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EXPERIMENTAL DETERMINATION OF MATERIAL MECHANICAL PROPERTIES AND MODELING OF MATERIAL BEHAVIOR IN SPECIAL ENVIRONMENTAL CONDITIONS

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Modern structural design is based on the known material properties and high computer capacity [1]. This means that selection of the appropriate material is carried out in accordance with the expected material behavior during its service life. In any case, the possible failures that can arise during design, manufacture, maintenance or service life need to be avoid [2]. In this sense, constructional steel (42CrMo4 / AISI 4140 / 1.7225) and stainless steel (X46Cr13 / AISI 420 / 1.4034) have been experimentally tested [3-4]. By means of experimental tests, their mechanical properties, creep and fatigue behavior were determined. All the mechanical properties are shown in time dependence. Mechanical tests related to mechanical properties included ultimate tensile strength, yield strength and modulus of elasticity at room and high temperatures. From the other hand, creep resistance was determined by uniaxial creep tests performed at different temperatures and stress levels. Short-time creep modelling is also presented. Fatigue limit (endurance limit) was determined by tensile test at stress ratio of $\boldsymbol{R = 0.25}$. Fatigue tests were performed as high cycle fatigue testing. As fatigue life model is used stress-life model ($\boldsymbol{\sigma - N \rightarrow S - N}$, $\boldsymbol{Wohler\ curve}$), where the ordinate (y-axis) covers maximal uniaxial stresses while apcisa (x-axis) covers number of cycles to failure. The mentioned stress-life model is divided into two region and that fatigue finite life region and fatigue infinite life region, or, it is designed as an inclined line and a horizontal line. The so called fatigue limit is defined by modified staircase method. As the results of the performed experimental investigations may be mentioned as follows. Tested materials have quite high ultimate tensile strength ($\boldsymbol{1.7225/735\ MPa}$; $\boldsymbol{1.4034\ /782\ MPa}$) and yield strength ($\boldsymbol{1.7225/593\ MPa}$; $\boldsymbol{1.4034\ /657\ MPa}$) while fatigue limit is of amount ($\boldsymbol{1.7225/532\ MPa}$; $\boldsymbol{1.4034\ /682\ MPa}$).

REFERENCES

[1] Bathe, K. J. (1996), Finite Element Procedure, Prentice-Hal, Inc., New Jersey.
[2] Collins, J. A. (1993), Failure of Materials in Mechanical Design, 2nd Ed., John Wiley & Sons, New York.
[3] Brnic, J., et al, Short-time creep, fatigue and mechanical properties of 42CrMo4 –low alloy structural steel, Steel and Composite Structures, 2016, 22 (4), 875-888.
[4] Brnic, J., et al, Analysis of the Mechanical Behavior , Creep Resistance and Uniaxial Fatigue Strength of Martensitic Steel X46Cr13, Materials, 2017, 10, 388.