PENGARUH KOMBINASI GRADE BAJA *STIFFENED PLATE* TERHADAP GAYA KONTAK DAN DISTRIBUSI TEGANGAN PADA SKENARIO TUMBUKAN ES

Handika Teguh Kurniawan

ABSTRAK

Stiffened plate merupakan komponen utama lambung kapal yang berfungsi menahan beban lateral, termasuk beban akibat tumbukan es pada kapal yang beroperasi di perairan dingin. Penelitian ini bertujuan menganalisis pengaruh kombinasi grade baja pada *side shell* dan *frame* terhadap gaya kontak dan distribusi tegangan akibat tumbukan es, serta menentukan konfigurasi material yang memberikan ketahanan terbaik. Analisis dilakukan menggunakan metode elemen hingga (*Finite Element Analysis*/FEA) dengan perangkat lunak Abaqus/Explicit. Enam variasi model (M1–M6) dianalisis menggunakan kombinasi baja S235, S350, dan S460 pada *side shell* dan *frame*. Es dimodelkan sebagai *rigid spherical ice* untuk merepresentasikan kondisi tumbukan konservatif (*worst-case scenario*). Hasil simulasi menunjukkan bahwa kombinasi material memberikan pengaruh signifikan terhadap respons struktur. Gaya kontak lateral maksimum (Fy) tertinggi diperoleh pada model M4 dengan kombinasi *side shell* S350 dan *frame* S460 sebesar 1.26E+07 N, sedangkan gaya kontak tangensial maksimum (Fx) tertinggi diperoleh pada model M6 sebesar 1.13E+07 N. Distribusi tegangan menunjukkan konsentrasi tegangan terbesar terjadi pada area kontak antara es dan struktur dengan tegangan von Mises maksimum sekitar 714 MPa. Berdasarkan evaluasi keseluruhan respons struktur, model M4 menunjukkan performa ketahanan terbaik terhadap tumbukan es.

Kata Kunci: *stiffened plate*, grade baja, gaya kontak, distribusi tegangan, tumbukan es.

EVALUATING CONTACT FORCE AND STRESS DISTRIBUTION ON STIFFENED PLATES WITH VARIED STEEL GRADE COMBINATIONS UNDER ICE IMPACT

Handika Teguh Kurniawan

ABSTRACT

A stiffened plate is a primary structural component of a ship hull that functions to withstand lateral loads, including loads caused by ice impacts on vessels operating in cold-water environments. This study aims to analyze the effect of steel grade combinations used in the side shell and frame on contact force and stress distribution under ice impact scenarios, as well as to determine the most effective material configuration. Finite Element Analysis (FEA) was conducted using Abaqus/Explicit. Six model variations (M1–M6) were evaluated by combining S235, S350, and S460 steel grades in the side shell and frame structures. The ice object was modeled as a rigid spherical ice body to represent a conservative worst-case impact scenario. The simulation results indicate that the steel grade combination significantly affects the structural response. The highest lateral contact force (Fy) was obtained by Model M4, consisting of an S350 side shell and an S460 frame, reaching 1.26E+07 N, while the highest tangential contact force (Fx) was achieved by Model M6 with a value of 1.13E+07 N. The stress distribution analysis revealed that the maximum stress concentration occurred at the contact region between the ice and the structure, with a peak von Mises stress of approximately 714 MPa. Based on the overall evaluation of the structural response, Model M4 demonstrated the best resistance performance against ice impact.

Keywords: *stiffened plate, steel grade, contact force, stress distribution, ice impact*.