SREE NARAYANA GURUKULAM COLLEGE OF ENGINEERING

Publications

List of student publications in the Department of Naval Architecture & Ship Building

Name of the Student	Title of the paper	Title of the proceedings of the conference	National / International	Month	Year of publication	ISBN number of the proceeding
Lin& Perunal loh.son Jishnu S Sama AfiulVinod	Numerical analysis of effect of bow shape of an anchor handling tug supply vessel through reverse engineering	Proceedings of the International Conference on Advances in Naval and Ocean Engineering (ICANOE '21)	International	November	2021	ISBN: 978-81-952577-5-1
Athul Vinod', Jishnu S Sarma, Linda Perumal Johnson',	Concept Design of Autonomous Underwater Vessel Bio Mimicked From Black Marlin Fish	Third International Conference in Shipbuilding & Offshore Engineering 2021 (ICSOE 2021)	International	June	2021	ISBN: 978-93-85434-72-3
Ann Maryr, PY Abia Azeen ', Ashil John Ajir, Rahul Babua	Latest developments in the use of composite materials in shipbuilding	Proceedings of First Maritime International Conference (MARINCO2019)	International	November	2019	ISBN: 978-93-85434-76-1
Nikhita Menon,Silpa	Impacts of IMO Environmental Regulations on Ship Design and Construction		National	August	2019	
Sandra K Anil,Arjun K R	Safety and Fire Protection Considerations in Ship Design		National	December	2019	
Abhijith K Sujith,Aadhith Mathew,Adarsh K S,Josna John	Development of Underwater Drone, ROV Varuna	Proceedings of the International Conference on Shipbuilding & Offshore Engineering 2018	International	October	2018	ISBN:978-93-85434-72-3

PRINCIPAL
Sree Narayana Gurukulam
College of Engineering
Kadayiruppu,Kolenchery-682

SNG COLLEGE OF ENGINEERING KADAYIRUPPU KOLENCHERY 682311

PARTICIPATION IN 35TH NATIONAL CONVENTION ON MARINE ENGINEERS	
Students from Naval Architecturee & Ship Building	
	
	

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LATEST DEVELOPMENTS IN THE USE OF COMPOSITE MATERIALS IN SHIPBUILDING

Ann Mary[1], P.Y. Abia Azeen [2], Ashil John Aji[3], Rahul Babu[4] and P.G. Sunil Kumar[5]

Abstract: A composite material is an amalgamation of two or more constituent materials, typically a matrix reinforced by glass, aramid or carbon fibers. Weight, corrosion, fatigue issues of weld joints, brittleness at low temperatures, magnetic properties, etc. have necessitated the quest for replacement of various grades of steels as the primary shipbuilding material, though steel is the most cost-effective material. The use of composites in shipbuilding is increasing in the industry as is evident from the projects such as Admiral Marine for Evviva, the largest fully foam-cored boat, SES Jet Rider of Karlskronavarvet, US Navy's patrol hydrofoil craft (PCH-1) Highpoint, etc. Composites enable the construction of vessels with lower fuel consumption, increased speed, improved stability, lower maintenance, higher cargo/weapon capacity, etc. On the financial side, optimally designed vessels with composites ensure lightweight at a competitive cost, mainly because of the lower life-cycle cost during operation by the lower fuel consumption. Though composites are at present not used for larger ships, hulls of small vessels, topside structure, masts, hatches, bulkheads, propellers, ladders, etc. can be constructed. Composite sandwich structures further improve the desirable properties like fire retardancy, survivability, etc. Composite materials promise low-maintenance, magnetic silencing benefits, and corrosion resistance for machinery components of naval vessels such as composite propulsion shafting, diesel engine parts, ball, composite ventilation ducting, piping systems, etc. The recreational maritime industry and the fishing sector have accepted composite hulls. The special properties of composites like chemical inertness, flexibility, better acoustics and stealth, and reduced magnetic signature have made composites formidable in naval applications and research and development. The composite superstructure of Kamorta class anti-submarine warfare corvettes of the Indian Navy, built by the defense PSU Garden Reach Shipbuilders and Engineering Ltd in Kolkata has not only improved the stealth and stability parameters but made a provision to annex more payload of weapons. Performance of composite structures can be enhanced by suitably selecting the composition of individual elements optimally, without compromising the local strength and stiffness. Sandwich Plate System is an alternative to conventional stiffened plate construction. Sandwich plate system with lightweight materials is another development in marine structural design. This consists of two metal plates separated by a core. Plates, usually made of steel, are joined via perimeter bars on the edges of the plate. Classification societies have introduced provisional Rules for the application of sandwich panel construction to ship structure, which is a major development. For analytical evaluation of the hull, simple beam theory can be employed, though the materials do not follow linear stress-strain relation. Finite element analysis is essential for local analysis of the structural performance of composite hull components, and many professional agencies are developing design guides for marine applications of composites. This paper examines the advancements in the use of composite materials in shipbuilding.

Keywords: Composites; shipbuilding, structural performance; stability, stealth

1. INTRODUCTION

Composites have been in use for the last 50 years on a commercial scale. During the initial stages, composites were only used in applications like aerospace and defence. Later with the introduction of composites in marine field composite market witnessed an exponential growth. Along with this, technological advancement enabled the composites to adapt to large scale industries. Among all the markets served by composite industry, the marine market is the most penetrating one.

Composites are a combination of fiber and resin materials in definite proportions. Resin fiber ratio of a composite structure depends on the strength and stiffness requirements. Resin matrix gives a definite final shape to composite part, while the fiber provides the reinforcement. Composite structures enable 30-40% reduction in overall weight of a component in contrast to steel and aluminum. In addition to this, the composites provide low operation cost, reduced greenhouse gas emission and better fuel efficiency. It enables better manufacture of composite parts.

Though composites are more costly than metals, it is not surprising that composites are gaining greater acceptance among naval architects and boat builders. Despite many disadvantages of composites, many boat builders are focusing on greater incorporation of composites on marine structures.

Literature review indicates an increasing trend in the use of composites in marine applications.

2. SHIP BUILDING MATERIALS

The evolution of ship building is much like the automobile - it used to be made completely of wood panels. Before the industrial era changed everything with the mass production of steel manufacturing, wood was the material used for ship building from the early Bronze Age. Now, many ships are built using steel plates, aluminum, or fiberglass.

[1]UG Student, Department of Naval Architecture and Ship Building, Sree Narayana Gurukulam College of Engineering, Kerala, INDIA
Email: *annmarysunil34@gmail*

IMPACTS OF IMO ENVIRONMENTAL REGULATIONS ON SHIP DESIGN AND CONSTRUCTION

Nikhitha Menon & Silpa
Student, Department of Naval Architecture and Shipbuilding, Sree Narayana Gurukulam College of Engineering, Ernakulam, Email id: nikhithamenon172@gmail.com, silpasasidharan7598@gmail.com
Sunil Kumar P.G
[1]Dean (Research), Sree Narayana Gurukulam College of Engineering, Ernakulam Email id:snlkmrpg@gmail.com

ABSTRACT

Synopsis: International shipping requires global regulations due to diversity of national interests unlike land transportation which is governed by local legislations. In accordance with article 59 of its constitutive Convention, International Maritime Organisation (IMO) is a specialized agency of the United Nations in the field of international shipping and the effect of shipping on the environment and has been entrusted to pursue safe, secure and efficient shipping on clean oceans. IMO has been formulating regulations regarding safety, security and environmental issues.Control and prevention of various types of pollution of the sea by ships is addressed by the Marine Environment Protection Committee (MEPC) of IMO. The main impacts on environment due to vessel in operating condition include air, water, oil pollution and acoustics. Pollution caused by oil, chemicals carried in bulk, sewage, garbage, emissions from ships such as air pollution and greenhouse gas emissions, ballast water management, anti-fouling systems, ship recycling etc. Pollution preparedness and response are regulated by MEPC conventions and protocols. The International Maritime Dangerous Goods code (IMDG) adopted in 1965 has provisions to prevent or minimize spillage of dangerous cargo at sea. Each of these regulations have impacted the design, equipment selection, construction, crew, operation, maintenance and scrapping of ships, thereby influencing all sectors of the shipping business. MARPOL, which has six annexes, dealing with oil pollution, pollution by chemicals carried in bulk, harmful substances in packaged form, sewage, garbage and air pollution. Double hull configuration for segregated ballast oil tankers is just one example of the sweeping changes brought in by MARPOL regulations. Conventions on the dumping of wastes at sea, on the rights of coastal states to intervene if their coastline is under threat of pollution following upon a maritime casualty, on the use of certain toxic substances in ships, anti-fouling paint, on ballast water management etc. also have a direct impact on shipping. IMO estimates total carbon footprints due to shipping to be 2.2% of total global carbon emission. The water ballasted from area of ecosystem should not be deposited on another ecosystem to avoid foreign organism invasion. If the water is not treated effectively before de-ballasting, the foreign organisms can act as predators in the new ecosystem. Recent ballast management convention tackles this problem. Ship breaking (recycling) generates various types of environmental pollutants including lead, cadmium, zinc, chromium, persistent organic pollutants

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SAFETY AND FIRE PROTECTION CONSIDERATIONS IN SHIP DESIGN

Sandra K Anil[1], Arjun K R[2] and Dr. P G Sunil Kumar [3]

[1] Final Year B. Tech Student, Naval Architecture and Ship Building, Sree Narayana Gurukulam College of Engineering, A P J Abdul Kalam Technological University, Kerala, India
[2] Final Year B. Tech Student, Naval Architecture and Ship Building, Sree Narayana Gurukulam College of Engineering, A P J Abdul Kalam Technological University, Kerala, India
[3] Dean (Research), Sree Narayana Gurukulam College of Engineering, A P J Abdul Kalam Technological University, Kerala, India.

Email: sjsandra265@ gmail com, 9995129554

Abstract

Ships, the largest manmade moving structures, are akin to floating cities. Shipping industry is projected to touch $1.3 trillion by 2020, carrying more than 95% of the world trade by volume and 70% by value. Almost 30% of global oil and gas production is from offshore. Large scale flooding due to collision/grounding, fire and structural failures are the major hazards on marine platforms. Operations and safety on-board marine platforms are riskier and critical than at conventional sites. At sea, the seafarer is solely responsible for safety, with no immediate external professional help available in hazardous situations. On-board a ship in distress at deep sea, the crew take on fire fighting and damage control, and undergo continuous training to handle such situations. It is the endeavour of the marine designer to ensure safety of life and property at sea, which has been a prime concern since the evolution of marine traffic. Titanic disaster was the wakeup call to review and upgrade the safety systems on-board, and resulted in the establishment of International Maritime Organization (IMO) as the watchdog for commercial shipping. Navies across the world also were developing more stringent standards for maritime safety. IMO's statutory regulations are binding on all UN members. The Safety of Life at Sea (SOLAS) convention mandates the regulations for safeguarding the marine platforms against flooding and fire. Metallurgical advances have resulted in lighter scantlings for steel ships. Composite materials, though combustible, have reduced weight and maintenance requirements, and are replacing steel for certain ships. The Kolkata class of ships of the Indian Navy has composite superstructure. Such innovations necessitate additional safety considerations in ship design. Advanced structural analysis methods such as safety factor/partial safety factor methods involving probabilistic/semi-probabilistic approaches, limit state methods etc. have been introduced to ensure structural safety. Various design aspects to ensure safety on board commercial ships, warships and offshore platforms with respect to large scale flooding, fire and catastrophic structural failures are discussed in this paper.

Key words: IMO, SOLAS, Flooding, Fire, Safety Factor

1. INTRODUCTION

It is a very interesting and notable fact that approximately 70 percent of earth's surface is covered by water. Hence it is no matter of surprise that, water plays an important role, as a medium for transportation of people and cargoes. Around 90 percent of the world trade is carried out by the International Shipping Industry. Shipping has become one of the most significant field in international business. Now-a-days, the global market is in great need of

Numerical analysis of effect of bow shape of an anchor handling tug supply vessel through reverse engineering

Linda Perumal Johnson Jishnu S Sarma Athul Vinod Sunil Kumar P G
Sree Narayana Gurukulam College of Engineering, Ernakulam, 682311, India
Corresponding Author Email: perumal24680@gmail.com

Abstract- **Performance parameters of an Anchor Handling Tug Supply Vessel (AHTSV) are analyzed for different bow configurations using reverse engineering. Reverse engineering is used to develop the hull model of an existing AHTSV with bulbous bow from available data. The resistance and seakeeping parameters of the model were analyzed in order to verify with the original values using various Maxsurf modules. After due verification of the model, the bulbous bow region was replaced with Ulstein's X-bow. Both the models were analyzed using Maxsurf, the results analysis for both the models conclude that the X-bow design has improved performance in various sea conditions.**

Keywords: *Re-engineering; Anchor Handling Tug Supply Vessel; Seakeeping behavior; Bulbous bow; X-bow; Resistance*

1. INTRODUCTION

A ship is subjected to various forces and motions during its voyage and is expected to have a good performance in the sea conditions it may face during its lifetime. In harsh environments where safety and stability are of great concern, the bow of the ship plays a vital part in reducing the resistance as it breaks through water. Thus, bow designs have undergone modifications several times in the past in order to improve the ship's efficiency and stability at sea. In changing conditions of higher sea state, a ship encounters fluctuating speeds and retardations. This grants higher normal speed decreasing control prerequisite and utilization of fuel.

Bows modify the flow around the hull, reducing drag at operating speeds and consequently increasing range and fuel efficiency. Every bow type has its own distinct characteristics and relative merits. Each bow design works in various manners on different vessels in order to accomplish the task it is intended for. Hence, selecting a bow form that is best suited is critical, paving way for novel approaches in bow design.

Reverse engineering, in this case is a method of bringing new innovation in watercrafts and retrofitting existing ones, which enables in minimizing the time required for design of new projects and reducing production cost. This also helps in controlling the quality of the elements used, in redesigning prototype structures, retrofitting existing constructions, etc.

2. RE-ENGINEERING

This paper presents the comparison of conventional bow and cross bow for an AHTS vessel with the application of reverse engineering. From the product sheet of the AHTS vessel having nabla type bulbous bow, the general arrangement and tank plan was obtained and imported into Rhinoceros 3D. The plans were scaled to the specified dimensions and the necessary lines were traced to acquire the lines plan. After fairing and making necessary changes, the stations were arranged and the vessel was modelled up to the accommodation deck (Figure 1). The curves were then faired and surfaced to generate the desired model, which was exported in IGES format. This way the model was imported into Maxsurf Advanced Modeler and its sectional area graph was checked to ensure (Figure 2) that there were no irregularities on the surface. Values for the station, waterline and draft were specified. The hydrostatic parameters were checked and the results were obtained with a tolerance of 0.05% compared to original ship.

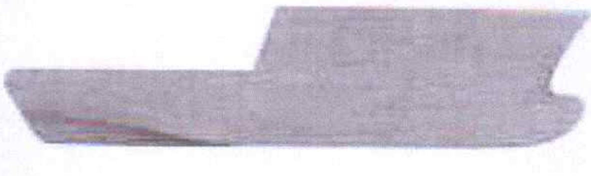

Figure 1.AHTSV with Bulbous Bow

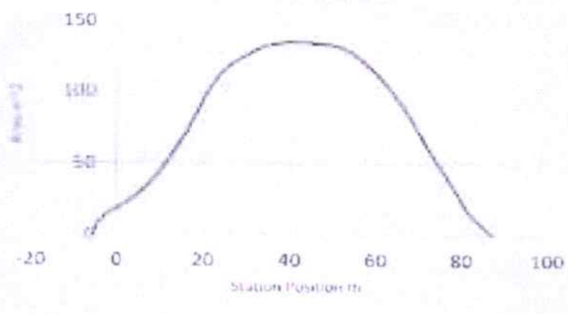

Figure 2. Area curve of AHTSV with Bulbous Bow

The resistance, stability and sea keeping analyses were performed in Maxsurf modules such as Maxsurf Resistance, Maxsurf Stability and Maxsurf Motions respectively.

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**For correspondence (e-mail: perumal24680@gmail.com)*

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CONCEPT DESIGN OF AUTONOMOUS UNDERWATER VESSEL BIO MIMICKED FROM BLACK MARLIN FISH

Athul Vinod[1], Jishnu S Sarma[2], Linda Perumal Johnson[3], and Prof. (Dr.) Sunil Kumar P G[4]

[1] Department of Naval Architecture & Ship Building, Sree Narayana Gurukulam College of Engineering, Kerala-682311, India, Email: athulvinod18@gmail.com
[2]Department of Naval Architecture and Ship Building, Sree Narayana Gurukulam College of Engineering, Kerala-682311, India, Email: jishnussarma@gmail.com
[3] Department of Naval Architecture and Ship Building, Sree Narayana Gurukulam College of Engineering, Kerala-682311, India, Email: perumal24680@gmail.com
[4] Sree Narayana Gurukulam College of Engineering, Kerala-682311, India, Email: snlkmrpg@gamil.com

Abstract

Autonomous underwater vehicles (AUVs) have amply spanned in oil and gas, marine, geological and other industries for their extensive applications for collecting deep-sea information (observation beyond ships reach). Drag analysis and shape optimization of an autonomous underwater vehicle (AUV) are significant for its energy utilization and endurance improvement. Trendsetting ideas like biomimicry in AUV hull design is focalized to provide comprehensive data for its users. This paper explores the feasibility of a sleek AUV hull, where the hull mimics the form of ***Black Marlin*** *which is among the world's fastest fish. The fish shares similarities with formula one racing cars about its aero dynamicity to reduce drag. Bio-mimicking this to the hull reduces the drag which in response will increase the efficiency. The drag of the 3D modelled AUV hull is calculated and is compared with the hull which mimics the aerodynamic body shape of the fish using Computational Fluid Dynamics(CFD).*

Keywords: AUV; Biomimicry; Black Marlin; Drag; CFD.

1. INTRODUCTION

The applications of underwater vehicles have shown a dramatic increase in recent years such as mine-clearing operations, feature tracking and deep ocean exploration. With these advancements the vehicles are put into challenging waters for environment detection and an optimised hull design is vital to the vessel and its ability to carry out intended missions. Based on such purposes the form and size are designed. For example, exploration through narrow reefs requires a small and flexible design to make it hydrodynamically efficient.

The optimised hull design enables the AUV to maintain the flow around it with minimum nose cavitation, thereby improving its high-speed moving capability, range and equipment energy efficiency which are vital for its missions. It further reduces the manufacturing cost.

Biomimicry offers an empathetic, interconnected understanding of how life works and ultimately where humans fit in. It focuses on putting nature's lessons into practice, thereby solving human problems by observing and replicating biological design strategies and patterns of the species alive today for clean and efficient technologies. The goal is to create products, process and policies- new ways of living- that solve the greatest design challenges sustainably, and in solidarity with all life on earth. Innovators who understand the needs of this century turn to nature for "bio-inspiration", and they are bound to achieve considerable progress to create great possibilities in a new era of industrialization.

The **black marlin (Istiompax indica)**, indicated in Figure 1, is a species found in the tropical and subtropical areas of the Indian and Pacific Oceans, with a maximum recorded speed of 132 km/hr. This is like a formula one racing car which is incredibly aerodynamic to reduce drag. Black marlins are extremely streamlined and have a fusiform shape, where they are shaped like spindles, wider in the middle and tapered at the ends and have an

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DEVELOPMENT OF UNDERWATER DRONE, ROV VARUNA

Abhijith K. Sujith, Aadith Mathew, Adarsh K S, Josna John, Sane Shajan, Sreekumar Pai G[#1], Satheesh Babu P K, P G Sunil Kumar[#2]

Abstract

Underwater robotics is increasingly being used in maritime sector for various applications. Remotely operated underwater vehicles (ROVs) constitute an important part of underwater robotic technology. This paper mainly deals with design aspects of ROV VARUNA; designed by a group of students from Dept. of Ship Technology SNGCE. ROV VARUNA is designed to perform underwater hull inspection and quality analysis. The paper focuses on structural design and control logic of ROV VARUNA.

Keywords- ROV, Thruster, Pressure hull, Stability, Maneuverability, Raspberry Pi, Pixhawk

I. Introduction

UNDERWATER DRONE (ROV VARUNA) are utilized for a wide range of commercial operations including underwater survey missions such as detecting and mapping submerged wrecks, rocks, and obstructions that can be a hazard to navigation for commercial and recreational vessels. Their applications in offshore sector include Baseline Environmental Assessment, Geophysical Survey, Pipeline Survey and Debris/Clearance Survey. In hydrography they are used in Route Survey, Habitat Mapping and deep-Sea mining, Charting, EEZ Survey and Pre/Post Dredging Survey. In environmental monitoring they can be utilized in Emergency Response, Water Quality and Ecosystem Assessment. They can also be deployed at the front lines of combat to provide situational awareness to small units of troops through real-time information about surrounding areas. An ROV conducts its survey mission without operator intervention. When a mission is complete, the ROV will return to a pre-programmed location where the data can be downloaded and processed. ROVs allow scientists to conduct other experiments from a surface ship while the vehicle is off collecting data elsewhere on the surface or in the deep ocean These ROVs can weigh very less compared to other vessels. However, even the lightest models must be fairly fast to provide sufficient speed while maintaining efficiency. These remotely controlled vehicles also need space to turn and although research has enhanced their capability to maneuver in small spaces over a specified area.

II. Concept

A mono hull six thruster vector configuration has been chosen for the proposed design titled ROV *VARUNA*. This design lays in the advantage of increased space for components and improved stability parameters, achieved by judicious arrangement of weights and usage of floating foam in the vertical direction. Batteries and all the necessary electronic components would be housed in the main hull to remain watertight. Capitalizing on the experience gained from a previous ROV project named ROV DANAS and having considered various shape options like torpedo like structures, flat fish configuration etc, a novel concept has been developed for the form of ROV VARUNA. A cylinder-shaped pressure hull has been used in ROV VARUNA, which has been optimized for a mono hull, six thruster configurations. The primary drawbacks which we were trying to overcome