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A Validated Methodology to Establish Structural Capacities for Subsea Connector Families

Abstract

Understanding the structural limits of subsea connectors used in offshore environments is critical to ensure safe operations. The latest industry standards establish the requirement for physical testing to validate analysis methodologies for connector designs. In this paper, an analysis methodology, compliant with the latest API 17G standard, is presented for calculating structural capacities of non-preloaded connectors. The methodology has been developed for complex combined loading scenarios and validated using full-scale physical testing for different connector families.

Detailed 3-D, non-linear, finite element models were developed for three different non-preloaded connections, which consisted of threaded and load shoulder connectors. For each connection, a comprehensive set of combined tension and bending moment structural capacities at normal, extreme and survival conditions were calculated. The calculated capacities were validated for each connection through performing a test sequence using full-scale structural testing. A final tension or bending to failure test was also completed for each test connection to validate the physical failure mode, exceeding the latest API 17G requirements.

For all connections tested, capacities calculated using the methodology were validated from the successful completion of the test sequences. The physical failure modes of the test connections also matched the predicted failure modes from the FEA, and the tensile or bending moment loading at physical collapse exceeded that predicted by the global collapse of the FEA model. Using the validated approach described in this paper significantly reduces the requirement of physical testing for connector families, establishing confidence in the structural limits that are critical for safe operations.