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Tue-Mo-Or7-03: 3D Design of F2D2, the FCC Block-coil Short Model Dipole

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F2D2, the FCC Flared-ends Dipole Demonstrator, is a 15 T single-aperture short model being developed within a collaboration between CEA Paris-Saclay and CERN. The design phase is ongoing at CEA; the magnet will be fabricated at CEA and then tested at CERN. The 2D magnetic and mechanical designs have been optimized previously and allowed defining the operating points and the required structural components. This paper reports on the preliminary design phase, focused on 3D mechanical optimizations of coils and structure. F2D2 will be the first Nb₃Sn block-coil magnet using two cable grades. The cables will be spliced outside of the magnet, which represent one of the most complex design feature, and requires a special focus on the magnet ends. To do so, the design of the magnet has been performed using a CAD (Computer Aided Design) and both magnetic and mechanical 3D FEM (Finite-Elements Models). The CAD defines precisely the complex coil-ends shape that allows positioning the layer jumps and routing the cable exits. The FEM are used to optimize the longitudinal pre-load system in order to contain the large Lorentz forces during operation. The magnet is pre-loaded transversally with bladders and keys and with an external Al shell; and longitudinally with Al tie-rods and end-plates. The pre-load levels are computed to operate the magnet under sufficient compression, while minimizing the stress in the coil and avoid degradation.

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