TOUCH OF **CLASS**

ISSUE 01 | 2015

IRCLASS AT INMARCO - INAvation, 2014

Contents

From the Chairman's Desk

Dear Reader,

New Year commences with new hope, new energy and new ideas. This year is no different. The good news being that the shipping cycle appears to have bottomed-out and its only time before we will see revival in shipping. The green shoots are already being seen, which may lead to a visible recovery by end 2016, assuming the geo-political situation remaining the same.

With the new MARPOL requirements on emission which have come into force from 1st January, 2015, there has been an impetus on using LNG as fuel in Sulphur Emission Control Areas, which are expected to cover most of the busiest ports. This in turn may aid the revival of new constructions with propulsion systems using dual fuel or LNG fuel. It is expected that by 2030, LNG transportation will touch around 1 billion tonnes. IRS is prepared to partner with the industry in providing services in this area.

In our efforts to continuously improve our services, last year, at IRS, we have streamlined our third party inspections and System certifications divisions and a subsidiary, IRCLASS Systems and Solutions Pvt. Ltd. (ISSPL) is formed. This has commenced working independently and I have no doubt that ISSPL will be among the market leaders, in future. At the organisation level, we are constantly making efforts to reach out to our clients, to understand and address their needs.

Hope you will enjoy reading this edition of Touch of Class and wish you a pleasant reading.

Arun Sharma
Chairman&Managing Director

Interactions with Stakeholders

At IRClass it is our constant endeavour to engage with various stakeholders on a regular basis to share developments at IRClass and also seek inputs from the industry. As a part of this engagement, IRClass has initiated 'Interactive Sessions' with various industry bodies including Indian National Ship-owners Association (INSA), Indian Shipbuilders Association (ISBA), Shipyards Association of India (SAI) and Ship Managers.

In the course of the year there have been 3 Interactive Sessions with INSA and one each with Shipbuilders and Ship Managers, apart from an interaction with the Ship Designers.

During these interactions, IRClass has shared regular updates on the developments at International Maritime Organisation and other relevant associations / events.

The industry has welcomed this initiative and the response to these events has been positive and encouraging.

News from China Survey Station

New Building Activity

Ever since the establishment of our China Survey Station in the year 2000, IRClass has been busy undertaking surveys of new construction and existing ships, repair activities and marine component approvals.

Recently, four mini bulk carriers built under single class of IRClass were delivered by Nantong Tongde Shipbuilding & Repair Co. Ltd. to SVS Marine Mumbai and AK Shipping Mumbai in January and July 2014 respectively.

Currently, there are 4 mini-bulk carriers and one self-propelled deck loading vessel under construction at Zhejiang Dongpeng Shipbuilding & Repairing Co. Ltd. and Nantong Tongmao Shipbuilding Co. Ltd. respectively under single class of IRClass.

Apart from above, IRClass will be classing two more 82000 DWT Common Structural Rule (CSR) compliant bulk carriers for Great Eastern Shipping Co. Ltd., to be built at Jiangsu New Yangzi Shipbuilding Co. Ltd., which will be delivered in 2015 and 2016.

Marine Components

The increasing number of single classed vessels under IRClass have resulted in an appreciation of our approvals seeked by manufacturers for marine equipment.

Going by the trend and the fact that shipping cycle has bottomed out, new building and ship repair activities are likely to increase in China in near future and we, at IRClass, are poised to meet with this demand growth.

M. T. Desh Vibhor of Shipping Corporation of India.

ISSPL (Industrial) secures yet another job from British Gas

ISSPL was entrusted by British Gas with the responsibility of providing Third Party Inspection and quality surveillance services covering the Procurement, Fabrication, Loadout, Installation & Commissioning phases of the project.

Scope of services

The scope envisaged by British Gas, was to act as their representative & associate in respect of all quality related matters including technical audit of vendors, stage-wise inspection of bought out materials, quality surveillance at fabrication yard and onboard installation & pipe laying barges.

ISSPL provided the services globally, including vendors located in Houston, Singapore, Indonesia, Malaysia, United Kingdom, Germany and Dubai. The major work involved was the supervision of fabrication of the platform, which was carried out at L&T Modular Fabrication Yard in Hazira. A dedicated team of 4 engineers with over 10 years of experience, was deployed at Hazira to ensure 24x7 inspection coverage.

Background

Oil & Natural Gas Corporation (ONGC), Reliance Industries Ltd (RIL) and BG Exploration and Production India Limited (BGEPIL) are joint operators of the Panna-Mukta offshore oil and gas production field situated in the Arabian Sea, off the west coast of India, near Mumbai. The Mukta Field is located about 120 kilometers offshore northwest of Mumbai, India. MB platform & pipeline project comprises the development of the Mukta B Area.

Project Facilities

The project comprises of:

- A conventional fixed jacket structure with through leg piles, topsides module comprising multiple levels namely Main Deck, Mezzanine Deck, Cellar Deck and Sump Deck.

- Space is provided for 9 well slots suitable for drilling and production wells with provision for lifting gas. It is also equipped with production & test manifolds and utility systems necessary for the operation of the platform.

- A 14" OD, 25 km export pipeline (19.1mm WT) to the PPA Host complex with pipeline pig launchers and receivers.

- A piggy back pipeline (5" OD Coiled Line Pipe x 7.6mm WT) on the export pipeline from the PPA complex, for the supply of lift gas.

- Risers for well fluid, lift gas (6.625"OD x 15.9mm WT) together with appropriate appurtenances. An import pipeline connecting MA platform to MB Platform to enable MA well-stream fluids to be transported to MB and then to the PPA Host complex.

- A piggyback pipeline on the MA- MB pipeline to provide lift gas to MA platform from MB platform.

Highlights

Surveyors/Engineers successfully completed the inspection of approx. 4200 MT of fabrication, within a over a period of 8 months to the complete satisfacation of British Gas.

As the client's representative at the yard, ISSPL assumed total responsibility of the entire fabrication work from the quality perspective.

Surveyors/Engineers were also stationed at Tenaris, Houston for inspection of coil tubing and at the PSL Coating Yard, Mundra for inspection of 3 Layer Poly ethylene coating & Concrete Weight coating of 14" dia, 25 km pipeline to be used for this project.

Value addition by ISSPL

To cope up with the construction and inspection schedule, dedicated surveyors/inspectors have been stationed at the yards and at the makers facilities, globally. Crashing the project schedule without compromising on quality, remained a significant aspect of this project.

The entire fabrication has progressed as per schedule and the first load out (Jacket Structure & Piles) was successfully completed in the 3rd week of Jan 2015. Further, the laying operation was completed in 25 days.

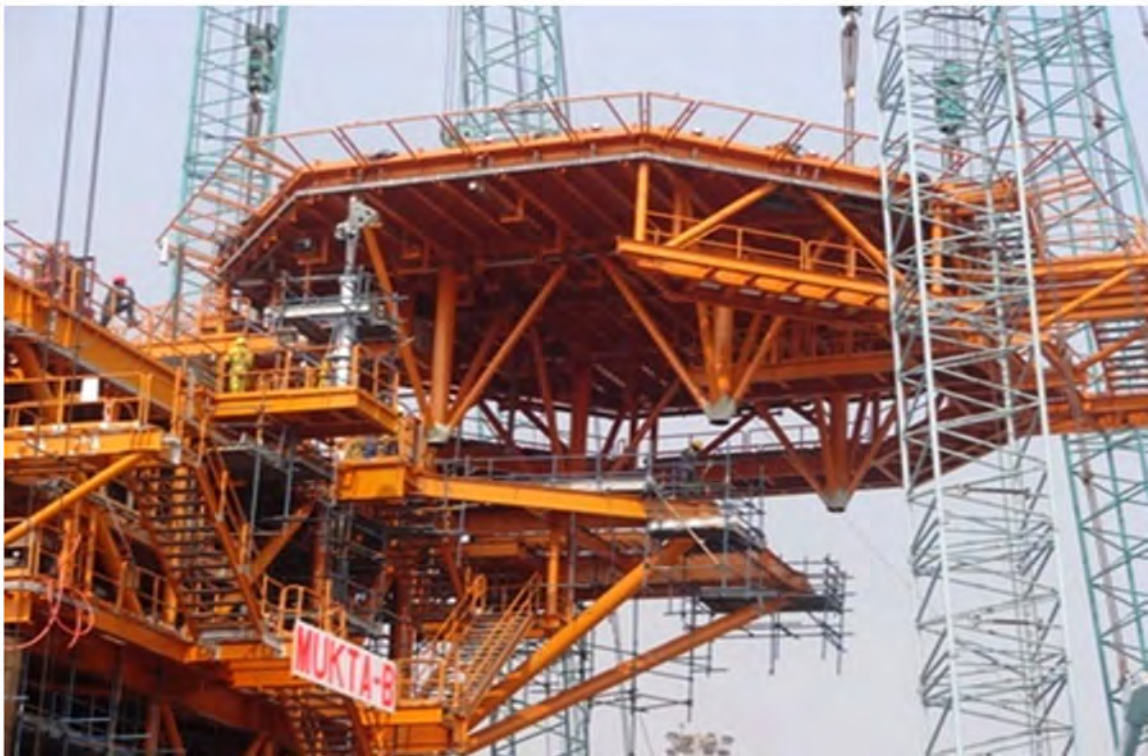
ISSPL has significant experience in the offshore field fabrication & inspections, including submarine pipelines and is committed to further invest in research activities to ensure a greener tomorrow.

ISSPL Surveyors/Engineers checking the equipment and piping

ISSPL team- prior to loadout

Jacket ready for loadout

Helideck installation in progress



POLAR CODE- An Introduction

N.Girish, Divisional Head,
Research and Rule Development

1. Introduction

With the receding of polar ice, the northern sea route has become operational for cargo ships with its advantages of shorter distances. Further, Polar regions are also becoming popular for cruise vessel operations. These developments and the concern for safety and environmental protection has resulted in the adoption of the International Code for Ships operating in Polar waters (Polar Code) by the IMO.

The objectives of the Polar Code are to increase the safety of ships operation in the remote, vulnerable and harsh polar waters and to mitigate the impact on the people and environment. The requirements of the Polar Code are additional to the existing requirements in IMO instruments and thus supplement them for polar water operation.

The Polar Code will be mandatory under SOLAS and MARPOL Conventions. The Maritime Safety Committee (MSC) adopted the Code at its 94th session in November 2014 and the Marine Environmental Protection Committee plans to adopt the code in May 2015. The Polar Code would apply to new ships constructed on or after 01 January 2017 and existing ships constructed prior to this date should meet the provisions of the code by the first intermediate or renewal survey which occurs after 01 January 2018.

A new chapter XIV is added to SOLAS to make the Polar Code mandatory. This chapter defines the Arctic and Antarctic areas covered by the Code.

The Polar Code has been developed using a risk based approach and adopts a holistic approach to reduce the identified risks.

2. Structure of the Code and Categories of ships

The mandatory requirements of the Code consist of Introduction, Part I covering safety aspects and Part II covering environmental protection aspects. Further, Part IA and IB gives further recommendatory guidance regarding safety and environmental protection aspects respectively. The Code divides ships into three categories A, B and C depending on the ice conditions in which they can operate:

Category	Ice conditions
A	Medium first year ice (70-120 cm thick) which may have old ice inclusions
B	Thin first year ice (30 to 70 cm thick) which may have old ice inclusions
C	Open water (having ice of concentrations less than 1/10) and in areas less severe than category A and B.

It may be noted that the IACS Polar Classes 1 to 5 correspond to Category A and Classes 6 to 7 correspond to category B as far as ice strengthening of hull, propeller, shafting and steering arrangements are concerned. The IACS Unified requirements for polar ships have already been developed few years back and are being applied.

Category C ships may not require ice strengthening or additional equipment to comply with the Code, if shown by the results of an operational assessment.

The Finnish Swedish ice classes and the corresponding class notations (Baltic) of Classification Societies generally would be considered as complying with Category C requirements. Though such vessels are ice strengthened they are not considered to fully comply with the Polar class 6-7 requirements in some respects.

The Polar Code also specifies some additional requirements for vessels operating in low air temperatures which is defined as areas where the lowest mean daily low temperature is below -10 deg. C.

3. Risk based approach

The Polar Code follows a risk based approach specifying the goals and functional requirements for each chapter of the Code. In this regard, the Polar Code specifies the hazards to be taken into account, such as the following:

- Effect of ice on hull structure, stability, machinery systems, navigation, outdoor working environment, maintenance and malfunction of safety equipment and systems
- Effect of low temperature on the working environment and human performance, material properties and equipment.
- Extended periods of daylight or darkness and its effect on navigation and human performance
- High latitude as it affects navigation and communication systems
- Remoteness of areas and lack of navigational aids and search and rescue facilities
- Potential lack of ship's crew experience in polar operations
- Potential lack of suitable emergency response equipment

4. Supplementary requirements for safety

The Polar Code specifies additional requirements to be complied with over and above that given in the SOLAS Convention. These are related to ship structure, subdivision and stability, watertight and weathertight integrity, machinery installations, fire safety, life-saving appliances, safety of navigation, communication, manning and training etc. The Code refers to the relevant Polar classes of IACS and the Unified Requirement S6 for the purpose of ice strengthening and materials for low temperature operation respectively. These are part of the classification society Rules.

All ships operating in areas where ice accretion is likely to occur are to have sufficient intact stability with a specified icing allowance. Damage stability in ice impact damage condition is to be satisfied by new ships of category A and B.

Machinery installations are to be suitable for working under the environmental conditions taking into account ice and snow accumulation, low temperature sea water and air, freezing of liquids etc. In this case also the Code refers to IACS Polar classes for ice interaction strengthening of propeller, shafting and steering equipment of category A and B ships.

The Code requires that fire-fighting equipment are to be operable in the environmental conditions. Design of fire safety systems are to take into consideration operation by personnel wearing bulky and cumbersome cold weather gear. All fire pumps are to be located in compartments maintained above freezing.

The Code gives special emphasis on life saving equipment and arrangements considering the need for evacuation and abandonment in the polar environment. Means are to be provided to clear escape routes of snow and ice. The escape routes and embarkation arrangements are to be suitable for persons wearing polar clothing. All passengers are to be provided with insulated immersion suits or thermal protective aids.

All life boats are to be partially or fully enclosed type. Life-saving appliances are to be suitable to protect persons from wind chill and are to be

insulated. Another special requirement in the Code, is the carriage of group survival equipment such as tents and other facilities where abandonment to ice or land is necessary.

Additional requirements for Safety of Navigation consider the need for availability of ice information, functionality of navigation equipment and means for detecting ice in darkness. All new vessels are to be provided with two independent echo-sounding devices or one device with two separate independent transducers. In category A and B ships, underwater sensors are to be protected against ice. It is also required that bridge wings are to be enclosed to protect navigational equipment and personnel. Means are to be provided to prevent ice accumulation on antennas required for navigation and communication.

All ships are to be provided with two non-magnetic means to determine and display their heading. Ships operating above 80 deg latitude are to have a GNSS compass or equivalent.

Provision is to be made for two way voice and /or data communications ship to ship and ship to shore at all points along the intended route. Means for two way on scene and SAR coordination communications for search and rescue purposes including aeronautical frequencies is to be provided. For ships intended for operation in low air temperatures, all rescue boats and life boats, whenever released for evacuation shall maintain capability for distress alerting, locating and on-scene communications.

The Code requires that the Master, Chief-mate or Officers of navigational watch have undergone specified training for operation in open waters and other ice infested waters. The Administration may allow use of other persons to satisfy the training requirements of the Code.

However, in such cases the Master, Chief-mate and officers of the navigation watch should have undergone the specified basic training.

5. Supplementary requirements for environmental protection

The Polar Code specifies some additional requirements for environmental protection for prevention of pollution by oil, noxious substances, sewage and garbage in Polar waters. Discharge of oil or oily mixtures as well as noxious liquid substances or its mixtures is prohibited. To prevent accidental outflow, tanks containing oil/ mixtures/ noxious liquids and its mixtures are to be located inboard of the shell by at least 760 mm.

Locations where discharge of sewage or garbage are permitted are specified based on distances from nearest land, nearest ice shelf and nearest land-fast ice and as far as practicable from areas of ice concentration exceeding 1/10.

6. Polar Water Operational Manual (PWOM) and Polar Ship Certificate

The purpose of the Polar Water Operational Manual is to provide the owner, operator, master and crew with sufficient information regarding the ship's operational capabilities and limitations in order to support their decision-making process.

The Manual should include or refer to specific procedures to be followed in normal operations and in order to avoid encountering conditions that exceed the ship's capabilities.

The manual should include the methodology to determine capabilities and limitations in ice. Specific procedures for dealing with incidents in polar waters and risk based procedures for measures to be taken in the event of encountering ice and /or temperatures that exceed the ships' design capabilities or limitations are also to be covered by the Manual.

Polar Ship Certificate

The Polar Ship Certificate indicates that a ship is compliant with the requirements of the Polar Code. Normally, a survey is required for this purpose. However, for category C ships, the Polar Ship Certificate may be issued based on documented verification that ship complies with the requirements, subject to on board verification at the next scheduled survey. The certificate is to be supplemented by a Record of Equipment indicating a list of additional equipment for compliance with the Code.

7.Guidance on Operational Limitations and Future work

The Polar Code gives some guidance to determine limitations for operation in ice in Part 1-B. Limitations can be determined using systems, tools or analysis that evaluate the risks posed by anticipated ice conditions to the ship taking into account factors such as its ice class, seasonal changing of ice strength, icebreaker support, ice type, thickness and concentration. Administrations may accept methodologies for assessment which have been in use and validated by service experience.

For this purpose IACS has submitted a Polar Operational Limit assessment Risk Indexing System (POLARIS) which was supported by Canada. IMO has formed a correspondence group to finalize the guidance on a system to determine operational limitations mainly based on POLARIS.

Ships operating in polar waters

Quality Service Division Attains Management Systems Accreditation:

IRQS is a division of IRClass Systems and Solutions Private Limited (ISSPL), which deals exclusively with the Management Systems certification of Quality, Environmental, Occupation Health & Safety, ISO/ TS 16949, Information Security Management System, Food Safety Management System/ FSSC 22000/ HACCP and Energy Management Systems.

IRQS has been accredited by Raad voor Accreditatie (RvA) for QMS, EMS, OHSAS, FSMS & ISMS Scheme(s), by National Accreditation Board for Certification Bodies (NABCB) for QMS, EMS, FSMS, EnMS & OHSAS Scheme(s), by ANAB for EnMS Scheme, by IATF-SMMT for ISO/TS 16949.

Training courses relating to Quality, Environment, OHSAS, EnMS are conducted under the aegis of ISSPL. ISSPL has been accredited by National Accreditation Board for Education and Training (NABET) for Lead Auditor Courses of QMS, EMS, OHSAS & FSMS and has also initiated the process for obtaining the NABET Accreditation for ISMS Lead auditor course. It has also developed the Lead auditor course material for Energy Management System for conducting the unaccredited training course. ISSPL has also been providing many customised training programmes designed to client requirements.

IRQS is now licensed for offering the FSSC 22000. FSSC 22000 is recognized by a Global Food Safety Initiative (GFSI) and blend of ISO 22000 and ISO 22002-1 requirements which are a prerequisite for exporting food items.

IRQS has initiated the HACCP accreditation from APEDA (Agricultural Product Export Development Authority) which is also expected to become a requirement for export promotion of agricultural products. IRQS is the first Certification Body in India to obtain the coveted accreditation from NABCB for Energy Management System. Having both the ANAB & NABCB Accreditations, IRQS has strengthened its position in Energy Management System through certification of a wide variety of organizations covering Power, Fertilizers, Cement, Chemicals, Steel and Commercials buildings. Enquiries have been received from many more sectors and IRQS expects significant demand in this area.

IRQS is the only Indian-origin certification body to be accredited for TS 16949 by IATF-SMMT. IRQS is well recognized & highly rated by IATF-SMMT as one of the leading Certification bodies associated with SMMT, in terms of KPI's achieved, results of witness assessments, results of office assessment, number of waivers requesting for audit execution. IRQS has good track record in retention of corporate clients like Ashok Leyland, Birla Tyres, Hinduja Foundries, Gulf Oil, PCBL-Kolkata and Tata Steel Group Companies. We have recently certified new clients for TS 16949 in Egypt.

In August 2014, NABCB has enhanced the scope(s) for QMS Scheme to sectors such as Agriculture, Hunting, Forestry & Fishing, Textiles and Textile Products, Leather and Leather Products, Engineering Services (Except Architectural and engineering activities and related technical consultancy) and for EMS Scheme for the sectors such as Non-metallic Mineral Products, Basic Metals and Fabricated Metal Products, Hotels and Restaurants.This will enable IRQS to extend our services to these sectors in future.

In 2014, IRQS has successfully completed the Office & Witness Assessments conducted by Accreditation Bodies i.e. RvA, IATF-SMMT, ANAB & NABCB for accredited scope sector(s) & has been recommended for continued accreditation.

Maritime Education & Training in India: What Next?

The International Maritime Organisation (IMO) has identified "Maritime Education & Training" (MET) as this year's World Maritime Day theme. While announcing the theme, the IMO Secretary-General Mr. Koji Sekimizu emphasised the significance of MET for the long-term sustainability of the sector, both at sea and on-shore.

India continues to be one of the world's major talent pools for seafaring and shore-based marine industry. Our Government is keen to continue enhancing our share of employment in this vital sector. In this context, this year's theme calls for an appropriate and timely response from all the stakeholders engaged in country's maritime sector.

Indian seafaring officers and engineers typically seek employment ashore after approximately 15 years of sailing. This puts them in the age group of 35-40, which means they still have 25-30 years of shore based working life ahead of them. Most of them are not equipped in terms of specialist qualifications and training to make this transition. As a result, all learning for them happens on-the-job, in an arduous and unstructured process.

In addition, there are a number of aspirants without the seafaring background who wish to pursue career paths in various segments of the maritime sector. They too perceive several obstacles that slow them down in their pursuits.

These gaps represent an opportunity for offering formal qualifications and training to our seafarers, as well as non-seafarers, which go well beyond the mandatory training courses.

What does the industry want?

Moving on to the demand side, there are a number of questions that need to be answered before embarking upon development of training solutions. These relate primarily to matching the supply of qualified personnel - including seafarers - to the requirements of industry segments in maritime sector. For example,

- What are the competencies that the shore-based maritime industries seek?
- What are the aspirations of seafarers and personnel in maritime industries?
- How do we bridge the competency gap and meet the employee aspirations?
- What is the future outlook for shore-based employment?

The Way Forward

Despite such questions and other uncertainties, there does exist a solid ground of certainty: With a large proportion of Indian seafarers continuing to choose shore-based employment early on and with a huge upsurge in numbers at the entry level, specialist maritime education in India will surely be an area to watch in coming years.

Being a knowledge-centric organisation, IRClass is keen to take the lead in this area of exciting possibilities through its newly-established institution, the IRClass Academy.

Structural optimization of Midship Section in Preliminary Design Stage

Author: Vikas A Kalase, New Construction Division

Introduction

Owner's requirements, the information available for similar type of existing vessels and anticipated requirements in future are important factors in the ship design process. A ship design may satisfy owner's requirements but it may not be the best possible design for the cost involved or the performance expected. However, attempting to improve a specific performance parameter may worsen other design properties. Ship design optimization produces feasible designs which will be more effective in desired performance yet have minimum penalizing factors like weight and cost.

Ships and offshore structures are complex in nature. They are generally composed of strongly stiffened plates, girders, deck plates, bottom plates, bulkheads, frames etc. Ship design is a sequential and iterative process. There are two approaches for analysis and design of ship structures viz. rationally based and rule based. In the preliminary design stage, structural calculations rely on classification society rules. Important decisions about structural components, such as material and scantlings, are made in this stage. Although the designs in this stage may alter slightly during subsequent design cycles, performance of the design is greatly dependent upon decisions made in the preliminary design stage. In order to define optimal amidships structure, preliminary design stage is the most relevant and the most effective period to modify design scantlings and to compare different alternatives.

An optimization tool

Structural optimization is the process of finding the structural design that is best of all design options within a given set of geometrical, strength and behavioral limitations. The performance characteristic which is attempted to be minimized or maximized is the objective function. The quantities which can be varied to control the objective function are called the design variables. Design constraints, which are also function of design variables, are the restrictions that must be satisfied for acceptance of the design.

The classical optimization methods such as simplex, steepest descent and sequential quadratic programming are useful for continuous and differentiable functions. These techniques have limited scope in ship structural design optimization since it involves constraints and variables that may not be continuous or differentiable.

Nontraditional methods are powerful and popular methods for complex engineering design optimization problems. These include genetic

algorithm, simulated annealing, particle swarm optimization, ant colony optimization etc. These are the heuristic approaches which can lead to global optimum after sufficient iterations.

The Genetic Algorithm

Figure1: Flow Chart of Genetic Algorithm Generation Cycle

A genetic algorithm (GA) is a heuristic approach based on the principle of natural evolution – survival of the fittest. In this, a population of strings (called chromosomes) encodes candidate solutions (called individuals) to an optimization problem. The process is evolved towards better solutions. The process starts from a completely random population. Fitness of the whole population is evaluated in each generation (iteration).

Multiple individuals are stochastically selected from current population based on their fitness, which are recombined to form new population. This becomes current population in next generation. The process is repeated until a predefined stopping criterion is fulfilled. Solution of the optimization problem is the best variant. Figure 1 shows flow chart of a genetic algorithm generation cycle.

This approach has a number of advantages.

- It can quickly scan a vast solution set.
- Bad proposals are eliminated so that they do not affect the end solution adversely.
- Unlike classical algorithms, genetic algorithms do not require an initial design to begin with.
- They are more efficient with discrete design variables than with continuous design variables.
- They are very robust in finding optimum solutions.
- Their generic nature allows same algorithm to be used in many fields.

Optimization toolbox in MATLAB

Genetic Algorithm Optimization Toolbox in MATLAB can search for global solutions to problems that contain multiple maxima or minima. It can be used to solve optimization problems where the objective or constraint function is continuous, discontinuous, stochastic or does not possess derivatives. This is an important feature as the optimization problems in this study have discrete variables. The solver supports linear, nonlinear and bound constraints.

It supports algorithmic customization. Initial population and fitness scaling options can be varied. The population diversity can be controlled by defining parent selection, crossover and mutation functions. It is an interactive tool wherein solution progress can be monitored. These give live feedback about optimization progress, enabling the user to make decisions to modify some solver options or stop the solver.

The functioning of GA mainly depends upon the population diversity. It should not be too high or too low. In mixed integer optimization, as would be the case for discrete variables, the population diversity can be varied using different combinations of population size and elite count.

The genetic algorithm attempts to minimize a penalty function. The penalty function includes a term for infeasibility. The penalty function value of a member of a population is:

- If the member is feasible, the penalty function is the fitness function, otherwise called as objective function.
- If the member is infeasible, the penalty function is the maximum fitness function among feasible members of the population, plus a sum of the constraint violations of the (infeasible) point.

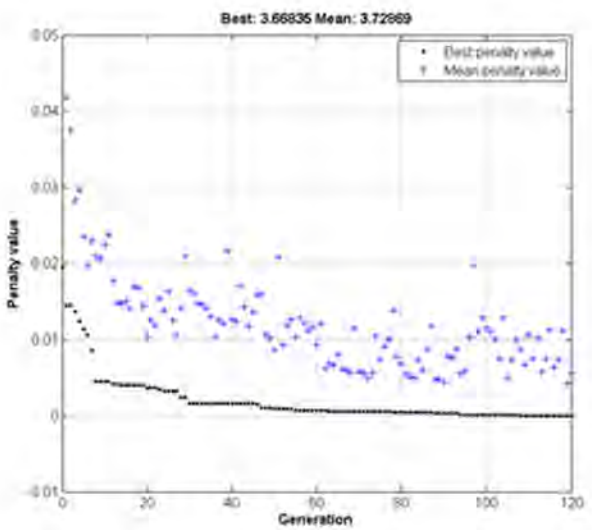


Figure2: Optimization History of Constraints Violation

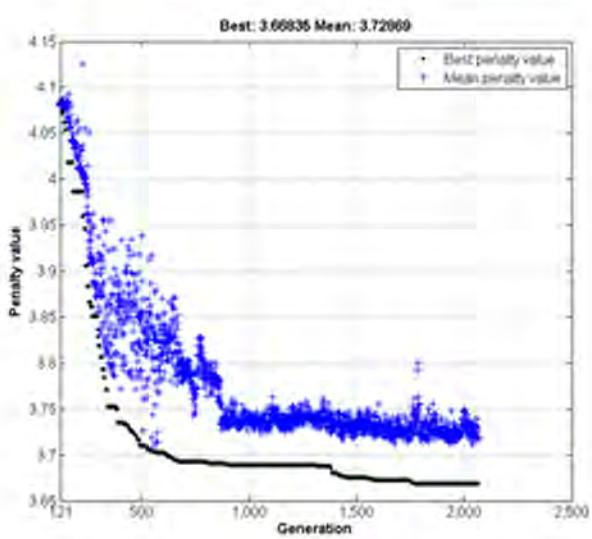


Figure3: Optimization History of Objective Function

Hence, the GA optimization history plot shows the constraint violation in the early generations and once the constraints are satisfied, in latter generations, it shows the fitness function. Figure 2 shows optimization history of a sample run in early generations wherein constraint violation is minimized. And figure 3 shows the optimization history after constraints are satisfied wherein the objective function is minimized. Maximization problems can be solved by the minimization of negative objective function.

Structural optimization of midship section of a container ship

With the application of the Genetic Algorithm Optimization Toolbox in MATLAB, structural optimization of midship section of a 3500TEU container ship was performed. The purpose is to improve structural aspects such as strength, weight etc. while satisfying applicable prescriptive scantling requirements of class. The vessel particulars are as follows.

Length overall = 230 m
Breadth = 32.2 m
Depth = 21.5 m
Design Draught = 12.5 m
Block Coefficient = 0.6839
Design Speed = 24.9 knots

The members in midship section which are effective in longitudinal strength are considered for the optimization. A total of 79 design variables were identified including thickness of plates, height of stiffener webs, breadth of stiffener flanges and thickness of stiffener webs and flanges.

As there are limitations on sizes of plates and stiffeners available for the construction, the plate and stiffener thicknesses were varied in the step of 0.5 mm and stiffener web and flange widths were

varied in the step of 10 mm. This makes the optimization problem discrete. A total of 116 design constraints were identified based on class rules. Transverse frames and bulkheads were considered fixed and not altered in the optimization.

Various objective functions to improve strength, safety and economy are discussed in the optimization study. The performance characteristics of the midship structure design which are optimized are: hull weight, vertical position of midship section centre of gravity, strength to weight ration in vertical bending and torsional strength.

Minimum weight

Minimizing weight is an important aspect in design of ships. Performance of high speed ships mainly depend upon hull weight. Performance parameters like cargo capacity, cost and fuel consumption can be improved by reducing hull weight. For efficiency and economy, steel weight is an objective function in this optimization study. Attempt is made to minimize weight of the members effective in longitudinal strength in the midship region. However, minimizing weight of these longitudinal members is also expected to reduce the total hull weight significantly.

Objective function in this case is cross sectional area of midship section which is an indication of steel weight. About 6% saving in the midship cross section area was achieved by optimization. If the cross section remains same for 0.4L, this amounts to about 160 tons of saving in hull weight.

Vertical centre of gravity

Vertical position of centre of gravity (VCG) plays important role in stability of a ship and a low centre of gravity is generally desirable. However, significant increase in weight was observed in lowest centre of gravity solutions. This is because of tendency of cross sectional area to accumulate at bottom in order to lower the centre of gravity. This accumulated area at bottom has lesser moment of inertia about centroidal horizontal axis than at deck.

The area was controlled by introducing an additional constraint that it should not be more than the existing reference design. VCG of the existing midship section area with longitudinal strength members is 8.584 m above the keel whereas, for the optimized design their VCG was observed to be 7.912 m above the keel. Although this is saving only in VCG of longitudinal strength members in midship region, it is expected to help lower the overall VCG of the hull. Performance of the design in stability can be improved by optimizing VCG of transverse frames and bulkheads which will further assist in achieving significant reduction in VCG of full hull.

Strength to weight ratio

Hull weight and strength in vertical bending are two conflicting objectives. Minimizing hull weight lowers the bending strength and maximizing bending strength increases the hull weight. High yield strength to weight ratio is an indication of optimal design where bending strength is improved yet weight is kept low. Objective function in this case is the ratio of maximum bending moment carrying capacity at yielding at deck to the cross section area. The ratio was improved by about 11% compared to the existing design, accompanied by significant increase in the section modulus at deck and reduction in cross sectional area.

Strength in torsion

Ship hull structures are thin walled, multi-cell structures subjected to various loads viz. bending moments, shear forces and twisting moments. A ship is subjected to high torsional loading when it is heading obliquely to a wave. Ships with closed decks have high strength in torsion and hence, shear and warping stresses arising from torsion are low. Ships with wide deck openings such as bulk

carriers and container ships have low strength in torsion. In result, high shear and warping stresses are expected at the corners of the openings. Therefore it is desired to have high torsional strength in container ships.

For a thin-walled hull section with a multi-cell profile, determination of the shear stresses and the angle of twist due to pure torsion is a statically indeterminate problem. An expression for the torsion constant, explicitly in terms of geometry of the section can be derived. Such an expression enables direct estimation of the torsion constant before the shear flow calculations. Stiffeners are the open sections attached to the multi-cell structure and their contribution to the torsion constant is negligible. Warping constant can be calculated based on structural idealization approach for optimization in preliminary design stage.

A part of external torque applied on an open section member is utilized in pure torsion and remaining part in warping torsion. Rigidity in pure torsion is the product of St. Venant constant (Jt) and shear modulus (G) and rigidity in warping is the product of warping constant (Jw) and Young's modulus (E). An additional constraint was introduced so as not to allow the cross section area to be greater than that of the existing design. After optimization, 8.5% increment in the St. Venant constant, otherwise known as torsion constant, and 6% increment in the warping constant were observed. Increased St. Venant constant reduces angle of twist and torsional shear stress whereas longitudinal warping stress depends upon warping constant. A higher weightage to warping constant in the optimization is expected to significantly reduce the warping stresses.

11. Conclusion

The optimization study in this research work shows that Genetic Algorithm Optimization Toolbox in MATLAB is a powerful tool for design optimization of complex structures. In order to demonstrate capabilities of the algorithm, a fairly complex case of a container ship with wide deck openings is presented. Optimization of performance characteristics in weight, stability and strength in torsion and bending can lead to safer, efficient and economic design alternatives. The method is found to be of relevance during the preliminary design stage to fix the scantlings of global strength members in midship region. It is concluded that, the developed method can be extended to design optimization of complex structures such as offshore structures and other ship types in early design cycles.

Comprehensive Inspection Programme for Maritime Training Institutes: IRS takes the lead

As the deadline set by the Directorate General of Shipping (DGS) for Comprehensive Inspection Programme (CIP) for pre-sea training closed on, the Training Department of IRClass has witnessed an upsurge in the requests from across India for undertaking inspections.

By end-March, IRClass completed the initial CIP of the last of the pre-sea training institutes, taking the cumulative total to 40 institutes.

Last three quarters of 2014 and the first quarter of 2015 have been busy times for Training Department. To cope with the workload and meet the requirements of its clients, IRClass marshalled its resources and delivered the inspection services that it committed to.

Taking stock and looking back on how did IRClass go about certification? What were the findings, overall? Did the CIP regime, introduced for the first time by DGS achieve what it targeted? How did the institutes perceive it – in terms of value-addition and enhancement of quality of training? and finally, what are the perceptions of the shipping industry, who are the end-users of the 'product' delivered by the pre-sea training institutes?

Here are some answers that are to say the least, very satisfactory. From the beginning, IRClass has been firm on the fact that the members of the CIP team are not to act merely as inspectors but also as mentors & advisors. Additionally, the team was tasked with motivating the managements to apply CIP in true spirit. The focus of the CIP team of IRClass has been on the assessment of skills and knowledge relevant for on-job roles through observation & interaction with trainees and faculty during class hours, assessment of skill development in workshops and labs and directly from cadets.

Wherever shortfalls have been observed and areas of improvement noticed, the institutes were asked to report details of action taken on the findings within a month.

This approach has resulted in realization of the objectives of the CIP.

Positive changes that are noticeable immediately include: improved living conditions and study environment for the cadets and sharper management focus on meeting the true intent of CIP.

Meanwhile, IRS continues with its efforts to take a holistic approach to maritime education and training in India by engaging with various stakeholders and by working closely with DGS.

Looking ahead, annual inspections of those institutes for which the initial CIP was carried out in 2014 will be due progressively in current year. With DGS extending the CIP regime to post-sea competency courses, IRClasss is geared up to face the challenges and ensure that maritime training remains a focus area.

Running as a Metaphor for life – IRClass Footprints

"If you want to run a race then run 100 meters, but if you want to experience bliss then run a Marathon – Emil Zatopek " - Olympic champion and long distance runner.

Distance running has become one of the most sought after sports in recent times. This is because it is a sport, and not a competition, where one challenges oneself, or as Edward De Bono puts it "it is a Sur petition".

At IRClass, we assign great importance to the health and safety of our employees. Participation in running events is one such initiative. In our effort towards inculcating a running culture in our people, we have established a Run Club that initiates participation in various running events taking place through the year in the Mumbai region.

Mumbai Marathon 2015

The Standard Chartered Mumbai Marathon (SCMM) is amongst the Top 5 Marathons of the world and is a gold event sought after by the finest athletes. Participation in this Marathon has gone up from 5000 in the year 2004 to about 40000 in 2015. The 6 participants from IRClass were no different.

This year, Mr Bijay Nair of IRClass completed the 42kms track in 5hrs & 28 minutes. Also, Mr Akula Chaturvedi, Mr Pravin Poojary, Mr Kunal Sharma, Mr Rakesh Namdeo, Mr Prakash Irde and Mr Shashikant Kadam managed to complete the 21kms track within 3hrs. Participation and track completion in SCMM is considered as a very prestigious matter.

Run Powai Run 2015

The Run Powai Run, an event organized every year by the Rotary Club of Mumbai Lakers, is aimed at raising charity fund for good cause. This year, around 100 IRClass employees enthusiastically participated in this event inspired by our management's initiative. The occasion was graced by Mr Sriramamurthy (COO) and other senior officers offering motivation to the employees.

Corporate Relay 2015

The Corporate Relay is a Puma sponsored event conducted every year during February/ March wherein 4 participants from a given company form a single team. There are over 250 such corporate teams across Maharashtra which participate in this race every year. Team IRClass has been participating in this relay race since the year 2013.

This year, both of our teams have won distinctions- one of them secured 3rd Place in the open category and the other won the 13th place. Both the teams got selected for Nationals. We intend to field three teams in the coming year.

Corporate Relay 2015

Run Powai Run 2015

Mumbai Marathon 2015

Mr Bijay Nair did
42kms in 5hrs 28 mins
and Mr Akula Chaturvedi,
Mr Pravin Poojary,
Mr Kunal Sharma,
Mr Rakesh Namdeo,
Mr Prakash Irde
and Mr Shashikant Kadam
all completed 21kms
in under 3hrs.

Standard Chartered
Mumbai Marathon
Jan 18, 2015

Dear Colleagues,

Let's congratulate our TEAM IRS that participated in the famous Mumbai Marathon held on 18th Jan 15. Our enthusiastic participants are.....

Name	Department/Div.	Category
Mr. Bijay Nair	MR & QA	42 Kms
Mr. Akula Chaturvedi	R & RD - Risk & Reliability	21 Kms
Mr. Prakash Irde	ASG - Finance & Accounts	21 Kms
Mr. Shashikant Kadam	ASG - Finance & Accounts	21 Kms
Mr. Pravin Kumar S Poojary	MR & QA	21 Kms
Mr. Kunal Sharma	New Construction	21 Kms

INDIAN REGISTER OF SHIPPING

Annual Day 2014

IRCLASS
Indian Register of Shipping

52 A, Adi Shankaracharya Marg, Opp. Powai Lake, Powai, Mumbai-400 072
Phone: 91-22-3051 9400, Fax: 91-22-2570 3611, E-mail: ho@irclass.org, Website: www.irclass.org