

POSSIBILITY OF STRESS MONITORING IN STEEL STRUCTURES WITH MAGNETOELASTIC EFFECT

D. Jackiewicz, R. Szewczyk, A. Bieńkowski

Institute of Metrology and Biomedical Engineering, Boboli 8, 02-525 Warsaw

d.jackiewicz@mchtr.pw.edu.pl

Received 10 May 2016; accepted 17 May 2016

Stress assessment in the steel constructions is crucial for maintenance purposes, and for risk mitigation during the given structure lifetime. Various NDT methods are widely used in such applications, many of which are established, commercially available and well developed. Many of these methods are hazardous for the environment and operators however, for example radiation method use very strong X-rays, dye penetrant inspection can utilize potentially harmful chemical compounds, etc.

The magnetoelastic effect is connected with the changes of flux density B for given magnetic field H , under the influence of mechanical stresses σ in the material. It is most easily observable as the shape change of the given material magnetic hysteresis loop.

Additionally, due to this effect new possibilities of constructions monitoring arise. The changes of microstructure of constructional steel significantly influences its magnetic properties. The application of magnetoelastic effect for stress assessment and construction state monitoring in large structures (such as trusses) was not considered previously.

In the paper the specially developed magnetoelastic method investigation of steel truss construction is presented. For the experiment were used the developed truss used for testing under varying mechanical load. Three central members of the constructed truss, that is the central bottom chord and the central webs, were designed and constructed as the test samples. Their dimensions were calculated in order to carry out tests without any plastic damage nor significant elastic deformation of the rest of the members.

During the magnetoelastic measurements, three member samples were installed into the truss. The truss was put under the mechanical load. The magnetic circuit was closed by these three samples.

The experimental results of measurements of the magnetic characteristics stress dependence of member samples are very interesting. Stress dependence of the shape of magnetic hysteresis $B(H)$ loops may be observed for different values of amplitude of magnetizing field H_m . Changes of the basic magnetic parameters are evident: flux density, remanence, coercivity.

The experimentally obtained characteristics were consistent with the magnetoelastic effect theory. Presented results confirm the feasibility of the magnetoelastic effect based measurements for NDT stress assessment in the steel truss structures. The development of new non-destructive test method for industrial applications is possible. Moreover, the method is neutral to environment and operators.