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Wpływ procesu starzenia na zachowanie dynamiczne giętych profili hybrydowych

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Abstract

The doctoral thesis presents the complex influence of the aging process on strength properties of aluminium alloy and the response of the construction subjected to time-dependent load. The results of the numerical computations were presented whereas the critical load and DLF (Dynamic Load Factor) based on the selected dynamic buckling criteria was determined.

"Channel" shape profile was considered. It was assumed that it was made of aluminium alloy Al6060 and analyzed in various hardened temper: T4, T5, T6 and T66. In relation to the axially compressing load duration, static, quasi-static and dynamic response was determined.

In order to calculate the critical load values and buckling mode, Eigen-Buckling analysis was carried. Furthermore, to define the impact load duration (by determining the frequency of natural flexural vibrations) and corresponding modal form, modal analysis was implemented.

Initially, static stability was analyzed. Linear-elastic material characteristic was analyzed. The strength parameters of considered material are presented in Table 1. The results for critical load values, which were achieved by analytical and numerical methods exhibit fine agreement. This proved the correctness of definition of numerical model and boundary conditions.

In the next stage, quasi-static response of the structure was analyzed. The time duration of the impulse was equal to 1,0 of natural period T_{np} of the first form of profile natural flexural vibrations. This modal form did not suit the lowest static buckling mode.

Next, basing on experimental static tensile tests, real, nonlinear material characteristics (for natural T4 temper and heat-treated T5, T6, T66) were achieved. These (presented in chapter 3) were used in the following numerical calculations and quasi-static stability analysis.

After modification of the load duration, which was herein equal to natural period T_{np} of the first form of profile natural flexural vibrations, dynamic stability was analyzed. Linear-

elastic and experimental T4-T66 characteristics were applied. Additionally, by shortening the load impact duration by half, strong dynamic stability analysis was included. As a result, critical DLF for both cases was determined.

By application of Perzyna viscoplastic model, the influence of strain rate effect on dynamic stability of aluminium profile was analyzed. This was achieved by modified the experimental material characteristics using relation (3.4.2.2) and parameters m and γ determined in chapter 3.4.2.

In the last section of the thesis, the dynamic stability analysis of boron-aluminium composite was analyzed. This composite exhibits outstanding strength properties which were obtained in chapter 3.5.

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