Stabilitas Kapal AHT Saat Mengangkat Beban Dengan Crane di Laut Lepas

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Abstrak

Kapal AHT dalam operasi di laut lepas, biasanya juga akan melakukan pekerjaan lifting operation. Kapal akan oleng karena kegiatan lifting tersebut, dimana biasanya cargo diangkat dengan crane, dan karena titik berat beban cargo punya lengan moment terhadap titik tangkap pondasi crane dikapal, maka lengan momen ini akan memberikan tambahan momen ke kapal. Gerakan oleng kapal ini akan bertambah, karena dalam operasi dilaut lepas, kapal akan menerima gaya lingkungan dari luar yang berupa gaya gelombang, angin dan arus. Sehingga stabilitas Kapal AHT harus memenuhi tidak saja criteria stabilitas intact, akan tetapi juga harus memenuhi kriteria stabilitas saat melakukan lifting. Dalam paper ini, dibahas mengenai Stability dari sebuah kapal AHT dengan ukuran tipikal 5000 BHP saat intact, dan saat operasi lifting memakai crane dengan cargo seberat sekitar 2 tons di laut lepas dengan mengacu standard.

Kata kunci : Stabilitas, Kapal AHT, Intact Stability, Lifting Stability

Abstract

AHT vessel in the offshore operation, usually will subject to do lifting operation. The vessel will heel and roll due to lifting activity, since the cargo is usually lifted by crane, and there are moment arms of the crane vessel between point foundation and the lifted cargo. The heeling moment will increase because the vessel receives environment forces such as wave, wind and current forces. However, the stability of AHT vessel must meet the stability criteria not only for intact, but also the criteria of stability during lifting. In this paper, we assess the stability of a typical AHT 5000 BHP in intact condition, and when lifting operations using cranes with cargo weighing about 2 tons on the offshore operation with the reference standard.

Keyword **:** *Stability, AHT Vessel, Intact Stability, Lifting Stability*

PENDAHULUAN

Saat beroperasi di laut lepas Kapal *Anchor Handling Tug* (AHT) akan dipergunakan untuk mendukung kegiatan pekerjaan di lepas pantai, termasuk pekerjaan menaik turunkan cargo (*lifting operation*). Kapal akan oleng karena kegiatan lifting itu, dimana biasanya cargo diangkat dengan crane, dan karena titik berat beban cargo punya lengan moment terhadap titik tangkap pondasi crane dikapal, maka lengan momen ini akan memberikan tambahan momen ke kapal. Yang jadi pertanyaan mendasar adalah seberapa besar kapal tsb masih memenuhi kriteria stabilitas, baik intact maupun lifting stability ?

Gerakan oleng kapal ini juga akan bertambah, karena dalam operasi dilaut lepas, kapal akan menerima gaya lingkungan dari luar yang berupa gaya gelombang, angin dan arus. Oleh karena itu study mengenai stabilitas kapal saat operasi lifting akan sangat berguna, terutama bagi operator kapal, pemilik kapal, pemilik barang dan regulator untuk melihat sejauh mana operasi lifting di laut lepas masih aman.

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KRITERIA STABILITAS

INTACT STABILITY

Intact Stability akan mengacu ke IMO Resolution A.749(18) Section 4.6 and 4.7. untuk aplikasi bangunan apung : " The above criteria which are deemed to be appropriate for applications on pontoon and mobile offshore drilling unit (MODUs)".

Intact Stability Criteria di jelaskan di bawah :

The vessel condition should meet the following criteria on intact stability:

a) The area under righting lever curve up to the angle of maximum righting lever, or the angle of downflooding, or 40 degrees, whichever is less, should not be less than 0.08 m-rad. (4.58 m-deg).

b) The static angle of heel due to a uniformly distributed wind load of 0.54 kPa (wind speed 30 m/sec) shall not exceed an angle corresponding to half the freeboard for the relevant loading condition, where the lever of wind heeling moment is measured from the centroid of the windage area to half the draught.

c) The minimum range of stability should be

For L < 100 metres 20 degrees

For L > 150 metres 15 degrees

For immediate lengths by interpolation

d) The area under the righting moment curve to the second intercept or downflooding angle, whichever is less, should be not less than 40% in excess of the area under the wind heeling moment curve to the same limiting angle.

Notes:

The above criteria which are deemed to be appropriate for applications on pontoon and mobile offshore drilling unit (MODUs) are extracted from IMO Resolution A.749(18) Section 4.6 and 4.7.

For intact condition, the vessel shall have sufficient dynamic stability to withstand the overturning effect produced by a sustained wind velocity of 100 knots (51.5 m/s).

LIFTING STABILITY

Lifting Stability akan mengacu ke ABS Intact Stability Guidelines For Derrick/Crane vessel.

Lifting Stability Criteria di jelaskan di bawah :

1. For every loading condition which is to be shown in the Trim and Stability Booklet, the righting arm curve (GZ Curve) is to be plotted. Then:

a. The area under the righting lever curve (GZ Curve) should not less than 0.08 metre-radians (4.58 metre-degrees) up to the maximum ordinate or the angle of downflooding, whichever comes first

b. The KG which is used in calculating the righting lever curve (GZ Curve) should be corrected for the free surface effects of liquid in tanks in every loading condition, including departures.

2. For lifting operations, the analysis methology is describe as follow:

The maximum heeling moment developed by multiplying the weight of the hook load by the horizontal distance to port or starboard of the hook load from centreline, considering the full range of crane elevations and weights, is to be determined. The resulting heeling moment is to be converted to a heeling arm at zero degrees of inclination by dividing the vessel's displacement. The heeling arm thus achieved is to be superimposed on the righting arm curve and is to be taken as a horizontal line.

The righting arm curve is to be corrected for the increase in vertical centre of gravity due to the load. Then:

a. For condition of loading, the first intercept of the heeling arm curve with the righting arm curve (equilibrium point) is to occur prior to submergence of the deck edge.

b. The residual area between the first intercept and the angle of downflooding, the second intercept or 40 degrees, whichever comes first, is to be not less than 0.03 metre-radians (1.72 metre-degrees).

3. When vessel under tow all openings and ventilators to be closed against water ingress.

Notes:

The above criteria which are deemed to be appropriate for applications on crane vessel are extracted from ABS Intact Stability Guidelines For Derrick/Crane vessel.

KAPAL, CRANE DAN CARGO

Detail dari Kapal, Crane dan Cargo dijelaskan pada paragraph dibawah :

Detail Kapal

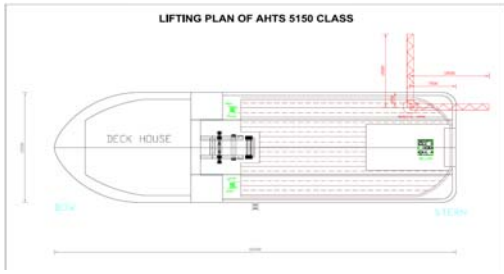
Type/Name	:	AHTS 5150 Class (Typical)
Horse Power	:	2 x 2722 BHP
Length O.A	:	60.4 m
Breadth (mld)	:	15.5 m
Depth (mld)	:	5.5 m
Bollard Pull	:	66 Tonnes
Clear Deck Space	:	390 m2

Crane dan Cargo

Crane Type	:	Pedestal Crane
Crane Weight	:	11 tonnes
Cargo Weight/Part Lifted	:	2 tonnes
Lift Radius	:	12 m
Expected Load Acting at Hook	:	2.6 tonnes
Lifting Height (from MWL)	:	28 m
Applied DAF	:	1.30

Posisi crane dan proposal lifting cargo diterangkan pada gambar di bawah.

Gambar 1. AHT 5,000 BHP Class (Typikal)

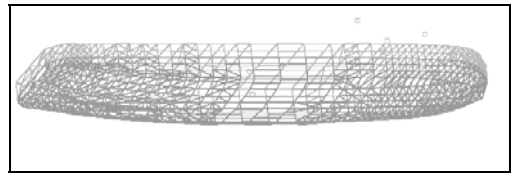


Gambar 2. GA AHT 5,000 BHP Class, Posisi Crane & Cargo

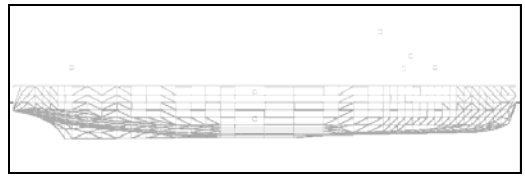
Posisi crane berada pada bagian Starboard side dan stern dari kapal. Dengan melihat posisi crane, maka diperkirakan kondisi yang paling berbahaya dengan mempertimbangkan sudut keolengan kapal saat mengangkat dengan crane adalah jika beban berada pada posisi stern kapal atau pada posisi Starboard kapal dengan lengan angkat sejauh lengan crane.

ANALISA

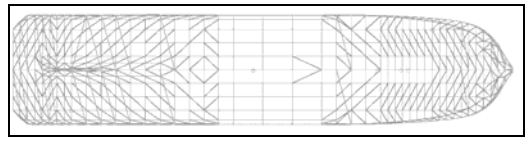
Dalam Study ini, analisa menggunakan pendekatan prediksi numerik dengan memakai software MOSES. MOSES adalah software yang menggunakan pendekatan Boundary Element Method, sehingga pemodelan kapal bisa akurat dimodelkan sesuai bentuk dari Kapal yang sebenarnya. Pemodelan kapal untuk prediksi numerik dalam MOSES diperlihatkan pada gambar dibawah :



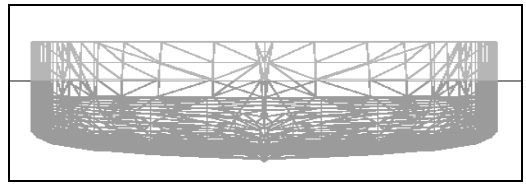
(Isometric view)



(Starboard view)



(Top view)



(Bow view)

Gambar 3. Modeling Kapal

HASIL ANALISA

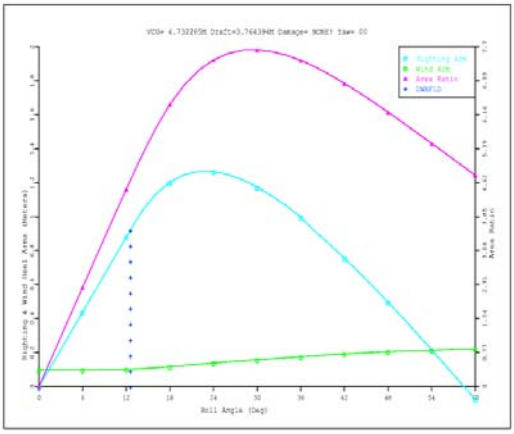
INTACT STABILITY

Hasil analisa stabilitas kapal di perlihatkan secara detail di bawah ini.

Intact Stability dengan Kapal di pasang dengan pedestal crane.

Draught Aft Port	:	3.68	m
Draught Aft Stbd	:	3.68	m
Draught Fore Port	:	3.68	m
Draught Fore Stbd	:	3.68	m
Draught Mean Port	:	3.68	m
Draught Mean Stbd	:	3.68	m
Displacement	:	2285.3	tonnes

Kurva Righting arm, Wind arm dan Area Ratio di perlihatkan pada gambar dibawah..



Gambar 4. Kurva Intact Stability

Hasil analisa Intact Stability dibandingkan dengan criteria di sumarikan di tabel bawah.

Tabel 1. Hasil Analisa Intact Stability

No	Stability Check	Results	Criteria	Remarks
1	Area up to down flooding	6.33 m-deg	>= 4.58 m-deg	OK
2	Static angle of heel	1.32 deg	< 4.58 deg	OK
3	Range of positive stability	61.03 deg	> 20 deg	OK
4	Area ratio at or before second intercept or down flooding angle	4.71	> 40% excess	OK

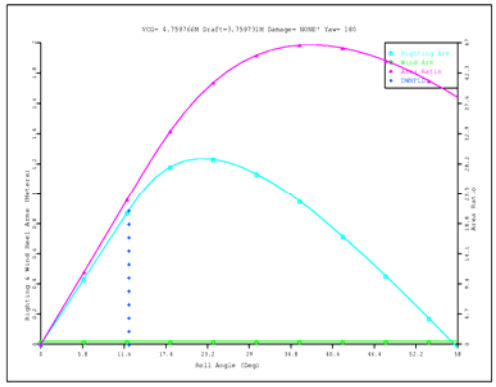
Lifting dari Starboard Side, Cargo 2 tonnes

Lift Radius	:	12	m,
Lift Weight (Static)	:	2	tonnes
Expected Load Acting at Hook	:	2.6	tonnes
Lifting Height (from MWL)	:	28	m
Applied DAF	:	1.30	

Hasil analisa lifting stability disumarikan di paragraph di bawah:

Vessel Equilibrium Condition

Draught Aft Port	:	3.65	m
Draught Aft Stbd	:	3.72	m
Draught Fore Port	:	3.63	m
Draught Fore Stbd	:	3.70	m
Draught Mean Port	:	3.64	m
Draught Mean Stbd	:	3.71	m
Roll (static)	:	-0.26	deg
Pith (static)	:	0.02	deg
Displacement	:	2287.9	tonnes



Gambar 5. Kurva Lifting Stability, Lifting dari Starboard side

Tabel 2. Hasil Analisa Lifting Stability, Lifting dari Portside

No	Stability Check	Results	Criteria	Remarks
1	Area up to down flooding	6.09 m-deg	>= 1.72 m-deg	OK
2	Static angle of heel	0.24 deg	< 1.72 deg	OK
3	Range of positive stability	60.00 deg	> 20 deg	OK
4	Area ratio at or before second intercept or down flooding angle	24.39	> 40% excess	OK

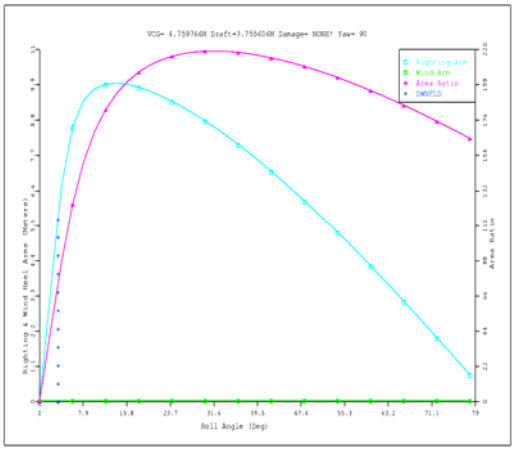
Lifting dari Stern Side, Cargo 2 tonnes

Lift Radius	:	12	m,
Lift Weight (Static)	:	2	tonnes
Expected Load Acting at Hook	:	2.6	tonnes
Lifting Height (from MWL)	:	28	m
Applied DAF	:	1.30	

Hasil analisa lifting stability disumarikan di paragraph

di bawah:

Vessel Equilibrium Condition			
Draught Aft Port	:	3.68	m
Draught Aft Stbd	:	3.70	m
Draught Fore Port	:	3.65	m
Draught Fore Stbd	:	3.68	m
Draught Mean Port	:	3.67	m
Draught Mean Stbd	:	3.69	m
Roll (static)	:	-0.08	deg
Pith (static)	:	0.03	deg
Displacement	:	2287.9	tonnes



Gambar 6. Kurva Lifting Stability, Lifting dari Stern

Tabel 3. Hasil Analisa Lifting Stability, Lifting dari Stern side

No	Stability Check	Results	Criteria	Remarks
1	Area up to down flooding	11.82 m-deg	>= 1.72 m-deg	OK
2	Static angle of heel	0.05 deg	< 1.72 deg	OK
3	Range of positive stability	78.00 deg	> 20 deg	OK
4	Area ratio at or before second intercept or down flooding angle	82.37	> 40% excess	OK

KESIMPULAN

- Working radius untuk 11 tonnes pedestal crane selama lifting cargo seberat 2 tonnes bisa sampai 12 meters selama lifting pada starboard side dan stern side.
- Kapal AHT memenuhi stability requirements untuk proposal crane dan kargo dengan limiting working radius seperti poin diatas pada offshore site.

SARAN

Crane capacity tidak termasuk dalam ruang lingkup study di paper ini, oleh karena itu harus di verifikasi berdasarkan load chart dari spesifikasi crane yang akan dipakai, dengan mempertimbangkan juga DAF (Dynamic Amplification Factor) = 1.30 yang terjadi akibat gerakan dinamis saat lifting di laut lepas.

DAFTAR PUSTAKA

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K.J. Rawson and EC. Tupper (2001). “Basic Ship Theory 5th Edition”, Butterworth-Heinemann Elsevier Group, Oxford-USA.

IMO International Maritime Organization, IMO Resolution A.749 (18) Section 4.6 and 4.7

ABS American Bureau of Shipping, Intact Stability Guidelines for Derrick/Crane Barge