CONTAINER LOSS AND DAMAGE

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INTRODUCTION

This is the second of two technical articles considering the transportation of containers by sea. In the first article the basics of container securing arrangements were examined. In this article we will discuss the common causes of container loss or damage from the deck of containerships.

In the first article the container securing arrangement was described as an integrated structural 'system', comprising the containers, the securing devices and the supporting ship's structure. All components of the system have to work effectively and within their capacity if container losses are to be avoided.

The causes of container loss or damage can be divided into three broad headings:

- stowage (of the container and the cargo within the container)
- container securing arrangements and
- vessel motions.

1. STOWAGE ARRANGEMENTS

i) Overloading the stack

The strength of any container securing system is only as good as the strength of the container frame itself. For example, if the bottom tier container in a stack of containers has one corner post overloaded in compression the stack may collapse even if the lashings and twistlocks are not overloaded.

The permitted container stack weights are stated in the Container Securing Manual (CSM) or on the Capacity Plan. These are sometimes exceeded because of errors in the container stowage planning or through the incorrect declaration of container weights. Errors in the planning may be detected when preliminary versions of the stowage plan are provided to the crew for data entry into the ship's Stability and Loading Computer. In the writer's view, the detection of incorrect declarations of container weights will only be achieved when the container transportation industry agrees on a universal procedure to weigh the containers before they cross the ship's rail.

Racked container (bottom left) and toppled stack (centre) due to uplift.

The consequences of excessive stack weight can be racking of the lower tiers of containers, buckling failure of the container corner posts, failure of container lashings or even damage to the hatch cover or tank top. Such failures invariably lead to heavy damage to the containers or, in the case of deck stowage, the loss of containers overboard.

ii) Stowing heavy containers on top of light containers

Guidelines for the permitted weight distribution of the containers within the stack are generally stated in the CSM. It is usually good practice to stow the heavier containers at the bottom of the stack and empty or light containers at the top.

Buckled container corner post due to compression force.

Unfortunately in our experience this basic principle is often neglected by the container stow planners. The problem often remains undetected by the ship's crew because container planning software rarely provides for automatic checking of the tier weights and there is insufficient time to manually check the entire stowage. Incorrectly declared container weights can also result in the inadvertent stowage of heavy containers in the upper tiers.

A change in the vertical distribution of container weights within the stack can have a considerable effect on the forces acting on the containers. If heavy containers are positioned towards the top of a stack the overall centre of gravity of the stack is higher and the stack overturning forces are greater. This can lead to greater compression and uplift (separation) forces on the container corner posts when the vessel rolls. The high compression forces can lead to similar

Base twist locks broken due to excess uplift.

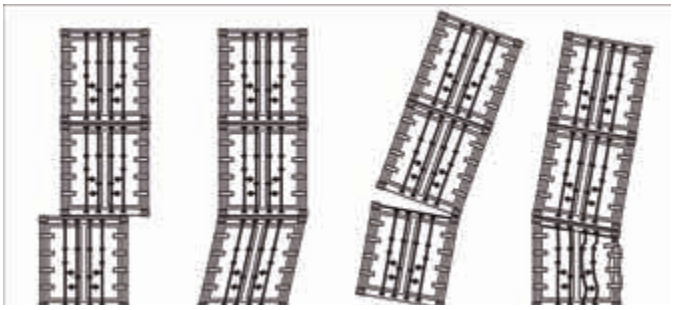
container overloading problems to those encountered when the stack is generally overloaded, as discussed above. In addition, the high separation forces may result in failure of the twistlocks or the container corner castings due to excessive pullout loads. Such failures will invariably result in the damage or loss overboard of containers stowed on deck.

iii) Over-height containers

With the greater cargo volume offered by over-height containers the use of 'high cube' containers is now very common. The containers have a higher centre of gravity than a standard container and this has the effect of raising the overall centre of gravity of the container stack. This can result in an increase in the compression and uplift forces.

iv) Verification of alternative stowage arrangements

The CSM can only offer general guidance on acceptable container stowage and 'approved' securing arrangements based upon the classification society rules. These will necessarily be based on assumptions regarding the weight distribution and heights within the container stow. In reality the actual stowage may deviate from the assumptions made when the standard lashing and securing schemes proposed in the CSM were devised.



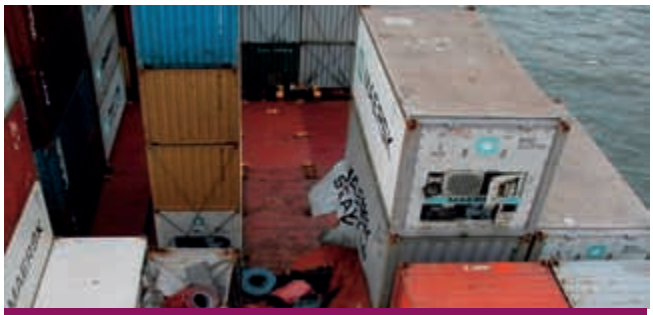
Container failure modes (from left) sheer, racking, uplift, buckling.

For example there may be high cube containers in the stack or some containers in the bottom tiers may have a lower weight than assumed, either of which could raise the centre of gravity of the stack. An empty row may expose an adjacent row to wind forces from which the CSM assumed the stack was sheltered. Only if the actual stowage and securing scheme has been checked for compliance against the classification society criteria can it be properly established that the containers as stowed and the lashings as configured remain within their maximum securing load (MSL).

Given the complexity of the calculations involved, the checks are more easily accomplished by utilising a ship-specific lashing computer program that calculates container and lashing forces based upon the appropriate classification society criteria.

v) Badly stowed cargo

While crew are able to verify that a container is correctly stowed and secured they are not able to ensure that the cargo is properly secured within the container. Inadequately secured cargo within a container does not usually affect the security of the container or the stack in which it is stowed. Even so, it can cause severe damage to the cargo and the container and that damage can sometimes extend to the surrounding containers.



Cold rolled steel coils bursting from container

Heavy unitised cargoes, such as cold rolled steel coils and project cargoes on open flat rack containers, can cause particular problems because the centre of gravity may be high and/or distant from the centre of the container.

2. SECURING ARRANGEMENTS

i) Incorrectly applied and checked securing equipment

Clearly the structural 'system' comprising the containers, the securing arrangements and the ship, will only work if the securing devices are correctly fitted and applied. The lashing arrangements are specified in the CSM, a copy of which will have been supplied to the stevedores. On some vessels the arrangements are shown diagrammatically in a notice posted on the hatch ends. It is important that the ship's crew check that the stevedores are fitting the lashing arrangement that is appropriate for the container stowage and that it is correctly installed.

After departure the lashing arrangements on deck should be checked at regular intervals and the lashings tightened when they have become slack either through vibration or the general motion of the ship and swaying of the stacks.

ii) Defects in the securing equipment

Although the design of container securing systems is often approved by a ship's classification society the maintenance of the lashing equipment is generally controlled by the Planned Maintenance System (PMS), which forms part of the vessel Safety Management System (SMS). The class surveyor may not always check the condition of the lashing equipment during Annual or Special Surveys. It is very important that the crew check the equipment on a regular basis. The checks should be recorded in the PMS log which will in turn demonstrate that regular checks, maintenance and replacement of the equipment, has been undertaken.

During service, it is not unusual for items of fixed and portable securing equipment to become worn or damaged. Unserviceable equipment, whether discovered during regular inspections or during cargo operations, should be removed from service immediately and quarantined until repaired or discarded. Replacement equipment should be consistent with that originally supplied. All lashing equipment should be supplied by a reputable manufacturer and be accompanied by a certificate of quality indicating the MSL and type approval by the ship's classification society.

The crew should ensure that all equipment used onboard is of the correct type. This is especially true with respect to manual/standard twistlocks, which can be supplied in both left and right-hand versions. A ship should carry only one type and any other type should be disposed of as soon as they are discovered. The use of an incorrect twistlock could result in a container stack being left unsecured inadvertently or the premature failure of a lock under moderate loads.

In practice, ships invariably 'lose' and 'acquire' twistlocks at both load and discharge ports. These gains should be thoroughly checked to ensure that they are certified, in good condition and consistent with the ship's equipment.

By performing regular audits of the securing equipment, the crew should ensure that there is sufficient lashing equipment of the right type carried onboard the vessel. The CSM should list the quantity of each item that is required to be onboard in order to carry the cargo as described in the Manual.

It is not only the portable lashing equipment that should be the subject of regular checks by the crew. Over time, the ship's fittings, including lashing plates, lashing 'D' rings and base cone dovetail or twistlock foundations, can become worn, damaged or corroded. Inefficiency of any of these items will clearly have a detrimental effect on the container securing arrangements and, in our experience, can be found to be the potential cause of container loss or damage, especially on older vessels.

Wasted container securing fittings

3. VESSEL MOTIONS

i) Excessive GM

As already discussed, the CSM will offer a standard cargo securing scheme based upon an assumed container stowage arrangement. A ship specific lashing computer program may

also be available onboard for use by the crew to determine an appropriate lashing scheme for any given stow. However both approaches rely on calculations performed in accordance with standard classification society criteria.

One of the parameters considered by the classification society rules on container securing is the GM of the vessel. A vessel's GM is one of the prime measures of a vessel's stability and it will dictate both the roll angle and period. The forces on the container stow are partly governed by roll angle and period. The classification society rules calculate the forces experienced by containers due to vessel motions based on an assumption that the GM remains within specified bounds. However, if the vessel has a very large GM, the vessel will tend to roll more rapidly with a short period. This can lead to large transverse accelerations and higher dynamic forces than anticipated by the standard calculations, particularly on the upper tiers of containers. The higher than anticipated transverse forces can result in excessive uplift (separation) forces on the corner castings and twistlocks and/or failure of the lashings.

ii) Operation of a container vessel in a seaway

Due to the large size and power of modern container vessels and the commercial pressures of maintaining a vessel's schedule on a time-tabled liner service, a master is sometimes reluctant to slow down when good seamanship should dictate that it would be prudent to do so. The actions that should be taken by the master when encountering heavy weather vary according to the size of the container vessel and can often be found set out in the company Safety Management System, Operator instructions and vessel standing orders.

Containers remain secure but damaged by wave impact

iii) Voyage planning

Containerships are often weather routed by charterers. Nevertheless it is vital that the master uses all available means to predict the possibility of encountering heavy weather so that early preparations can be made and appropriate options for avoidance examined. In particular, he should have available a passage plan, weather bulletins, weather charts and forecasts, routeing chart and pilot book information, weather routeing as well as being able to call upon his own experience. The master should also be familiar with his own vessel, its handling characteristics and permitted engine settings in heavy weather.

iv) Preparing for heavy weather

Once it is known that heavy weather conditions will be encountered it is imperative that the vessel is properly prepared. This entails numerous tasks in all areas of the ship and a checklist is often used to verify that all tasks have been completed. Fundamentally the vessel should be put into its most favourable sea-keeping condition in terms of stress, stability (where possible improving the ballast conditions with particular reference to the comments on GM discussed above), watertight integrity, security of cargo, security of equipment and reliability of equipment, including the main engine and critical auxiliaries.

Container vessel in heavy weather - too late to check the lashings now!

Particular attention should be paid to checking the container lashings although these should have been checked at least daily throughout the course of the voyage, irrespective of the weather conditions (subject to the personal safety of the crew on deck in heavy weather). Also, it is important that consideration is given to increasing the level of lubricating oil in the sump of both the main engine and generators in order to reduce the chance of engine failure due to loss of suction during rolling.

v) Observation of the environmental conditions

When heavy weather is expected, it is important that detailed environmental conditions are monitored and recorded accurately. For example on large modern containerships the sea and wind conditions should be observed from main

deck level if possible. The main engine load, exhaust gas temperatures and turbocharger revolutions should all be carefully monitored as the data can be used as an indicator that a speed reduction is required.

The above actions will ensure that the master has the information necessary to make an early decision on speed reduction or an adjustment of course. In the writer's experience all too often a reduction in speed is not made until after the first damage has occurred or containers have been lost.

vi) Ship handling

Notwithstanding the commercial pressures imposed by container shipping schedules, and the possible constraints imposed by *The Hill Harmony* ruling with respect to charterers' orders, it remains the master's responsibility to take action to maintain the safety of the crew, vessel and cargo. Driving the vessel too hard may result in damage to the containers or to the vessel itself.

The phenomenon of parametric rolling has been advanced by some parties as a particular cause of some of the more spectacular container losses in recent years. However the dangers of parametric rolling notwithstanding, it is only one of many types of extreme motions that a ship might experience in a seaway including synchronous rolling and broaching-to. Guidance for masters in recognising the sea conditions in which dangerous situations can arise is set out in detail in IMO Circular MSC.1/Circ.1228 published in 2007 and freely available on the IMO web site. The "Revised guidance to the master for avoiding dangerous situations in adverse weather and sea conditions" provides recommendations on actions to avoid extreme motions resulting from certain phenomena, including parametric rolling motions in head or stern seas. If a vessel is rolling or pitching heavily, an alteration of course and/or speed or even, to heave-to, should be considered in order to avoid overloading the container securing system. Any course alteration should be performed with due care to ensure that the turn is not violent nor coincides with the roll period.

CONCLUSION

Our company has investigated more than a hundred cases of container loss or damage involving both large and small containerships. In all but one or two instances the loss or damage has been mainly confined to locations in the container stow where one or more of the following conditions existed:

- The stacks were overweight;
- Permitted tier weights were exceeded;
- Hi-cube boxes were loaded without verification of the increased forces that result;
- Lashings were improperly applied;
- Fixed and/or portable components of the lashing system were in poor condition.

In conclusion, it is vital for a master to ensure that the ship's stability is adequate and the cargo stowed and secured in the correct manner. However, if a ship is unfortunate enough to encounter extreme heavy weather conditions, a ship should be manoeuvred as required by the normal demands of heavy weather seamanship, taking into account the IMO guidance to Masters.