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THE OPERATION OF A CONTAINER SHIP

by

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Introduction

Although the title of this paper indicates primarily concern with operational problems, the intention is not so much to emphasize the functioning of a containership, but to discuss briefly the engineering involved under the somewhat peculiar conditions associated with container cargoes in ships. The proposition that the design of any materials handling equipment is inevitably closely related to the actual mode of handling, needs, I think, no elaboration.

The primary interest of this meeting is ships and the equipment to be found in ships, but it may also be necessary to refer occasionally to the details of lifting equipment located ashore, since this equipment is to day influencing the design of containerships as well as other types both currently in operation and for future projects.

It is sometimes necessary to give a brief resume of the history of containerization for a proper appreciation of some of the finer points, but I think most members present here are familiar with this aspect, however brief mention should perhaps be made of the now familiar debate which sometimes rages around the question of ship-mounted or shore-based cranes, particularly as it has a bearing on container handling.

However, before proceeding to enter into this argument, it is advisable to take a short sweeping glance at the object of our affections - the cargo container itself.

1. The Cargo Container

While containers are not necessarily confined to the carriage of general cargo - many types of liquid container, for example have been in use for years - the general cargo container is the one which has caused the "revolution" of which we still read so much in the press.

Dry or general cargo containers are not cheap as an individual unit, being engineered to close tolerances when actual overall dimensions are considered, but even more so, when the methods of handling and packing are taken into account.

The capital outlay for the shipowner fitting out a new vessel capable of carrying say 400 containers may be approximated by assuming a further 400 units will be required for use in conjunction with the loading terminals ashore, and at a rough cost of $1,500 each, the outlay for containers alone is in the region of $1¼ million.

Naturally the price of a container is a function of the materials and method of construction, but assuming the design meets the recommendation of the International Standards Organisation, one of the Classification Societies, the Australian Standard E44 for Large Freight Containers, or the

Australian Department of Shipping & Transport, then the most expensive unit is likely to be a stainless steel unit or composite stell/aluminum combination.

Associated Steamships Pty. Ltd. has used such steel/aluminium both general cargo and refrigerated unitsfor over 5 years, and no major deterioration has been experienced, and certainly no problem has arisen in the areas of junction between steel frame and aluminium panel. The initial care taken in these areas has paid dividends.

On the other hand, a number of similar sized containers constructed principally of mild steel, have already required extensive panel repairs. This has led to the selection for the second generation of containers of a corrosion-resistant low-nickel alloy mild steel in order to obtain the benefit of a 30% lower unit construction cost, coupled with a longer service life. Certain design modifications have also been incorporated one of which is the substitution of a corrugated panel for the original flat panel with external stiffeners. The comparison may be noted from the slides which will be shown later.

As noted earlier there are a number of different sized containers currently in use for specific purposes, but as they generally follow the same basic pattern as the general cargo container, there is no point in examining each of them in detail. Suffice it here to say that the container unit itself, irrespective of whether it be designed for general or special purpose use, is responsible for a not inconsiderable percentage of the high capital outlay which is involved in containerization.

The most common unit is the I.S.O. standard 19' 10½" long, 8' 0" wide and either 8' 0" or 8' 6" high as per the Australian Standard. Before the end of this year there will certainly be a number of 40' 0" long dry cargo containers carried in Australian containerships: these units have a maximum gross weight of 30 long tons.

Needless to say container design is far from static and many further developments will undoubtedly be made in the immediate future, but one of the controlling factors will remain - the lifting equipment.

2. <u>The Ship-mounted Crane</u>.

In the hard light of experience there are a number of disadvantages encountered in the operation of ship-mounted cranes, the major ones being:-

i. They have a high capital cost compared with the conventional equipment which they replace.

ii. The utilization factor compared with a shore crane is small since they cannot be used while the ship is at sea.

iii. They are more intricate than conventricate than conventional cargo gear and are consequently more adversely effected by bad weather,

iv. In container handling operations the effect of pendulation due to a single wire suspension can be a serious problem in the jib-type crane.

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v. If the cranes are of gantry type and travel along the ship's hatch length, the necessity for adequate protection of electrical devices is accentuated.

vi. Increased ship stability is necessary.

Of all the above objection, the one which has caused most concern operationally is the problem of protecting the electrics from a salt-laden atmosphere, and the next difficult problem is the effect on stability.

However, as is usually the case, the economics of the system heavily influence the final choice, and in view of the low utilization factor, coupled with size and capacity restrictions, in some operations the installation of powerful cranes ashore is to be preferred to carrying seral smaller types about as part of a containership's equipment.

3. <u>The Shore-based Crane.</u>

If there is one single factor apart from economics which operates in favour of shore-based cranes for a modern container operation, it is the lifting capacity necessary.

The principle evolved in Australia of twin-lifting i.e. lifting two containers simultaneously, demands a Safe WorkingLoad of at least 45 tons neglecting the weight of spreaders etc.

As these incidental weights may total nearly 20 tons, it is not difficult to appreciate the naval architectural and engineering problems associated with trying to mount that kind of gear on board the ship. The solution is to arrange for your one million dollar investment to be mounted on the wharf where it may be available for continuous operation if necessary on a procession of containerships, rather than be restricted only to one.

"Twin-lifting" is an operation restricted to "pure" containerships and invloves the use of a pair of spreaders equipped with the normal hydraulically-operated twist-lock fittings for lifting, but in addition a fitting known as a "spacer" must be employed to hold the spreaders a given distance apart. The "spacer" must also permit a certain amount of misalignment between containers in all three planes, due to unequal wire stretch, unsymetrical loading of the container etc.,

The major problem associated with the "spacer" is how to disengage it on entering the twin container cells and re-enganqe it on emerging from the cells. This may be done by arranging for the "spacer" to remain resting on the transverse structure of the ship while the two spreaders move downwards and disengage from the four "spacer" legs. On the way up the four legs re-engage rectangular holes in the top face plate of each spreader. The position of the face plate is adjustable horizontally by means of remotely-controlled hydraulic cylinders which, moving either towards or away from each other, either reduce of increase the distance between the two containers being lifted. This distance may be adjusted from zero to about 36 inches to suit OCL ships which

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require a setting of 28 inches or ASP ships which require 18 inches. This distance adjustment is simply made by the crane driver from the cabin.

By means of twin-lifting it is possible - and has already been done - to make over 10 lifts per hour which on the basis of each container having a cargo weight of say 20 tons, total 400 tons per hour. When it is considered that this weight of cargo is hadled across the ship's side by one man, assisted occasionally by another man and a "walkie-talkie" set, some of the implications of containerization begin to be realized.

4. The Containership

i. The Overall Concept.

Not so many years ago, a ship was designed for a particular trade, the major considerations being maximum cubic capacity coupled with flexible cargo gear. Today, however, the parameters have changed radically.

To begin with, the ship itself is no longer the principal capital cost item in the operation. The terminal may now cost more than the ship - about $8 million against about $5 million. This termianl figure will most likly be doubled to provide for a terminal at the other end of the voyage, so that the capital cost of the containership is now only about 31% of the total capital investment.

However, the load on the Naval Architect and the Engineer is increased, because he must now produce a highly specialised unit to connect these high-priced facilities, and speed and reliability become paramount after achieving optimum container stowage capability.

ii. The Function of the Ship

As has been indicated previously, the containership is a specialised piece of equipment; in a nutshell, its prime function is to carry a specified number and type of containers between terminals on as short a regular schedule as possible. Regularity is an important factor if the functions of the terminal are to be effectively utilized. This demands reliability in the ship operation.

But reliability isn't much use unless the requisite number of containers is delivered in good order and condition, and presented in such a way to the shore crane so that they may be readily and rapidly lifted out or lowered into place. This requirement leads to the "pure" containership axiom that the only cargo movement within the ship must be vertical - either straight up or straight down.

The design of the ship's cargo hatches is fundamentally effected by this requirement to the extent that hatch openings in the deck become very large. This serious reduction is deck area brings its own troubles and some of these will be briefly touched on shortly.

Due to the inherent loss of cargo capacity in a containership by endeavouring to fit a "square peg into a round hole", or more correctly a rectangular peg, the loss of capcity below decks is re-couped by carrying large numbers of containers on top of hatch covers. Coamings and covers must therefore be designed to withstand static cargo loads ../5

of the order of 350 tons each.

Finally the ship must be static when alongside the terminal wharf and preferably not listed more than 5° during cargo operations. To restrain the ship longitudinally against the wharf requires much more powerful mooring machinery than in a conventional vessel where small movements are of little consequence. For this purpose a medium-sized containership of say 500' overall length would need to be equipped with at least two 15 ton automatic self-tensioning winches at each end, in addition to any other moorings considered necessary.

iii. Some of the Problems

One problem associated with intial design is the result of the necessity for very large hatch openings mentioned previously, and the consequent severe reduction in upper deck area. It is often not possible to restore the modulus of section above the neutral axis without installing a second deck below the upper deck, after the same style as in some bulk-carriers.

This second deck, if properly designed into the basic structure is useful in a cotainership by providing longitudinal access below the upper deck which is likely to be congested with deck cargo attachments. In addition great care must be taken of course in the provision of adequate hatch corner radii if cracking is to be avoided.

A second problem of comparatively recent experience associated with operation is the effect of torsional rigidity or lack of it. Again because of the size of hatch openings, particularly the length, torsional rigidity is reduced. This gives rise, under certain conditions, to relative movement between hatch coaming bar and hatch cover particularly at the ends of hatches, which in turn causes difficulty with the hatch dogging arrangements coupled with excessive wear of the hatch cover side-panels.

Needless to say these are not the only problems encountered but time does not permit coverage of them all, here this evening.

iv. What of the Future?

While as in all other fields of endeavour, it is impossible to predict with certainty exactly what developments will occur, in the field of Australian containerization it is fairly certain that the next generation of containership will be faster and probably larger than the present types, to cater for a much higher percentage of 40 ft. containers than at present being handled.

Looking to the much more distant future, it is extremely difficult to even guess at the direction in which development will take place. However, in my own opinion serious consideration will have to be given to hovercraft type vessels operating of the air-reaction principal if greatly increased speeds are necessary for economical operations, particularly on short hauls such as Sydney to Melbourne. Using a vessel of this type

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the trip could be done in about 10 hours. The major limiting factor would probably be that of maximum all-up weight, which I think is about 4,000 tons. One major advantage over the present system would be the elimination of the intermediate handling operation between the wharf and the terminal since the hover-craft could dock right inside the termianl underneath the crane if necessary, and in addition roll-on/roll-off cargo could do precisely that without any additional facilities being required.

Perhaps such a system as this will provide the marriage of roll-on/roll-off and "pure" container operation which will finally put an end to the argument as to which is the better system. Only time will tell.