UK P&I CLUB

Carefully to Carry

SEPTEMBER 2006

Lashing on containers on deck

In general terms, by a process of evolution, the lashing systems in use on small container vessels and post-panamax are very similar

In the early years of containerisation, existing general cargo vessels were converted with the removal of 'tween decks and the addition of cell guides into the cargo holds. On deck, the hatchcovers were strengthened and fittings added for lashings. However, the containers on deck were seldom stowed above one high and so were secured to the vessel by 'traditional' cargo ship methods.

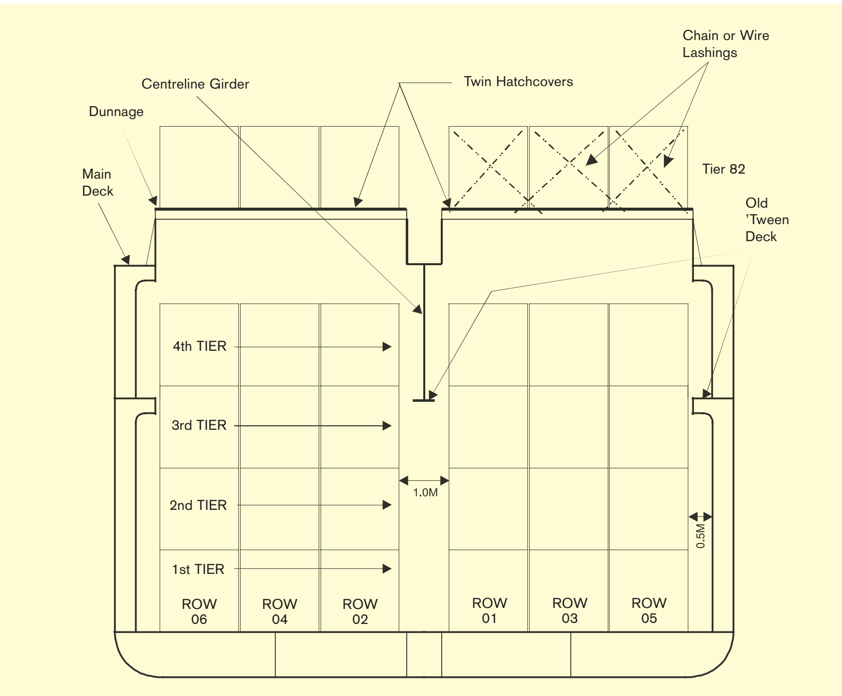


Figure 1: Typical midship section of an early vessel conversion

Often seen still trading today, are a few of the 'first generation' vessels built during the late sixties and early seventies. These ships were the first to be designed and built as pure container carriers. The holds and hatchcovers were as wide as possible, and container posts were fitted on deck to facilitate loading of deck-stowed containers out to the ship's side (see Figure 2).

"The carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Hague Rules, Articles iii, Rule 2

Carefully to Carry Advisory Committee

This report was produced by the Carefully to Carry Committee – the UK P&I Club's advisory committee on cargo matters. The aim of the Carefully to Carry Committee is to reduce claims through contemporaneous advice to the Club's Members through the most efficient means available.

The committee was established in 1961 and has produced many articles on cargoes that cause claims and other cargo related issues such as hold washing, cargo securing, and ventilation.

The quality of advice given has established Carefully to Carry as a key source of guidance for shipowners and ships' officers. In addition, the articles have frequently been the source of expertise in negotiations over the settlement of claims and have also been relied on in court hearings.

In 2002 all articles were revised and published in book form as well as on disk. All articles are also available to Members on the Club website. Visit the Carefully to Carry section in the Loss Prevention area of the Club website www.ukpandi.com for more information, or contact the Loss Prevention Department.

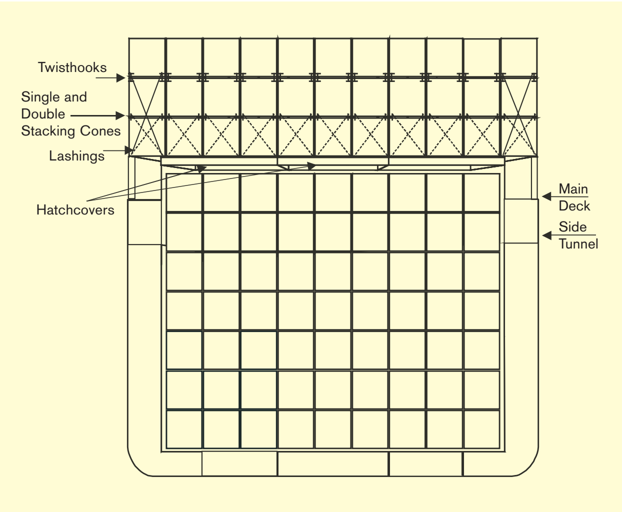


Figure 2: Typical midship section through an early generation cellular container vessel

For this generation of vessel, two systems of securing the cargo were common. One relied on the use of twistlocks in conjunction with lashing bars or chains, and the second relied on the use of stacking cones and bridge pieces in conjunction with lashing bars or chains. Gradually, due to the increased utilisation of differing height containers, the second method became redundant and it became common practice to use twistlocks throughout the stow. This method normally allowed containers to be stacked three high and, in some cases, four high if the fourth tier was light in weight or empty.

For first generation vessels, computer technology was not available onboard to speedily calculate dynamic loads acting on container lashings and frames. The shipboard computer (if any) was only used to calculate stresses and stability for the ship itself. Therefore, the shipboard staff would ensure the vessel was lashed according to a lashing plan taken from the lashing equipment manufacturer's manual, which appeared to assume an ideal stow with respect to the distribution of weight in each stack (the homogenous stack).

With further development in the industry during the 1970s and 80s, the size of containerships continued to grow, with 9-high stowage in holds and 4-high stowage on deck becoming commonplace and the industry began to wake up to the fact that standards in lashing were required. Ships were, at this stage, still supplied with loading computers that continued to calculate a ship's stability, shear forces, bending and, occasionally, torsion moments. Very few had the capability to calculate dynamic loads on container frames and lashing systems caused by ship motions and wind forces. And so the lashings were still applied throughout the stow in accordance with the manufacturer's manual. Cargo was being lost overboard even though a properly designed securing system was in place and the cargo was correctly stowed. It became apparent that there was a great deal of ignorance concerning the combined static and dynamic loads acting on a securing system when adverse weather was causing severe ship motions, particularly rolling.

Today, large container ships are being built - known as the 'post-panamax' class (too large to transit the Panama Canal) - capable of carrying up to 8,500 TEUs, and small container ships down to coaster/feeder vessels of a few hundred TEUs. But in general terms, by a process of evolution, the lashing systems in use on both types of vessels are very similar. Both have adopted the twistlock and lashing bar/turnbuckle system.

Lashing bridge

On post-panamax vessels - where among other features the vessel's large beam results in an unavoidable, relatively large GM (metacentric height), and 6-high stowage on deck is common - the modern practice is for the vessel to be fitted with a lashing bridge; a substantial steel structure running athwartships between each forty foot container bay. This allows the second and third tiers of containers to be secured to the bridge using lashing rods and turnbuckles, whilst the whole stow is secured throughout with twistlocks (see Figure 3). The lashing bridge allows the anchoring points for each stack to be moved higher up the stack, which allows the lashings to be more effective in reducing the tipping moments acting on a stack when a vessel is rolling heavily. However, the practice of fitting the bridges between forty foot bays means that the twenty foot containers can only take advantage of the lashing bridges at one end. So, in effect, the twenty foot stacks have to revert to the limits of a conventional lashing system. This is the case, because the practice of estimating the forces acting on a stack divides the container weight equally between each end of the container. So the weight in each twenty foot container is limited by the capacity of the lashing system at the container end, which does not have the advantage of being secured by a lashing bridge.

On smaller vessels, the whole stow is also secured throughout with twistlocks, and the lowest three tiers are secured to the hatchcover or support post using the lashing bar/turnbuckle combination (see Figure 4).

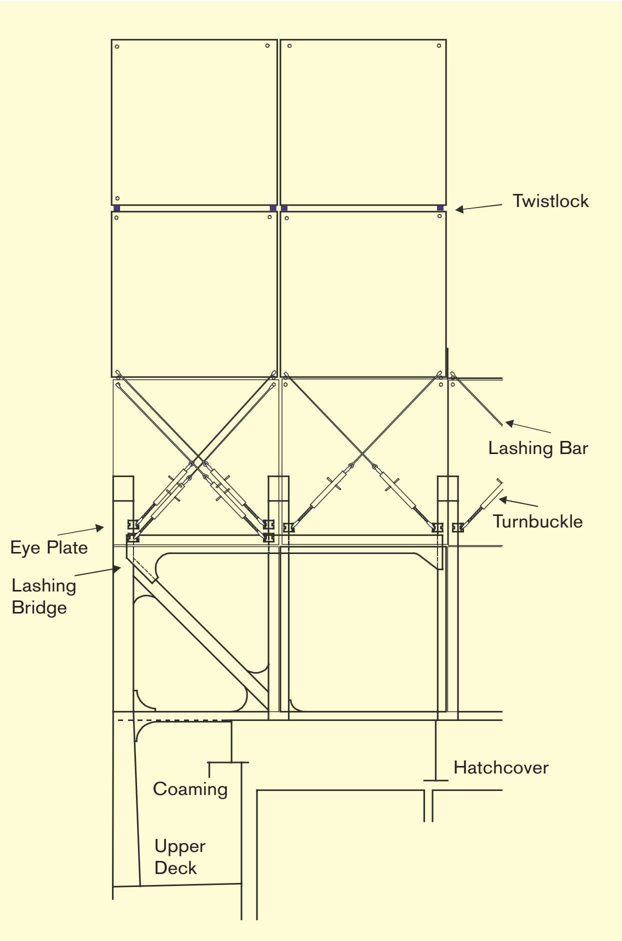
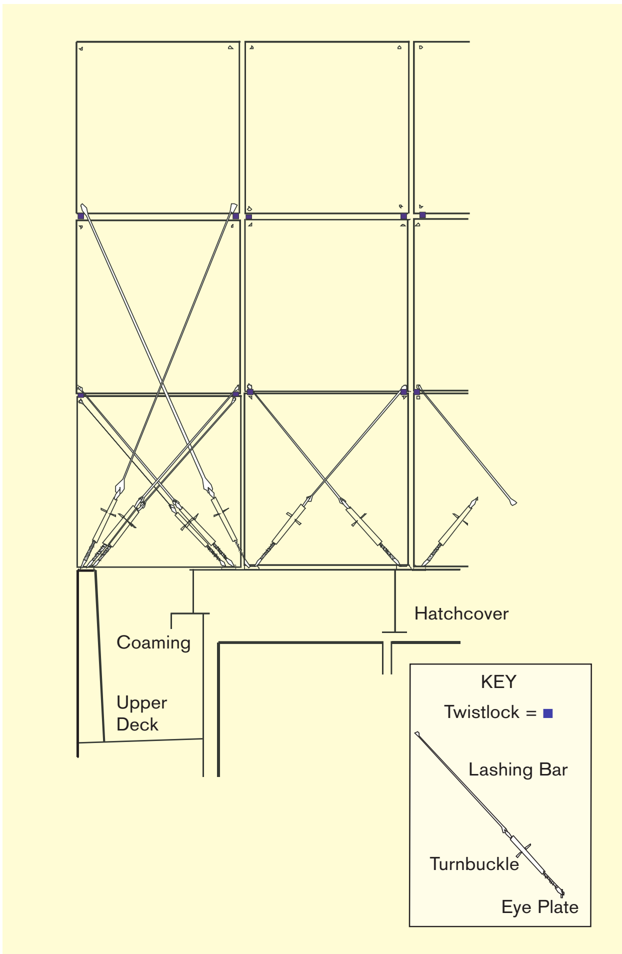


Figure 3 (above): Typical post-panamax lashing bridge arrangement (shown 4-high) . Figure 4 (below): Typical container vessel's hatchcover lashing arrangement

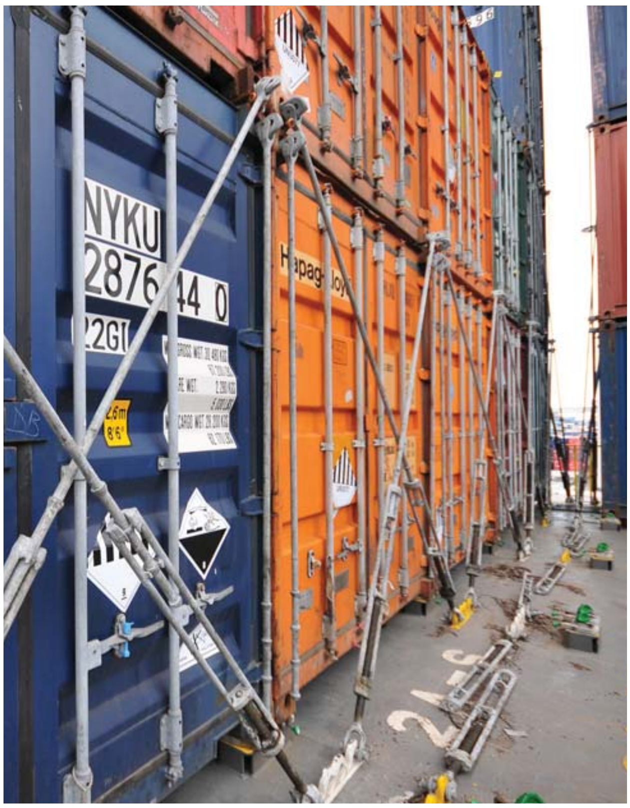


However, since the mid 1980s, naval architects have produced computer programs to calculate the dynamic loads acting on container stacks. Such programs have been designed for use by ships' officers and container planners. On modern vessels, 5-high and 6-high stowage on deck is common; the use of onboard computers to check the dynamics of the stow in all weather conditions is vitally important for the safe carriage of the cargo. The use of a computer lashing program, together with the IMO requirement for every vessel to carry onboard an approved Cargo Securing Manual, should mean a reduction in collapsed stows and losses overboard, provided the operators maintain the lashing equipment and comply with the requirements of the Manual. The vigilance of ships' staff is therefore vital to ensure that lashings are applied correctly.

Requirements of lashing systems

In 1985, the advent of IMO SOLAS resolution A.489(XII) required vessels to carry onboard a Cargo Securing Manual drawn up to a standard contained in MSC/Circular 385, such that on 1st July 1996. This was extended to new container ships and to existing vessels on 1st January 1998. Such Cargo Securing Manuals need to be approved by the relevant Classification Society. The IMO published guidelines on the standard required of the Cargo Securing Manual in the form of MSC/Circular 745, which superseded the earlier MSC/Circular 385, and has been published as IMO 298E *Guidelines for the preparation of the Cargo Securing Manual.*

Typical 'on lid' loading



The amended SOLAS Chapter VI: Regulation 5, *Stowage and Securing* states:

"Cargo and cargo units carried on or under deck shall be so loaded, stowed and secured to prevent as far as is practicable, throughout the voyage, damage or hazard to the ship and the persons onboard, and loss of cargo overboard."

It goes on to say that:

"Cargo units, including containers, shall be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration...The Cargo Securing Manual shall be drawn up to a standard at least equivalent to the guidelines developed by the Organisation" (IMO).

Therefore, following MSC/Circular 745, any Classification Society which approves a Cargo Securing Manual will need to ensure the following:

- The information in the Manual is consistent with the requirements of the vessel's trim/stability and hull strength manual, International Load Line (1966) requirements, and the International Maritime Dangerous Goods Code (IMDG), where applicable.
- The Manual specifies arrangements and cargo securing devices provided onboard for the correct application to the containers, based on transverse, longitudinal, and vertical forces, which may arise during adverse weather and sea conditions.
- Such securing arrangements and devices, mentioned above, shall be suitable and adapted to the nature of the cargo to be carried.
- There is sufficient quantity of reserve cargo securing devices onboard the ship.
- The Manual contains information on the strength and instructions for the use and maintenance of each specific type of cargo securing device.
- The Manual should consist of a comprehensive, and understandable, plan providing an overview of the maximum stack weights and permissible vertical distribution of weight in stacks.
- The Manual should present the distribution of acceleration
- The Manual should provide information on forces induced by wind and sea on deck cargo, and contain information on the nominal increase of forces or accelerations with an increase in GM.
- The Manual should contain recommendations for reducing the risk of cargo losses from deck stows, by applying restrictions to stack weights or heights where high stability cannot be avoided.

IMO Circular 745 also states that the cargo securing devices should be maintained in a satisfactory condition, and that items worn or damaged to such an extent that their quality is impaired should be replaced. It is commonly accepted that obligatory survey of portable fittings is not generally pursued by the Classification Society, and so inspection and replacement should be the responsibility of the operators. When replacement securing devices are placed onboard, they should be provided with appropriate certification.

Portable fittings should be certified by some form of type-approval system, usually coming from the manufacturer (when approved), a Classification Society, or other accepted testing body.

Ship managers may request a Classification Society to approve their particular lashing system and the lashing program software, in addition to the requirement of approving the Cargo Securing Manual.

Until the Cargo Securing Manual and the computer lashing program are produced and approved 'hand in glove' in the same way as the ships stability loading computer and Stability/Loading Manual are already used, there is bound to be confusion with respect to the safe capabilities of the ondeck container lashing system for each ship.

One note of caution: the different Classification Societies have set their own standards for the minimum SWLs of lashing gear and maximum allowable forces acting on a container, and the roll angle which any calculations should include.

Types of lashing failure

In general terms, whenever a vessel is 'working' in a seaway it will incur three main movements which are described as rolling, pitching, and heaving. These give rise to accelerations, and therefore forces, which act on the container frames and lashing system in use. Figure 5 illustrates the ship motions experienced by a container stack.

Of the forces acting upon an individual container and its lashings as a result of these movements, the separation force is the tipping force which is acting to 'pull out' or separate the corner fittings or twistlocks.
When the vessel is rolling heavily, if the separation force is excessive, it may pull the twistlocks out of the corner castings of the container, break the twistlocks at their weakest point, or separate the corner castings from the main body of the container.

When the vessel is rolling heavily, and containers stowed on higher tiers are heavy, a racking force will be set up in the frame of the lowest containers. The larger the roll of the vessel, the larger the racking force will be.

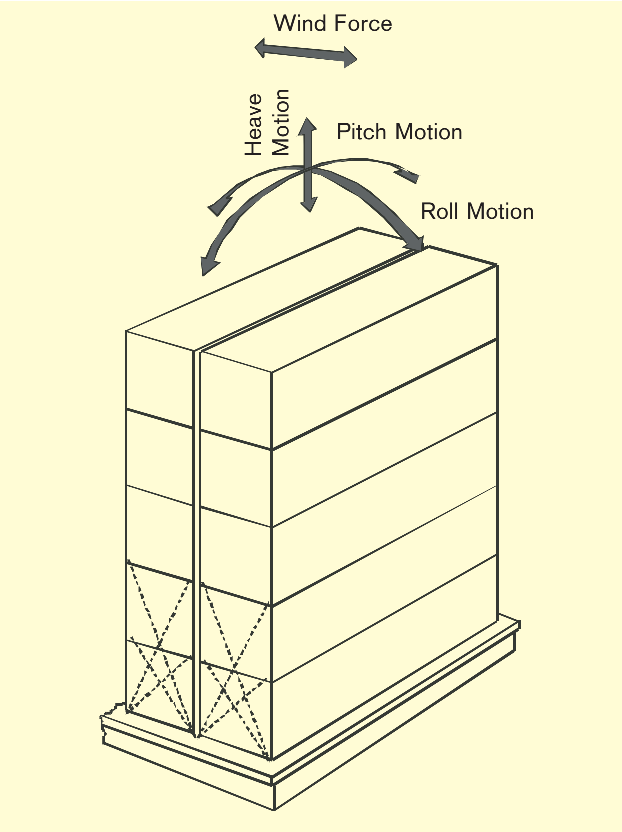


Figure 5: The accelerations acting on a container in a seaway

Figure 6: Excessive tipping moment or separation force on corner fittings

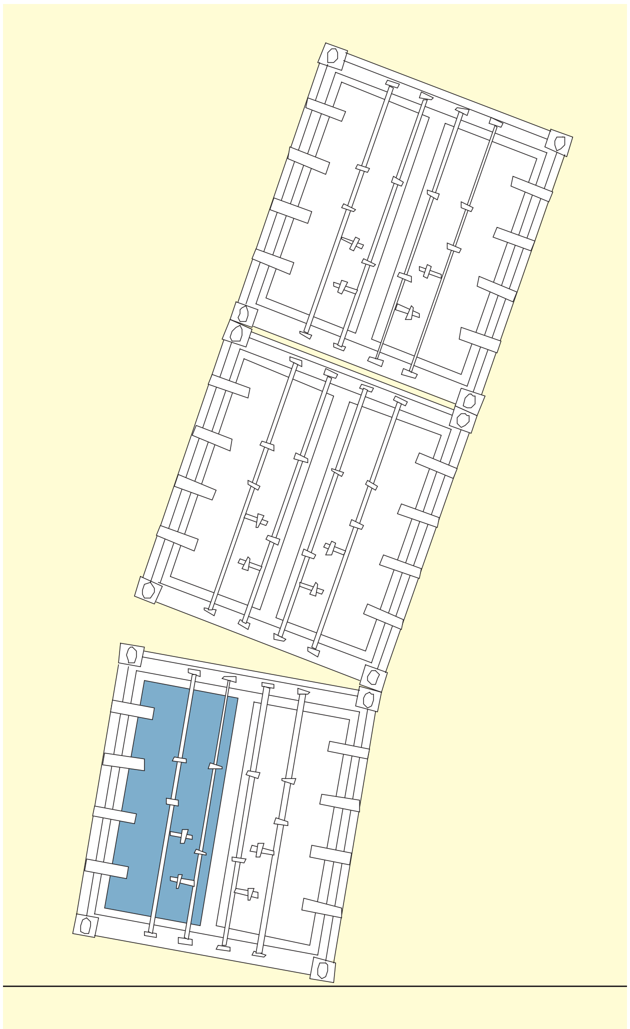
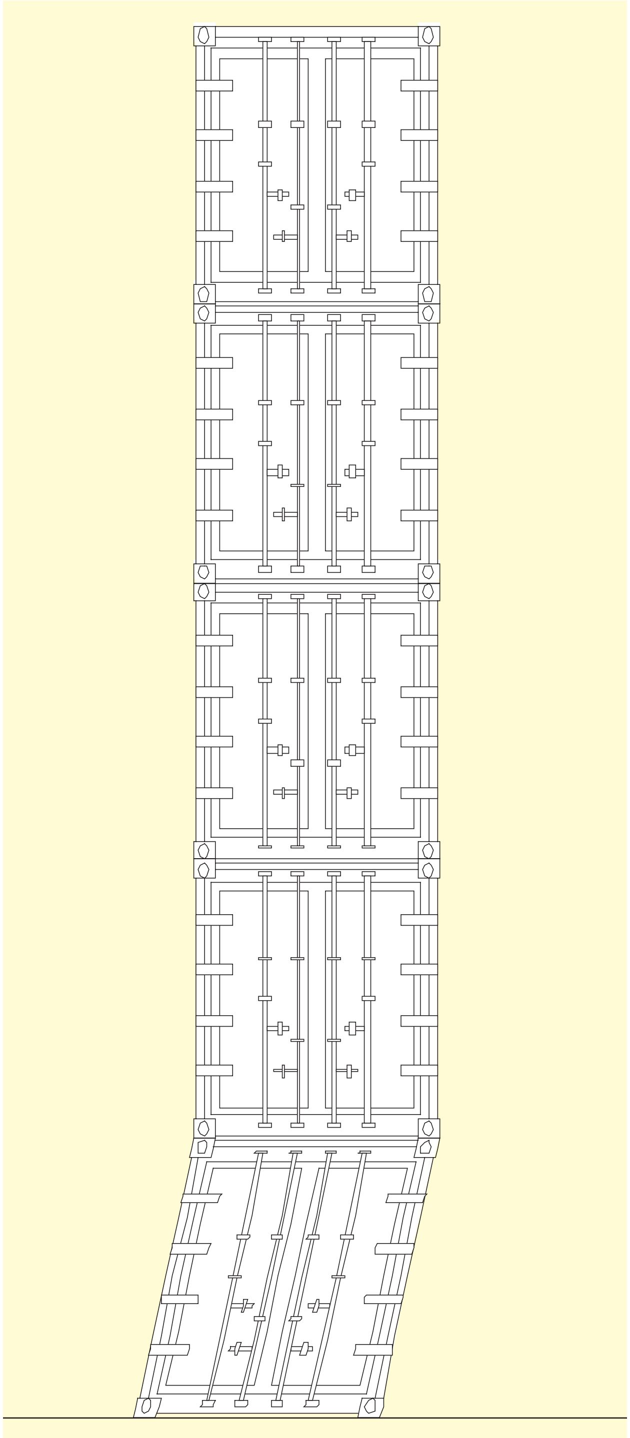
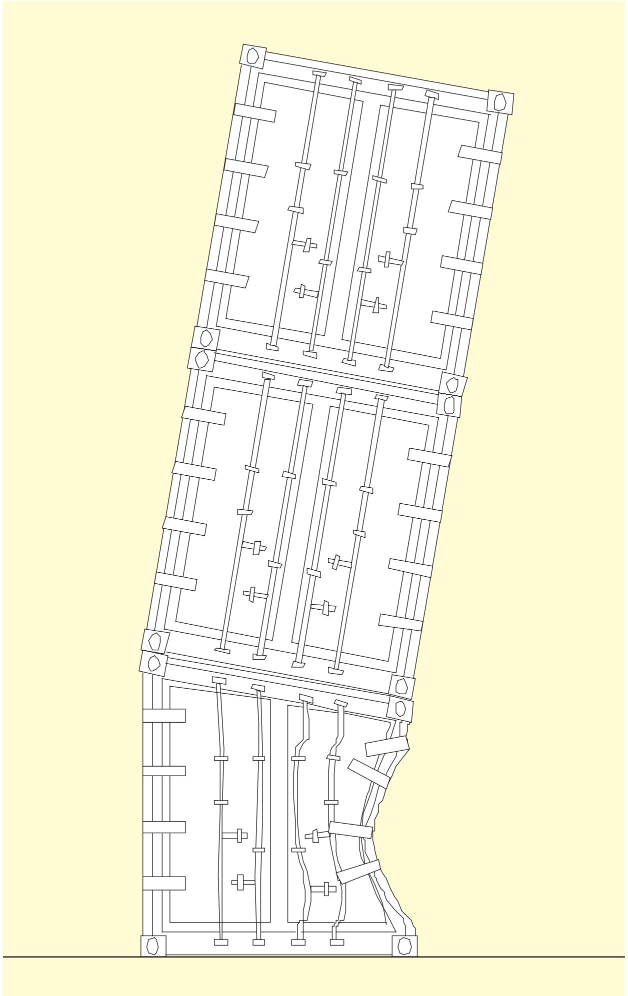


Figure 7 and photo below: Excessive racking force on a container end wall, causing the frame of the lower container to deform (rack)



A large GM - particularly when coupled with a short roll period - increases the dynamic loadings caused by rolling, and all of the loads previously mentioned, will increase the compression and tension forces acting at the corner posts of the containers and at the twistlocks between them. If excessive, they may result in structural failure of one or more of the corner posts (see Figure 8).

Figure 8 and photo below: Excessive compression force on container corner post, leading to failure of the post



Application of computer software

Having identified that containers were being lost overboard - despite apparently having a properly designed and implemented securing system in place and that cargo was correctly stowed - analysis showed that there was much ignorance concerning the combined static and dynamic loads that were present in adverse weather. In such cases, the bad weather being encountered had caused severe ship motions, in particular a rolling motion. The result of this analysis is that, of all the ships motions, rolling is the most likely cause of overloading the container frames and lashings.

It is interesting to note that the same difficulties were being experienced in the mid 1980s. The solutions, in principle, are also similar. A number of computer programs are available - such as Seamaster, Seacos and Loadstar to name but a few - that calculate not only the vessel's stability, but the forces experienced within a container stack.

A note of caution: many ports supply the chief officer with a disk containing a Bayplan file of the preload plan, which should include all the relevant container data - it is important to check that the correct container height has been entered, as this affects the vessel's stability and any calculation of the forces experienced within the stack.

Included here are excerpts of printouts from the Seamaster program representing the force analysis of an actual cargo carried by a post-panamax container vessel and the applied lashings, utilising a lashing bridge and with a 'conventional' lashing system (parallel lashings only in both cases). The vessel experienced heavy weather and, as a result, containers were either lost overboard or severely damaged. The printouts show how much a container stack can be overloaded in severe weather taking into account ships' motions due to wave action and wind. It can be seen that the stack weights and individual container weights are not excessive, but when subjected to heavy rolling and wind, the container frames and lashings become overloaded; particularly the transverse racking forces and the tension/ compression forces which are primarily caused by heavy rolling and wind action on the outside stacks.

The benefits of using a program such as this can be summarised, therefore, as helping to ensure a safer carriage of deck-stowed containers, a saving on lashing requirements both in terms of usage and employment of lashing gangs, and the possibility of loading more cargo (depending on the voyage). Because so much high value cargo is containerised and carried on deck, it is essential that each vessel has onboard a computer program capable of assessing the forces acting on container stacks during a voyage, allowing for adverse weather. It goes without saying, of course, that lashing equipment also has to be in good condition, and certified as suitable. However, use of these programs could lead the user into a false sense of security. Forces calculated assume that all containers are in good condition - no damage to corner posts and castings, that all lashings are correctly applied, with equal tension on lashing bars, etc. These programs also calculate to a theoretical angle of roll that the ship shouldn't exceed, but in many cases, does.

Forces within a stack are affected by all ship motions, but the angle of roll is normally the most critical. Classification Society regulations assume values, which are the default values in these programs. They calculate the forces acting on each non-cellular stack, using the environmental and lashing data already set. The lashing data is set up on a row-by-row basis, allowing for lashing bridges, etc. The natural period of roll can be determined using the rule-of-thumb formula:

$$Period\ (T_R) = \frac{0.7\ Beam}{\sqrt{GM}}$$

The case illustrated, with a GM of 0.9m, leads to a natural roll period of 16 seconds. This would lead to quite a long roll, with the loadings increasing to the maximum, and then reducing until the vessel becomes upright, and then rolls back the other way.

A detailed breakdown of the forces in each stack is obtained, displaying the relevant forces acting on each container. The programs assume, as a default, that all containers are stowed with their door ends aft, but this can be altered by the user. As an example, an excerpt of a printout from the *Seamaster* program is shown on the following page. The bottom line for each row of containers indicates the maximum allowable forces (MAF) for the forces identified in the column directly above, highlighted in blue. If a force exceeds the MAF it is highlighted in red.

Racking force: The first two columns are the transverse forces tending to distort the container ends, primarily due to a rolling action. This should not exceed a MAF of 15t. If a lashing is applied, the force varies between the forward and aft ends of the container because of the different 'stiffness' of the door and closed ends.

Corner shear: This is closely related to racking, but is the force tending to shear off the twistlocks. It should not exceed a SWL of 15t for a standard twistlock.

Compressive force: This is the force acting on the container corner posts and fittings, and is the result of tilting the stack and the vertical acceleration. It should not exceed 45t for a standard 20' container corner post, or 67.5t for a 40' container's corner post. Larger compression forces are allowed for corner castings at the base of a stack (83.8t).

Separation force: This is the tipping force which is acting to 'pull out', or separate the corner fittings and should not exceed 15t for the top fitting, and 20t for the bottom. It is shown as a negative value in the force table. This force does not refer to the tensile loadings on the twistlocks.

Lashing tension: This is the tension in the applied lashings. Lashing rods should only ever be applied hand tight, not over-tightened with large spanners, as this induces unnecessary tension in the lashing rod, reducing the angle of roll at which the SWL would be exceeded. The Germanischer Lloyd (GL) limit for lashing rods is 23t SWL; turnbuckles are rated at 18t. *Seamaster* uses the LRS 1999 rules for reporting (see excerpt from a printout on the next page).

The examples of the *Seamaster* printout are from an actual incident involving container loss in heavy weather. They illustrate the advantages of using a lashing bridge arrangement for securing containers. Both the number of instances of forces in excess of the Class limits (figures in red), and the degree of those excesses, is reduced with a lashing bridge. However, compressive forces are transferred higher up the stack as the lashing bars are attached at the base of the tier 86 containers.

Just because a container, or item of lashing equipment, has exceeded its safe working load / maximum allowable force, does not automatically lead to the conclusion that that item will fail. SWLs are mostly set at 50% of the breaking load. The use of a SWL is to give a safety margin, allowing for occasional over-stressing. A container that has been highlighted as having exceeded the Class limits will not automatically be lost when the vessel rolls to 24.9ø. Indeed, many container stacks remain onboard after having suffered greater loadings than some of those lost. The calculations cannot allow for the domino effect of an inboard stack collapsing, falling against its neighbour thereby inducing far greater forces upon it, which in turn collapses, etc.

The correct application of the lashing equipment is also important; one example of incorrect application of semi-automatic base twistlocks occurs when there is an element of fore and aft movement of the container immediately prior to landing it onboard; the base locks tend to be placed in the deck fitting rather than the base of the container prior to loading. Any fore and aft movement of the container, as it is aligned over the

WITH LASHING BRIDGE – Report for Deck Bay 54 on the basis of LRS 1999 Rules

(with 78 kn wind & 24.9° roll, assuming draught = 12.6 & GM = 0.90m)

Row 12 Deck Bay 54

Tier	Ht(ft)	Wt(t)	Wind(t)	Cl	Door	Fwd < LASHINGS		> Aft	
						length	type	length	type
88	9.5	19.5	4.3		Aft				
86	9.5	26.2	4.3		Aft				
84	9.5	21.4	4.3		Aft	3.92	St 30	3.92	St 30
82	9.5	26.2	4.3		Aft				

Rolling:	Racking Force			Corner Shear		Compression Forces				Lash Tension	
Tier	Fwd	Aft	Side	Fwd	Aft	Fwd	Aft	Fwd	Aft	Fwd	Aft
88	2.9	2.9	0.0	4.2	4.2	9.2	9.2	0.3	0.3		
86	11.2	11.2	0.0	2.1	-2.9	49.9	62.8	-6.5	-6.5		
84	6.8	-2.3	0.0	6.5	1.5	64.7	65.9	-9.7	-0.6	**23.2**	**38.9**
82	**15.2**	6.1	0.0	11.6	6.6	**91.6**	81.2	**-20.3**	-2.2		
(MAF)	(15)	(15)	(10)	(15)	(15)	(67.5/83.8)		(-15.0/-20.0)			

Row 11 Deck Bay 54

Tier	Ht(ft)	Wt(t)	Wind(t)	Cl	Door	Fwd < LASHINGS		> Aft	
						length	type	length	type
88	9.5	21.2	4.3		Aft				
86	9.5	22.0	4.3		Aft				
84	9.5	26.3	4.3		Aft	3.92	St 30	3.92	St 30
82	9.5	26.3	4.3		Aft				

Rolling:	Racking Force			Corner Shear		Compression Forces				Lash Tension	
Tier	Fwd	Aft	Side	Fwd	Aft	Fwd	Aft	Fwd	Aft	Fwd	Aft
88	3.1	3.1	0.0	4.5	4.5	9.9	9.9	0.4	0.4		
86	11.3	11.3	0.0	1.6	-3.4	49.7	62.6	-7.2	-7.2		
84	6.5	-2.7	0.0	6.8	1.8	65.4	66.6	-9.2	-0.1	**23.3**	**39.2**
82	**15.8**	6.7	0.0	11.9	6.9	**93.1**	82.6	**-20.4**	-2.2		
(MAF)	(15)	(15)	(10)	(15)	(15)	(67.5/83.8)		(-15.0/-20.0)			

NO LASHING BRIDGE – Report for Deck Bay 54 on the basis of LRS 1999 Rules

(with 78 kn wind & 24.9° roll, assuming draught = 12.6 & GM = 0.90m)

Row 12 Deck Bay 54

Tier	Ht(ft)	Wt(t)	Wind(t)	Cl	Door	Fwd < LASHINGS		> Aft	
						length	type	length	type
88	9.5	19.5	4.3		Aft				
86	9.5	26.2	4.3		Aft				
84	9.5	21.4	4.3		Aft				
82	9.5	26.2	4.3		Aft	3.68	St 30		

Rolling:	Racking Force			Corner Shear		Compression Forces				Lash Tension	
Tier	Fwd	Aft	Side	Fwd	Aft	Fwd	Aft	Fwd	Aft	Fwd	Aft
88	2.9	2.9	0.0	4.2	4.2	9.3	9.3	0.3	0.3		
86	11.2	11.2	0.0	9.5	9.5	31.1	31.1	-6.6	-6.6		
84	**20.3**	**20.3**	0.0	7.6	13.9	**77.8**	63.1	**-25.1**	**-25.1**		
82	**17.3**	**28.7**	0.0	12.7	**19.0**	**107.4**	**107.3**	**-39.8**	**-54.4**	**18.6**	
(MAF)	(15)	(15)	(10)	(15)	(15)	(67.5/83.8)		(-15.0/-20.0)			

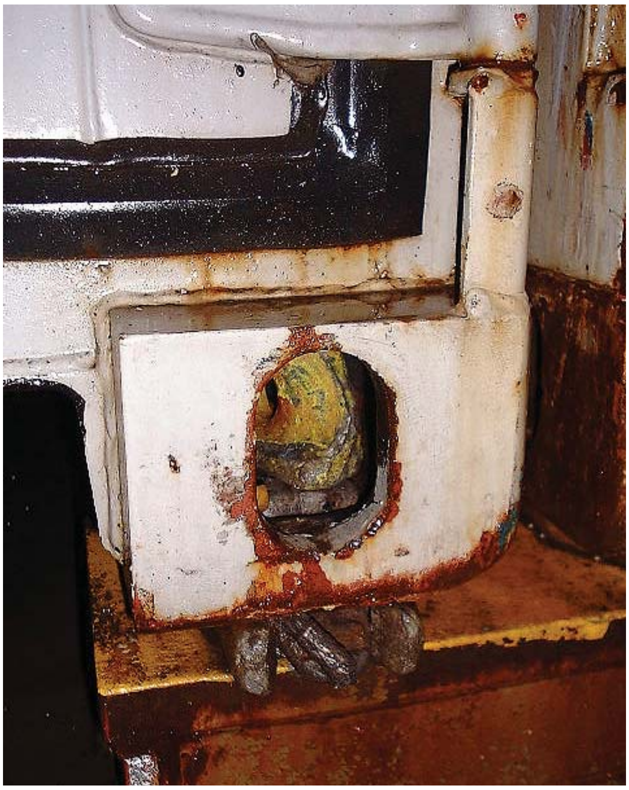
Row 11 Deck Bay 54

Tier	Ht(ft)	Wt(t)	Wind(t)	Cl	Door	Fwd < LASHINGS		> Aft	
						length	type	length	type
88	9.5	21.2	4.3		Aft				
86	9.5	22.0	4.3		Aft				
84	9.5	26.3	4.3		Aft				
82	9.5	26.3	4.3		Aft	3.68	St 30		

Rolling:	Racking Force			Corner Shear		Compression Forces				Lash Tension	
Tier	Fwd	Aft	Side	Fwd	Aft	Fwd	Aft	Fwd	Aft	Fwd	Aft
88	3.1	3.1	0.0	4.5	4.5	10.0	10.0	0.4	0.4		
86	11.3	11.3	0.0	9.1	9.1	30.7	30.7	-7.3	-7.3		
84	**20.0**	**20.0**	0.0	7.9	14.3	**78.8**	63.8	**-24.4**	**-24.4**		
82	**17.7**	**29.4**	0.0	13.0	**19.4**	**109.0**	**108.9**	**-39.7**	**-54.6**	**19.0**	
(MAF)	(15)	(15)	(10)	(15)	(15)	(67.5/83.8)		(-15.0/-20.0)			

base lock, risks the actuating wire being caught under the container, rendering the twistlock inoperable unless the container is lifted and landed correctly. This highlights the necessity of continual vigilance on behalf of ship's staff during the loading process.

Twistlock failure



Unlocked twistlock

Heavy weather seamanship for container vessels

The actions required to be taken by the master, upon encountering heavy weather, vary according to the size of the container vessel, but some actions have a common thread:

- **Intelligence**: It is vital the master uses all available means to forecast the possibility of experiencing heavy weather, so that early preparations can be completed and any options for avoidance examined. This would be in the form of a passage plan, weather bulletins, weather faxes, routeing chart and pilot book information, weather routeing, and past experience.
- **Familiarity**: The master should also be familiar with his own vessel, its handling characteristics and allowable engine settings in heavy weather. This can only be gained by experience.
- **Preparation**: Once it is known that heavy weather conditions will be experienced, it is imperative that proper preparation is carried out. This would entail the completion of numerous tasks in all departments and an aide-memoire checklist is commonly used. Fundamentally, the vessel should be put to its best sea-keeping condition possible in terms of stress, stability, watertight integrity, security of cargo, security of equipment, and reliability of machinery.
- **Handling**: When heavy weather is expected it is important that the outside conditions are monitored and recorded in greater detail and with best accuracy. This will provide data to ensure the master reduces speed in good time. (Too often the first reduction in speed occurs after the first damage has happened). For example, on modern, large containerships the sea and wind conditions should be observed from main deck level. With modern engine-monitoring equipment, the main engine load value, the exhaust gas temperatures, and the turbo charger revolutions should be carefully monitored, as these values can be used as a precursor to indicate when speed should be reduced.
- **Handling**: The standard tactic of 'heaving to', by keeping the main conditions two points on the bow with the vessel at reduced speed, is often still the best action to take. Keep the vessel in hand, steering at all times, and endeavour to maintain the best lookout, both visually and by radar. If the vessel is rolling excessively (assuming she has already been put into the best stability condition) alteration of course towards a 'hove to' type of heading followed by a reduction of speed, should be carried out as soon as possible. Care should be taken when carrying out this course adjustment, ensuring the turn is not violent or coinciding with the roll period.
- **Record keeping**: At all times regular weather and sea-state information, positions, courses steered, engine settings, should be recorded, and all received weather information should be retained onboard.

As well as the points already mentioned, the master will be faced with a number of considerations pertinent to his own vessel, such as:

- If fitted, at what speed do the vessel's stabilisers cease to have an effect?
- When running before heavy weather, what is the potential for damage aft caused by a boarding sea - reefer sockets, steering gear vents, etc.?

These recommendations are not intended to be definitive - each incident being judged on its own merits. However, through years of experience, these factors have been found to come in to play in most heavy weather incidents.

There is no doubt that defensive navigation may increase the time on passage, but when navigating in, or near, heavy weather, being cautious may prevent an accident, saving both time and money.

For further information please contact:
Loss Prevention Department, Thomas Miller P&I Ltd
Tel: +44 20 7204 2307. Fax +44 20 7283 6517
Email: lossprevention.ukclub@thomasmiller.com