

Material properties and crashworthiness of ASTM A131 steel-plated structures in Arctic environment: An experimental and numerical study

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Summary

The global warming has reduced the extent of ice in Arctic region and brought some environmental issues including the rising of sea level and the changing of ecosystem. On the other hand, it is also true that the possibility of using Arctic sea route by trading ships and of developing the subsea resource in the Arctic region by offshore installations is increasingly growing due to the global warming. There are still a lot of challenging issues to be resolved for robust design of ships and offshore structures operating in Arctic region.

The aims of the present study can be divided to two main objectives. The first one is to investigate the reliable material properties of ASTM A131 carbon steel which is satisfying a classic requirement i.e. ASTM A131 "Standard Specification for Structural Steel for Ships" for ships and offshore structures. For this purpose, a series of tensile coupon tests were performed with satisfying the ISO15579 and ASTM E8 as the test methods. The test covers three grades of material and temperature considered typical Arctic temperature, cryogenic environment and room temperature for a comparable database. Every test result is stored into a useful database. The second object is to investigate the crashworthiness of steel-plated structures in the Arctic environment. A series of axial crushing test was carried out with a square tube shaped structure which was made of the same materials with tensile coupon tests. The quasi-static loading was considered even though the collision accident must be a dynamic action. Because of this study is an ongoing study, other materials and dynamic loading will be considered in next step. This study will be a reliable database of material properties and a procedure of material and structural tests at low temperature for Arctic structure designers and researchers.

