THERMO-HDRAULIC AND STRUCTURAL ANALYSIS FOR FINGER-BASED CONCEPT OF ITER BLANKET FIRST WALL

B.Y. Kim, D.H. Kim, H.J. Ahn, J.S. BAK

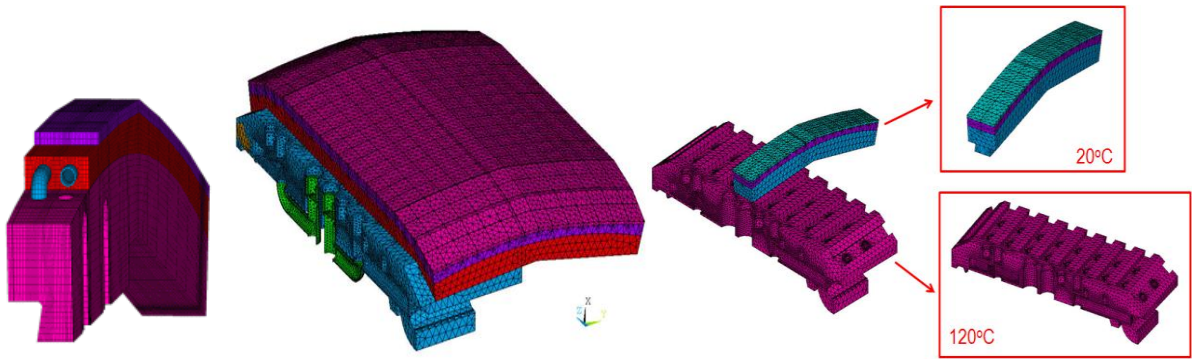
[1] *ITER Korea, National Fusion Research Institute, Daejeon, 305-333 Republic of Korea*

Corresponding author: bykim@nfri.re.kr

The blanket first wall is the main plasma facing component in ITER tokamak. The Finger-typed first wall was proposed through the current design progress by ITER. In this concept, each first wall module is composed of a beam and twenty fingers. The main function of the first wall is to remove efficiently the high heat flux loading from the fusion plasma during its operation. Therefore, the thermal and structural performance should be investigated for the proposed finger-based design concept of first wall.

The various case studies were performed for the unit finger model considering different surface heat loads and nuclear heating condition. The finite element model was made for a half of a module using symmetric boundary conditions to reduce the computational effort. The thermo-hydraulic analysis was performed to obtain the pressure drop and temperature profiles. Then the structural analysis was carried out using the maximum temperature distribution obtained in thermo-hydraulic analysis.

Finally, the transient thermo-hydraulic analysis was performed for the generic first wall module to obtain the temperature evolution history considering a moderate heat flux loading and nuclear heating. After that, the thermo-mechanical analysis was performed at the time step when the maximum temperature gradient was occurred. Also, the stress analysis was performed for the component with a finger and a beam to check the residual stress of the component after thermal shrinkage assembly.



(a) (b) (c)

Figure 1: Finite element models for (a) 1/2 unit finger, (b)1/2 first wall, and (c) assembly simulation

[1] K. Ioki et al., Fus. Eng. Des., 81, 2006, pp443-448
[2] D. L. Youchison et al., Fus. Eng. Des., 83, 2008, pp1025-1033