$

$$S_{stress\ amplitude} = \frac{varying\ load}{2}$$

Ansys Workbench Fatigue Module Result



In the Gerber mean stress correction theory, the compression mean stress has a penalizing impact on the fatigue life of the part.

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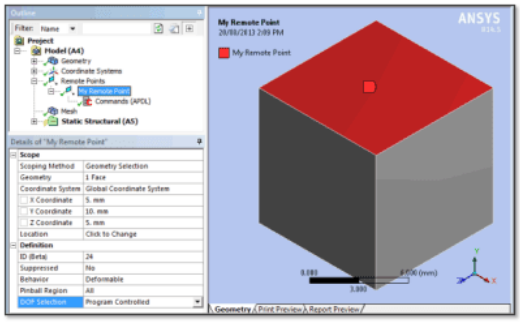

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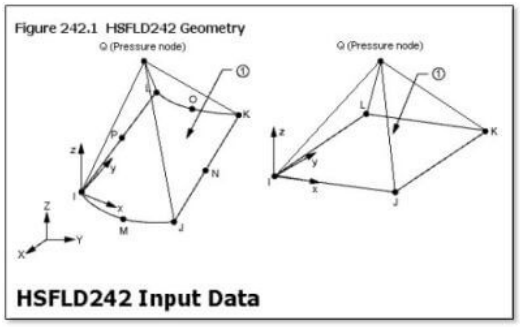

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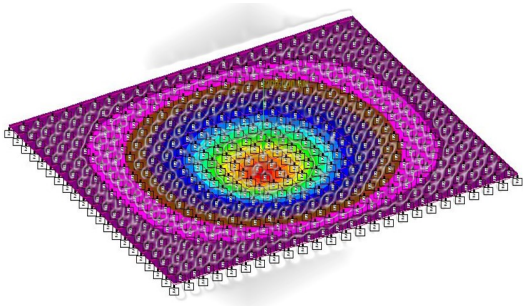

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