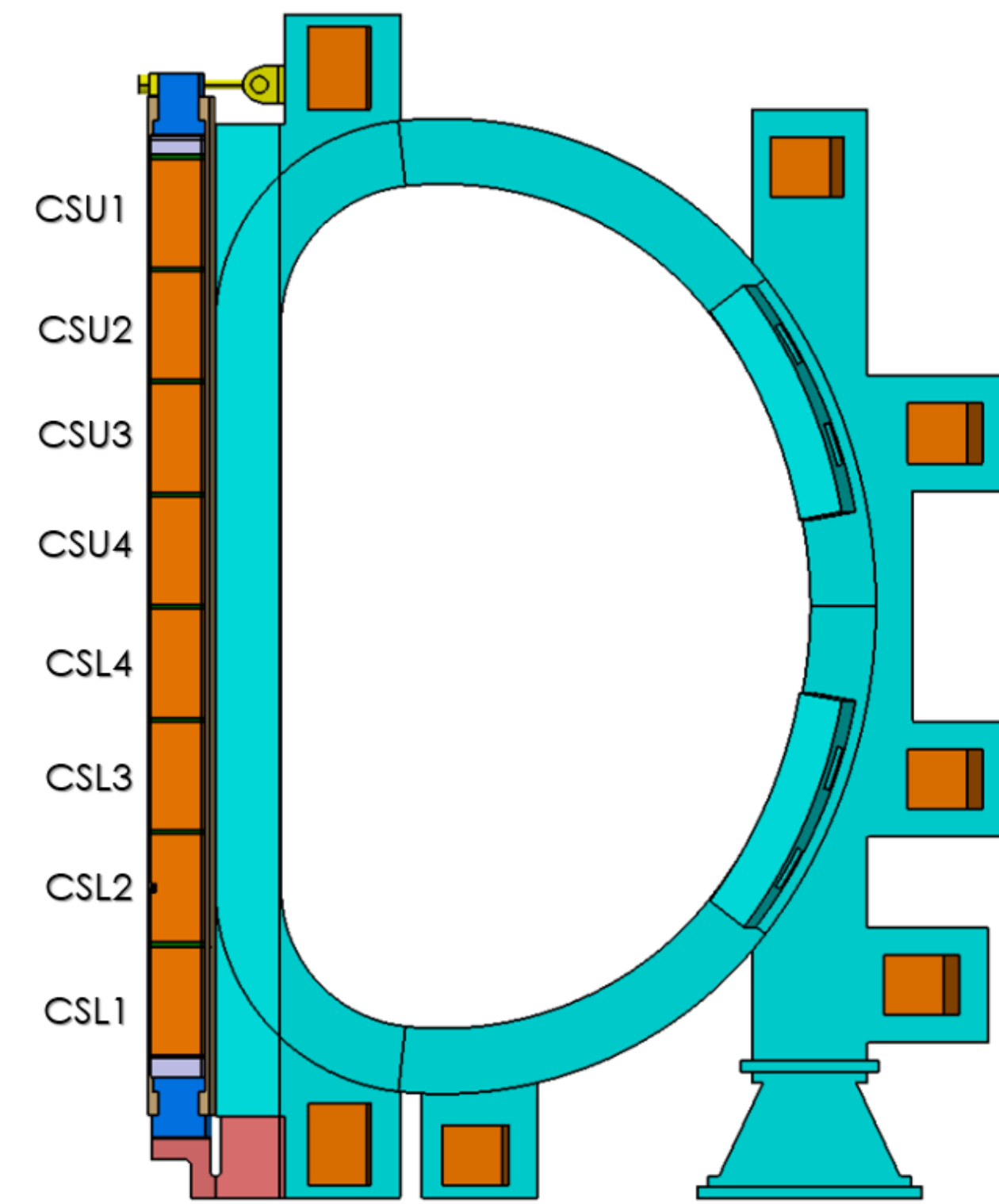
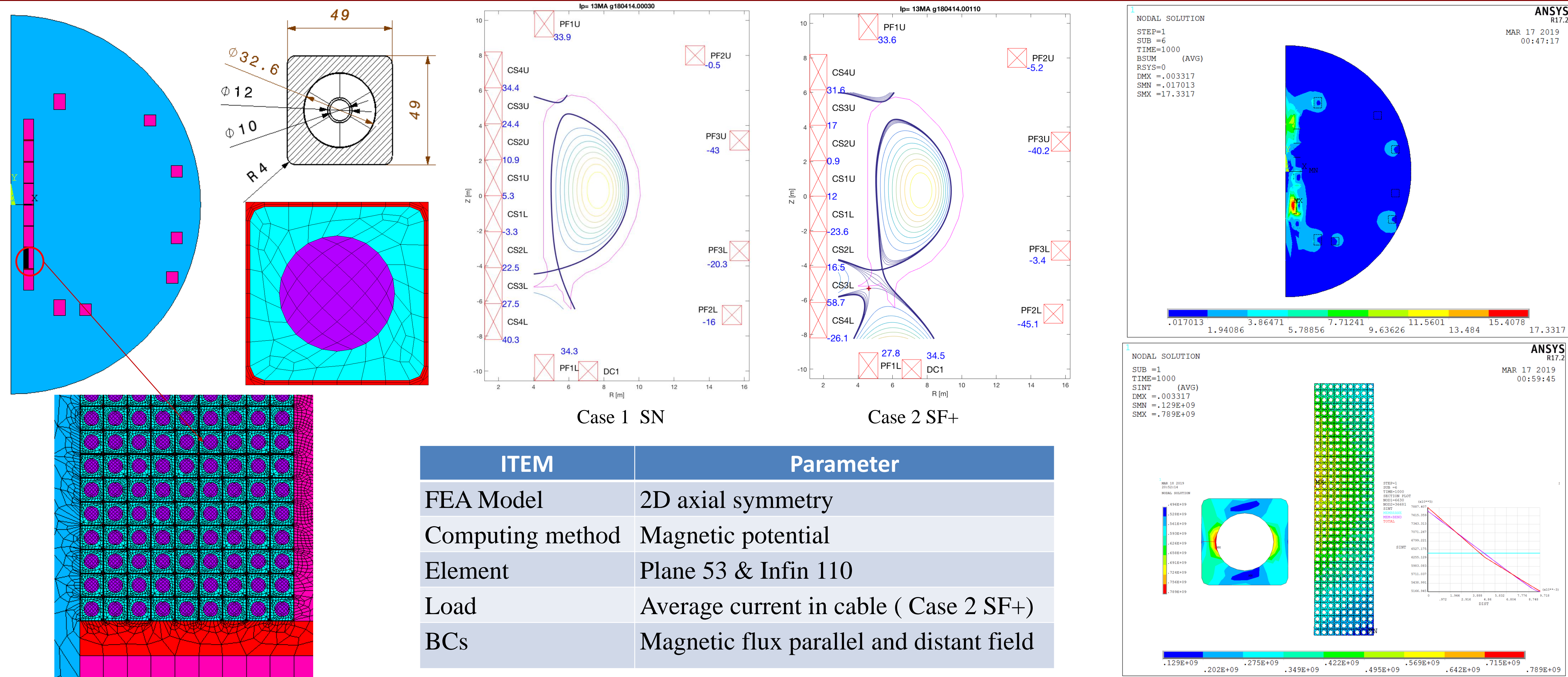


1. Introduction

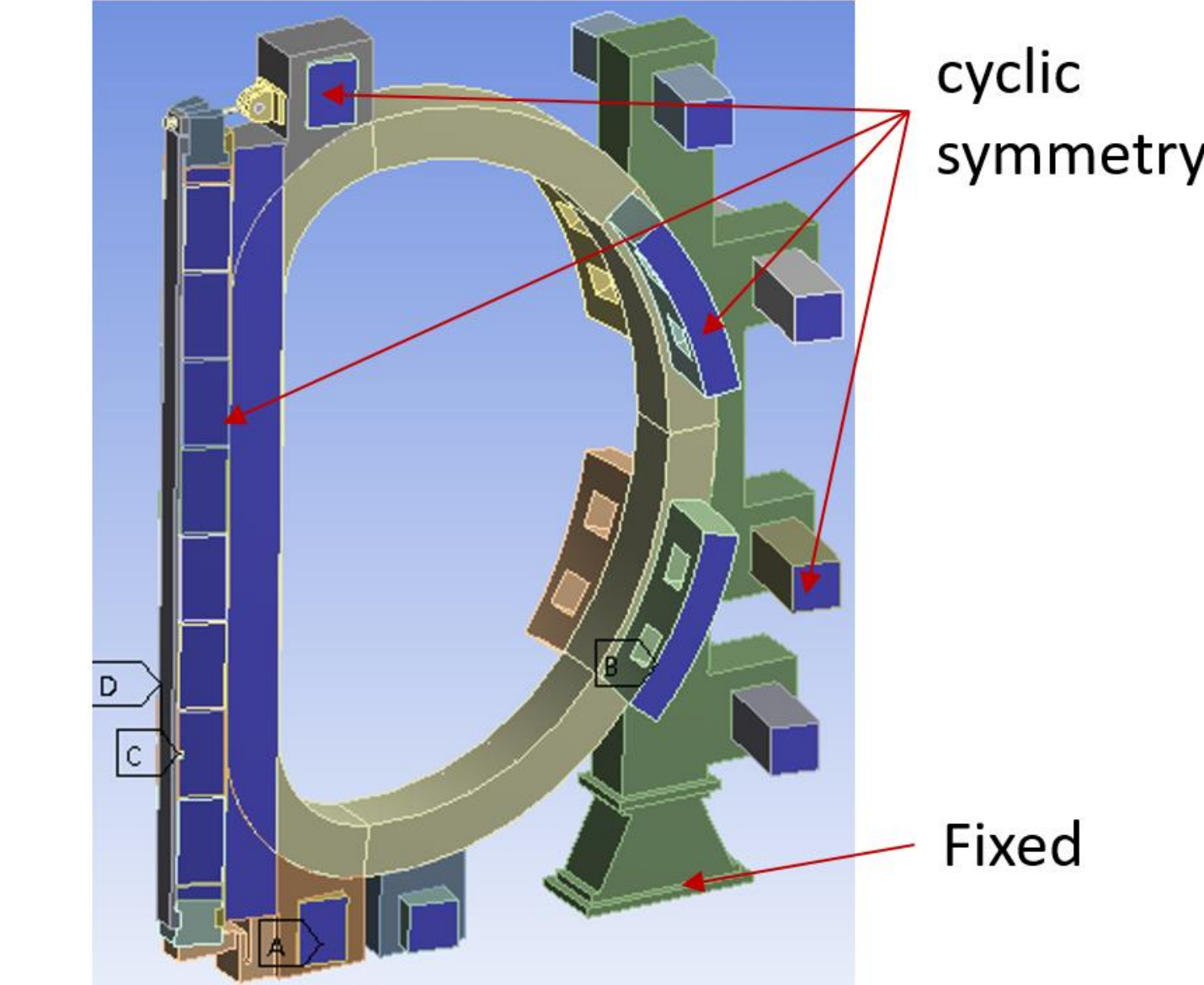
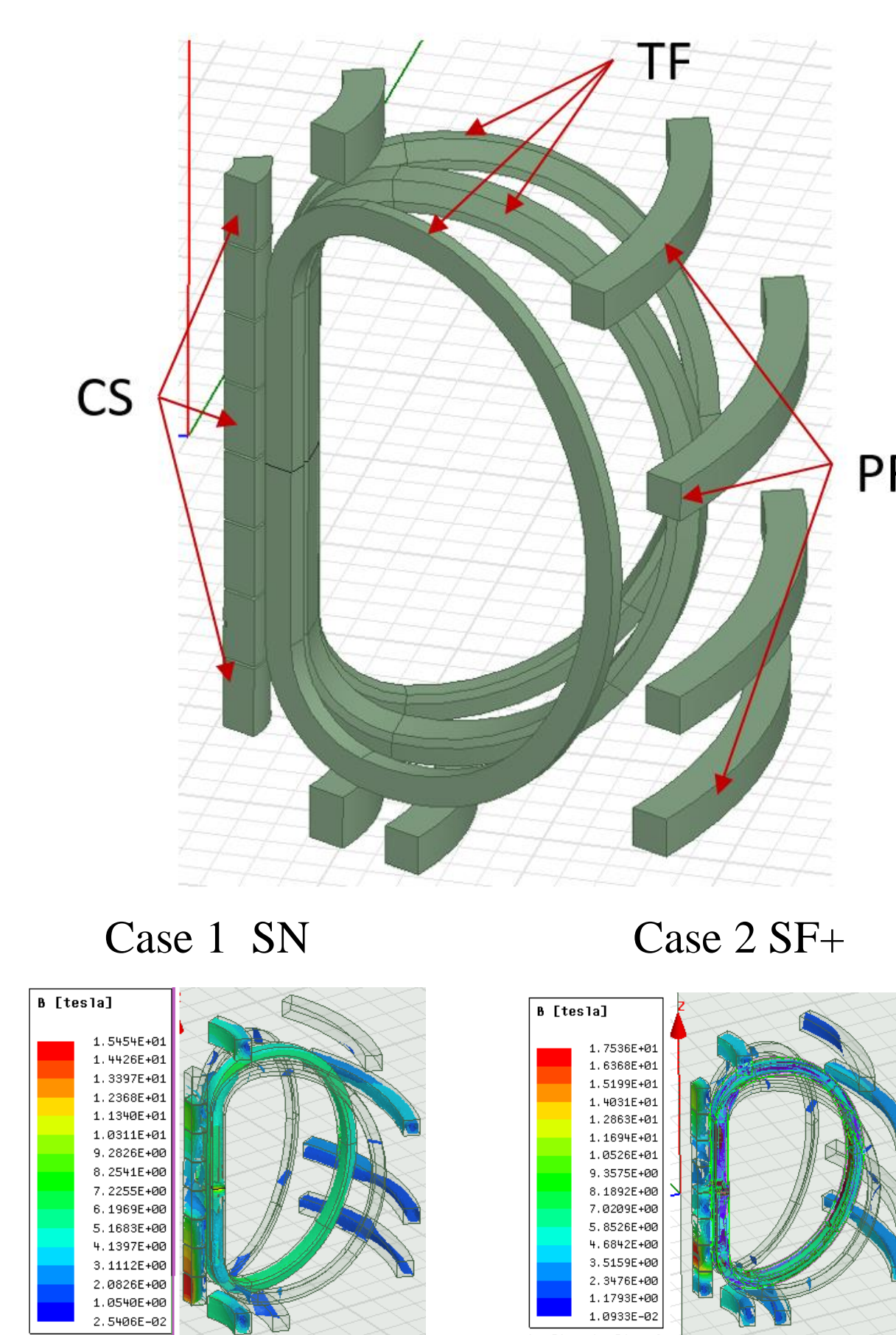
Conceptual design of China Fusion Engineering Test Reactor (CFETR) Central Solenoid (CS) coil had been started in Institute of Plasma Physics, Chinese Academy of Sciences. The highest field of CS coil is 17.2T when the running current is 60 KA. The Central Solenoid (CS) is one of the sub-systems of the CFETR Magnet System and it contributes to the inductive flux to drive the plasma, to the shaping of the field lines in the diverter region and to vertical stability control. CS magnet system mainly consists of 8 Nb₃Sn coils compressed with 8 sets of preload structure. The functions of the preload structure are to apply an enough axial compression to the CS coils and to have a mechanical rigidity against the repulsive force between 8 Nb₃Sn coils. This paper describes structural design of CFETR CS magnet system. At the top, there is a sliding connection to provide a locating mechanism and support against dynamic horizontal forces. A global finite element model was created based on the design geometry data to investigate the mechanical property of CFETR CS preload structure and support structure under the different operating conditions. 2D finite element model under electromagnetic was created to calculate the stress on the conductor jacket and turn insulation.



2. 2D FE Model



3. 3D FE Model



Properties		G10	316LN	CS Winding pancake
Young's modulus (GPa)	E _x	12	206	57.9
	E _y	20	206	177
	E _z	20	206	57.9
Shear modulus (GPa)	G _{xy}	6	78.8	14.6
	G _{yz}	6	78.8	16.5
	G _{xz}	6	78.8	7.9
Poisson's ratio	ν _{xy}	0.33	0.3	0.205
	ν _{yz}	0.17	0.3	0.358
	ν _{xz}	0.33	0.3	0.205
Thermal contraction (%)	α _x	0.7	0.295	0.312
	α _y	0.246	0.295	0.295
	α _z	0.246	0.295	0.312
Density (kg/m ³)	ρ	1800	7900	7048

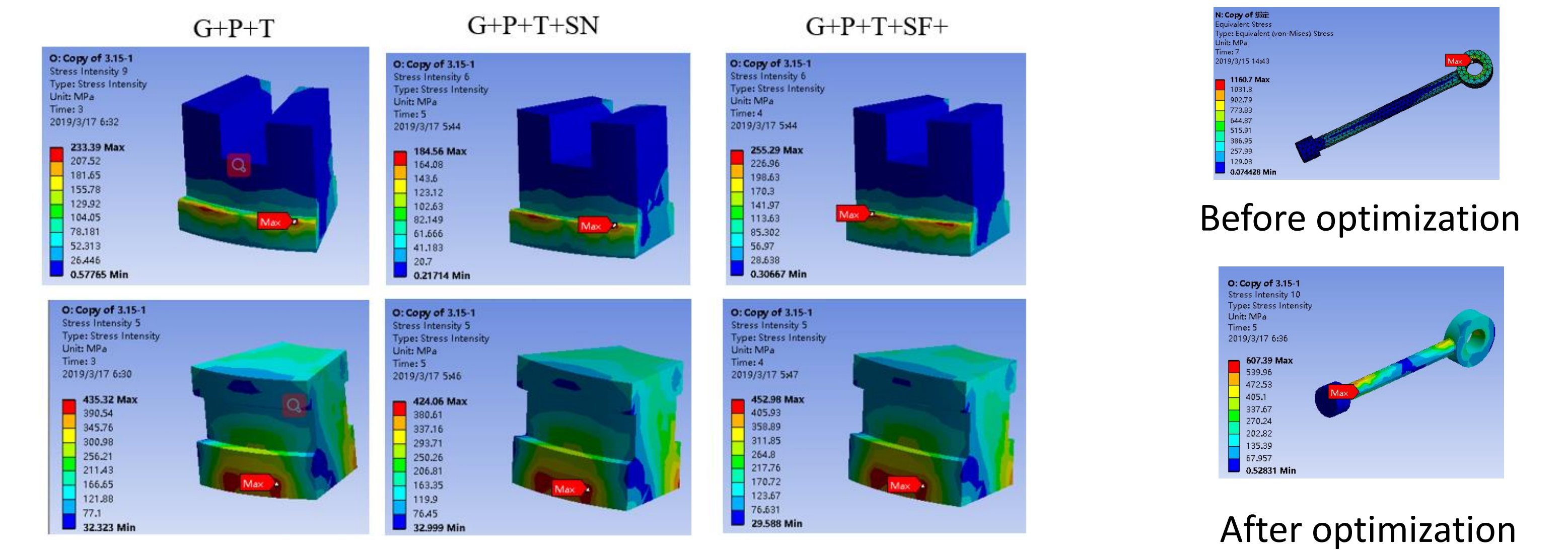
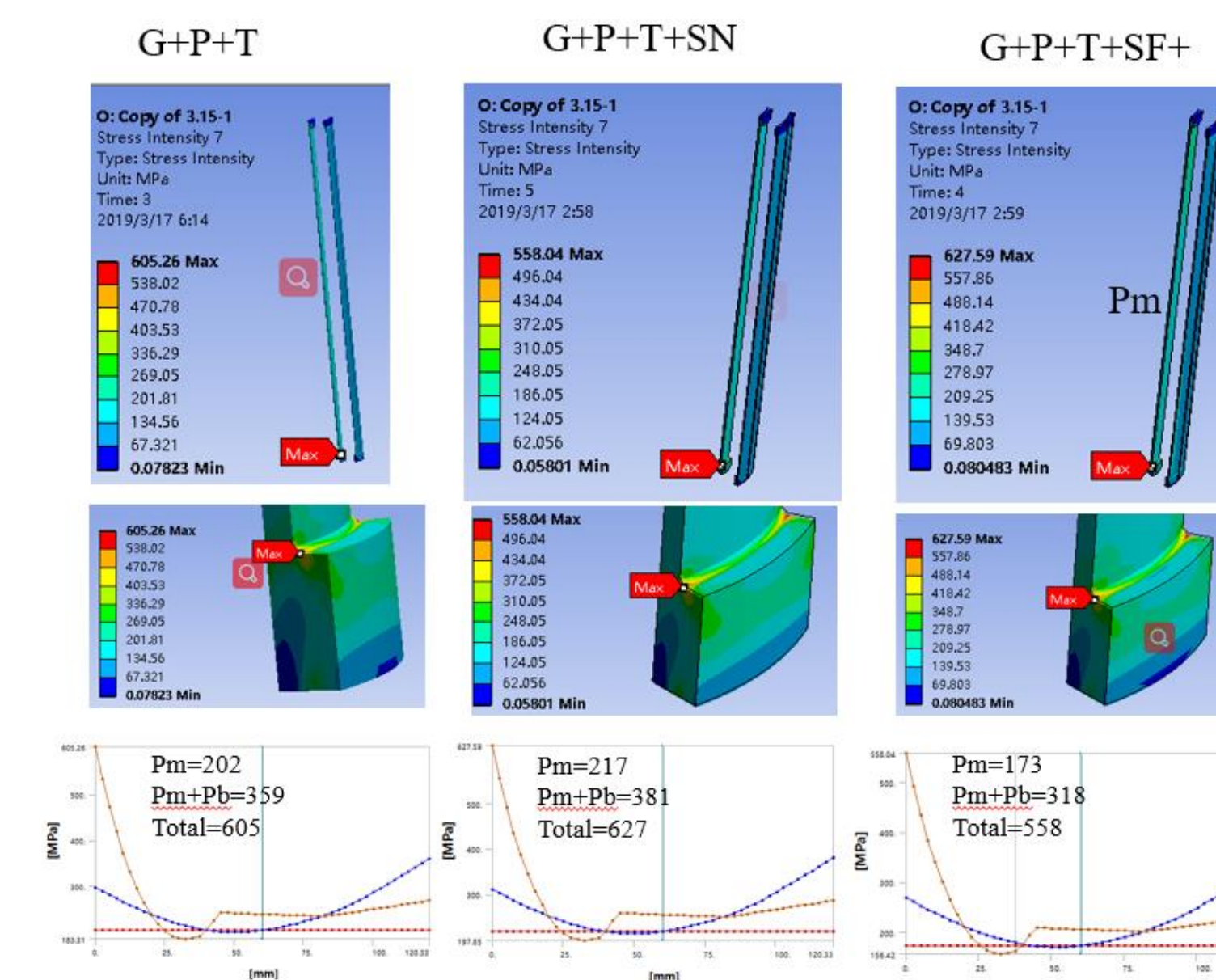
Model

➢ 45° CS, 22.5° PF and TF

Load

- Weight of CS structure (G)
- Initial preload, a total of 200MN (P)
- Cool-down from RT (293K) to 4K (T)
- Electromagnetic load (SN&SF+)

Orthotropic smeared property used for CS winding pancake are calculated with one so-called 'unit cell' finite element model of the jacket and insulation.



4. Conclusions

To investigate the structural integrities of the CFETR CS, the global structural analysis of CS system had been carried out under different load case. Orthotropic smeared property used for CS winding pack were calculated with one so-called 'unit cell' finite element model of the conduit and insulation. Accord to the analysis result of 3D model, stress in the preload structure and plates are acceptable. 2D model shows that stress in the jacket can meet the assessing criterion.