

**PENGARUH PENGgantian *HOPPER TANK* TERHADAP
STABILITAS PADA KAPAL *SPBC NUSANTARA PASIFIC 1*
(STUDI KASUS KAPAL MODIFIKASI DESAIN TANGKI DARI
WING TANK MENJADI HOPER TANK)**

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ABSTRAK

Penggunaan wing tank pada kapal Self-Propelled Barge Carrier (SPBC) diketahui memiliki sejumlah keterbatasan operasional, terutama terkait efisiensi penanganan muatan, potensi terjadinya cargo hanging, serta tingginya free surface effect pada kondisi pengisian parsial. Bentuk wing tank yang datar dan melebar menyebabkan distribusi muatan menjadi kurang homogen, meningkatkan momen permukaan bebas, dan menurunkan parameter stabilitas awal seperti tinggi metasentrik (GM) dan karakteristik lengkung lengan pemulih (GZ). Untuk mengatasi permasalahan tersebut, dilakukan modifikasi struktur dengan mengganti wing tank menjadi hopper tank yang memiliki bentuk trapesium dan kemampuan aliran muatan yang lebih baik serta dapat mengurangi free surface effect secara signifikan.

Penelitian ini bertujuan untuk menganalisis besarnya pengaruh perubahan geometri tanki tersebut terhadap kinerja stabilitas kapal SPBC. Metode penelitian dilakukan melalui pemodelan lambung menggunakan Maxsurf Modeler, penyusunan skenario pengisian muatan (loadcase), serta analisis hidrostatik dan stabilitas menggunakan Maxsurf Stability. Perbandingan dilakukan antara kondisi sebelum modifikasi (wing tank) dan sesudah modifikasi (hopper tank), meliputi perubahan displacement, pusat gravitasi vertikal dan longitudinal, tinggi metasentrik (GM), kurva GZ, luas stabilitas dinamis, dan koreksi permukaan bebas.

Hasil penelitian menunjukkan bahwa penerapan hopper tank memberikan peningkatan stabilitas yang signifikan. Konfigurasi baru menghasilkan nilai GM yang lebih tinggi, area di bawah kurva GZ yang lebih luas, serta pergeseran sudut GZ maksimum ke rentang yang lebih aman. Geometri hopper yang menyempit ke bawah secara efektif mengurangi free surface effect, sementara distribusi muatan yang lebih terpusat di garis tengah kapal menghasilkan perilaku trim yang lebih stabil. Secara keseluruhan, modifikasi hopper tank terbukti memberikan manfaat nyata terhadap stabilitas hidrostatik, margin keselamatan operasional, dan efisiensi bongkar muat kapal SPBC.

Kata kunci: Hopper Tank, Wing Tank, Stabilitas Kapal, Hidrostatika, Maxsurf, Kapal SPBC.

**THE EFFECT OF *HOPER TANK* REPLACEMENT ON
STABILITY ON THE SPBC NUSANTARA FASIFIK 1
(CASE STUDY OF SHIP MODIFICATION FROM
WING TANK DESIGN TO *HOPER TANK*)**

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ABSTRACT

The conventional application of wing tanks on Self-Propelled Barge Carrier (SPBC) vessels presents several operational and stability-related limitations, particularly in terms of cargo handling efficiency, the potential for cargo hanging, and the amplification of free surface effects during partially filled conditions. The flat and wide geometry of wing tanks contributes to dispersed cargo distribution, elevated free surface moments, and reductions in initial stability parameters such as the metacentric height (GM) and the righting lever (GZ) characteristics. To address these issues, a structural modification was introduced by replacing the wing tank configuration with a hopper tank arrangement, characterized by a trapezoidal cross-section that promotes improved cargo flow dynamics and minimizes free surface effects.

This study investigates the quantitative influence of this tank geometry modification on the overall stability performance of an SPBC vessel. The methodological framework involves hull modeling using Maxsurf Modeler, the development of representative loadcase scenarios, and hydrostatic and stability assessments using Maxsurf Stability. Comparative analyses were conducted between the pre-modification (wing tank) and post-modification (hopper tank) configurations, focusing on changes in displacement, longitudinal and vertical center of gravity positions, metacentric height (GM), righting lever curves (GZ), dynamic stability areas, and free surface corrections.

The findings demonstrate that the implementation of hopper tanks results in a substantial improvement in vessel stability. The modified configuration yields higher GM values, enlarged areas under the GZ curve, and a shift in the angle of maximum righting arm toward a more favorable range for operational safety. Furthermore, the hopper geometry effectively reduces free surface effects due to its narrowing lower section, while simultaneously enhancing cargo concentration along the vessel's centerline, thereby contributing to improved trim behavior. Overall, the hopper tank modification provides notable benefits in terms of hydrostatic stability, operational safety margins, and loading performance for SPBC vessels.

Keywords: *Hopper Tank, Wing Tank Replacement, Ship Stability, Hydrostatic Analysis, Maxsurf, SPBC Vessel.*