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TAMILNADU, INDIA

NUMERICAL ANALYSIS OF A CONTAINER VESSEL

A Report on Internship

In

Department of Naval Architecture & Offshore Engineering

By

Mr.Hari Parasanth N

ANA17082L

May-2021

BONAFIDE CERTIFICATE

This is to certify that the Home based Internship entitled "Numerical Analysis of a container Vessel" submitted by Mr.Hari Parasanth N .to the Department of Naval Architecture & Offshore Engineering, AMET, India for the award of degree of Bachelor of Engineering is a Bonafide record of technical work carried out by him under my supervision. The contents of this Internship, in full or in parts, have not been submitted to any other institute or university for the award of any degree or diploma.

Signature

(Mentor)

Mr. Gopi Krishna

Assistant Professor

Department of Naval Architecture &
Offshore Engineering

Signature

(HOD)

Mr. MSP Raju

Associate Professor

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Offshore Engineering

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INTERNSHIP ALLOCATION REPORT 2020-21

Name of the Department: Naval Architecture & Offshore Engg.

(In view of advisory from the AICTE, internships for the year 2020-21 are offered by the Department itself to facilitate the students to take up required work from their home itself during the lock down period due to COVID-19 outbreak)

Name of the Programme : B.E - NA & OE

Year of study and Batch/Group : Final Year / Group - 2

Name of the Mentor : Mr. T. Gopi Krishna

Title of the assigned internship :

Numerical Analysis of a container vessel.

Nature of Internship : **Individual/Group**

Reg No of Students who are assigned with this internship:

ANA17082L

Total No. of Hours Required to complete the Internship: 60.

Signature of the Mentor	Signature of the Internal Examiner	Signature of HoD/Programme Head

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INTERNSHIP EVALUATION REPORT 2020-21

Name of the Department: Naval Architecture and offshore Engg

(In view of advisory from the AICTE, internships for the year 2020-21 are offered by the Department itself to facilitate the students to take up required work from their home itself during the lock down period due to COVID-19 outbreak)

Name of the Student	Hari prashanth N
Register No and Roll No	ANA17082L
Programme of study	B.E - NAOE
Year and Batch/Group	Final year - Group-I
Semester	II / IV / VI / VIII
Title of Internship	Numerical Analysis of container vessel.
Duration of Internship	60 Hours
Mentor of the Student	Mr. Yarabala Gopi krishna.

Evaluation by the Department

Sl No.	Criterion	Max. Marks	Marks Allotted
1	Regularity in maintenance of the diary.	10	8
2	Adequacy & quality of information recorded	10	9
3	Drawings, sketches and data recorded	10	8
4	Thought process and recording techniques used	5	4
5	Organization of the information	5	4
6	Originality of the Internship Report	20	19
7	Adequacy and purposeful write-up of the Internship Report	10	8
8	Organization, format, drawings, sketches, style, language etc. of the Internship Report	10	7
9	Practical applications, relationships with basic theory and concepts	10	7
10	Presentation Skills	10	8
Total		100	82

Signature of the Mentor	Signature of the Internal Examiner	Signature of HoD/Programme Head
[signature]	[signature]	[signature]

ABSTRACT

The New Suez canal, the expanded division of Suez Canal is expected to increase the trade along its shipping route. The ships moving in shallow, restricted regions or canals would experience various shallow water effects due to its reduction in under keel clearance, banks and other vessel interactions. The variation in under keel depth causes reduction in pressure and leads to additional sinkage and trim or squat of the vessel. For the ship's navigational behaviour in shallow waters, the squat is a confining factor. The squat depends on several factors, where the speed of the vessel and the canal dimensions are most significant. The focus of this study is to numerically study the effect of squat in three different canal configurations in CFD solver to predict the possibility of grounding in the New Suez Canal.

The canal dimensions of three different passages in the shallow and restricted waters and a deep water condition is selected for the present study. Rectangular and trapezoidal computational domains similar to the New Suez canal is modelled to replicate the canal configurations. Since the effect of viscous effect is significant in shallow waters, a grid independence analysis is carried out for fixing the boundary layer thickness. The simulations are performed at five different ship speeds, in sub-critical range. The effect of speed and canal configurations on trim, sinkage and resistance is evaluated for all four cases. The estimated results are validated with the available literature. The wave pattern and their variations due to the canal configuration is analyzed and compared. The present research is important to predict the effect of canal width and dredging depth on the ships through the New Suez Canal and assist in taking decisions on the additional provisions to be considered in the canal.

Keywords: shallow water, squat, New Suez Canal, CFD

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CHAPTER 1

SQUAT PHENOMENON

1.1 INTRODUCTION

During the ship motion in shallow water there are chances when the clearance between the ship under keel and the sea bed decreases. This phenomenon occurs due to significant change in potential flow around the hull, which shadows the principle of Bernoulli's theorem. As per this theorem where the differences regarding the velocity of flow there is change of water pressure along the hull. In shallow water there is a smaller value of pressure at the midship in comparison with the deep water condition. In the opposite way, there is a bigger value of pressure in the bow and aft parts of the ship. According to the pressure distribution the water level increases in the bow and aft parts of the ship but at the midship the water level decreases. This drop in pressure is compensated by the sinkage as well as the trim angle variation of the vessel which as a combination is the reason of the ship squat, a crucial factor that restricts ship navigation in shallow water and is shown in Figure 1.1. For ships with fine form such as container vessels, squat usually occurs at the stern.

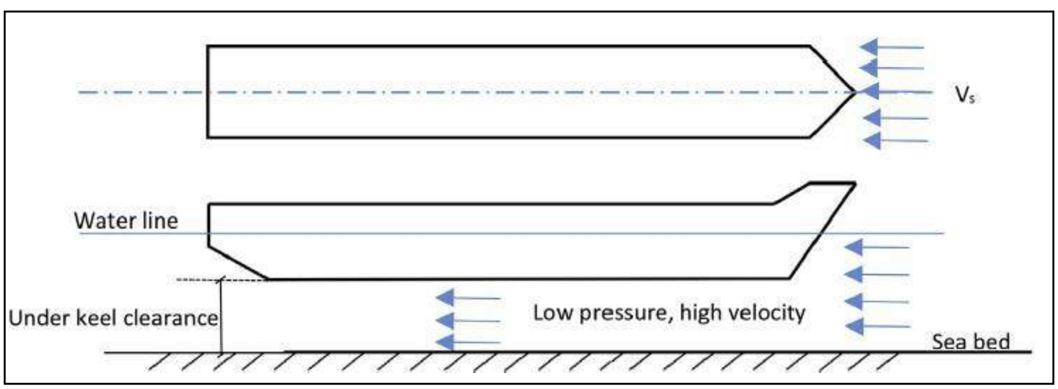


Figure 1.1: Squat effect on ship in shallow water.

1.2 DETERMINANT FACTORS OF SQUAT

i. Ship characteristics:

The main parameters of the vessel that influence the squat are the draught (*T*), the shape of the hull represented by the block coefficient of fineness (C_B), the speed in knots or (m/s), the length between perpendicular (L_{PP}) and the breadth (*B*).

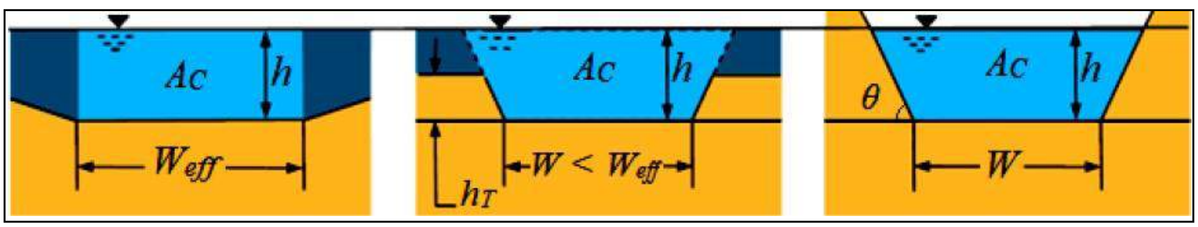
ii. Canals configuration:

The main types of configurations of waterways are

- Open or unrestricted.
- Restricted (bottom dredged).
- Canal.

Unrestricted waterways shown in Figure 1.2.a are relatively large stretches of water without side restrictions but with shallow waters, and are usually encountered at channel entrances. The second type of channel shown in Figure 1.2.b shows at its bottom a dredged underwater hat (h_T), which does not protrude to the surface of the water. The last type of configuration is the canal shown in Figure 1.2.c this characterizes the canals with consolidated banks, which may or may not be exposed to tidal fluctuations.

The canal configuration is characterized by: the width at the bottom (W), the depth (h) and the slope of the side wall or bank θ.



(a) (b) (c)

Figure 1.2: Canals configuration.

iii. Ship – canal combination characteristics:

Several dimensionless parameters are required to be used in squat calculation formulas:

- The most important being the Froude number of depth (Fn_h), given in Eq.1.1.which is a measure of the ship's resistance to advancing in shallow waters, where u is the speed of the vessel (m/s), g is the acceleration due to gravity (m/s^2) and H is the water depth.

$$Fn_h = u / \sqrt{gH} \quad (1.1)$$

- The second non-dimensional parameter is the blockage ratio (K) represents the ratio between the ships immersed amidships section and the cross section of the canal or the waterway, given in Eq.1.2, shown in Table 1.1 and given in Figure 1.3. Blockage factor values are typically between 0.03 and 0.25 or greater for restricted (bottom drag) channels or 0.10 or less for unrestricted waterways.

$$\mathrm{K} = \frac{b * T}{B * H} \quad (1.2)$$

Table 1.1: Abbreviations of ship-canal combination

Abbreviations	
Canal Width	B
Water depth	h
Ship breadth	b
Ship draught	T
Under keel clearance	ukc
Ship static position	1
Ship position at (V_k) speed	2

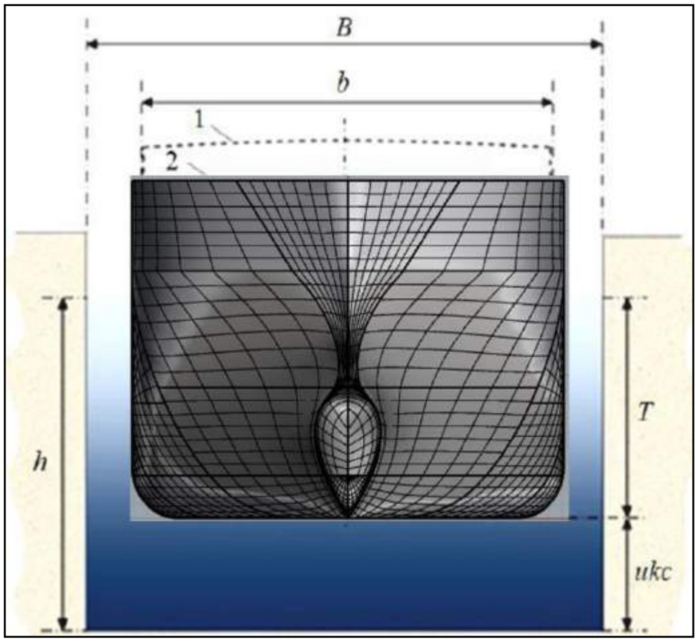


Figure 1.3: Ship – canal combination

iv. Width of influence:

If a ship is in open water conditions, there are two artificial limits on the starboard and port side, parallel to the ship's centerline, outside of which an obstacle cannot bring any change in vessel speed, resistance or squat. This artificial limit is known as the width of influence.

v. Depth of influence:

There is also a depth of influence, which defines an artificial depth limit. If the depth of water h is greater than the depth of influence, the ship is not influenced by the bottom of the waterway or canal. Otherwise, the presence of the bottom will cause changes in the ship's hydrodynamics and may influence squat.

It is said that a ship is in "open water" conditions when it sails in shallow waters but without side restrictions. A vessel found in shallow waters and having side restrictions is considered to be in narrow canal or "restricted waters".

CHAPTER 2

NEW SUEZ CANAL

2.1 INTRODUCTION

The Suez Canal is an artificial sea-level waterway running north to south across the Isthmus of Suez in Egypt to connect the Mediterranean Sea and the Red Sea. The canal separates the African continent from Asia, and it provides the shortest maritime route between Europe and the lands lying around the Indian and western Pacific oceans shown in Figure 2.1. It is one of the world's most heavily used shipping lanes.The Suez Canal is one of the most important waterways in the world.

Figure 2.1: Suez Canal geographical map

The Suez Canal is a sea level Canal and the height of water level differs slightly and the extreme tidal range is 65 cm in the north and 1.9 m in the south. The banks of the Canal are protected against the wash and waves, generated by the transit of ships, by revetments of hard stones and steel sheet piles corresponding to the nature of soil in every area. On both sides of the Canal, there are mooring bollards every 125 m for the mooring of vessel in case of emergency, and kilometric sign posts helping locate the position of ships in the waterway. The navigable channel is bordered by light and reflecting buoys as navigational aids to night traffic.

Suez canal New Suez canal North- South transit

Figure 2.2: Expansion of Suez Canal geographical map

A new shipping lane termed the New Suez Canal was added to the Suez Canal and inaugurated on 5 August 2014. In addition, other parts of the Suez Canal were made deeper and wider. The idea of the project was to construct a new canal parallel to the old one. The new canal is 72 km long. The New Suez Canal is expected to expand trade along the fastest shipping route between Europe and Asia. The new canal allows ships to sail in both directions at the same time shown in Figure 2.2, where the wakes behind the ships show that those on the left side cruise southward while ships on the right move north. The new section of two-way traffic shortens the time spent waiting for ships to pass in the opposing direction. This decreases the transit time from 18 h to 11 h for the southbound convoy. It also shortens the waiting time for vessels down to a maximum of 3 h, rather than the previous 8–11 h. This will cut down on trip costs and make the Suez Canal more attractive for ship owners. The New Suez Canal is expected to virtually double the capacity of the Suez Canal from 49 to 97 ships a day.

2.2 NEW SUEZ CANAL ADVANTAGES

The unique geographical location of the Suez and the New Suez canal which not only provides the shortest east and west link but also provides the largest international trade thus, obliged to certain advantages to the world which are as follows:

i. It is the longest canal in the world without locks.
ii. The accidents are almost minor compared with other waterways except the grounding of the vessels.
iii. Navigation goes day and night.
iv. The canal is suitable for widening and deepening in future when required to cope with the development in ship sizes and tonnages.

2.3 NEW SUEZ CANAL CHARACTERISTICS

i. Cross section of the canal:

The main dimensions of the canal cross section in addition to the maximum ship speed and draft permitted are given in Table 2.1 and in Figure 2.3 respectively.

Table 2.1: Canal dimensional characteristics

Parameter	Unit	Value
Overall length	km	193.30
Double path length	km	113.30
The width range along the canal at 11m depth.	m	205-225
Water depth	m	24.00
Max. Draught of ship	m	20.12
The cross sectional area range along the canal	m^2	4800-5200
Max. Loaded ship	DWT	2,40,000
Vessel speed	knot	7.00
Maximum boat beam	m	77.50
Distance between two ship	km	2.00

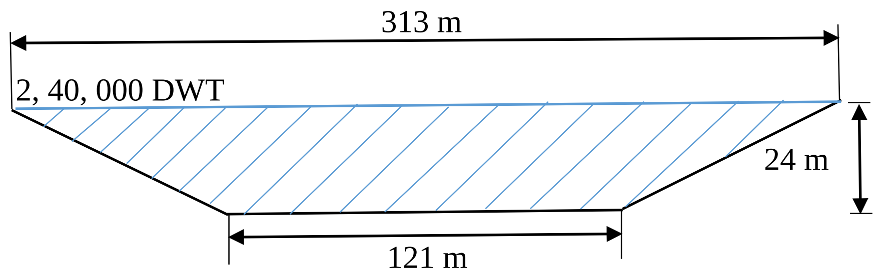


Figure 2.3: New Suez Canal cross section

ii. Capacity of canal:

The expansion phase of the canal to permissible draught of 22m, enables the canal to accommodate the 100% of the fully loaded container ship as shown in Figure 2.3

CHAPTER 3

SHIP HULL AND TEST CASES

3.1 GENERAL

In this chapter, the selection of hull and the different test conditions which are being carried out for obtaining the squat characteristics at various depth Froude numbers are discussed.

3.2 SHIP HULL

As a case study, the well-known benchmark KRISO container ship (KCS) model was chosen to study squat characteristics tests in calm water. The KCS geometry was originated approximately in the year 1997 by the Korea Research Institute for Ships and Ocean Engineering (KRISO) in an effort to provide a set of experimental results for a realistic bulbous-bow container ship. The experimental data has been used extensively to evaluate various numerical simulation tools including CFD.

A scale factor of 1:75 was chosen to match the experiments performed on this ship in other studies. A 3D model of the KCS as modelled in *RHINOCEROS* software is shown in Figure 3.1 and the hull sections are presented in Figure 3.2. As part of the initial conditions, an even-keel draught was set throughout the case-studies performed in this study. The main particulars in full and model-scale are presented in Table 3.1.

Figure 3.1: CAD drawing of KCS (using Rhinoceros software)

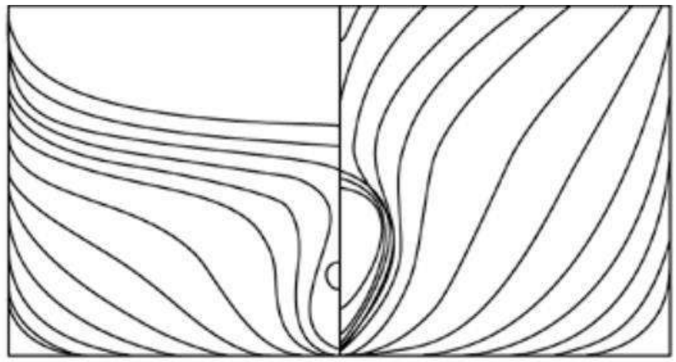


Figure 3.2: Hull section of KCS

Table 3.1: KCS main particulars (from SIMMAN, 2008)

Parameters	Full scale	Model scale with scale factor 1:75
Length between perpendiculars (m)	230.00	3.06
Length at water line (m)	232.50	3.10
Breadth at water line (m)	32.20	0.42
Depth (m)	19.00	0.25
Draft (m)	10.80	0.14
Volumetric Displacement (m^3)	52,030.00	0.12
Wetted surface area w/o rudder (m^2)	9530.00	1.69
Block Coefficient	0.65	0.65
Midship section area Coefficient	0.98	0.98
Longitudinal centre of buoyancy (%), fwd+	−1.48	−1.48

3.3 TEST CASES

Four test cases shown in Figure 3.4 are taken into consideration where the squat characteristics are being studied.

Case 1: The domain cross section is rectangular (4.6m wide and 0.32m water depth). This is to simulate water depth effects only on ship sailing characteristics. Channel bank effects are excluded. In this case, the blockage ratio is made to be the same as that of case 2.

Case 2: This configuration is intended to test the effects of both water depth and width (blockage effects). This case also aims to simulate the cross sectional area of the New Suez Canal. It was prepared at a scale of 1:75 with respect to its real dimensions.

Case 3: As per Case 2 but with reduced water surface width and bottom width of 62.5%. This case was designed for studying higher blockage ratios.

Case 4: The water depth is increased to a 2.3 m deep with 4.6 m water surface width. These configurations are intended to test deep water motion characteristics.

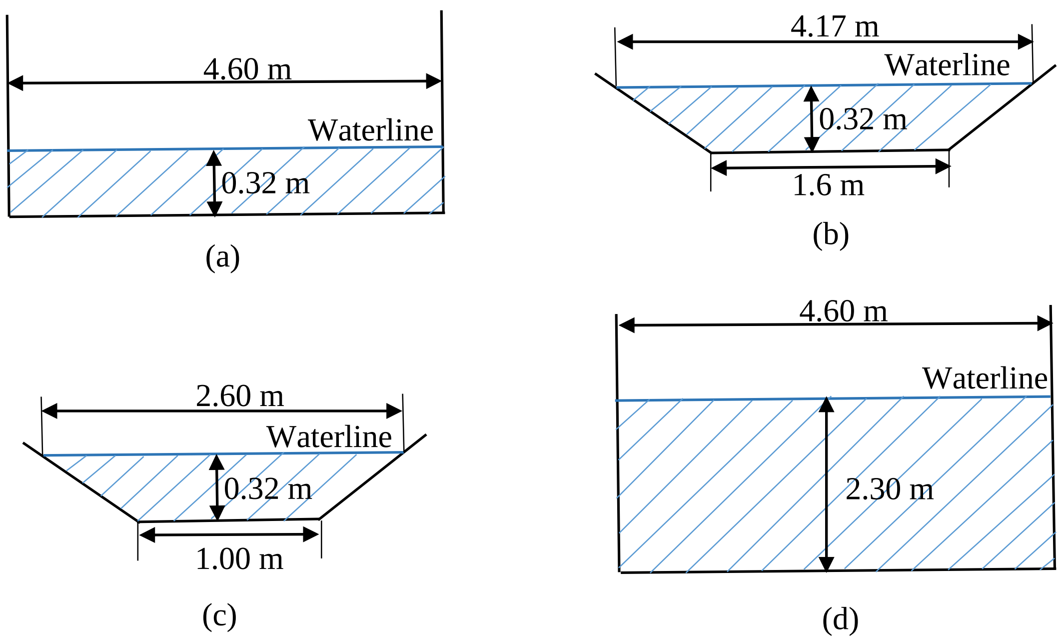


Figure 3.4: Depictions of the four cases with schematic drawing; a: case 1, b & c: case 2, d: case 3, e: case 4

These test are carried out at a range of speeds which falls under the sub-critical speeds as shown in table 3.2 where the speeds for full scale and model scale are also shown. The present investigation focuses on practically relevant operational speeds in the Suez Canal

Table 3.2: Speeds taken for running the tests

Full scale speeds (knots)	Full scale speeds (m/s)	Froude number for model scale	Model scale speed (m/s)
4	2.06	0.134	0.238
6	3.09	0.200	0.356
7	3.60	0.235	0.416
8	4.12	0.269	0.475
10	5.14	0.335	0.594
14	7.20	0.469	0.832

CHAPTER 4

COMPUTATIONAL SETUP

4.1 INTRODUCTION

The commercial available RANS (Reynolds-averaged Navier- Strokes) solver, an advanced CFD tool, Siemens STARCCM+ is used in this study which employs the finite volume method to model the flow, uses the integral form of the governing equation and divides the computational domain into finite number of adjoining cells. RANS solver approach links the continuity and momentum equations. To model the turbulence in the fluid a standard $k - \omega$ turbulence model is used with the all y+ wall treatment, which showed reliable predictions over a range of different case- studies. $K - \omega$ turbulence is inexpensive and reduce the computational time, providing the solutions in good agreements with the experimental results of the available literature. DFBI (Dynamic Fluid Body Interaction) module is used to model the ship squat this computes the normal (pressure) forces and tangential (shear or frictional) forces on the ship hull and adjusts its position to achieve equilibrium. In the examined case-studies, only motions in the vertical plane (y – z) are allowed. To dampen the initial shock, resulting from the initiation of the simulation, the ship is constrained during the first 10 s, which is imposed to allow the flow to develop before the ship is allowed to move. Once this time limit has been overcome, the solver gradually applies forces and moments on the hull during an additional 10 s. The important step in a CFD solution process is to accomplish an appropriate domain and meshing strategy to obtain a converged solution. To minimize the wall effect, the domain has to be fixed far from the 3000TEU container ship. The setting of the domain size usually carried out after analyzing through a domain study to reach an appropriate domain size and hence the effects are minimum or negligible.

4.2 FLOW DOMAIN

The dimensions of domain follow the recommendation of ITTC (2017) and CD-ADAPCO (2016). As the domain boundaries are required to replicate the experimental setup, the domain top is placed at a distance of 1.127L away from the still waterline. The inlet is positioned at a distance of 1.22L upstream of the forward perpendicular where a velocity inlet boundary condition is imposed. The outlet is positioned at a distance of 2.23L downstream from the aft perpendicular and is set to maintain the hydrostatic pressure. A symmetry plane is selected across the center line of the container ship and all other sides are imposed with wall. Domain dimensions and boundary conditions of all the four case studies are shown in Figure 4.1, 4.2, 4.3, 4.4 respectively, where L is the length of the ship.

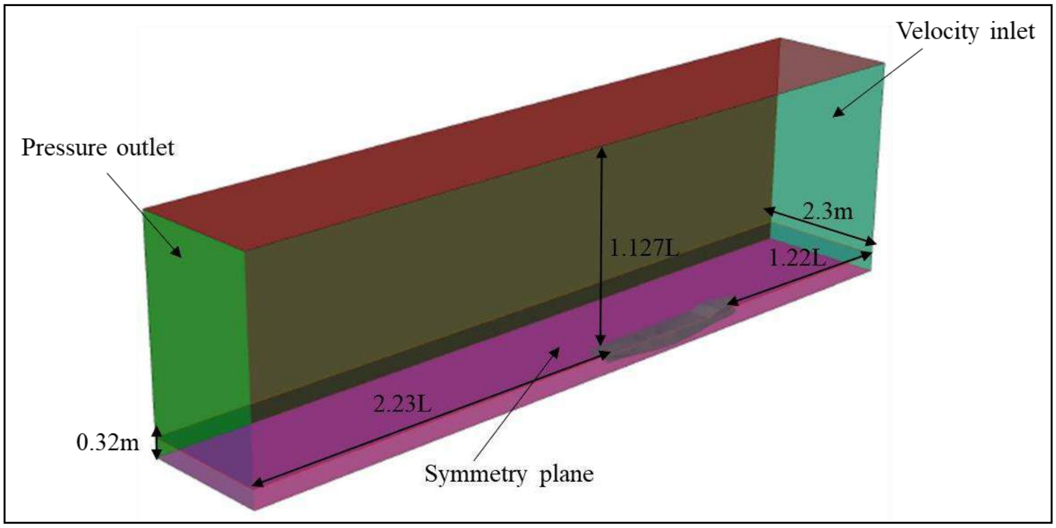


Figure 4.1: Case 1 computational domain

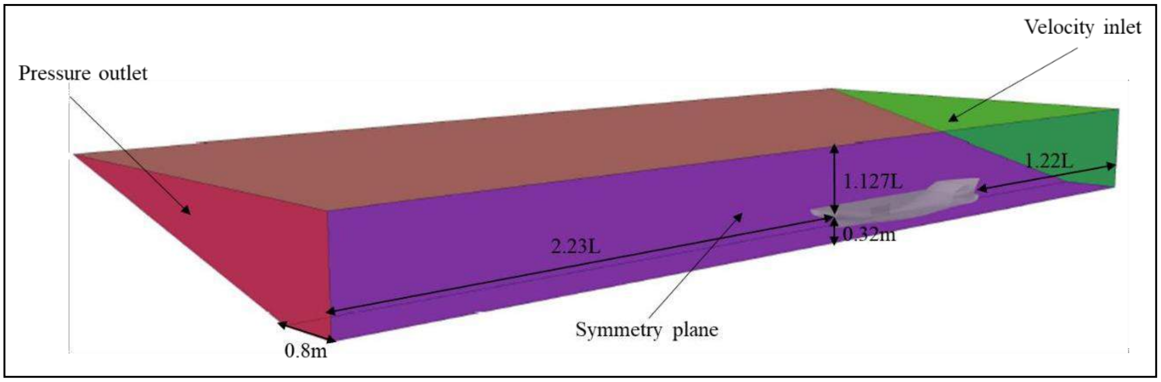


Figure 4.2: Case 2 computational domain

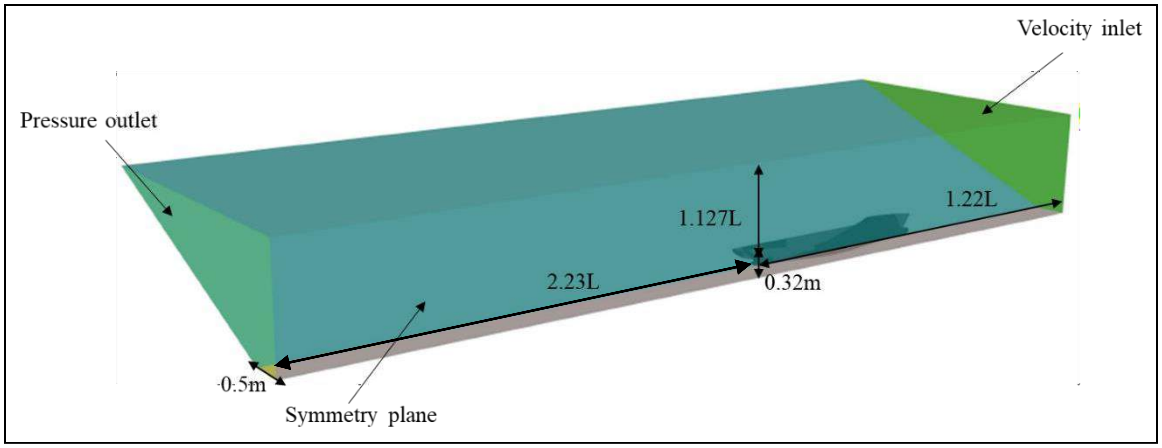


Figure 4.3: Case 3 computational domain

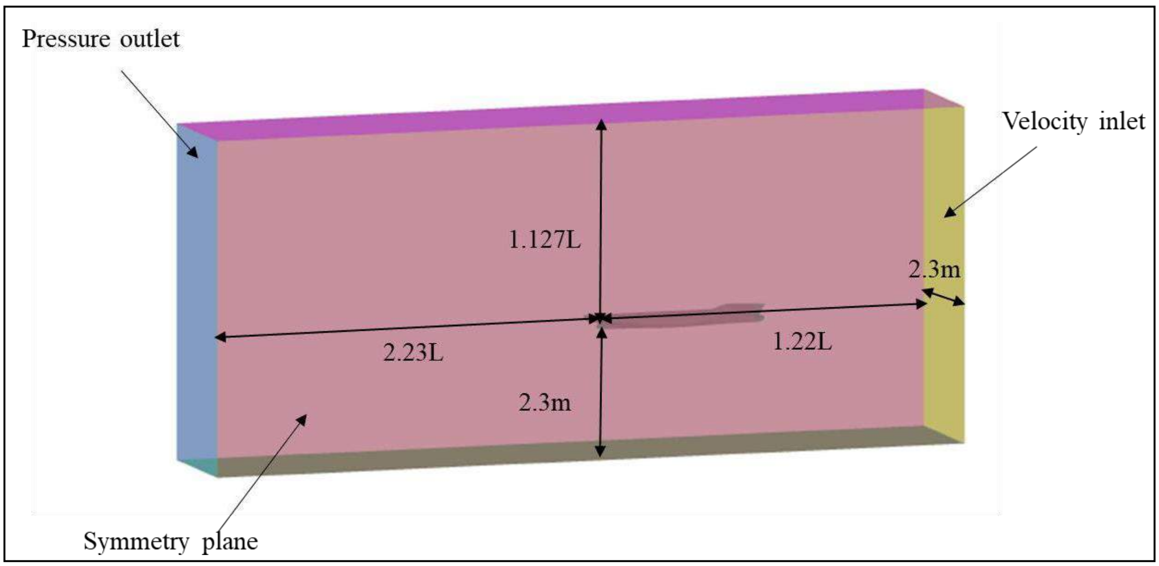


Figure 4.4: Case 4 computational domain

4.3 MESH GENERATION

The mesh generation is carried out using the automatic mesh generator in STARCCM+. To obtain good results a high quality trimmed hexahedral cells are utilized particularly at complex geometries like rudder. The trimmed mesher cells have a minimum cell skewness. The prism layer mesher instigates orthogonal prismatic cells near to the hull resolving the near- wall flow accurately as well as capture the effects of flow separation or boundary layer characteristics. The near-wall cells are prescribed via the prism layer meshes, which is set to ensure a $y^+<1$ over the wetted area of the ship. The volume meshing on the hull and the case four canal configuration are shown in Figure 4.5, 4.6, 4.7, 4.8, 4.9 respectively. the method of Volume of Fluid (VOF), an interface tracking method is used to track the free surface Computational volumetric refinements are provided where the kelvin wake is generated in rectangular computational domain, whereas the trapezoidal computational domain representing the New Suez canal refinements are concentrated near the lateral extent of the canal as well as the waves interacting with the ship bottom, leading towards increased mesh density.

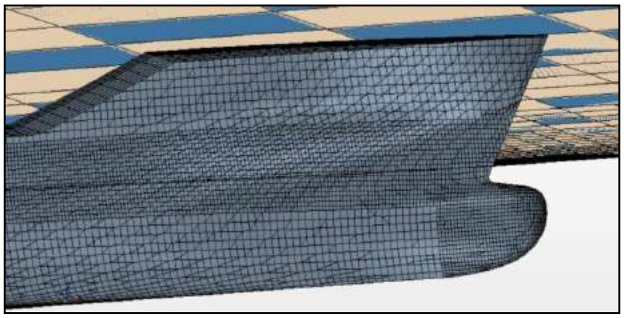


Figure 4.5: Bow mesh

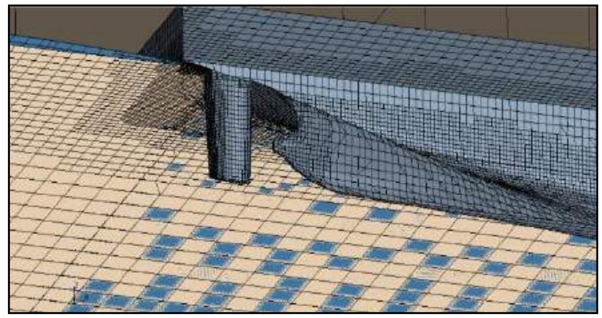


Figure 4.6: Stern mesh

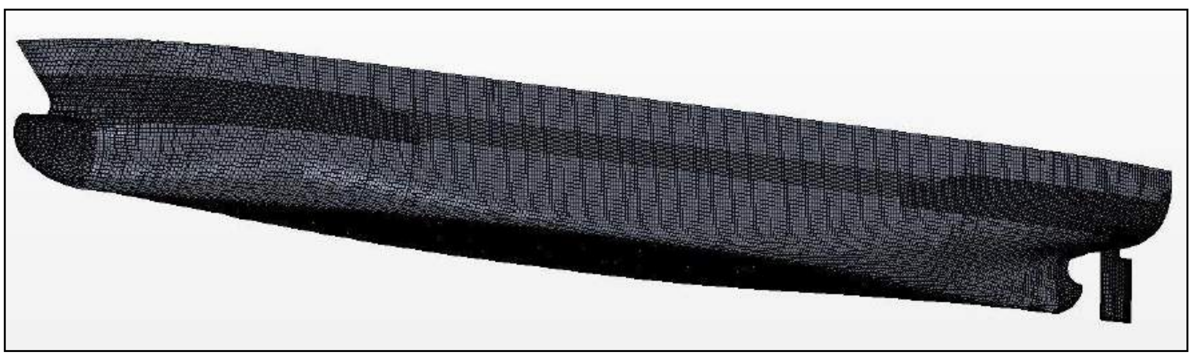


Figure 4.7: Surface mesh of the hull

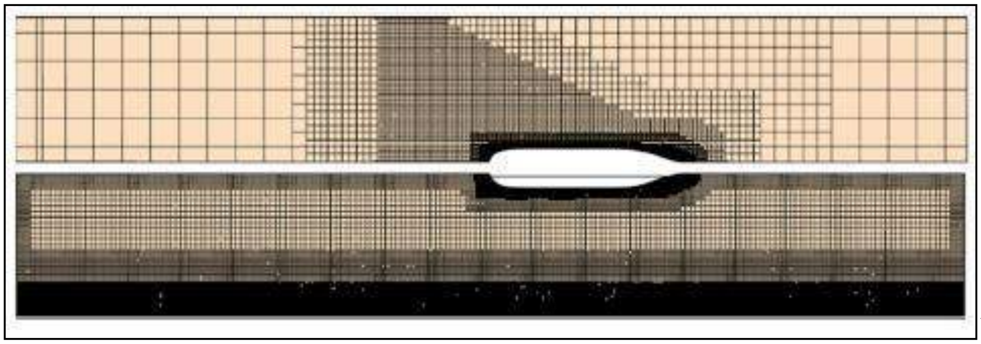


Figure 4.8: Case 4 computational domain free surface mesh

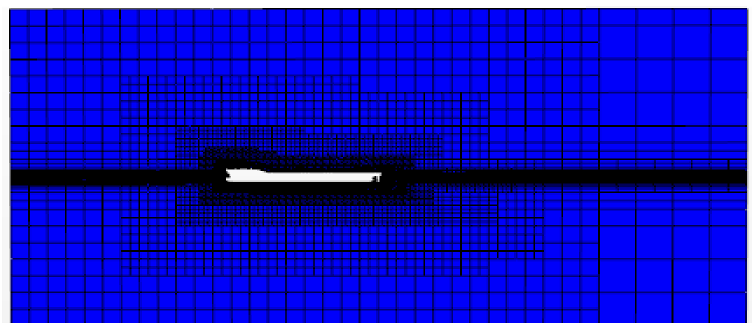


Figure 4.9: Case 4 computational domain horizontal view mesh

CHAPTER 5

RESULTS AND DISCUSSION

As mentioned previously, sinkage and trim are of great practical importance in restricted water. This study also aimed to investigate the effect of incorporating dynamic sinkage and trim into numerical simulation on identifying the variation of the squat characteristics for different test cases ran at several speeds. To this end, first resistance coefficient curves were obtained at level trim for various speeds then the dynamic trim and sinkage values were compared with experimental data (EFD) presented for each case study.

5.1 SQUAT AND TOTAL RESISTANCE COEFFICIENT FOR CASE 1

Squat and total resistance coefficients for the KCS for restricted depth domain are being analysed when the KCS is ran at various speeds.

(a) Total resistance coefficient

The results are tabulated for the percentage error and are given in Table 5.1. The results obtained through CFD analysis shows an error of 0.2% against the experimental values. The comparison of the results is shown in Figure 5.1.

Table 5.1: Case 1-Percentage error of C_T (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	model speed (m/s)	C_T		Percentage error %
			Experiment	CFD	
4	0.134	0.238	0.00487	0.00585	0.201
6	0.200	0.356	0.00496	0.00561	0.131
7	0.235	0.416	0.00529	0.00558	0.053
8	0.268	0.475	0.00546	0.00483	-0.115
10	0.335	0.594	0.00529	0.00503	-0.049
14	0.469	0.832	0.00538	0.00430	-0.200

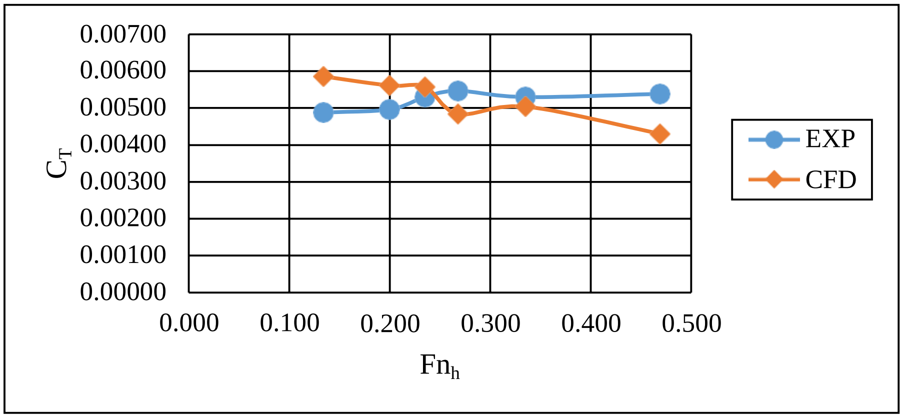


Figure 5.1: Total resistance coefficient for experimental results and Case 1 CFD results

(b) Squat : Sinkage and trim

The results demonstrate that the present CFD model agrees well with experimental observations in the rectangular canal as seen in figure 5.2 and figure 5.3. Moreover, the assertion that our CFD model will have a tendency to provide a small negative error is validated for the entire speed range for sinkage in this case-study. In terms of trim, the CFD model has also performed well, predicting values within a reasonable margin. The percentage error is calculated for sinkage and trim which is given in table 5.2 and 5.3 respectively.

Table 5.2: Case 1-Percentage error of sinkage (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	Speed (m/s)	Sinkage		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.0313	-0.4459	0.954
6	0.200	0.356	-0.5919	-0.8393	0.418
7	0.235	0.416	-0.8404	-1.0360	0.233
8	0.268	0.475	-1.2145	-1.3639	0.123
10	0.335	0.594	-2.4597	-2.4787	0.008
14	0.469	0.832	-5.7046	-5.2327	-0.083

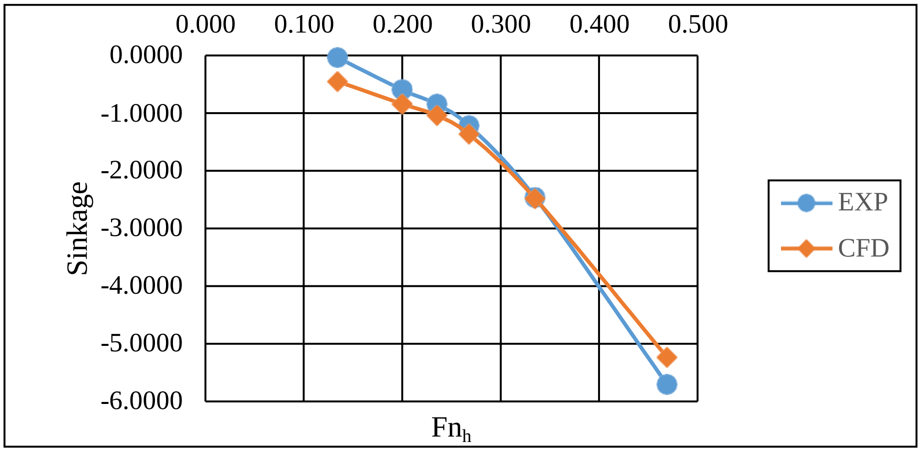


Figure 5.2: Sinkage for experimental results and Case 1 CFD results

Table 5.3: Percentage error of Sinkage (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	Speed	Trim		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.00178	-0.0110	5.187
6	0.200	0.356	-0.01033	-0.0200	0.936
7	0.235	0.416	-0.01189	-0.0260	1.187
8	0.268	0.475	-0.01656	-0.0330	0.993
10	0.335	0.594	-0.02667	-0.0420	0.575
14	0.469	0.832	-0.05622	-0.0670	0.192

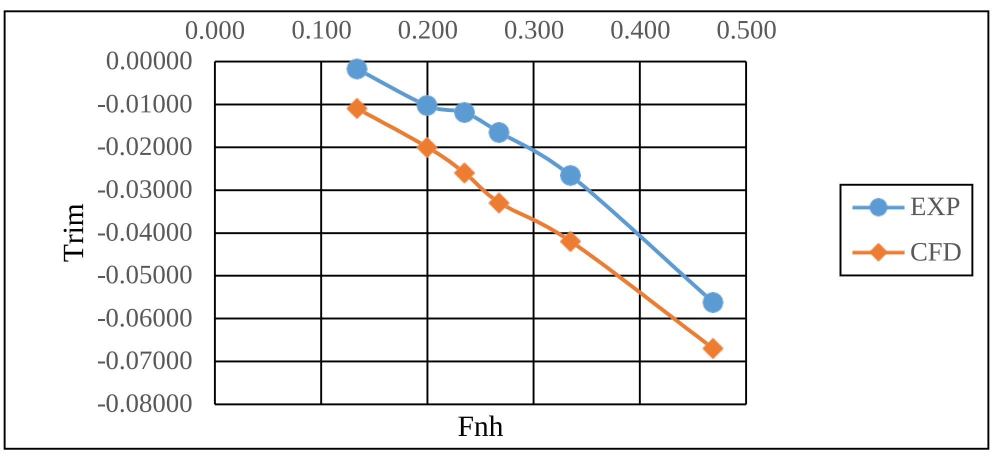


Figure 5.3: Trim for experimental results and Case 1 CFD results

5.2 SQUAT AND TOTAL RESISTANCE COEFFICIENT FOR CASE 2

Squat and total resistance coefficients for the KCS in Case 2 where the combined effect of restricted depth and width of the realistic canal domain are manifested for the range of depth Froude numbers test.

(a) Total resistance coefficient

The results are tabulated for the percentage error and are given in Table 5.4. The results obtained through CFD analysis shows an error of 0.4% against the experimental values. The comparison of the results is shown in Figure 5.4. It was also found that the resistance increases when compared to that of case 1.

Table 5.4: Percentage error of C_T (Experimental results v/s CFD results)

Full scale speed (knots)	Fnh	model speed (m/s)	C_T		Percentage error %
			Experiment	CFD	
4	0.134	0.238	0.00562	0.00579	0.030
6	0.200	0.356	0.00586	0.00554	-0.055
7	0.235	0.416	0.00594	0.00569	-0.042
8	0.268	0.475	0.00602	0.00483	-0.198
10	0.335	0.594	0.00651	0.00532	-0.182
14	0.469	0.832	0.00747	0.00645	-0.136

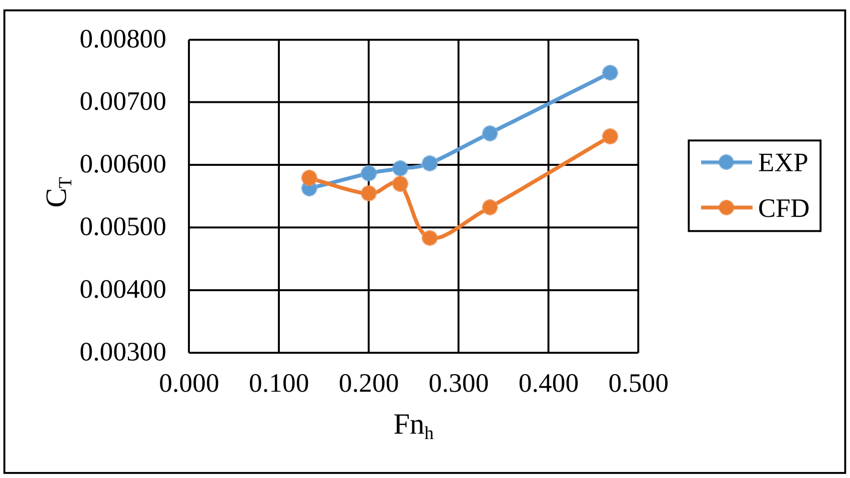


Figure 5.4: Total resistance coefficient for experimental results and Case 2 CFD results

(b) Squat: Sinkage and trim

The figure 5.5 and figure 5.6 indicate that the present CFD model, whose physical modelling characteristics have been carried from the experimental case-study, performs adequately in case of trim and sinkage. The CFD and the experimental results of squat were found that there is a slight difference and their percentage errors for different speeds are shown in table 5.5 and table 5.6.

Table 5.5: Percentage error of Sinkage (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	model speed (m/s)	Sinkage		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.122	-0.608	4.004
6	0.200	0.356	-0.641	-1.200	0.871
7	0.235	0.416	-1.395	-1.627	0.166
8	0.268	0.475	-1.647	-2.136	0.297
10	0.335	0.594	-2.401	-3.188	0.327
14	0.469	0.832	-6.747	-7.779	0.153

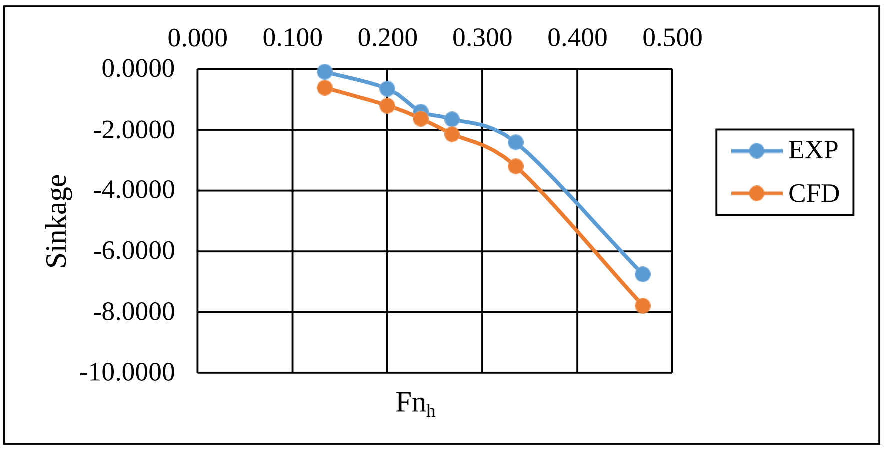


Figure 5.5: Sinkage for experimental results and Case 2 CFD results

Table 5.7: Percentage error of Trim (Experimental results v/s CFD results)

Full scale speed (knots)	Fnh	model speed (m/s)	Trim		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.0050	-0.0036	-0.279
6	0.200	0.356	-0.0076	-0.0078	0.021
7	0.235	0.416	-0.0128	-0.0109	-0.150
8	0.268	0.475	-0.0093	-0.0161	0.719
10	0.335	0.594	-0.0180	-0.0279	0.550
14	0.469	0.832	-0.0137	-0.0236	0.722

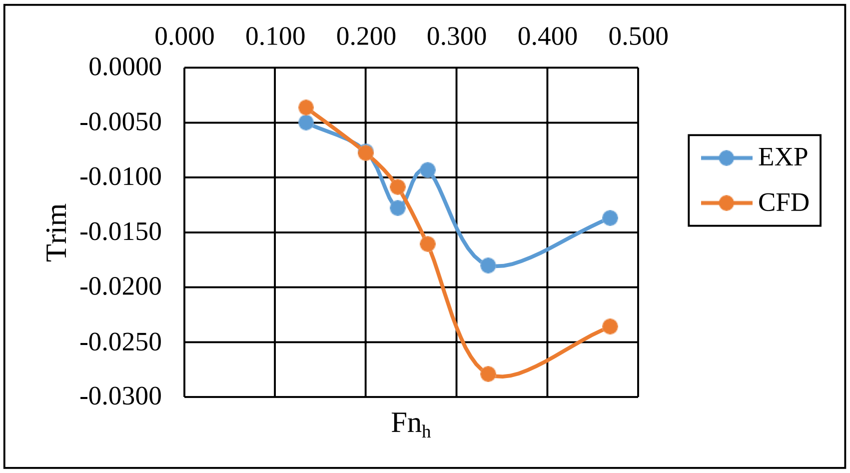


Figure 5.7: Trim for experimental results and Case 2 CFD results

5.3 SQUAT AND TOTAL RESISTANCE COEFFICIENT FOR CASE 3

Squat and total resistance coefficients for the KCS in a reduced width of the realistic cross sectional area canal domain are being analysed when the KCS is ran at different depth Froude numbers.

(a) Total resistance coefficient

The results are tabulated for the percentage error and are given in Table 5.7. The results obtained through CFD analysis shows an error of 0.2% against the experimental values. The comparison of the results is shown in Figure 5.7

Table 5.7: Percentage error of C_T (Experimental results v/s CFD results)

Full scale speed (knots)	Fnh	model speed (m/s)	C_T		Percentage error %
			Experiment	CFD	
4	0.134	0.238	0.00662	0.00579	-0.125
6	0.200	0.356	0.00817	0.00654	-0.199
7	0.235	0.416	0.00711	0.00625	-0.121
8	0.268	0.475	0.00739	0.00583	-0.211
10	0.335	0.594	0.00704	0.00632	-0.102
14	0.469	0.832	0.00965	0.00785	-0.186

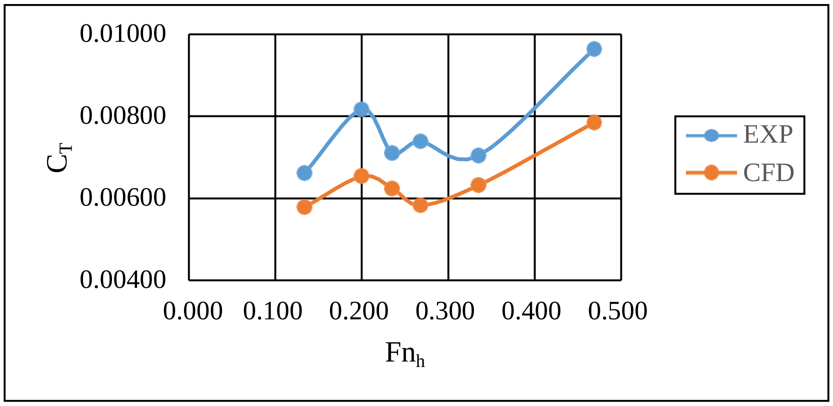


Figure 5.7: C_T for experimental results and Case 3 CFD results

(b) Squat: Sinkage and trim

From the results obtained it was found that the sinkage and trim values are higher than that in case 2 the reason behind it is due to the effect of higher blockage ratio. The error between experimental results and CFD results for squat at various speeds are given in table 5.8 and table 5.9 and the comparison is shown in figure 5.8 and figure 5.9.

Table 5.8: Percentage error of Sinkage (Experimental results v/s CFD results)

Full scale speed (knots)	Fnh	model speed (m/s)	Sinkage (mm)		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.499	-0.708	0.416
6	0.200	0.356	-0.714	-1.270	0.777
7	0.235	0.416	-1.831	-1.927	0.052
8	0.268	0.475	-1.831	-2.226	0.216
10	0.335	0.594	-2.950	-3.888	0.318
14	0.469	0.832	-7.330	-7.979	0.089

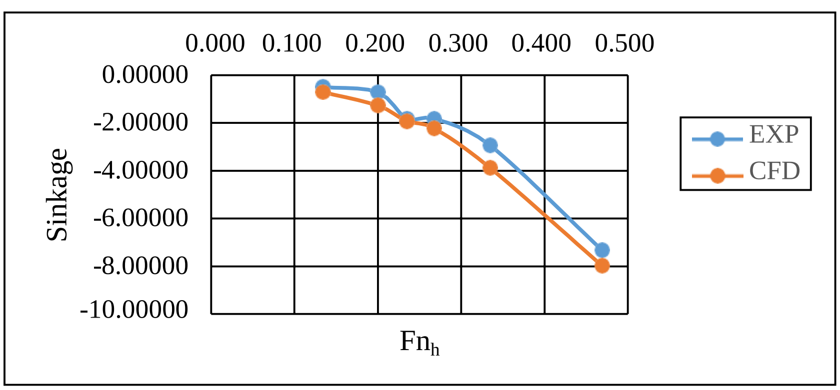


Figure 5.8: Sinkage for experimental results and Case 3 CFD results

Table 5.9: Percentage error of Trim (Experimental results v/s CFD results)

Full scale speed (knots)	Fnh	model speed (m/s)	Trim (deg)		Percentage error %
			Experiment	CFD	
4	0.134	0.238	-0.00761	-0.0036	-0.524
6	0.200	0.356	-0.00761	-0.0078	0.021
7	0.235	0.416	-0.01020	-0.0109	0.067
8	0.268	0.475	-0.00934	-0.0161	0.719
10	0.335	0.594	-0.01190	-0.0279	1.345
14	0.469	0.832	0.05030	0.0346	-0.312

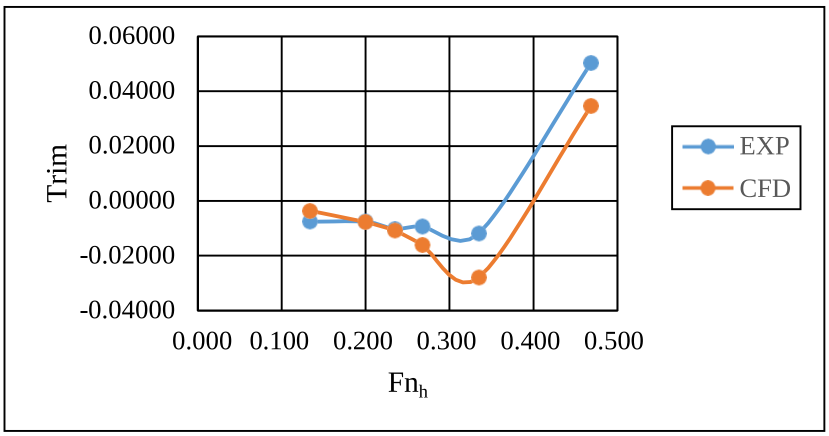


Figure 5.9: Trim for experimental results and Case 3 CFD results

5.4 TOTAL RESISTANCE COEFFICIENT, SINKAGE AND TRIM FOR CASE 4

Case 4 represents mostly deep water behaviour, where the squat and total resistance coefficients for the KCS are analysed at a range of Froude numbers.

(a) Total resistance coefficient

The results are tabulated for the percentage error and are given in Table 5.10. The results obtained through CFD analysis shows an error of 0.04% against the experimental values. The comparison of the results is shown in Figure 5.10. It was also observed that the resistance is lesser in deep water than in shallow water.

Table 5.10: Percentage error of C_T (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	model speed (m/s)	C_T		Percentage error %
			Experiment	CFD	
5	0.167	0.297	0.00497	0.00484	-0.027
6	0.200	0.356	0.00480	0.00463	-0.035
7	0.235	0.416	0.00463	0.00449	-0.029
8	0.268	0.475	0.00463	0.00452	-0.023
9	0.302	0.535	0.00463	0.00447	-0.035
10	0.335	0.594	0.00480	0.00473	-0.014

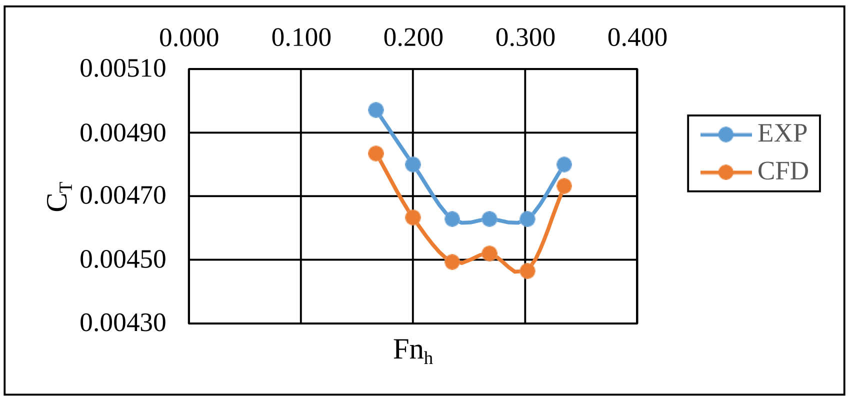


Figure 5.10: C_T for experimental results and Case 4 CFD results

(b) Squat: Sinkage and trim

The motion characteristics are checked in this case and it is found out that the rotation around the y axis as well as the motion in the z direction are comparatively less to that of the other previous cases. The experimental and CFD results were also compared as shown in Figure 5.11 and figure 5.12 with the error percentage calculated as shown in table 5.11 and table 5.12

Table 5.11: Percentage error of Sinkage (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	model speed (m/s)	Sinkage (mm)		Percentage error %
			Experiment	CFD	
5	0.167	0.297	-0.00286	-0.00152	-0.466
6	0.200	0.356	-0.00359	-0.00197	-0.452
7	0.235	0.416	-0.00488	-0.00233	-0.522
8	0.268	0.475	-0.00592	-0.00379	-0.360
9	0.302	0.535	-0.00644	-0.00395	-0.386
10	0.335	0.594	-0.00730	-0.00456	-0.375

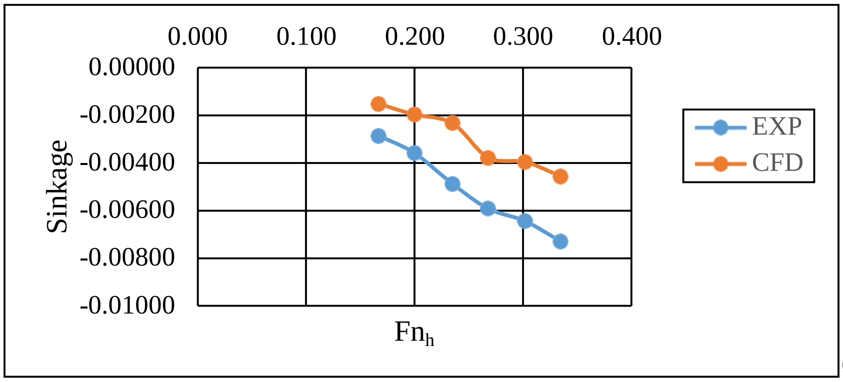


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Figure 5.11: Sinkage for experimental results and Case 4 CFD results

Table 5.9: Percentage error of Trim (Experimental results v/s CFD results)

Full scale speed (knots)	Fn_h	model speed (m/s)	Trim (deg)		Percentage error %
			Experiment	CFD	
5	0.167	0.297	0.02330	0.01485	-0.363
6	0.200	0.356	0.04610	0.03256	-0.294
7	0.235	0.416	-0.11800	-0.14418	0.222
8	0.268	0.475	-0.14100	-0.16546	0.173
9	0.302	0.535	-0.15900	-0.17078	0.074
10	0.335	0.594	-0.17300	-0.18597	0.075

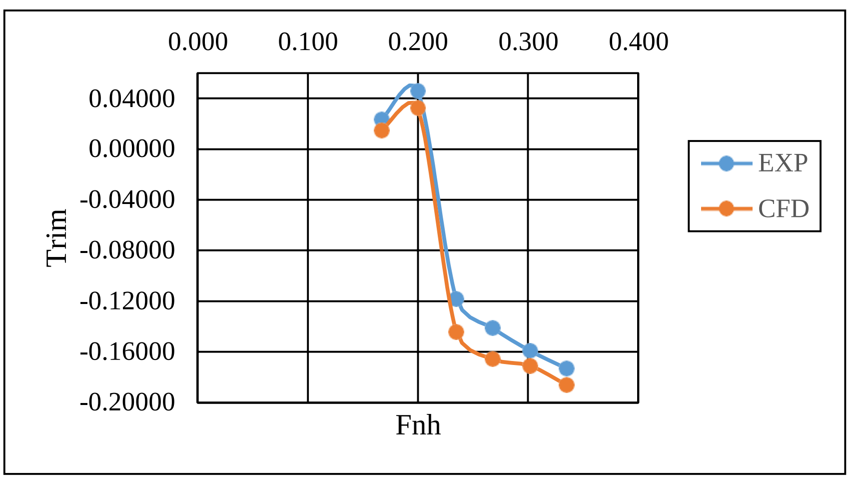

Figure 5.12: Trim for experimental results and Case 4 CFD results

CONCLUSION

This study presented a numerical assessment of the effects of ship squat and resistance. To demonstrate the practical importance of the work, the Suez Canal was modelled as well as rectangular computational domains under both deep and shallow water operating conditions were investigated. Importance was placed on low and moderate speeds in the Suez Canal, following the restrictions imposed on ships in the abovementioned waterway. Specifically, the maximum allowed speed is 7 knots. A ship's speed can be increased to up to 9 knots inside the canal with no adverse effects, thus significantly reducing the time for a ship to pass through the canal.

In this study, the numerical results showed best agreement with the experimental data. Two main factors were studied in this study to observe their effects on ship navigating the Suez Canal, they are water depth and cannel width. No drastic change in trim angle and sinkage was observed when compared between case 1 and case 2, since the Froude numbers selected falls under the subcritical range. After reducing the canal width to 62.5% of its real-life cross sectional area, no significant effect was observed on ship squat.

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ACADEMY OF MARITIME EDUCATION AND TRAINING (AMET)

(Declared as Deemed to be University u/s 3 of UGC act 1956)

135, EAST COAST ROAD, KANATHUR, CHENNAI – 603 112.

TAMILNADU, INDIA

SHIP RECYCLING

A REPORT OF INTERSHIP

IN

DEPARTMENT OF NAVAL ARCHITECTURE AND OFFSHORE ENGINEERING

BY

BASKAR ANTONY PETLEES.A

(ANA18013)

BONAFIDE CERTIFICATE

This is to certify that the Home based Internship entitled "Ship Recycling" submitted by Mr. Baskar Antony Petlees to the Department of Naval Architecture & Offshore Engineering, AMET, India for the award of degree of Bachelor of Engineering is a Bonafide record of technical work carried out by him under my supervision. The contents of this Internship, in full or in parts, have not been submitted to any other institute or university for the award of any degree or diploma.

....	....
Signature	Signature
(Mentor)	(HOD)
Mr. Prasob P.A	Mr. MSP Raju
Assistant Professor	Associate Professor
Department of Naval Architecture & Offshore Engineering	Department of Naval Architecture & Offshore Engineering

AMET

ACADEMY OF MARITIME EDUCATION AND TRAINING

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(Under Section 3 of UGC Act 1956)

INTERNSHIP ALLOCATION REPORT 2020-21

Name of the Department: Naval Architecture & Offshore Engg.

(In view of advisory from the AICTE, internships for the year 2020-21 are offered by the Department itself to facilitate the students to take up required work from their home itself during the lock down period due to COVID-19 outbreak)

Name of the Programme : B.E NAOE
Year of study and Batch/Group : Third Year
Name of the Mentor : Mr. Prakash P.A
Title of the assigned internship :

ship recycling

Nature of Internship : **Individual/Group**

Reg No of Students who are assigned with this internship:

ANA18013.

Total No. of Hours Required to complete the Internship: 60

Signature of the Mentor	Signature of the Internal Examiner	Signature of HoD/Programme Head
[signature]	[signature]	[signature]

AMET

ACADEMY OF MARITIME EDUCATION AND TRAINING

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(Under Section 3 of UGC Act 1956)

INTERNSHIP EVALUATION REPORT 2020-21

Name of the Department: Naval Architecture and offshore Engg

(In view of advisory from the AICTE, internships for the year 2020-21 are offered by the Department itself to facilitate the students to take up required work from their home itself during the lock down period due to COVID-19 outbreak)

Name of the Student	Baskar Antony peles
Register No and Roll No	ANA18013
Programme of study	B.E - NA&OE
Year and Batch/Group	Final year - Group I
Semester	II / IV / VI / VIII
Title of Internship	Ship Recycling
Duration of Internship	60 Hours
Mentor of the Student	Mr. Prasob. P.A.

Evaluation by the Department

Sl No.	Criterion	Max. Marks	Marks Allotted
1	Regularity in maintenance of the diary.	10	9
2	Adequacy & quality of information recorded	10	9
3	Drawings, sketches and data recorded	10	8
4	Thought process and recording techniques used	5	4
5	Organization of the information	5	4
6	Originality of the Internship Report	20	18
7	Adequacy and purposeful write-up of the Internship Report	10	9
8	Organization, format, drawings, sketches, style, language etc. of the Internship Report	10	9
9	Practical applications, relationships with basic theory and concepts	10	9
10	Presentation Skills	10	9
Total		100	88

Signature of the Mentor	Signature of the Internal Examiner	Signature of HoD/Programme Head
[signature]	[signature]	[signature]

PREFACE AND ACKNOWLEDGEMENT

We had the privilege and pleasure of joining a team of Naval Architecture. The goal of the internship was to understand the ship recycling and its process and how its takes place. We have brought new idea of ship recycling yard construction. We are profoundly motivated to get along with this study and career.

ABSTRACT

The aim of this project is to know about the clear information of ship recycling. In ship recycling what is the entire process takes place and how it can take place are clearly explained in our project. We have attached some information about the safety of environment during recycling and the ship recycling bill which were passed by Indian parliament in 2019. In our project we came through an idea about the construction of ship recycling yard like ship yard. In this we also discussed about the advantage and disadvantage of ship recycling.

Keywords: ship recycling, ship recycling bill, ship recycling yard, advantage and disadvantage and process.

INTRODUCTION

SHIP RECYCLING

Ship-recycling or ship demolition is a type of ship disposal involving the breaking up of ships for either a source of parts which can be sold for re-use, or for the extraction of raw materials chiefly scrap. It may also be known as ship dismantling, ship cracking, or ship recycling. It is most demanded and unsafe work. India leads the one of the world largest ship recycling yard or ship graveyard. Ship-breaking allows the materials from the ship, especially steel, to be recycled and made into new products. This lowers the demand for mined iron ore and reduces energy use in the steelmaking process. The main reason for recycling the ship is that the life time of the ship will be end after 25 to 30 years from the year of they built. If they left as it without demolishing, the material will get loss its characteristic and it became waste. In order to utilizing that we are recycling it and main reason is that without breaking if we keep the vessel after its end of lifetime more space is required to maintain and store that.

Around the world there are many ship recycling yard. They are Chittagong Ship Breaking yard in Bangladesh, Gallo Ghent formerly Van Heyghen Recycling in Belgium, Changjiang Ship Breaking yard in China, Alang-Sosiya Ship Breaking Yard in India, Gaddani Ship Breaking yard in Pakistan, Aliağa Ship Breaking Yard in Turkey, Able UK, Gray Thorpe Dock, Teesside in United Kingdom, SteelCoast, Brownsville, Texas and International Shipbreaking, Brownsville, Texas in USA. Some of the ship recycling yard has added with their image

Image of Chittagong Ship Breaking yard, Bangladesh

Image of Changjiang Ship Breaking yard, China

SHIP RECYCLING IN INDIA

India is home to one of the largest ship breaking facilities in the world with over 150 yards along its coast. On an average, close to 6.2 Million GT is scrapped in India every year, which accounts for 33% of the total scrapped tonnage in the world. The Ship breaking sites in India are distributed along coastline; prominent among them being Sewri in Mumbai, Maharashtra, and Kolkata in West Bengal and Alang in Gujarat. As among these ALANG is the largest ship graveyard in India. Even though there are many ships in the world only few type of ships are recycled in India based on their consideration ad rules taken in the specific ship graveyard. The ships are General Cargo and Bulk carrier, Refrigerator Cargo vessel, Oil tanker, Passenger ship and War-ship, Cruiser and Drill-ship. The recycling In India will do in near to sea shore. This cause many problems. The problems may for human health and environment. In India ship recycling will be done by uneducated person. As per the information in the year of 2014 to 2016 in Bangladesh ship graveyard, each year 15 persons has died due to hazardous substance and some accidents. Image of Alang ship recycling yard, Gujarat

Gujarath Maritime Board has an exclusive wing for monitoring ship recycling in Gujarath region whereas other states do not have any such administrative or technical mechanism to manage ship recycling activities in the centres coming under their geographic limits.

STEPS FOR SUSTAINABLE RECYCLING

Steps 1 – Contract for ship recycling

In addition to the clause to meet the requirements as per the HKC and/or the EU SRR and its guidelines, the IHM, ship recycling facility plan (SRFP), SRP, SoC and IRRC should be listed above all. Moreover, a SRF monitoring programmer should be mentioned.

Step 2 – Inventory of hazardous materials (IHM) preparation

The IHM needs to be ship-specific, should be prepared by a qualified expert and cover all 13 or 15 substances listed in the regulations.

Step 3 – Ship recycling plan (SRP) development

The SRP should be developed accordingly to MEPC.196(62), refer to a specific SRF, reflect the specific IHM and provide licensed disposal and recycling solutions for all materials listed in the IHM.

Step 4 – SRP approval process

The SRP requires Competent Authority (CA) of the recycling State's approval. Explicit approval shall be with written notice of result and tacit approval shall specify the end date of a 14-day review period. An expert assessment of the SRP is recommended until the regulations are fully applicable.

Step 5 – Approved SRP

The SRF forwards the approved SRP to the ship owner. The SRP should contain the final version of the IHM.

Step 6 – Final survey by class

The final survey shall be conducted before the recycling activity starts. The survey guidelines (MEPC. 222[64]) should be followed. After the successful survey, an IRRC can be issued. The documents to be submitted for the survey include: the IHM (Parts I, II and III), the approved SRP and a copy of a valid SRF document of authorization of ship recycling (DASR).

Step 7 – Report and start of ship recycling

The SRF launches the start of the ship recycling with the submission of the IRRC to the CA.

Step 8 – Statement of Completion (SoC)

After completion, the SRF issues a SoC together with a report on accidents damaging human health and the environment and reports this to its client and CA. All involved stakeholders receive a copy of the SoC

VESSEL DISMANTLING METHODS

After the ownership of the ship has changed as mentioned above the dismantling process takes place. Some of the major methods are BEACH method, DRY DOCK method, BUOY method

Beach Method

Beach method is employed at shallow basins with long shelf
Bed where high tidal variations are available. The main beaching is done during high tide. The beached vessel is progressively slide up, to the recycling yard during successive high tides. Entire dismantling operations are done in the beach area available in the water front of the recycling yard. This method has been employed at Alang Recycling yard, in Gujarat, Darukhana in Mumbai, and Chittagong in Bangladesh and Gaddani in Karachi.

Dry Dock Method

In Dry Dock method or Berth method, obsolete ship is taken to dry dock facility in a ship recycling yard. This method can be called as disassembly method of ships in ship recycling yards. The major difference between dry dock method and beach method is the presence of a concrete barrier between the dismantled vessel and sea water. Progressive sliding for transporting the vessel within the yard premises is absent in the latter. Western European countries and United States practice this method. Obsolete ship docked in a dry dock ready for dismantling.

Buoy Method

Buoy method is named after the dismantling process being carried out in floating conditions. Obsolete vessels are berthed in quay side of sea ports and shipyards for dismantling. The dismantling is done by cutting and removing the ship parts in vertical direction. Starting from top of navigation deck and subsequently reaching double bottom. The cutting peripheries do not come in contact with sea water. Most of the recycling yards operating in China make use of buoy method of ship dismantling.

DISPOSAL OF SHIP

Disposal of ship involves removing or dismantling of ship after its lifespan. Some ships have been recycled and their metals are reused. But some ship will be left over and it can be demolished by sinking into deep sea. Every type of ship comes with a specific lifespan. After serving a successful tenure at the sea (a tentative period of thirty years or so), all ships are expected to be discontinued from service according to the maritime law. The disposal of ships, after having ruled oceanic waters, has been carried out since the early days of shipping. Ship disposal in early days meant that ships were just left unattended which lead to the making of some of the biggest shipyards in the world. Moreover, before the ships are reduced to mere scraps of steel, it’s mandatory to eradicate any toxic substance present in them. As ship breaking is costly in developed nations, some of the developing countries of Asia have become ship breaking hubs of the world. Some of the techniques used in disposal of ship are,

Artificial Reefing

On many occasions, artificial reefs are created by drowning the disposable ships in deep water, offshore. Precautionary measures are undertaken to ensure that the disposable vessel is devoid of any hazardous elements or electrical devices, before it is compelled to sink.

These man-made reefs offer a secure habitat for innumerable species of the marine world. The artificial reefs are used to provide food and shelter to the fishes, and also aid in promoting the spawning prospects. Such ship disposal technique is used in several countries

SINKEX

The SINKEX ship disposal technique involves a fire-shooting exercise conducted by the Navy to rehearse and train in weaponry, missile practicing, torpedo accuracy etc. The target ships are useful in warfare training sessions where these are deemed as targets for shooting. The practice ships are blasted into pieces by using military torpedoes, which eventually leads to sinking of ship and its disposal. This is an effective way to test military weapons without damaging new vessels. .

The Navy gets hold of a live target training session, while the unused ships are efficiently turned into a pile of waste. According to records, the US Navy conducts the SINKEX operations in remote regions of Hawaii, Kauai, California coast and Puerto Rico

Wreck Diving Sites

Wreck diving sites are artificial ocean diving sites that are created by sinking unused vessels, on purpose. The shipwreck might serves as a training place for divers or may acquire commercial revenues by allowing recreational diving facilities. Before ship disposal, it needs to be free from all sorts of hydraulic liquids, oils, and harmful toxins like PCBs.

In fact, the greater portion of the vessel's superstructure is isolated to prevent it from water erosion. While the ship is being purged of hazardous chemicals, essential materials such as the copper wiring may be used to draw the expenses required for preparing the ship for sinking.

Scuttling

Scuttling ship disposal is a common method of deliberately drowning an abandoned or retired vessel, by allowing water to fill up its hull by opening the ship valves or through creating holes in the ship with the help of explosives.

ACTIVITES IN SHIP RECYCLING

Before ship was going to recycle there is some procedure which has been taking place between owner of the ship and the ship recycling owner.

- Decision to decommission vessel by the owner
- Appointment of a broker for selling the vessel
- Identification of buyer
- Preparation of terms and conditions of sale
- Inspection by buyer’s surveyors
- Change of ownership of the vessel to buyer
- Acquirement of certificates as per rules of
- Recycling nation
- Transfer or towage of vessel to recycling yard
- Positioning of vessel at the site of dismantling
- Dismantling of vessel by sliding
- Intermediate storage of dismantled products
- Disposal/Reuse/Selling of dismantled Products

Disposal of the hazardous materials

PCBs

Polychlorinated biphenyls (PCBs) is a mixture of synthetic organic chemicals bearing the same basic chemical 15 structure, similar physical properties and chemical properties as belonging to a broad family of man-made organic 16 chemicals known as chlorinated hydrocarbons. It was first used as early as 1929, and was banned in 197917 according to U.S. Environmental Protection Agency (USEPA), given its toxicity. PCBs come in different forms 18 from thin light liquid to yellow or black waxy solid. Due to their non-flammability, chemical stability, high 19 boiling point and electrical insulating properties, PCBs were widely used in various industries. It was also widely 20 used in ship building industry in the 1970s~1980s. Exposure to PCBs can cause a variety of adverse health effects 21 in animals and humans, including cancer and serious non-cancer health effects.

Glass fiber

Glass fiber (wool) is a material consisting of numerous extremely fine fibers of glass. The use of a glass-wool 3 reinforced composite in marine structures is becoming more common, particularly due to the potential weight 4 savings (Li et al., 2015). In ship building industry, glass wool board, glass wool felt, glass wool pipe, shell of 5 glass fiber products are widely used. During ship recycling, the toxicity and waste recycling process methods of 6 glass fiber require further improvement.

Waste oil

Remnants of waste oil are mostly found in fuel bunker, oil container, oil drum and oil tank, gearbox, shaft, 23 hydraulic system and oil pipe of various kinds of equipment, and oil sludge that may remain in fuel bunker. If 24 remnant oil is not cleaned up in time, it would be hazardous to the health of human being and environment.

Involvement of Naval Architects

At present recycling of ship and offshore structures is not treated as an entity in shipbuilding. Recycling yards do not employ naval architects and almost all the ship dismantling is carried with minimum guidance from an engineer who knows total technology of ships and offshore structures. The disassembly and subsequent recycling activities, which are integral parts of life cycle of ship, have to be guided by the basic principles of naval architecture and shipbuilding. Very limited number of naval architects and offshore engineers take part in ongoing research and training programmers in ship recycling at global level. Environmental scientists, chemical engineers, structural engineers, production engineers and safety engineers usually steer such project.

HEALTH AND SAFETY RISKS FACED BY RECYCLING WORKERS

- Exposure to harmful chemical and biological substances.
- Moving vehicles and improperly secured material bales.
- Moving machinery: compactors, conveyor belts, and sorting machinery.
- Respiratory hazards: dust and airborne contaminants.
- Awkward positions and repetitive motion injuries.

BENEFITS OF SHIP RECYCLING

- Reduces the amount of waste sent to landfills and incinerators.
- Conserves natural resources such as timber, water and minerals.
- Increases economic security by tapping a domestic source of materials.
- Prevents pollution by reducing the need to collect new raw materials.
- Saves energy.

ADVANTAGES OF SHIP RECYCLING

- Isolate those parts of the ship which are harmful and dangerous to both marine and human lives.
- Conserve marine ecosystem by proper discarding of ship breaking waste.
- Reusing those parts of the ship that are important and can be re-used successfully while making new ships, thus saving resources.
- Help the ship-owner benefit from the process by optimum utility of the ship's parts.
- Reduce the storage of area of the ship after its end of its time

DISADVANTAGES OF SHIP RECYCLING

Ship breaking is a difficult process due to the structural complexity of the ships and it generates many environmental and safety and health hazards.

- During ship breaking, oil residues and other refuses from ships are spilled and mixed with soil and water on the beach, causing widespread pollution of the marine environment.
- Large amounts of carcinogens and toxic substances (PCBs, PAHs, TBT, mercury, lead, isocyanides, and sulfuric acid) not only intoxicate workers but are also dumped into the soil and coastal waters.
- Ship recycling process will lead to death if the recycling not done properly.
- The workers who are all working in the recycling area will affect indirectly by hazardous toxic gases.

SHIP RECYCLING ACCIDENTS

A fire that took place in the shipbreaking yards of Gaddani, Pakistan, on Monday 2017 has claimed the lives of five more workers from the recycling yard, according to non-governmental organization, Shipbreaking Platform.

The deadly fire was reported to have broken out on board of the beached vessel GAZ FOUNTAIN (IMO 8406054). Ship Breaking Platform said that the LPG tanker's last beneficial owner was the Greek shipping line Naftomar and that the vessel's name was changed to RAIN and its Panama flag swapped for the end-of-life flag Comoros just before the last voyage – a clear indicator of the use of a cash buyer.

The accident was reported to have occurred at yard, owned by Rizwan Divan Farooq, the former president of the Pakistan Ship Breakers' Association. According to newspaper, The Dawn, Farooq was detained after having fled the yard. The newspaper reported that the fire broke out due to a "chemical foam" present in the ship.

The local Environment Department said that all combustibles should have been removed before the cutting process started and that the accident signaled serious neglect.

SHIP RECYCLING BILL

Parliament passed a landmark **"The Recycling of Ships Bill 2019''** for Safe and Environmentally Sound Recycling of Ships in India. Passing of this Bill is a giant step and historical moment in the Indian Maritime arena and will have far reaching effects in Indian Ship Recycling industry. The existing Shipbreaking Code (revised), 2013 and the provisions of the Hong Kong Convention, 2009 are dovetailed in this Bill. **The Bill, upon becoming Act,** will ensure environment friendly recycling process of Ships and adequate safety of the yard workers. With the enactment of this bill, India will set global standards for safe and sound environmentally-friendly recycling of Ships, as well as ensure adequate safety of the yard workers.

The Key Benefits of the bill are as follows:

- The bill will harbinger significant increased number of global ships entering into Indian Shipyards for Recycling.
- Recycling of Ships will boost business & employment opportunities and strengthen India's position in the recycling industry.
- It will raise the brand value of our Ships Recycling Yards located at Alang in Gujarat, Mumbai Port, and Kolkata Port & Azhikkal in Kerala.
- 10% of country's Secondary steel needs, as an outcome of Recycling of Ships, will be met in an eco-friendly manner.
- Ships recycling facilities will become compliant to International standards and Ships will be recycled only in such authorized facilities.

WHY THERE IS NO SHIP RECYCLING YARD?

Ship recycling yard should be like a shipyard. There is no recycling yard similar to shipyard. Because when the ship comes for recycle it should be bring to the seashore by dragging the ship with use of chain. It is very dangerous while dragging. So that they will bring the ship to half of seashore and they will dismantle. The all process of dismantling will takes. So that they prefer beach method. To avoid pollution we can construct the ship recycling yard. In that we can develop the dragging section near to the seashore and dragging will be done machines. There will be many sections for each process.

CONSTRUCTION OF SHIP RECYCLING YARD

To reduce the pollution and develop the growth of ship recycling we can construct the ship recycling yard which should be similar to shipyard. What are all the section and facilities which have taken place in the shipyard, same the facilities should takes place which related to the ship recycling process? In that ship recycling yard, different sections like dismantling the waste liquid in the ship, dismantling the ship by each section and more. By constructing, we can reduce the pollution and we can maintain that material. This idea should takes place and we need to construct mainly in India. Because India is the leading country in the ship recycling process. By making that India can dismantle all the ships and economically we can develop and we can reduce the accidents and death rate. Construction rate of this may be higher. But by considering the environmental and safety of the workers the construction of the yard must takes place.

ADVANTAGE OF SHIP RECYCLING YARD

- We can control marine pollution.
- Wastage of metal can get reduce.
- We can reduce accidents and deaths.
- We can increase our economic.
- We can invade all category of ship to recycle.

DISADVANTAGE OF SHIP RECYCLING YARD

- Construction cost will be more.
- More area will be required.

CONCLUSION

Ship recycling is important and dangerous process. In India it is a leading work process. Ship recycling yards in Gujarat and Bangladesh are more polluted areas. In these yards they are using the unrelated field employees to break the ships. Due to this they don't know the problem takes place in the yard which leads to death of the workers. So the yard owner should take the awareness to keep them aware. Even though many other field related workers are working in the ship recycling yard the naval architectures should work on that area as many as possible.