Fatigue of Structures - Assignment 1

Assignment report is delivered in PDF-format (one pdf file) using to MyCourse page. The file should be clearly named such as AssignmentNumber_FirstName_Surname.pdf"

Problem 1

Select an article form Engineering Failure Analysis journal and write a summary of the paper. The summary report should be short (1-2 page with the most relevant picture) and it should include the description of the following issues:

- Analyzed structure and failure location
- Fatigue mechanics (crack initiation, propagation, final failure)
- Possible reasons for the failure and main affecting factors

You can find Engineering Failure Analysis journal here:
http://www.journals.elsevier.com/engineering-failure-analysis/

Problem 2

Perform a Rainflow counting for the following load history (see Figure 1).

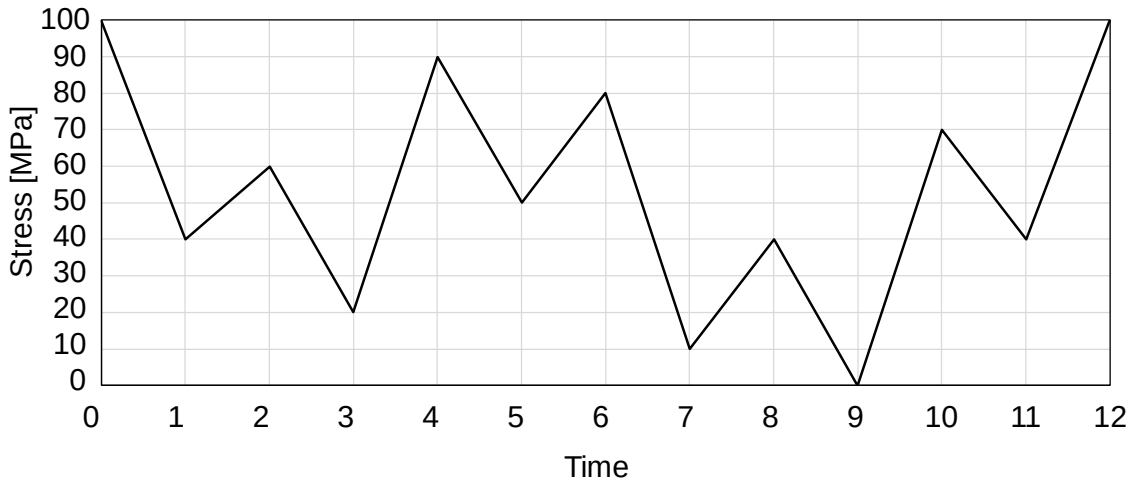

Figure 1 Load history for one repetition

Problem 3

An unnotched member fabricated from Man-Ten steel (see Table 1) is subjected to the load history shown below.

a) Perform a Rainflow counting of the following load history (see Figure 2).
b) Estimate the number of repetitions and the number of cycles to failure (Miner rule). Use the Goodman equation (see Dowling book section 9.7 and Lecture 2 slides):

$$\sigma_a = \left(1 - \frac{\sigma_m}{\sigma_u}\right) \cdot A \cdot N_f^b$$

Suggestions: Constants for Goodman equation from Table 1.

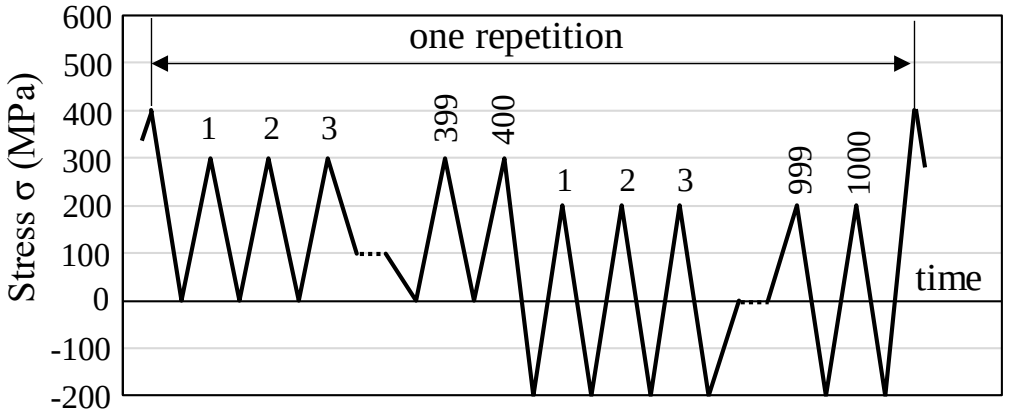

Figure 2 Load history for one repetition

Table 1 Constraints for stress-life curves: tests at zero mean stress on unnotched axial specimen

Material	Yield Strength σ_o	Ultimate Strength σ_u	True Fracture Strength $\tilde{\sigma}_{fB}$	$\sigma_a = \sigma_f'(2N_f)^b = AN_f^B$ σ_f'	A	$b = B$
(a) Steels						
AISI 1015 (normalized)	227 (33)	415 (60.2)	725 (105)	976 (142)	886 (128)	−0.14
Man-Ten (hot rolled)	322 (46.7)	557 (80.8)	990 (144)	1089 (158)	1006 (146)	−0.115
RQC-100 (roller Q & T)	683 (99.0)	758 (110)	1186 (172)	938 (136)	897 (131)	−0.0648
AISI 4142 (Q & T, 450 HB)	1584 (230)	1757 (255)	1998 (290)	1937 (281)	1837 (266)	−0.0762
AISI 4340 (aircraft quality)	1103 (160)	1172 (170)	1634 (237)	1758 (255)	1643 (238)	−0.0977

Notes: The tabulated values have units of MPa(ksi) except for dimensionless $b = B$. See Table 14.1 for sources and additional properties.