

VERIFICATION OF RAPID METHOD FOR DETERMINING THE S-N CURVE IN LIMITED LIFE REGION

P. Strzelecki*, J. Sempruch**

Abstract: *The paper presents the method for determining the S-N curve in limited life region. To verify the method, C45 material was tested to estimate fatigue characteristics. The load was applied by rotating bending and the testing equipment used had been designed by us. The data analysis confirms a good functioning of the testing machine. The verification of the method proposed and the results are presented.*

Keywords: *fatigue design, S-N curve, high-cycle fatigue, accelerated method*

1. Introduction

To estimate the life or fatigue strength of the component, we use, depending on the assumed load conditions, the corresponding computational models. By using any of the calculation models, we need to know the fatigue characteristics of this component. To acquire such characteristics, experimental, analytical and experimental-analytical methods can be used. The method of determining the fatigue characteristics for high-cycle material fatigue can be found e.g. in PN H 04325:1976. Analytical characteristics determination methods have been presented, among others, by Neimitz A. et al. (2008), Lee Yung-Li et al. (2005) and Strzelecki & Sempruch (2011).

The above accelerated and approximated fatigue curve plotting methods need defining the fatigue properties determining accuracy. To do so, the use of a specially planned experiment is most applicable. An attempt at determining the error made applying the methods presented has been given in Strzelecki & Sempruch (2011) and Sempruch & Strzelecki (2011).

2. Experimental procedures

In order to determine the reference curve, own-design research testing equipment was applied. The research involved the use of C45 + C material ($R_m = 826 \text{ MPa}$ $R_{p0.2} = 647 \text{ MPa}$) supplied in a form of the rod 10 mm in diameter the sample shown in Figure 1a was made of.

Figure 1b presents C45 + C material fatigue plot. In its upper right corner regression equation and the coefficient of determination (0.952) are found.

3. Method of verification and conclusions

Based on the experimental results, it was possible to perform statistical calculations verifying the null hypothesis which assumes that the slope and the absolute term of the regression line determined based on the experimental data are equal to the coefficients of the line obtained by applying the analytical method. Examples of calculations results are presented in Table 1.

* M.Sc. Ing. Przemysław Strzelecki, a Ph. D. student, Institute of Mechanical Engineering, University of Technology and Life Sciences, 85-789 Bydgoszcz, Poland; PL, e-mail: p.strzelecki@utp.edu.pl

** Prof. Ing. Janusz Sempruch, Institute of Mechanical Engineering, University of Technology and Life Sciences, 85-789 Bydgoszcz, Poland; PL, e-mail: semjan@utp.edu.pl

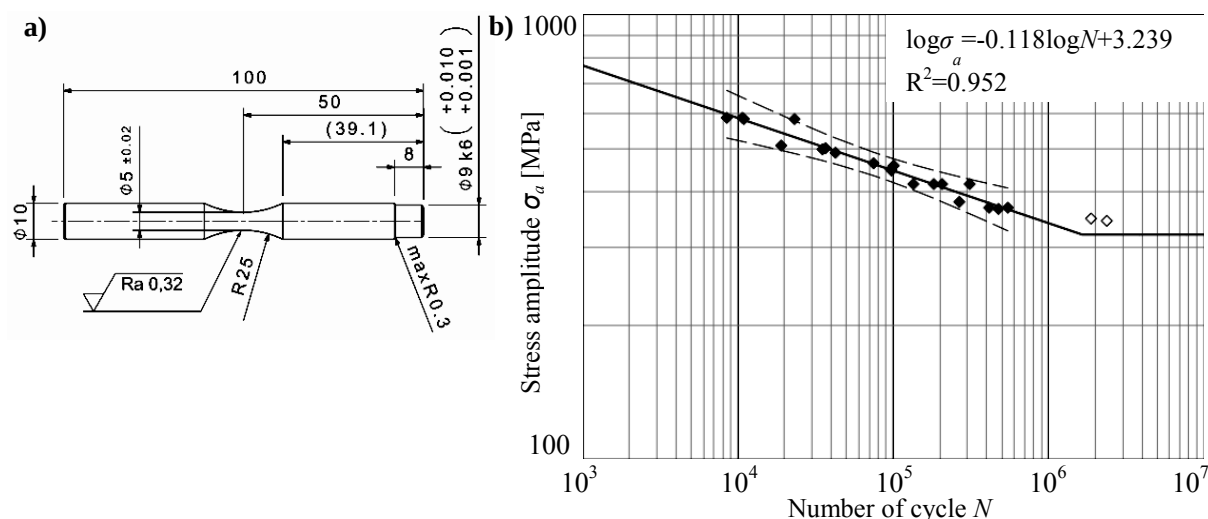


Fig. 1. a) Figure of the sample b) S-N curve for C45+C

Tab. 1: Results of statistical calculations

Statistics type	Method given in the paper Strzelecki & Sempruch (2011)	FITNET method	Method by Lee Yung-Li et al. (2005)
t_a	-1.063	2.163	-3.099
t_b	1.435	-2.506	3.242
$t(97.5\%, 19)$		2.093	

It is assumed that there is no reason to reject the null hypothesis when the following is met:

$$|t_a| < t(p, n-2) \text{ or } |t_b| < t(p, n-2) \quad (1)$$

Based on the statistical calculations made, one can note that the method provided by Strzelecki & Sempruch (2011) is the only one which facilitates assuming the hypothesis of the equality of slope and the absolute term of the equation determined and the equation of the regression curve defined drawing on the experimental data.

Acknowledgement

The work has been co-financed by the European Union Social Fund, the state budget of Poland and the budget of the Kujawsko-Pomorskie Province as part of the project 'Krok w przyszłość – stypendia dla doktorantów' the 4th edition.

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