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Magnetic interaction between a tokamak reactor and its reinforced-concrete building

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Magnetic interaction between a tokamak reactor and its iron reinforced-concrete basement has been studied using the analytical model and ANSYS electromagnetic code. When the magnetic material is used for tokamak building, the leakage magnetic field from the tokamak is enhanced due to the normal angle incidence of the magnetic field line to the magnetic material wall. As this study is motivated from the ITER building construction, we use the similar dimensional data on ITER building. In this study, the magnetic field is assumed to be stationary.

We have analyzed the influences of the magnetized material on the position of the magnetic field null in the plasma break down phase, and on the x-point location during the divertor operation. We assume the iron wall plate instead of discrete reinforced-concrete wall, so that this assumption provides the larger magnetic disturbance than that of the actual case with rebars. When we assume floor and bio-shield wall made of 1 m thick iron plate with the relative permeability of 100, the null regime is shifted to the inboard side in the vacuum chamber. This can be understood by image currents induced by the ceiling, floor and outer wall. As the magnetic null regime is in the small magnetic field area, it is disturbed when it is away from the floor and the ceiling. Such shift could be adjusted by the PF coil current. On the other hand, the x-point location during divertor operation is not affected by the magnetic wall because of the dominant contribution of the large poloidal coil current.

While the effect of the magnetic material on the plasma performance seems to be not crucial, we further investigate the degaussing operation, the mechanical strength of the floor due to the magnetic force and the induction effect by PF coils.

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