STRATEGY OF STRUCTURAL ANALYSIS OF W7-X MAGNET SYSTEM

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The Wendelstein 7-X (W7-X) stellarator project goal is to demonstrate that the stellarator is a viable option for a fusion power-plant. The W7-X is in advanced construction phase and has entered the assembly phase in Greifswald, Germany.

The W7-X "pentagonal" basic magnet system composed of 50 non planar coils and 20 planar coils is capable to generate a magnetic field up to 3 Tesla at the magnetic axis. The weight of the coils and the electromagnetic (EM) loads are transferred to the central support ring by two central support elements (CSEs) per each coil. The complexity of W7-X Magnet system is not only due to complicated configuration of the non-planar coils, but also due to contact-sliding interfaces between adjacent coils, between winding pack and coil cases, and the bolted CSEs relying on the flange openings.

The system is highly sensitive to the parameter variations; therefore the strategy of the structural analysis is based on the analysis of the system with two completely independent finite element (FE) models created in ADINA and ANSYS commercial codes. Due to symmetry peculiar to the stellarator, the normal operation loadings are analyzed on the cyclic symmetry 72° module, while the preliminary choice of the parameters under EM forces is performed on a 36° semi-module with challenging boundary conditions. The local analyses of components are performed under loads extracted from the ADINA model or by submodelling procedure in the ANSYS code. The ultimate goal is the creation of a tree of numerical models, which has to reliably predict stellarator structural behaviour under different EM scenarios.

This paper gives an overview of the strategy and focuses on challenging boundary conditions and the most interesting results of the analyses.