Analysis of Magnetic Field Distribution in C-yoke System

Slawomir TUMANSKI

Warsaw University of Technology, Koszykowa 75, 00-661 Warsaw, Poland, tusla@iem.pw.edu.pl

Abstract. Magnetic field distribution in the C-yoke magnetizing system was computed. This numerical analysis was verified experimentally using Magnetovision scanning system. Various magnetizing circuits have been tested.

The C-type yoke is commonly used for magnetization of the electrical steel sheets and strips. For example the C-yoke system is used as a standard Single Sheet Tester (SST) [1]. The design of the yoke is often assumed intuitively – the distance between poles should be as large as possible to diminish of the shorting leakage flux. Also the depth of the yoke should be large for the same reason. In the case of the SST device the tested area 50 cm × 50 cm is assumed to obtain similar weight of the sample as in the case of the standard Epstein frame. Fig.1. presents the example of the C-type yoke used to magnetize of the electrical steel sheet for test of the anisotropy [2].

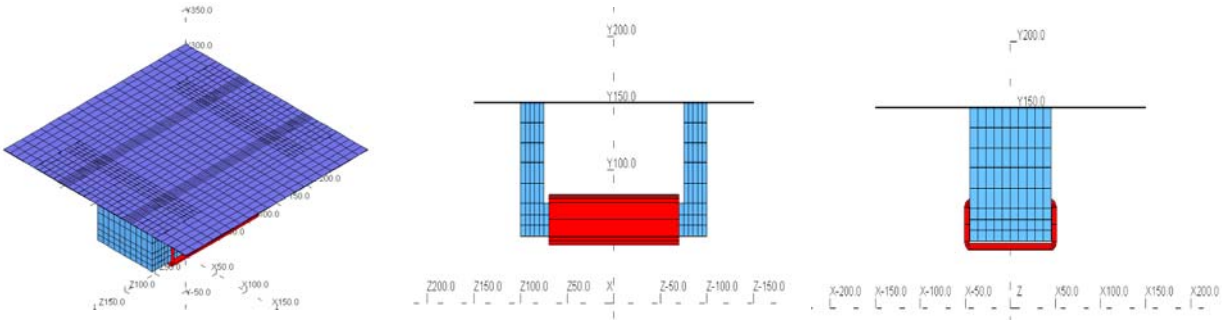

Fig.1. The design of the asymmetrical C-yoke system used to magnetize the sheet sample

Although the shape of the magnetic circuit seems to be relatively uncomplicated the numerical calculation and design are rather complex. The mesh of the calculated area is difficult to prepare because very thin (for example 0.2 mm) sheet is merged with relatively large yoke. Only the 3D computations guarantee the correct results of modeling. Fig.2 presents the example of numerical calculation of the magnetic field distribution in the cross-section C-C of the yoke circuit shown in the circle B.

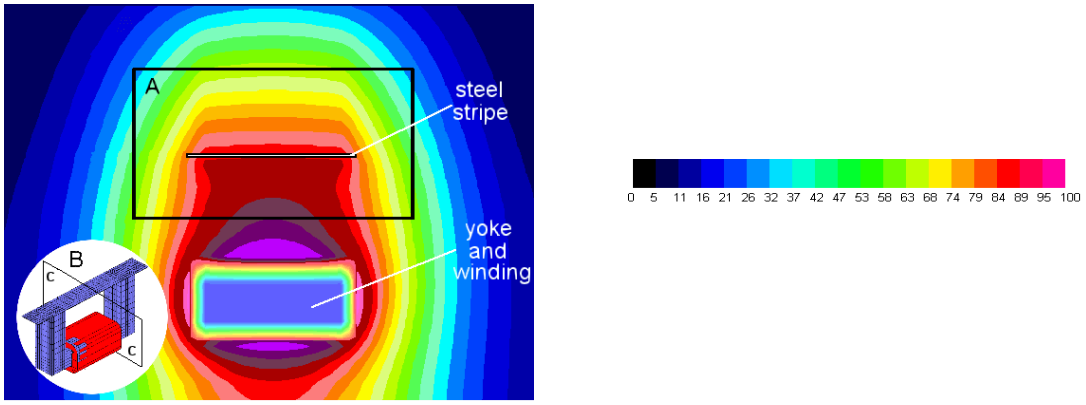

Fig.2. The results of calculation of magnetic field distribution in the single strip tester device

The results of computations without the experimental verification are not fully reliable. The author developed the original system for 3D scanning of magnetic fields called the Magnetovision [3]. This system was used to test the magnetic field around various C-yoke circuits. Fig.3 presents the user interface of the Magnetovision software showing the results of scanning of magnetic field around the yoke.

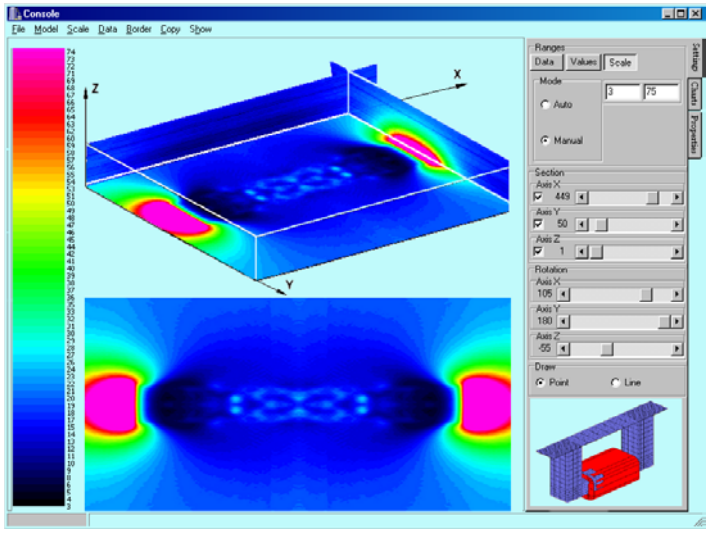

Fig.3. The magnetic field distribution in arbitrary cross-section obtained using the Magnetovision system

The results of scanning of magnetic field indicated certain important differences in comparison with computed results. For example large field at the end of the strip was detected. This field was created because the strip concentrated stray fields what was not provided in the numerical model. Fig.4 present an example of the magnetic field measured in the cross section indicated as letter A in Fig.2.

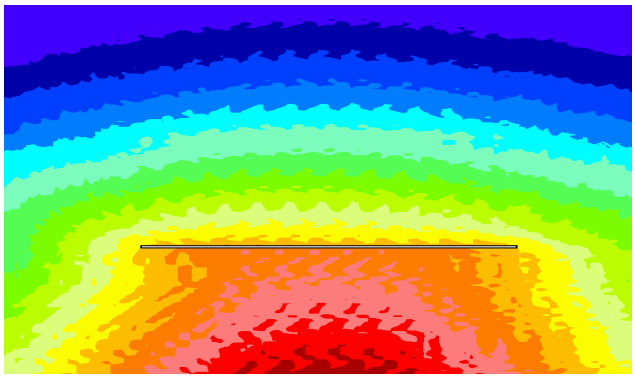

Fig.4. The magnetic field distribution measured in the C-yoke circuit using the Magnetovision system

Various C-type yoke system have been analyzed – symmetrical and asymmetrical, for strips and sheets. As conclusion the design recommendations have been formulated.

References

[1] European Standard IEC 404-3: Magnetic materials. Methods of measurement of magnetic properties of magnetic sheet and strip by means of a single sheet tester
[2] S. Tumanski – The method of testing of the plane distribution of anisotropy, IEEE Trans.Magn., in print
[2] S. Tumanski, A. Liszka – The methods and devices for scanning of magnetic fields, J.Magn.Magn.Mat., 242-245 (2002),1253-1256