LOAD SPREADING AND SEA FASTENING

INTERMARINE

Captain Brian Powney, Elissa Clark and Samuel Vernon,
Intermarine Technical Department, Intermarine, Texas, US

Circa 1760, the rise of the Industrial Age in Great Britain was primarily characterised by power driven technology that replaced hand operated tools. These technologies included the steam engine, which gave rise to locomotives, steamboats, and by 1815, the golden age of massive ocean transportation vessels. In turn, these advancements enabled the worldwide transportation of the proliferation of manufactured goods via global waterways.

As manufactured goods became larger, heavier, and more complex, the multipurpose fleets became more diversified. Crane capacities and deck strengths increased and we witnessed the introduction of Ro-Ro and semisubmersible vessels. As recently as four decades ago, a unit of a mere 60mt was considered a heavy lift for a marine vessel.

MODERN TIMES

In today's developing world, large infrastructure projects are becoming more and more prevalent. Large power stations, oil refineries, and LNG plants were initially "stick built". This system involved shipping small components which were assembled at the site.

Inevitably, a lack of resources, skilled labour and complicated supply chains resulted in significant delays and cost overruns. Today, we see a significant increase in 'modularisation', whereby large components are fabricated at an industrial facility, shipped to the final destination, and then rolled into position. This process typically requires vessels with large crane capacities or Ro-Ro capabilities.

REGULATORY AGENCIES

Various international regulatory organisations, such as the IMO, GL/DNV and Noble Denton have been instrumental in drafting and enforcing rules and guidelines specific to this industry. These organisations have developed recommendations unifying procedures and calculation methods to ensure safe ocean transportation and to keep up with the tremendous increase in offshore projects. There is an obvious need to follow these guidelines very closely when handling heavier, over-dimensional cargo.

ENGINEERING CALCULATIONS

Significant planning, analysis and documentation are all required before executing a project loadout. Advanced heavy-lift shipping companies prepare a detailed method statement that will include a stowage plan, lifting arrangement, materials list, load spreading arrangement, securing plan, and risk assessment. The document will also include all the required supporting documentation and certification for the loadout.

In the past, these types of calculations were performed mostly by hand and were based on the accepted engineering principles of the time. Today, sophisticated engineering software and various spreadsheet-based modelling techniques are utilised for complex equations and formulas for securing, accelerations, strength, and other dynamic factors.

In addition, commercially available software has reached the marine industry. A few examples of these are visual cargo care for securing calculations, MACS3 for stability calculations, and AutoCAD, SolidWorks and ANSYS for 3D modelling and stress analysis (Figure 1).

LIFTING AND SPREADER BEAMS

A spreader bar is a lifting device which is connected to a vessel's crane hook or hooks. A single longitudinal beam may be fixed or adjustable in length and may consist of one set of lift/drop points or multiple lift/drop points to offer flexibility during lifting operations (Figure 2). A single longitudinal bar can be used to perform a tandem lift, whereby two cranes are used to lift a unit whose weight exceeds the capacity of one crane.

As cargo weights and dimensions have increased, so has the need for more complex spreader bar configurations. Combinations of longitudinal and transverse bars are becoming more common for larger units such as turbines and locomotives. In some cases, cargoes such as process modules may require a combination of eight bars to minimise the possibility of structural damage. Detailed lifting plans are prepared to show the spreader bar configuration and rigging arrangement that are planned to handle the cargo.

LOAD SPREADING

As unit loads have increased, so has the need for detailed load spreading calculations. The permissible tons/m2 allowance is normally readily available and is commonly sufficient for most loads. A comparison to the cargo footprint will indicate whether the limit is exceeded. Container stack weights and line loads are also provided by the hatch cover manufacturers.

When planning for heavier cargo more detailed calculations are required that consider the various forces that are experienced in a seaway and additional materials that may be required to distribute the weight over an acceptable area. Materials such as timber, crane mats, I-beams, or steel load spreading mats (Figure 3) may be utilised to achieve adequate load spreading.

CARGO SECURING

After the load spreading materials have been installed, and the cargo is safely loaded using the approved lifting device, the cargo must be secured for ocean transportation (Figure 4). All ocean going vessels have a cargo securing manual

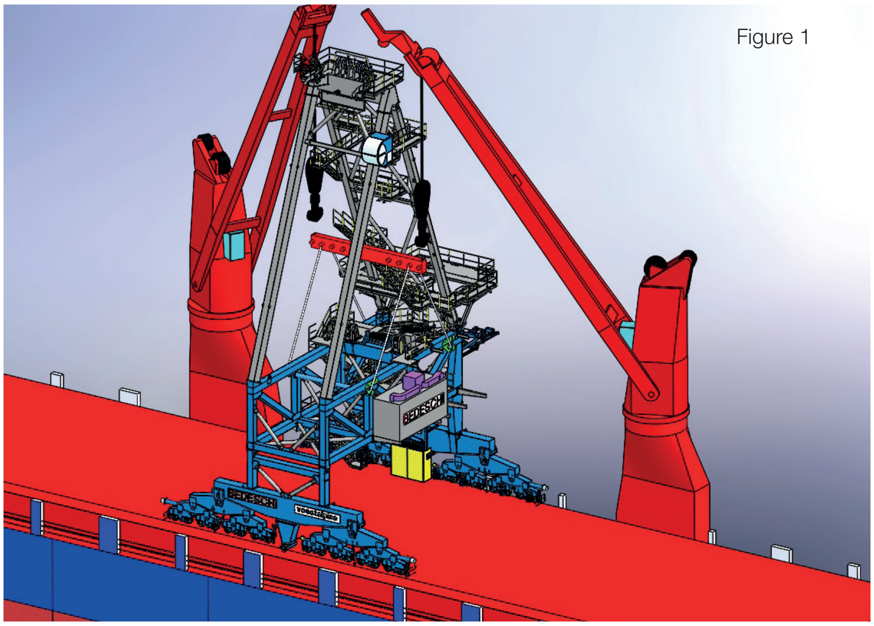
Figure 1

Figure 2

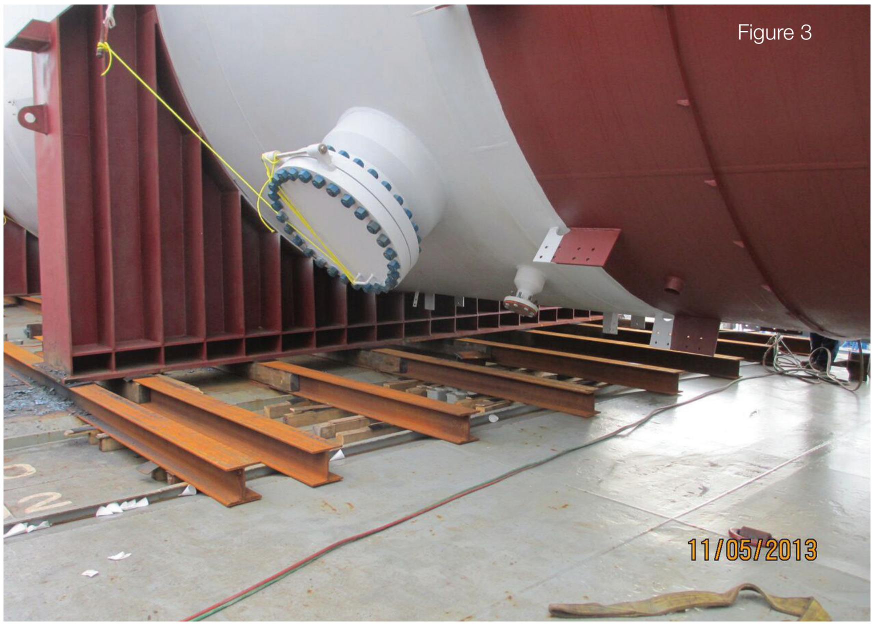

Figure 3

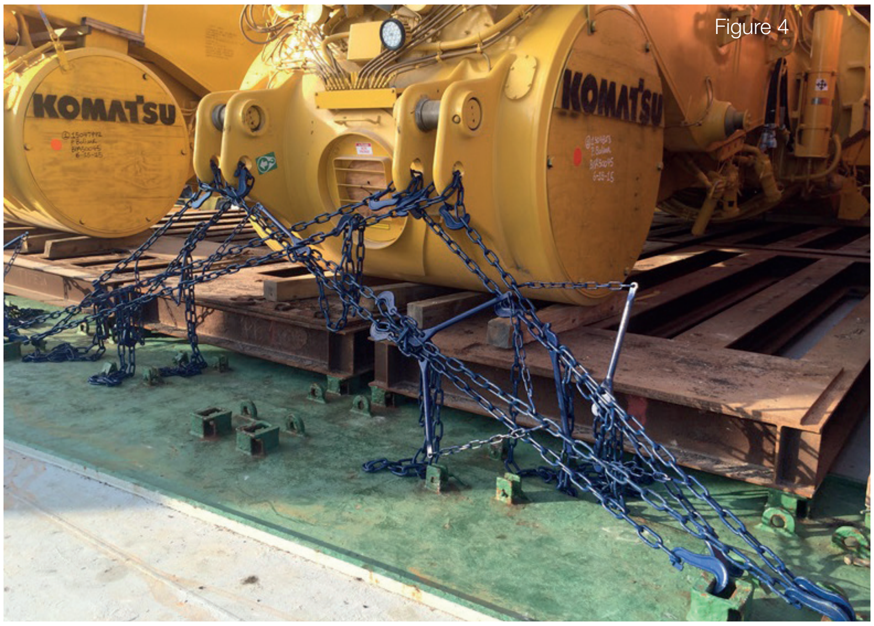

Figure 4

Figure 5

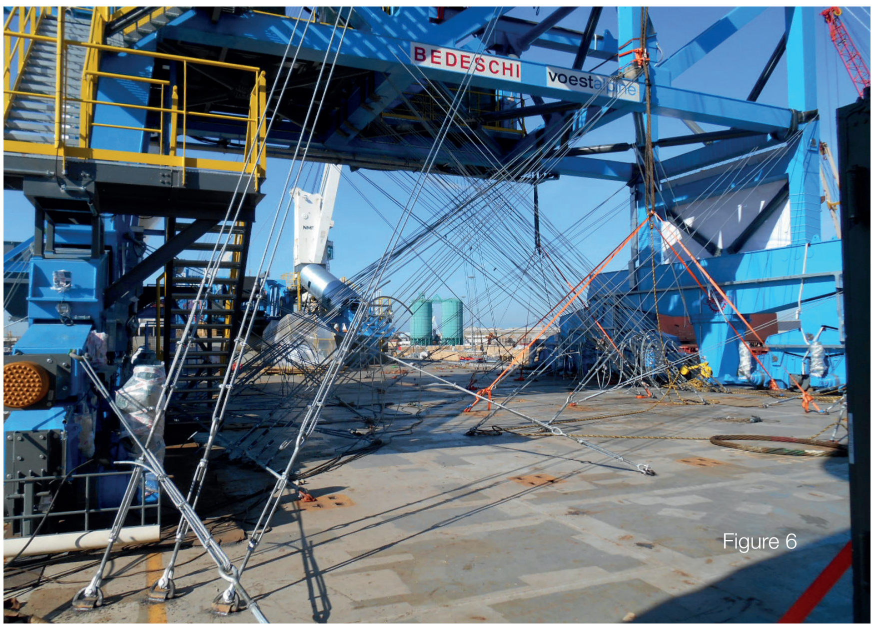

Figure 6

on board that is normally drafted by the hatch cover manufacturer. It defines how containers should be secured and also includes basic information on forces and accelerations that may be expected. Simple formulas are included that can be used to calculate the required securing for non-standardised cargo.

Heavier, larger units require more detailed calculations. As with engineering calculations, load spreading calculations were initially calculated by hand. However, maritime cargo securing software and programs such as Visual Cargo Care are now readily available for commercial use. These programs accurately calculate acceleration forces, lashing and securing requirements, and create the necessary reports for inclusion in the method statements.

The materials used for sea fastening vary according to the cargo specifics, but generally include welded stoppers and clips, chains, wires and turnbuckles, and nylon belts.

Intermarine recently loaded a ship loader (Figure 5) in Porto Marghera (Venice, Italy) and safely delivered it to Corpus Christi, Texas. The loadout presented many diverse challenges due the nature of the cargo. The main unit had overall dimensions of 22.8m x 24.4m x 36.9m and a gross weight of 320 tonnes. The extreme height resulted in a hook height problem that was resolved by designing a custom-made lifting arrangement. The cargo height also contributed to the excessive forces that were overcome by an intricate securing web of lashing wires and turnbuckles (Figure 6).

The main body and the boom section were shipped separately and the client requested that they be reassembled on the dock. This was successfully achieved by utilising the ship's cranes in a tandem lift operation.

A tremendous amount of planning is involved in a project of this magnitude, which requires the participation of the Technical, Operations, and Commercial Departments. Roughly 300 man hours went into planning this particular project, while 40 man hours were involved in both the loading and discharge. Adequate planning reduces the possibility of accidents, loss of life or injury, material damage, and time lost on the vessel. Projects such as this typically have long lead times. As such, damages or delays will inevitably result in liquidated damages with a tremendous financial impact.

THE FUTURE

All indications are that we will see more modularisation, with corresponding increases in unit weights and dimensions.

Project managers will have to ensure construction is completed on time, with minimal damages, and within budget. Ocean transportation is a vital part of achieving this. In recent years we have seen considerable advancements in training and technology.

Ship staff are trained on crane simulators prior to joining the vessel and schooled on the procedures for loading and discharging heavy-lifts. Modern vessels are fitted with sophisticated ballast systems to ensure all stability requirements are satisfied and cranes that can be operated from the main deck level. Advanced Dynamic Positioning Systems ensure a vessel can maintain its position and heading offshore by using its own propellers and thrusters.

ABOUT THE AUTHOR

Captain Brian Powney serves as Vice President of Technical Services for Intermarine. Captain Powney began his career at sea. He then came ashore to apply his experience toward improving cargo handling and securing techniques. After working in operational and managerial positions for Canadian Pacific Steamships, he accepted an offer from Transcan Marine Consultants & Surveyors to serve as Vice President of Operations. Through his direction; Transcan became the leading provider of Port Captain services for Intermarine. He holds a Masters Foreign Going Certificate and other seamanship certificates, all of which he obtained from attending the School of Navigation, University of South Hampton Warash Hants. Now with more than 30 years of maritime experience, Captain Powney oversees all vessel management and cargo handling activities for Intermarine.

ABOUT THE ORGANISATION

Intermarine is the global leader in the transport of project, breakbulk and heavy-lift cargo. Founded in 1990, the company, through its subsidiaries and worldwide network of 20 offices, controls an international fleet of more than 50 vessels. Intermarine provides ocean transportation and marine logistics services with regular sailings in the Americas, West Africa, Europe, Asia, and the Middle East, plus inducement voyages to Australia and other international ports. The company operates the largest US flag heavy-lift fleet and controls Industrial Terminals (Houston), the busiest project cargo terminal in the US.

ENQUIRIES

www.intermarine.com