

Experiences from fatigue assessments

Sandra Thorén



SCANIA

Contents

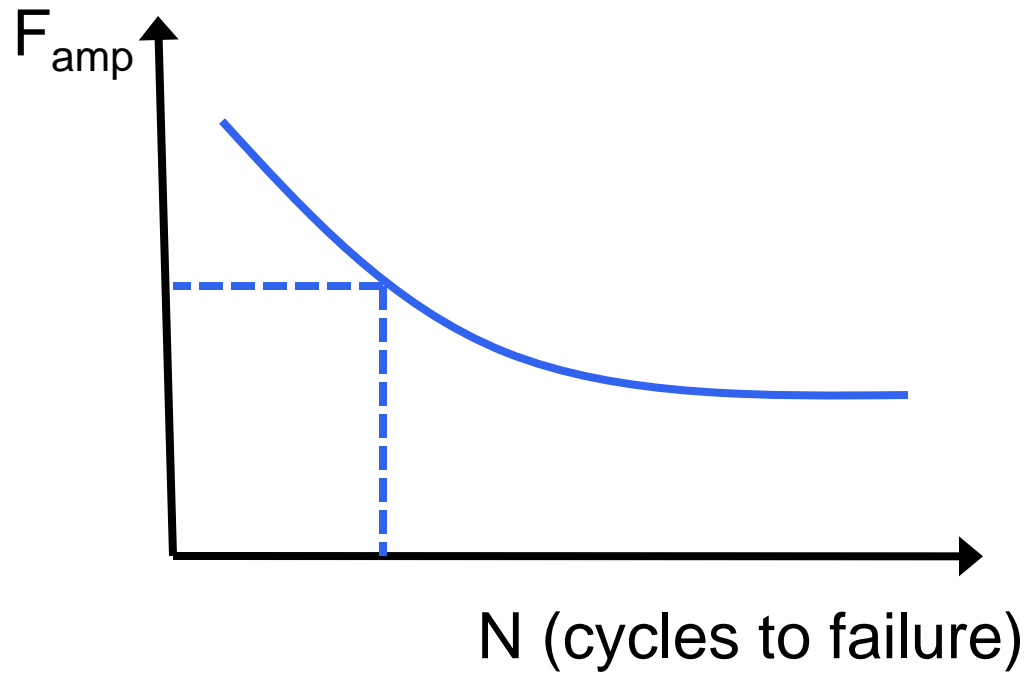
- Scania
- Fatigue predictions at Scania
- Round Robin
- Experience of FEMFAT

Axle Development



SCANIA

Wöhler curve





- Finite Element Calculation

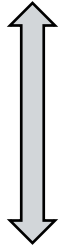
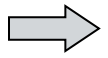
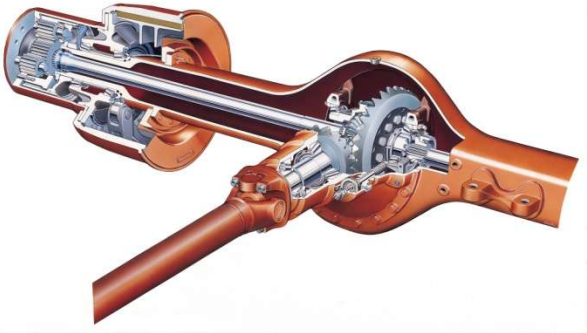


- Fatigue Analyses



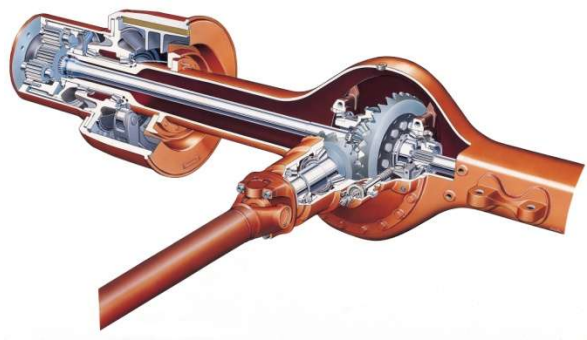
SCANIA

"Old" rear axle

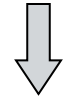
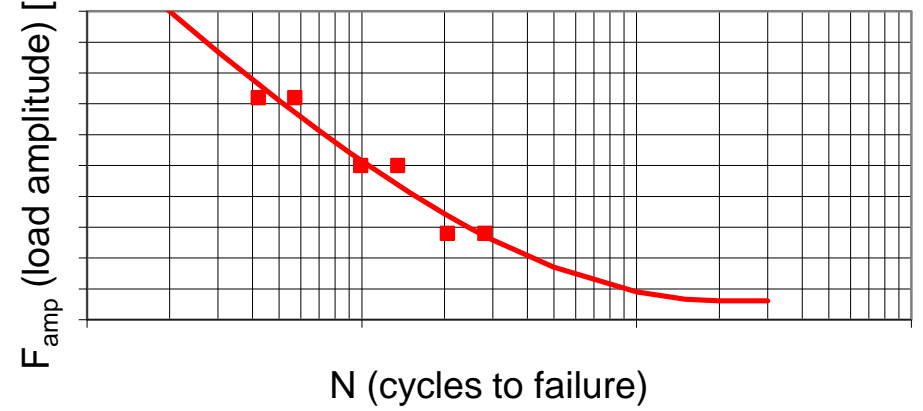


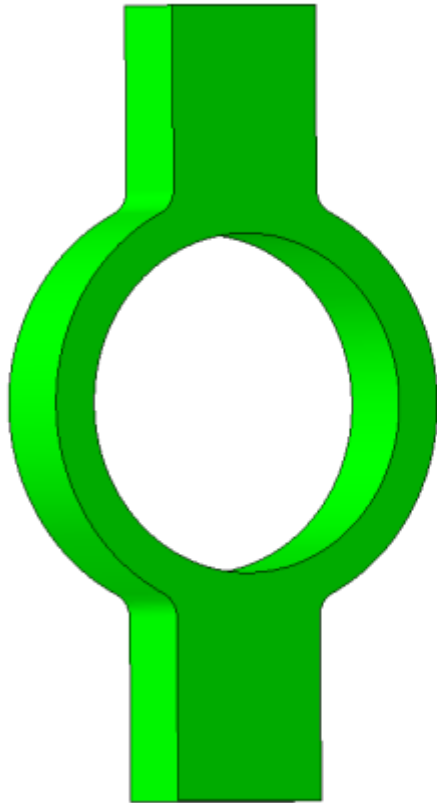
?

"New" rear axle



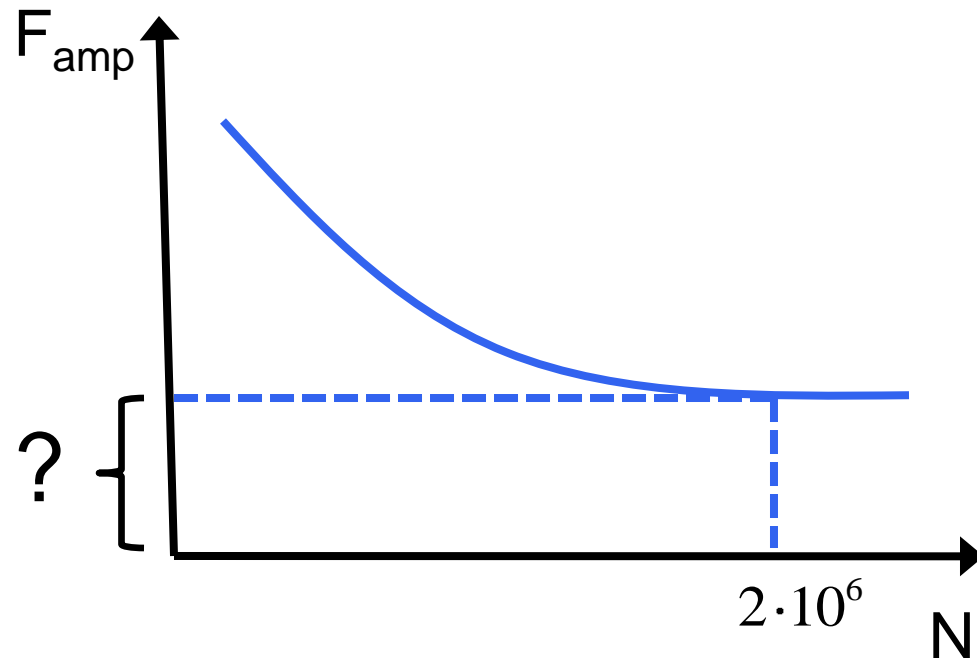
Wöhler curve

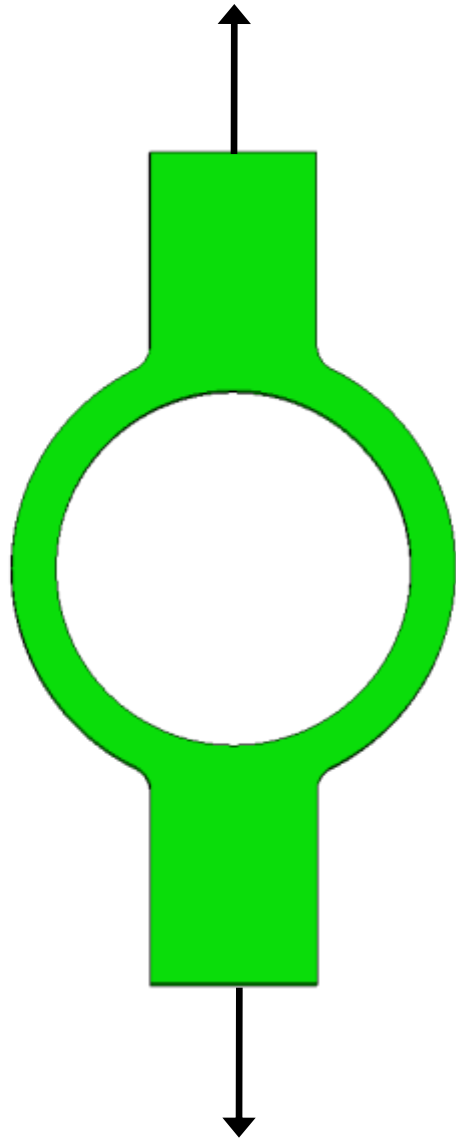




Geometry used in the Round Robin project for 2008

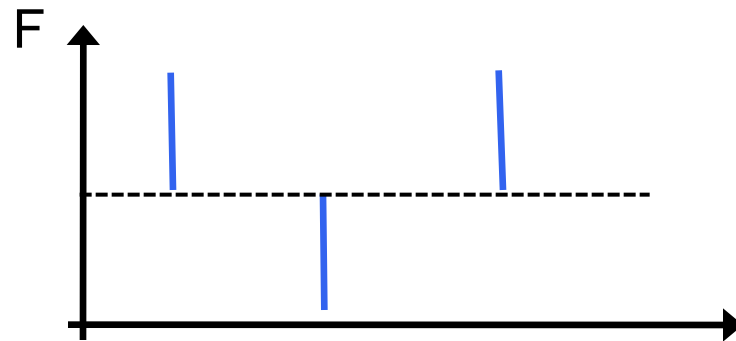
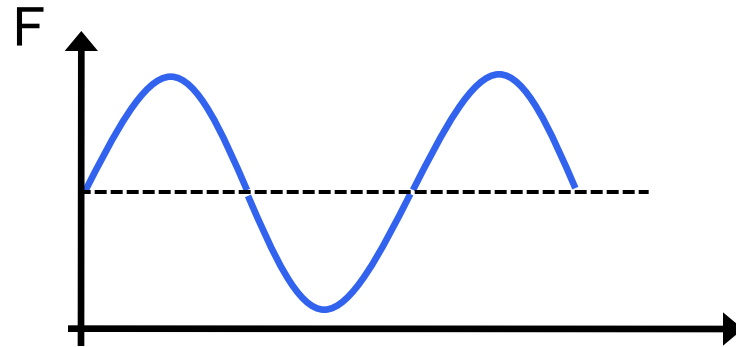
Wöhler curve





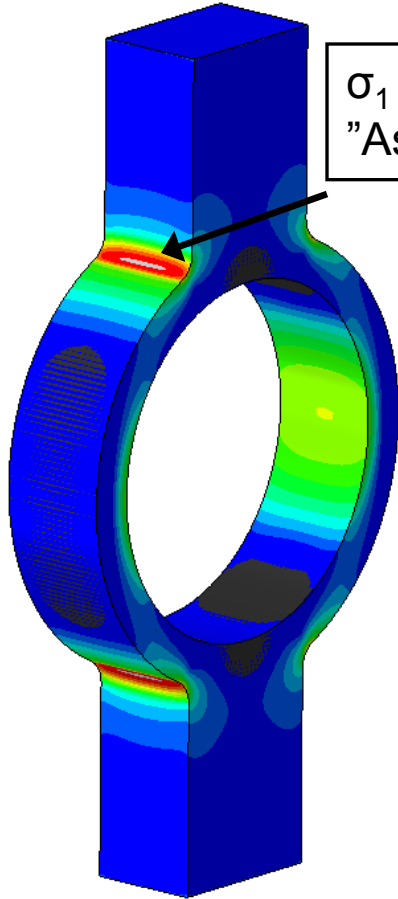
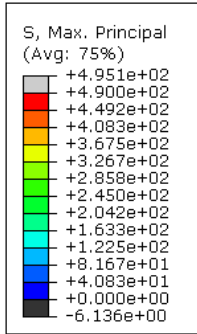
Load ratio for tension: $R = 0.1$

Load ratio for compression: $R = 10$

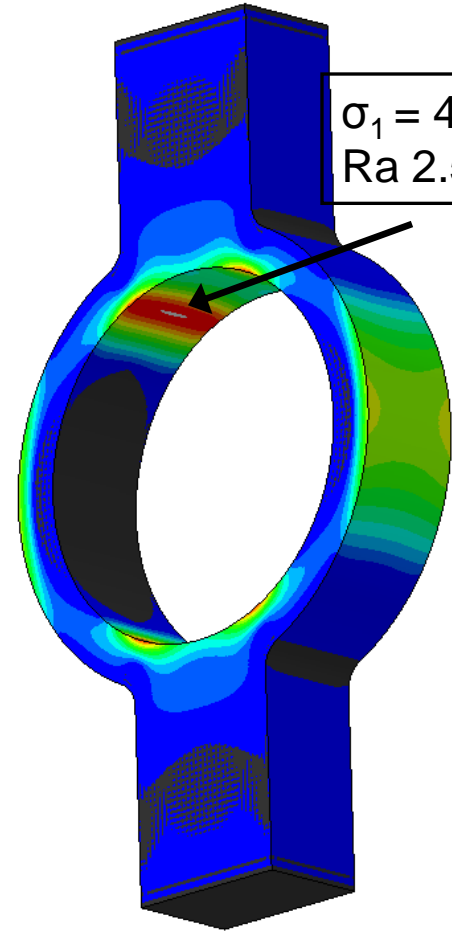
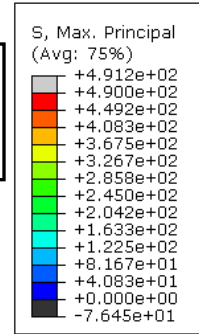


Tension, F_{max}

Compression, F_{min}



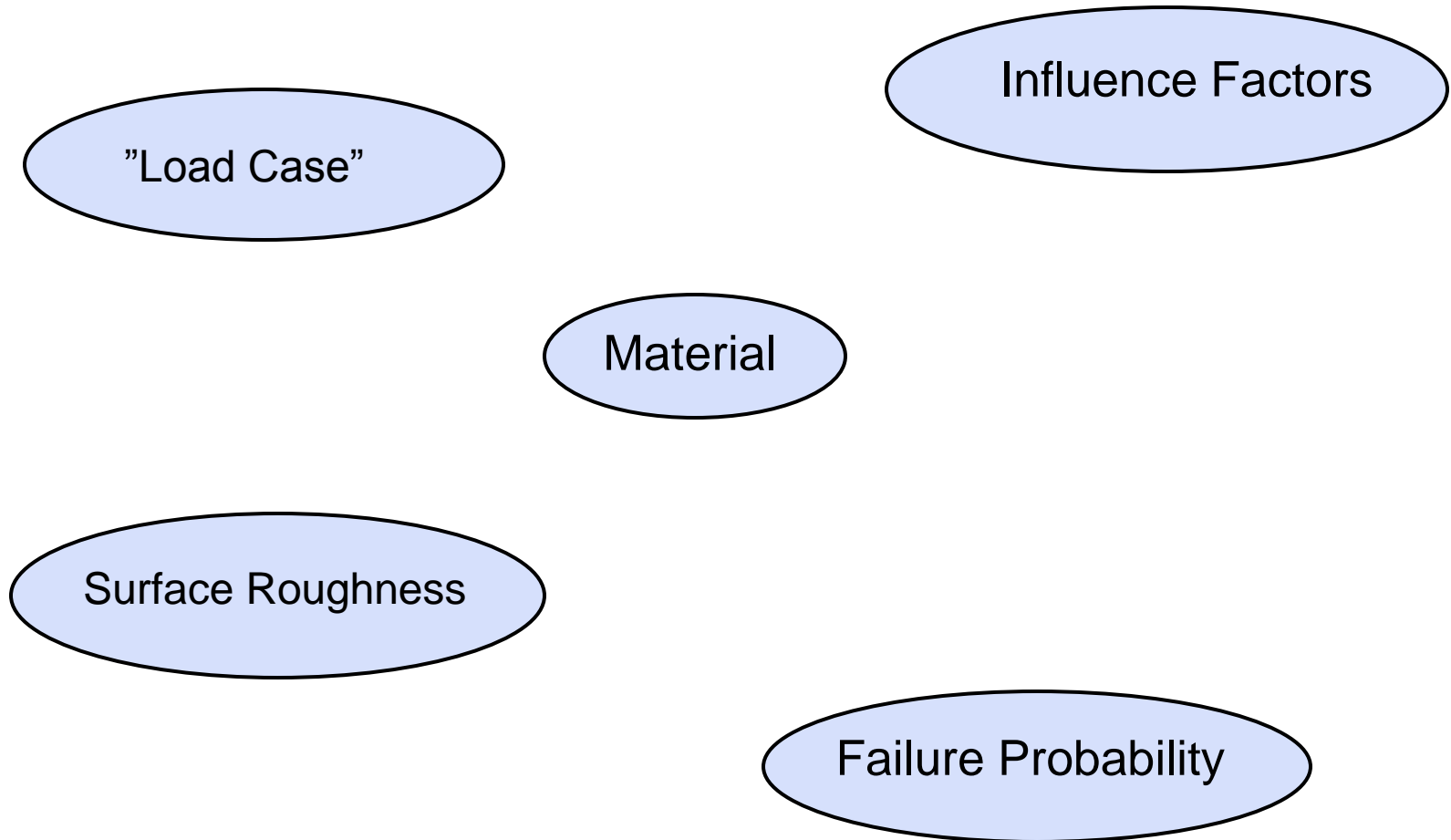
$\sigma_1 = 495 \text{ MPa}$
"As Cast"



$\sigma_1 = 491 \text{ MPa}$
Ra 2.5



FEMFAT



General Factors | Surface Treatment | WELD | SPOT

- Stress Gradient
- Surface Roughness
- Mean Stress
- Constant Stresses
- Mean (and Amplitude) Stress Rearrangement
- Modified Haigh Diagram (Ultimate Tensile Strength)
- Technological Size Influence
- Statistical Influence
- Isothermal Temperature Influence
- Thermomechanical Temperature Influence
- Tempering Influence (for Tempering Steel only)
- Cast Microstructure
- Effective Plastic Strain
- Boundary Layer

PLAST

HEAT

FEMFAT 2.4

FEM (Re)

FEMFAT 4.1

FEMFAT 2.0

Mean: Without Sequence Infl.

Stress Gradient Influence

FEM-Guideline (mod.)

Gauss

FEMFAT 4.8

FEMFAT 3.2

Method of Variable Slopes

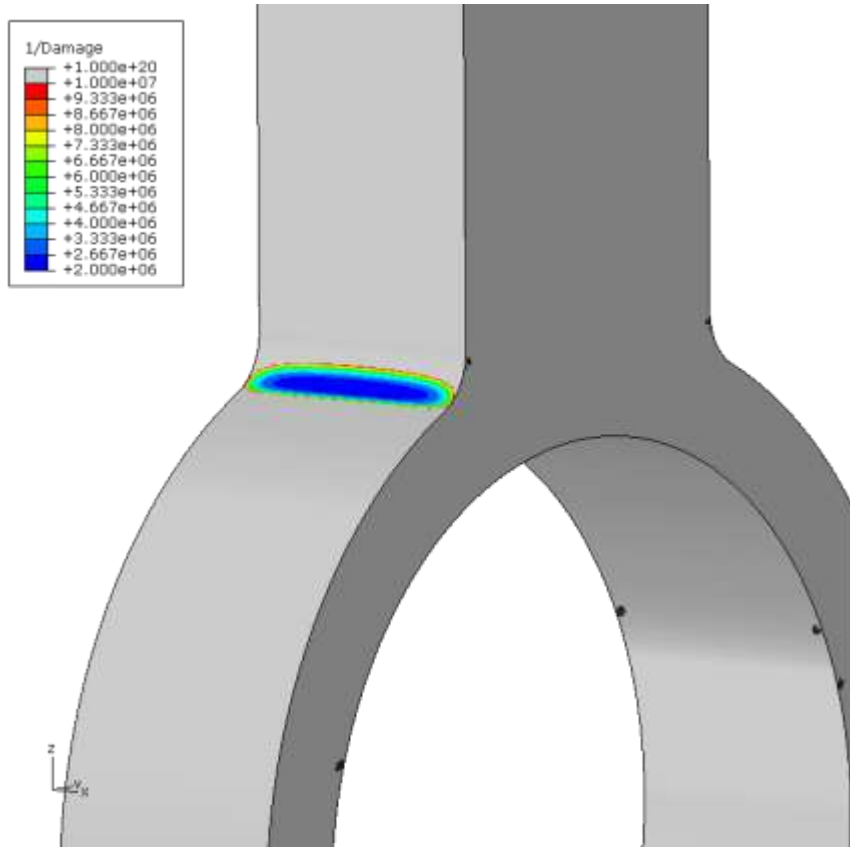
Combination Method Influence Factors

FEMFAT 2.0

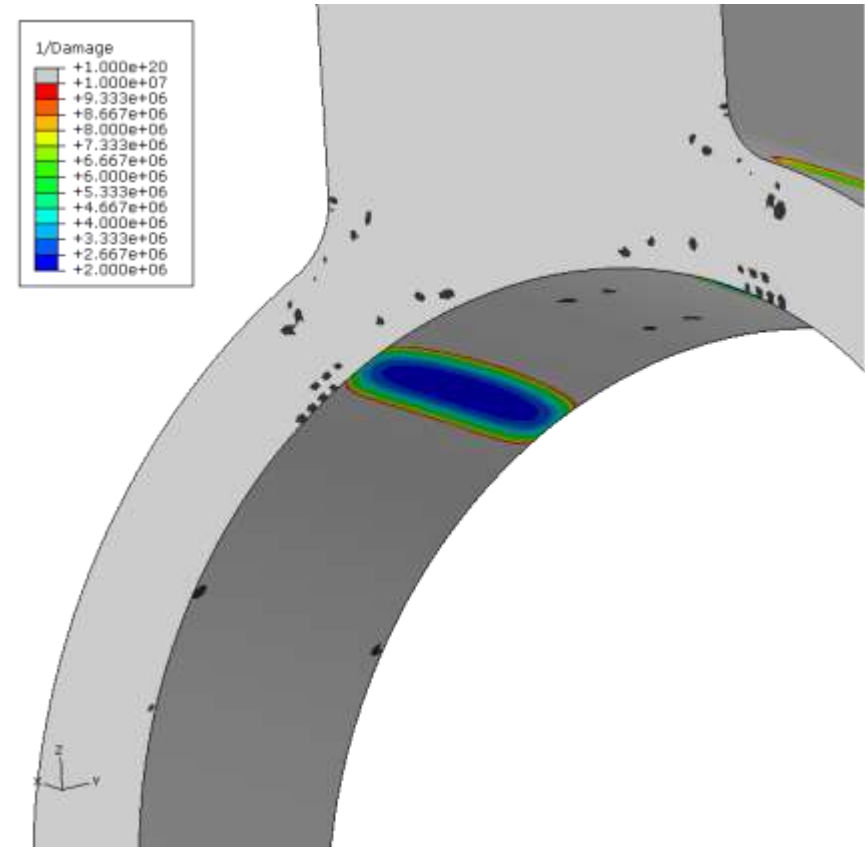


SCANIA

Tension, $F_{\text{amp}}=5.4 \text{ kN}$



Compression, $F_{\text{amp}}=8.5 \text{ kN}$



SCANIA

- Stress Gradient
- Surface Roughness
- Mean Stress
- Mean (and Amplitude) Stress Rearrangement
- Modified Haigh Diagram
- Technological Size Influence
- Statistical Influence



2 million cycles

- Stress Gradient
- Surface Roughness
- Mean Stress
- ~~• Mean (and Amplitude) Stress Rearrangement~~
- Modified Haigh Diagram
- Technological Size Influence
- Statistical Influence



1 million cycles



SCANIA



FEMFAT

Listing of Material Database

List of Available Materials with Corresponding National Standards

March 2000

Steyr Material Data Base	Germany EN/DIN	USA AIS/SAE/AST M	Japan JIS	Sweden SIS	UK B.S	France AFNOR
EN-GJS-600-3_FKM2002.ffd (0.7060; EN-JS1060)	EN-GJS-600-3 GGG-60 EN 1563	A 536 (80-55-06) A 536-84	FCD 600-3 G 5502	EN-GJS-600-3 EN 1563	EN-GJS-600-3 EN 1563	EN-GJS-600-3 EN 1563



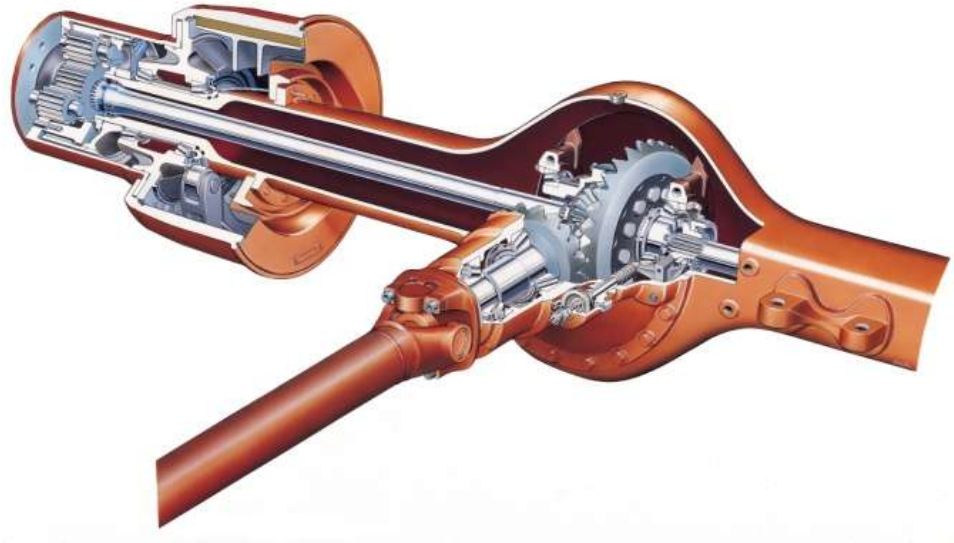
Calculation made by hand?

$$K_t = \frac{\sigma_{\max}}{\sigma_{\text{nom}}}$$

$$K_f = 1 + q [K_t - 1]$$

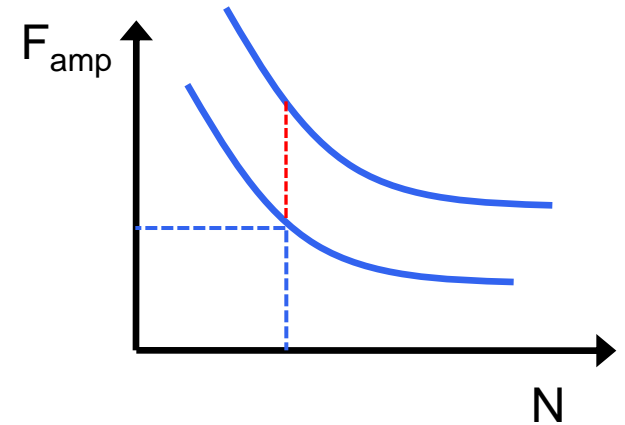
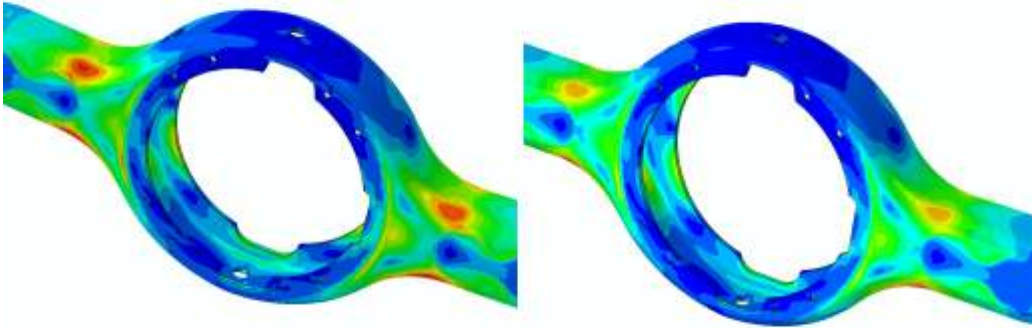
$$K_d = \left(\frac{Y}{Y_0} \right)^{\frac{1}{m}}$$

▪
▪
▪



SCANIA

Comparative studies is "the key"



SCANIA

Questions?



SCANIA