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Effect of the sub-elements layout on the electro-mechanical properties of high J_c Nb₃Sn wires under transverse load

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The brittle intermetallic Nb₃Sn superconductor is currently being used to develop high field magnets in the framework of the Hi-Luminosity upgrade of the Large Hadron Collider at CERN. Despite its excellent superconductive properties, Nb₃Sn wires suffer from significant critical current I_c reduction due to the transverse load applied during the magnets' assembly and energization.

A dedicated FEM 3D numerical model coupled with a J_c scaling law has been developed to predict the electro-mechanical behaviour of RRP and PIT wires under transverse loads. By using this model, the effects of different geometrical factors have been studied to identify the keys parameters that allow limiting the effect of transverse loads on the I_c reduction under transverse load. In particular, this paper deals with the role of the: 1) wire twist pitch, shape (round or rolled), diameter and copper to no copper ratio; 2) sub-elements numbers, disposition, shape (round or hexagonal) composition.

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