
NO SMOKING
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CONTENTS

ABSTRACT

Like many economic activities that are intensive in infrastructure the transport sector is an important component of economy impacting on development and the welfare of population.

From a general standpoint the economic impact of transport are:

☐Direct impact related to accessibility change where transport enables larger markets and enables to save time and cost.

☐Indirect impact related to economic multiplier effects where the price of commodities , goods or services drops and their variety increases.

Shipping transportation being the major of all forms of transportation has a dominant contribution towards the national economic growth. So our main emphasis would be on improvement in marine transportation to enhance national economic growth which could be achieved by advancement in ships design and technology. Amongst various developments in ships design and technology our presentation would precisely deal with hull and propeller parts of ship.

Regarding hull design we would discuss different types of hulls such as catamaran , pentamaran , aluminium hull, air cavity hulls and various other advanced designs of hulls.

KEYWORDS :

Hull, Development, Resistance, Air cavity .

INTRODUCTION

The interface between transportation and economic development has broad ramifications that go beyond transportation's basic purpose of moving goods and people from one place to another. Whereas there is no doubt that transportation is essential in the operation of a market economy, much still needs to be understood about ways in which an efficient transportation system can improve the productivity of economy.

An efficient transportation system would have following impacts :

☐Enviromental protection which include preservation of present air and water quality.

☐Ecnomical growth

☐Safer and faster transportation

In order to build an efficient transportation we require the best techniques to use the limited resources available to us upto a 100% level. So continous development is required in transportation field.

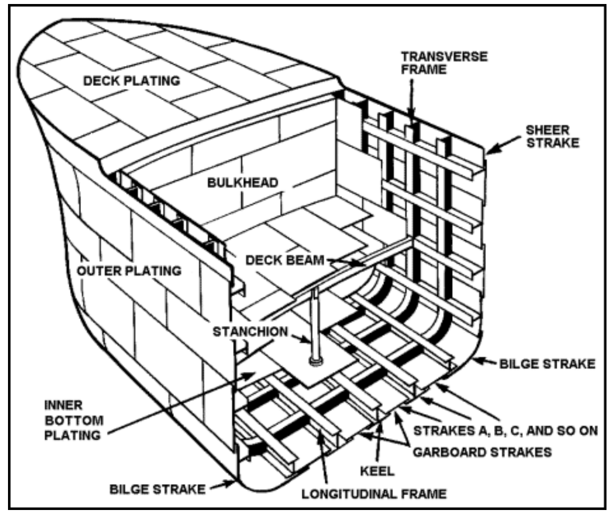
MARITIME TRANSPORTATION

Maritime transportation being the widest mode of transportation has the most dominant effects on economy of the world and different nation.

So, continuous development is a must in the shipping industry so as to have an efficient transportation system.

Regarding developments in ships there can be numerous areas for development such as engines, quality of fuel being used, construction of ship, infrastructure, materials being used, and various ship parts. Out of them our main emphasis would be on developments in hull designs technology precisely.

☐HULL



- A hull is a main watertight body of the ship below the main outside deck .
- The structure of hull varies depending on the vessel type .
- In a typical modern steel ship ,the structure consists of watertight and nontight decks , major transverse and longitudinal members called watertight (and also sometimes nontight) bulkheads , intermediate members such as girders ,stringers and webs and minor members called ordinary transverse frames , frames ,or longitudinals ,depending on the structural arrangements.

☐HULL EFFICIENCY

The efficiency of a hull is directly proportional to thrust generated and inversely proportional to wake developed.

Wake is defined as the water set in motion by the movement of ship. Whereas the thrust deduction is defined as the drag generated at the after end of the ship due to the low pressure region on the forward side of propeller.

Hull efficiency is given by the relation below, Hull efficiency = {1- thrust deduction (t)} / {1 – wake (w)}

So to increase hull efficiency we either need to reduce thrust deduction or increase wake produced. To achieve these several hull designs have been introduced till date, some of them are as follows:

- Catamaran
- Pentamaran
- Blade runner hull
- Small waterplane area twin hull (SWATH)
- Air cavity hull

Out of these ,the hull of our main concern would be 'Air cavity hull' as it is being considered as the future of shipping industry.

☐Air cavity hull :

Air cavity hull development has been one of the focal points on marine hydrodynamic research for the last 30 years . Considerable amount of progress has been achieved by the development of hull forms to reduce resistance, which resulted in considerable fuel consumption savings in vessels.
A number of proposals have been made such as boundary layer modification, microbubbles, riblets (Bechert et al., 2000; Lee and Lee, 2001), air lubrication by air injection (Fukuda et al., 2000) etc.
One of these concepts to minimise viscous resistance was developed by Russian scientist known as ship with artificial air cavity which was actually applied to a number of built ships (Butuzov et al., 1999a, b).Some of these ships were river ferryLinda , 30 knot 105 displacement ton tank landing ship Serna, 38 knot 13 displacement ton patrol boat Sajgak, 50 knot 99 displacement ton Merkurj.

☐Principle :

- The basic principle of air cavity hull is to form a layer of air between the hull surface and water surface and hence thereby reducing the drag.
- ACHs use the same basic principle as supercavitating torpedoes, in that an object or hull encased in a bubble of air can slip through water much more easily than a hull slicing the water directly.
- Most drag in water is caused by friction created by the hull and water. Air has less than 1% the viscosity of water, so it basically "lubricates" the ship as it moves through the thicker medium, allowing much easier passage.

But where supercavitating torpedoes completely encase the torpedo, an ACH uses a broad cavity filled with compressed air to allow a large percentage of a ship's subsurface hull to glide through the water with less resistance. This produces less drag and increases fuel efficiency.

☐Construction :

- Its construction is quiet simple.

- About 20% of the bow is arranged as conventional semi-planing /planing hulls, hence good sea keeping ability is assured .
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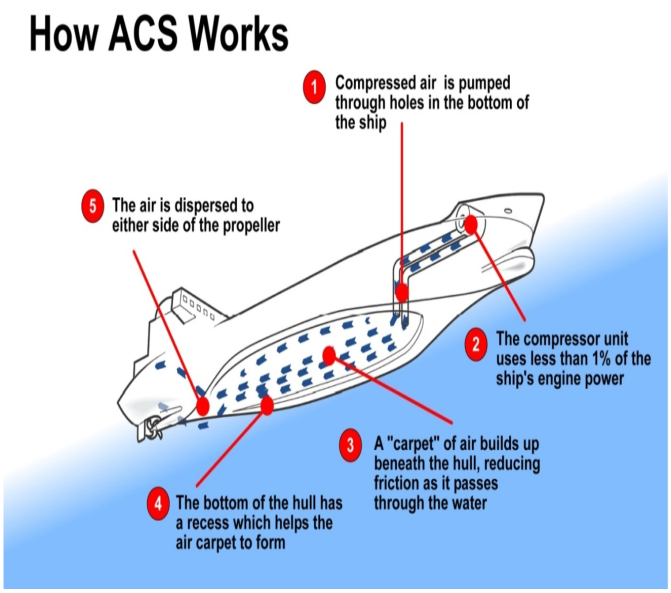
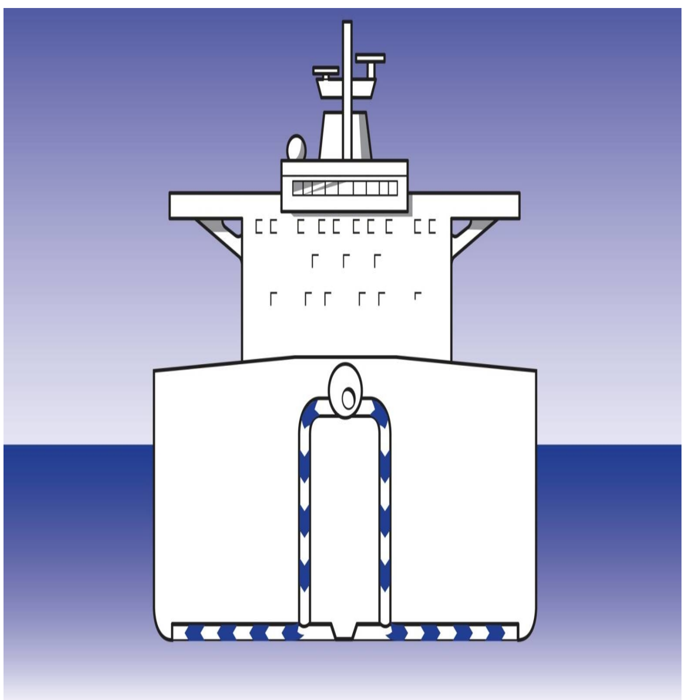
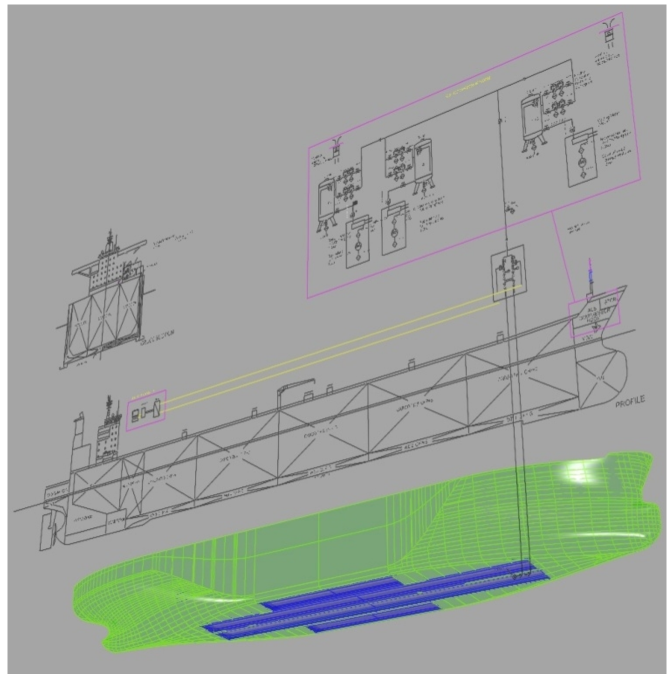




A cavity chamber is created by arranging a step behind the bow part and a longitudinal channel with deeper hull section on the sides.

- The stern part of the air cavity chamber is inclined downwards forming a planing surface.
- This surface is in contact with water to reduce air escape from the cavity.



This figure shows how an existing ship can be retrofitted with air cavity system.

☐ Working :

- A compressor near the bow would draw in air from the deck and pump it into the subsurface cavity.
- Air would build up in the cavity under pressure, giving the vessel a large swath of its 'hull' that produces far less drag than the rest.
- Air would also slowly seep away along the sides and the stern of the cavity, but under

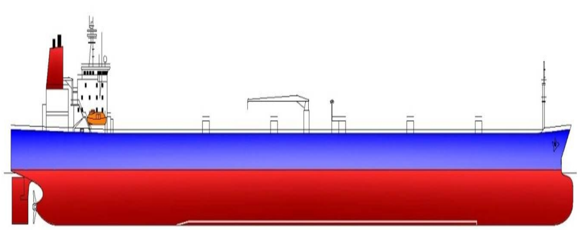
most circumstances can be readily replaced by the compressor to maintain optimal pressure.

- Tests have shown that the compressor would use about one percent of the ship's available power,

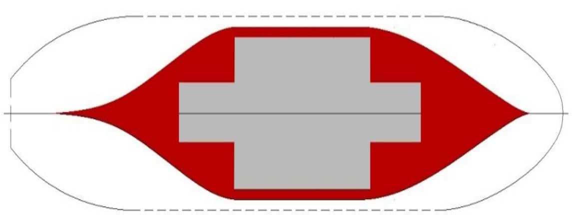
which is more than made up for in the increased engine efficiency the air cavity hull provides.

☐Case study :

(A) (115,000 DWT tanker modified for ACS :

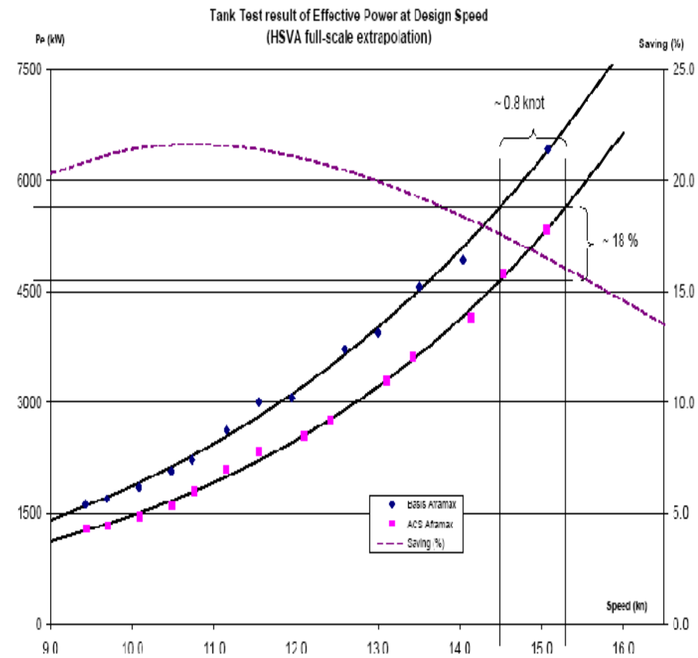


a LNG



carrier being retrofitted with air cavity hull

Graph showing the impact of the retrofitted air cavity hull:



Advantages:

☐Economic impacts of air cavity technology:

- It reduces the fuel oil consumption .Ship owners would save between $0.5m and $3m per year in bunker fuel costs.
- It is being stated that for a 300,000 DWT VLCC annual savings would be approximately DKK 3.5 millions.
- With a predicted annual average growth of the world economy of 2.8%, the cost of a barrel of oil is expected to rise to $120 a barrel by 2030; equivalent to bunker fuel costs in excess of $600 per metric tonne.
- Hence cost savings would increase incrementally throughout the life span of vessel.
- The most exciting and economic feature of this technology is that existing vessels can also be retrofitted with this technology and that also with just an investment of 2-3% of the cost of a new vessel.
- This technology has an average fuel cost payback of under two years at current bunker fuel prices, with some ship classes achieving substantially better payback periods.
- In today's world time is everything, keeping this thing in mind this technology can be installed in any vessel within 2 weeks.

□ Advantages:

- According to DK group , their test vessel showed a 7% increase in fuel efficiency with air cavity hull installed in it.
- Emissions of harmful gases such as CO, SO_x, NO_x are reduced.Substantial reduction in resistance is observed i.e. upto 20%.
- Overloads in rough seas are reduced due to a damping effect of the air cavity.
- Fouling growth on the hull in warm seas is lessened due to decreased wetted surface.
- ACS is a convenient platform for effective landing and shallow-water operations.
- CO_2 emissions are reduced by 6000 tonnes per year.

□Disadvantages :

- Low directional stability.
- Not effective during extreme manoeuvres.
- Smaller fuel saving when traveling in large waves.
- Smaller savings with relatively lower speeds.
- Chances of corrosion.

☐Can a change in hull design revolutionize a

country's economical growth and trade?

The answer to this question lies in an article of (ASIAN MARITIME BUSINESS , 2005) in which an aluminium ship with a stabilized monohull has made revolutionized the trade in china .

China's pearl river delta in Guangdong Province has attracted enormous international interest with its rapid economic growth, the growth faces some huge problems related to port congestion and inadequate lad infrastructure. The big logistics problem for the Pearl River Delta is that it lies on the opposite side of an ocean inlet to its nearest international port hub – Hong Kong. All freight and containerised cargo must be either moved around the ocean inlet or across it to get to Hong Kong.

Macau lies at the entrance of the inlet on the same side as the Pearl River Delta and is about 35km from Hong Kong. Shenzen is on the same side of the bay as Hong Kong and Guangzhou is at the furthest extremity of the bay – about 100km from Hong Kong. This introduces the massive problem of how to move containers around this water obstacle between the Pearl River Delta and the major hub port of Hong Kong.

Currently proposed solutions include a new rail link between Hong Kong, right around the bay to connect with the Pearl River Delta on the western shore. Another solution is to build a 35km bridge from Hong Kong to Macau on the western shore. But both of the proposed solutions are a hell lot of time consuming and huge capital investment is required. Silting of the estuary of the Pearl River is a problem for creating improved access by deep draught vessels.

The recent development in hull design made all the difference . An aluminium vessel with stabilized monohull with draft of just 4m made the trade possible . This reduced the congestion in the delta and also solved the problem of grounding of vessels as it have a draft of just 4m and hence can get through the silting estuary easily.

This shows how development in hull design entirely changed the economic aspect of a nation. By having some changes in design high economic benefits can be achieved and hence economic growth can be achieved by development in hull design and development in shipping sector.

☐Impacts of development :

This table shows how development in certain areas would effect the fuel consumptions:

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Conclusion

- A simplified air cavity form can be created from a conventional planing form with a low resistance penalty.
- Wave pattern resistance is also reduced by using air supply which causes pressure field changes due to air film.Penalty was 10% at low speeds ,dropping down to 2%.
- Wave pattern resistance reduction is small as compared to viscous resistance reduction.Air can be supplied only to maintain the air film and replenish it.
- Further research is required to establish optimized hull forms.
- The forming of air cavity is related to the ship velocity, pressure in the air cavity and geometric size and shape of the groove.
- Most important of all, air cavity system when fully developed would reduce the fuel consumption to a lot and hence would make transportation more economically viable.
- This would be the most successful technology in history of shipping to decrease the fuel consumption to highest i.e. around 15-20%

after full research and development of this technology.

☐REFERENCES

- **BOOKS :**
  - Ship Constrution – D.J.Eyres
  - Evaluation of Advanced Double Hull (ADH) – J.Beach
  - Stranding Experiments on Double Hull Tanker Structures – J.Rodd and M.Philips
- **WEBSITE :**
  - www.dkgmt.com
  - www.scientificamerican.com

- www.bentley-marine.com
- www.marinetalk .com
- www.marinelink.com