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Master Thesis

Guidelines for Hull Condition Assessment Applicable to Single Skin Bulk Carriers on International Trade

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1. INTRODUCTION & OBJECTIVES

- 1) To develop a documentation aide in the form of clear procedures and guidelines for hull condition assessment
- 2) To be used internally and exclusively by Overseas Marine Certification Services (OMCS CLASS)
- 3) To aid to hull surveyors during their inspections for conducting their inspections
 - As informed as possible
 - Making standardize and sensible decisions
 - Optimizing their time by focusing on structural areas prone to failure or degradation.

WHY?

**Ship Dimensions + Safety Concerns & Difficult Access to Ship Structure
+ Commercial Pressure + Harsh Operational Requirements**

=

DISASTERS & MANY TECHNICAL/OPERATIONAL CHALLENGES!



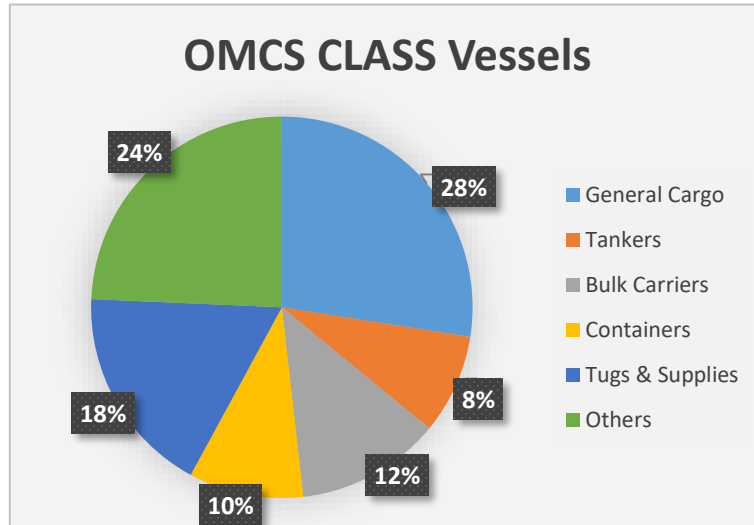
Ship hull structure assessment is a process to determine the **reliability** of the existing structure in terms of **carrying current and future loads and to fulfil its task for a given period**. With main objectives:

- 1) **The assurance of structural safety and serviceability (SAFETY)**
- 2) **The minimisation of costs and repair time. (COMMERCIAL)**

2. INTERSHIP COMPANY & THESIS METHODOLOGY



OMCS CLASS
Overseas Marine Certification Services



- Classification society, Recognized organization, recognized security organization founded on 2004;
- Head Quarters in Panama with offices in Shanghai, Dubai, Spain, Colombia & Paraguay;
- ISO 9001 & ISO 17020 Certified; Authorized to act on behalf eleven (11) maritime administrations;
- Classifies more than 500 vessels worldwide; approximately 12% are bulk carriers with more than 60 Exclusive Surveyors Worldwide

A) *Bibliographic Review (IMO, IACS, INTERCARGO, OMCS CLASS, Flag Administrations & PSC Regimes circulars)*

B) *Survey history information review of 10 single skin bulk carriers classified by OMCS CLASS up to the last two SS.*

- 1) Class survey statements,
- 2) Transfer of class information,
- 3) Hull related deficiencies and/or conditions of class,
- 4) PSC detention records,
- 5) Thickness measurement reports and finding,
- 6) ESP survey reports.

C) *Supplemented by on the field inspections that were carried out along with OMCS CLASS Surveyors.*

3. BULK CARRIERS SAFETY RECORD

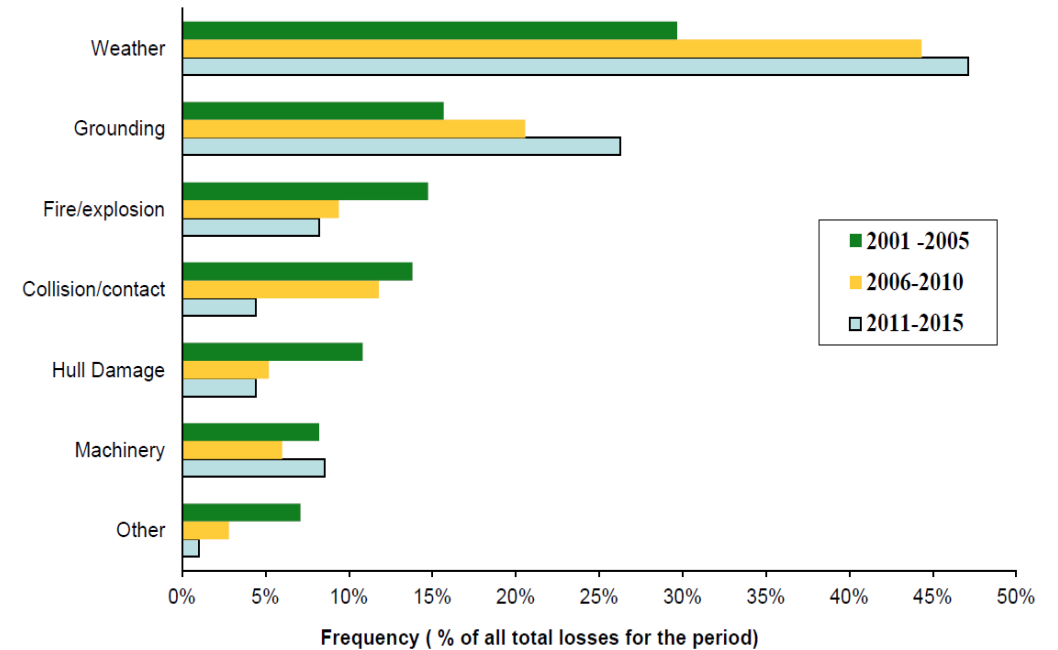
Between 1983 & June 1997, 73 bulk carriers were lost due to known or probable structural failure and more than 40 suffered severe damages. 70% of the total losses had three common factors:

- ✓ ship with age > 18 years
- ✓ carrying heavy ore cargoes
- ✓ suffered water flooding of the cargo holds during bad weather conditions

Poor safety record and innumerable accidents recorded coupled with the type of cargoes and hardships of its operational life; triggered the maritime community to **REACT!**

Special attention to the design, construction (**Common Structural Rules**) and overall the scope and quality of the inspections (**Enhanced Survey Program**) of the bulk carriers.

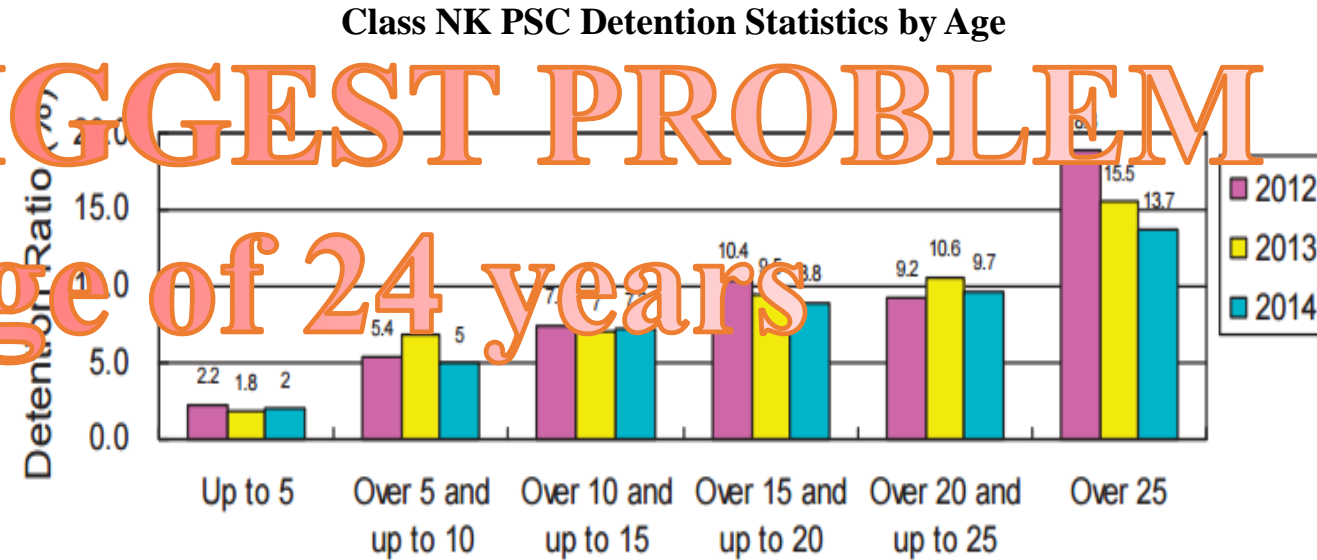
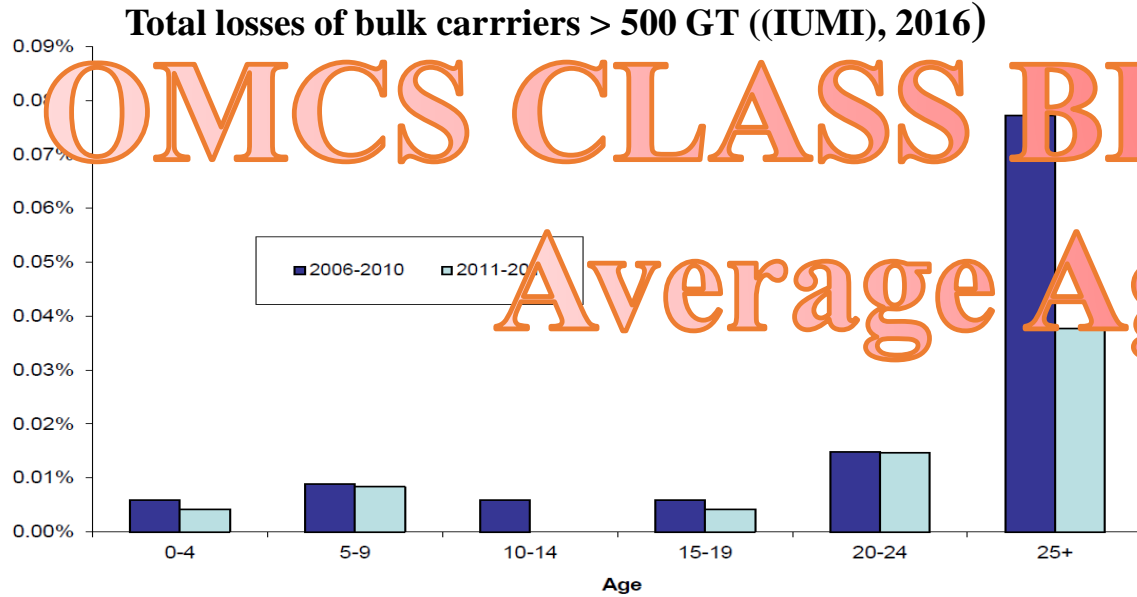
Total losses by causes for all vessel types greater than 500 GT ((IUMI), 2016)



As per Clarkson Research, in 2016 were more than 10,000 bulk carriers of different sizes in service trading around the world

4. Factors Influencing the Condition of a Bulk Carrier Hull

1) Ship Age



OMCS CLASS BIGGEST PROBLEM
Average Age of 24 years

2) Protective Coating

- Water Ballast Tanks (The single largest surface area)
- Recent Requirement July 2008 (15 Years Target)
- Grading Required (GOOD, FAIR, POOR)
- Coating degradation due to inadequate surface preparation and paint application, loss of coating flexibility over time causing cracking and debonding.

3) Corrosion Wastage

- The most important causes of structural damages and wears of a ship structure
- General, Pitting, Stress Corrosion Cracking, Microbiological and Erosion Corrosion

Uniform corrosion of unprotected ballast tanks (A.R.R. of 0.2 - 0.4 mm)

Factors influencing corrosion rates: corrosion protection effectiveness, stress, heat, humidity, oxygen content, type of cargoes (acidity of the cargo), frequency of ballasting, sludge/scale accumulation, frequency and method of tank cleaning, trade route, corrosion films, speed of flow, and enclosed atmospheric environment.

4) Cracking & Deformations (Most Noticeable Damages)

- Cracks found at locations where stress concentration, fatigue. Timely repairs important!
- Deformations: Buckling and Bending (structural overloads (heavy weather, poor design, improper loading, accidents))

5) Mechanical Damages due to Wear & Tear

- Bulk Carriers have one of the toughest operational life of all commercial vessels.
- During the loading (cargo drop) and unloading (grabs, bulldozers)
- Corrosive Cargo



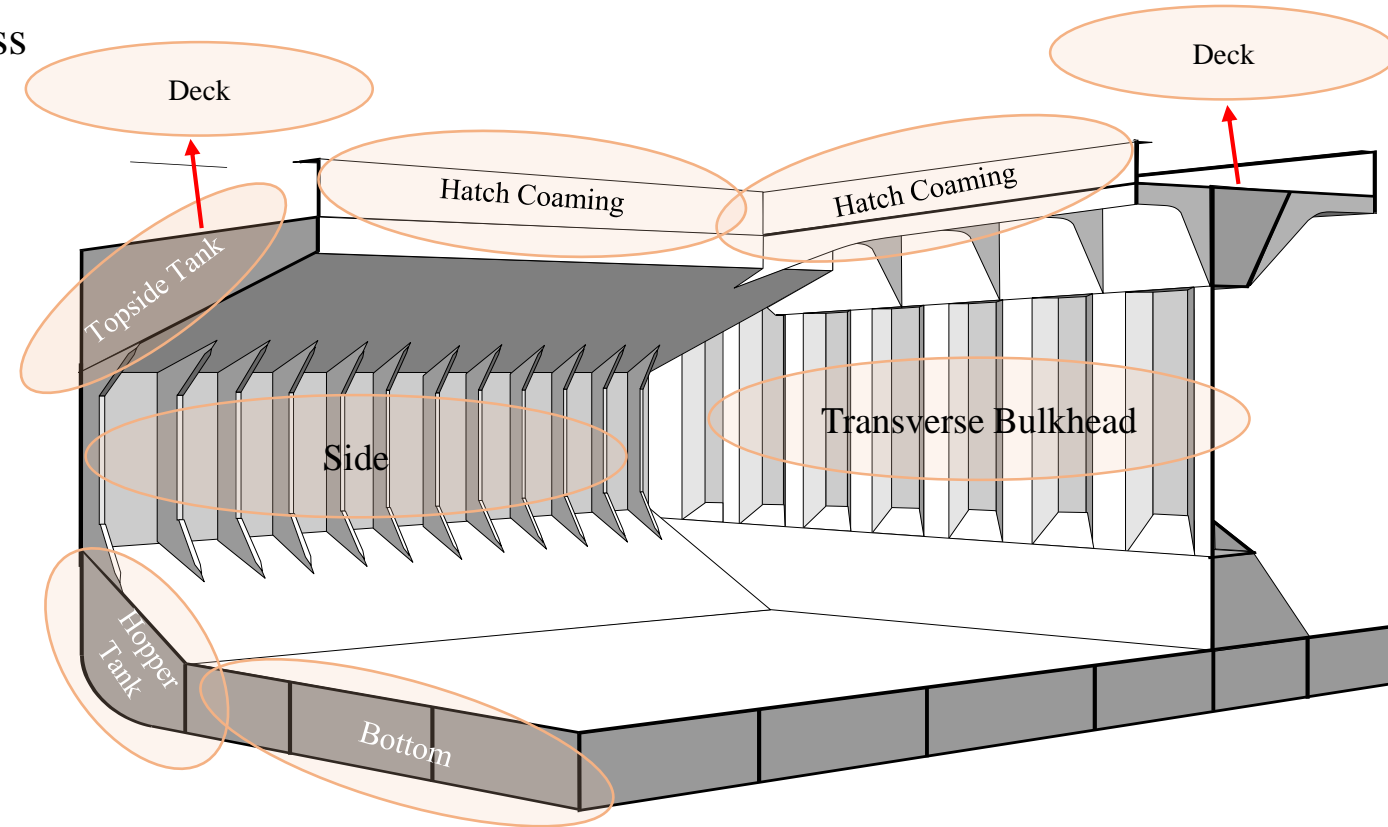
5. SINGLE SKIN BULK CARRIER HULL STRUCTURES

Some unique characteristics that influence and affect the condition of the hull:

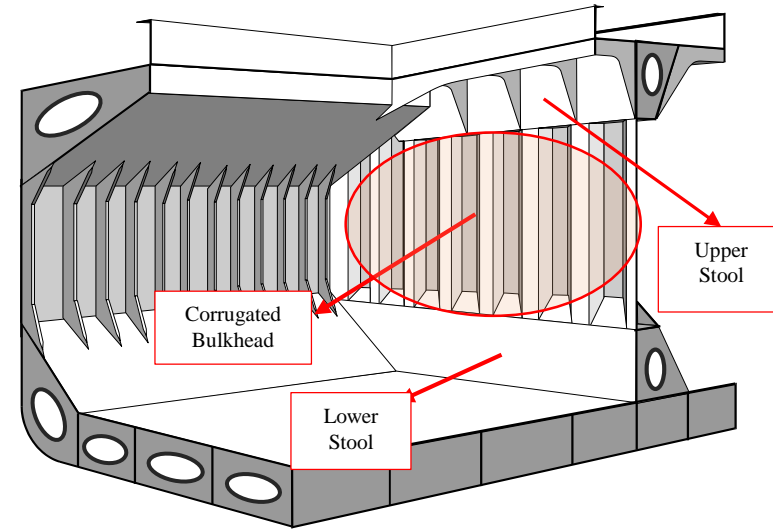
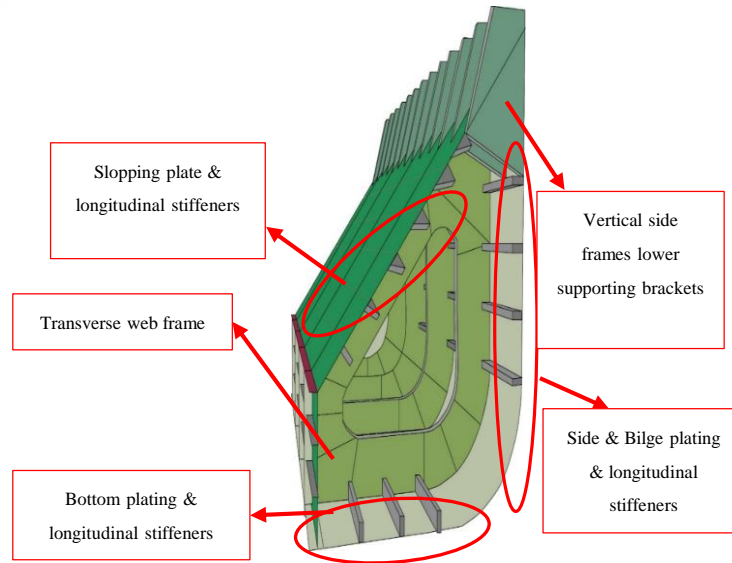
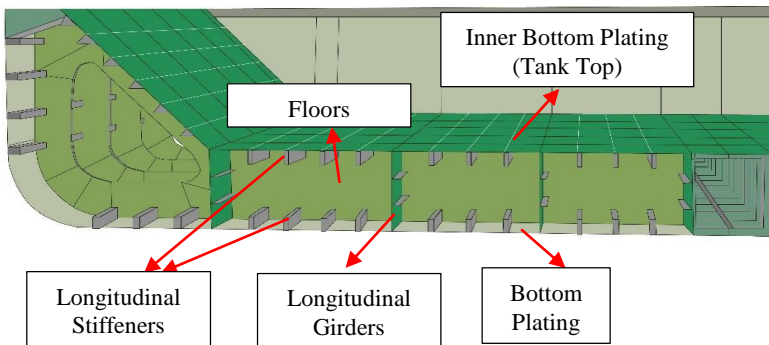
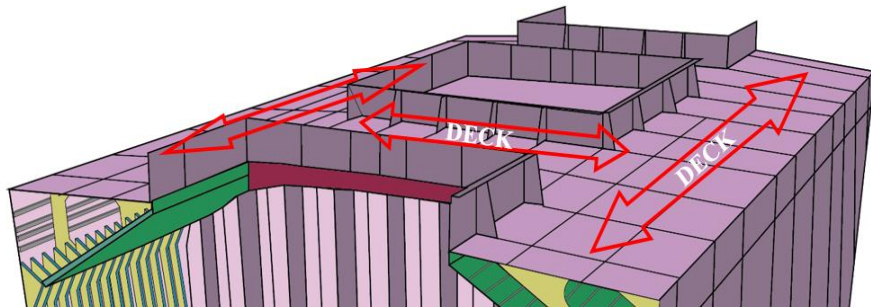
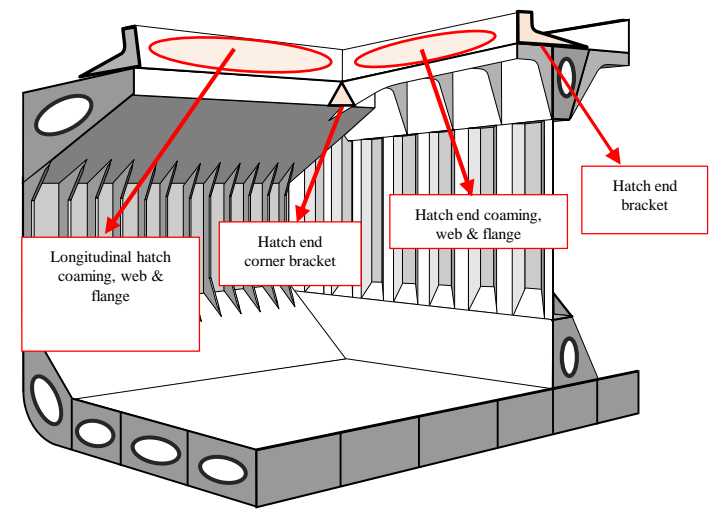
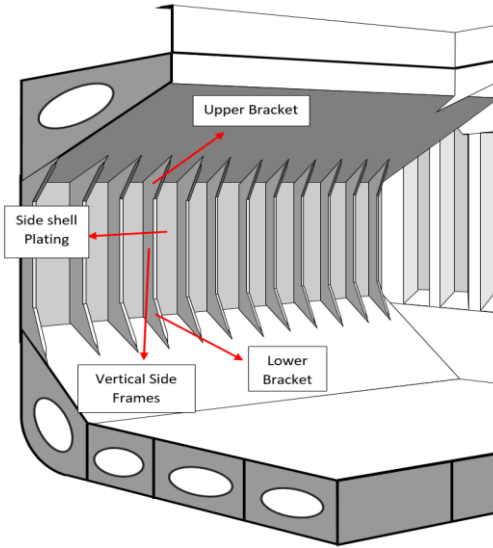
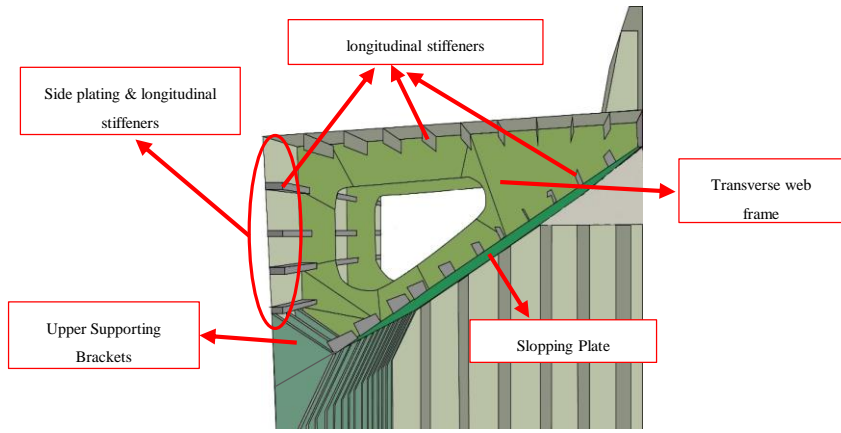
- ✓ Large net load on double bottom
- ✓ High shear stresses on the shell sides
- ✓ Sensitive to leakage and prone to total structural loss
- ✓ High loading rate, transverse strength
- ✓ Green seas among others

Seven (7) main structural regions:

- ✓ Side
- ✓ Bottom
- ✓ Deck
- ✓ Corrugated transverse bulkhead
- ✓ Topside tank
- ✓ Hopper tank
- ✓ Hatch coaming and cover



Guidelines for Hull Condition Assessment Applicable to Single Skin Bulk Carriers on International Trade

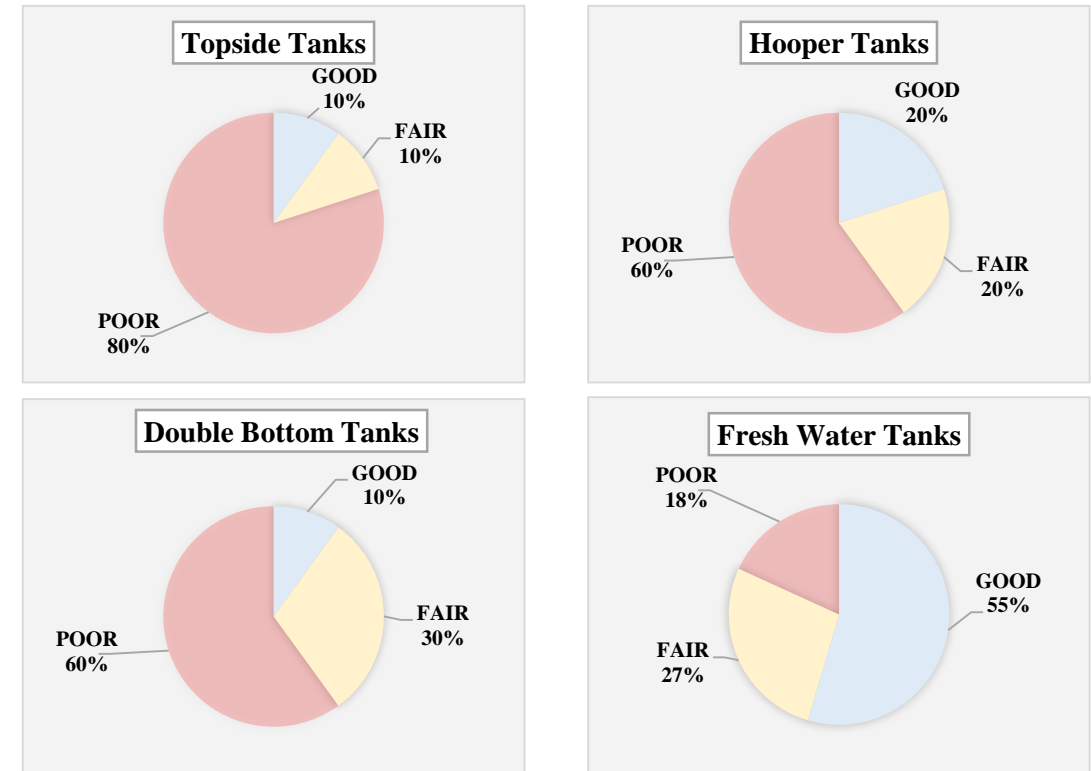


6. ANALYSIS OF OMCS CLASS BULK CARRIER FLEET

	Average Grt	Average DWT	Average Length	Average Ageing
Averages of Ten (10) Vessels Reviewed	18,419 tons	24,054 tons	173 m	23.8 years

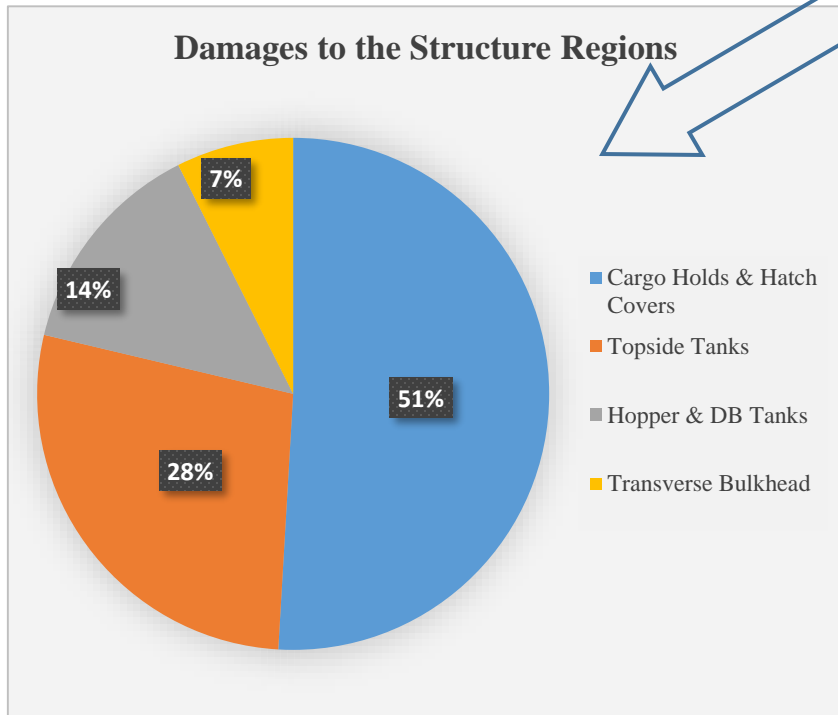


Status of Protective coatings

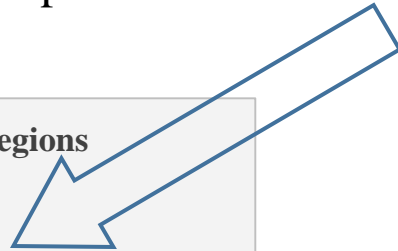


Ballast tanks, the corrosive protection system for the most part consist only of the presence of sacrificial anodes since the coating condition was rated POOR for most them. In particular, topside tanks were the ones worst rated.

- Most common **defects** found were corrosion and cracks at areas of stress concentration
- All existing vessels (Built under IACS)
- TOCA enforcement could be improved



Most Common Defects found on OMCS CLASS Bulk Carriers
1.Generalized and localized corrosion of cargo hold side shell frames and brackets.
2.Cracking at cargo hold side shell frame bracket toes.
3.Excessive corrosion on hatch covers
4.Operational damages (grab & bulldozer) to the side shell frames lower brackets, inner bottom plating, hopper and lower stool plating. (Deformations (buckling and indentations)
5.Cracking at intersection of the inner bottom plating and the hopper plating.
6.Cracking at fore and aft extremities of topside tank structures.
7.Excessive corrosion within topside tanks (Frames, longitudinal stiffeners and brackets).
8.Excessive corrosion within Hopper and Double Bottom tanks (Frames, longitudinal stiffeners and brackets).
9.General corrosion and cracking of transverse bulkheads.
10.Cracking of hatch coamings & hatch corners.



7. SUMMARY OF OMCS CLASS GUIDELINES (APPENDIXES OF THE THESIS)

- **Two (2) Confidential Appendixes** to the master thesis. Ninety five (95) pages guidelines developed
- Covering topics from surveyor safety, ESP survey requirements, Defects, Thickness measurements among others
- Expose the different main hull structural regions where damages have been recorded on OMCS CLASS bulk carriers, focusing on the main features of the structural items of each region.

1. General (Objective, Aim, Definitions)
2. OMCS CLASS Surveyor (PPE, Virtues, Etiquette, Code of Ethics)
3. Hull Survey Requirements (ESP, Close-ups, UTM)
4. Hull Survey Planning & Preparation (Meetings, UTM, Aloft)
5. Hull Survey Execution & Examinations (Defects (Corrosion, Deformations, Cracks), Hose Test, Areas of Concern)



Guidelines for Hull Condition Assessment Applicable to Single Skin Bulk Carriers on International Trade

AREAS OF CONCERN

Fractures/Cracks

Shear Buckling

Fracture/Cracks

Heavy Corrosion between the connection of lower stool and tank top

Web Frame Buckling

Fractures/Cracks

Web Frame Buckling

Excessive corrosion at the mid-height and at the bottom of bulkheads

Shear Buckling Region

Fracture/Cracks

Area Prone to Excessive Corrosion

Fracture/Crack

Fractures/Cracks

Side shell

Area of Side Shell Prone to Contact Damage, Wastage and Operational Damages

Areas prone to excessive corrosion

8. CONCLUSIONS

- Due to the great dimensions of the bulk carriers' hull structures, the dangers and difficulties to access the different elements, the commercial pressure inherited in the maritime operations and the very short time allocated make the hull inspection on board bulk carriers very challenging. Thus, highlighting the importance to have standardized and detailed procedures and guidelines for hull condition assessment surveys of bulk carriers.
- In the classification business the competence and knowledge of the on field surveyors (Boots on the Ground) are of paramount importance.
- Thus the creation of specific guidelines that focus on the particular problems that OMCS CLASS bulk carrier faces could be of great assistance to the company.
- A similar study is recommended to be performed on the Oil Tanker fleet of OMCS CLASS that is also subject to the requirements of the ESP Code 2011 and the results to be adhered to these propose guidelines.

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Dziękuję Ci!

