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FRACTURE ANALYSIS AND OPTIMAL DESIGN OF THE UMBILICAL BAR OF THE
SPACECRAFT LAUNCHING TOWER**Abstract**

As an important part of the aerospace launching tower, the umbilical bar performed a function of supporting the pipes and the cables and acted as the channel through which the astronauts went into the cabin when necessary. In this paper, the fracture analysis of the umbilical bar was made. First, a detailed electron metallographic analysis of the cracks and welds was made. Second, the 3D finite elements model (FEM) of the swinging umbilical bar was built with ANSYS, as a long-cantilever-girder spatial steel pipe truss structure. At the same time, the dynamic load caused by the exhaust plumes of a launch vehicle was calculated. The results show that the failure of the umbilical bar was brittle fracture. The umbilical bar with low mechanical strength occurred early fatigue cracks at action of alternation stress, and fractured instantly under high dynamic stress caused by the exhaust plumes. After that, an optimal design of the umbilical bar was made, and the safety of the aerospace launching site was enhanced.