



CARGO LASHING

1. REGULATORY BACKGROUND & INDUSTRY STANDARDS

- 1.1. The safe stowage and securing of cargo are a compulsory requirement of the SOLAS Convention. In the Convention Chapter VI '*Carriage of cargo and oil fuels*', Regulation 5 '*Stowage and securing*' it is required that:

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

and

"All cargoes, other than solid and liquid bulk cargoes, cargo units and cargo transport units, shall be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration"

- 1.2. IMO published guidelines on the proper stowage and securing of non-standardised cargo (meaning everything except containers and bulk cargoes) in the CSS Code, the purpose of which is: *"..to provide an international standard to promote the safe stowage and securing of cargoes..."*

Some of the general principles of the CSS Code indicate that:

"The safe stowage and securing of cargoes depend on proper planning, execution and supervision.

and

Decisions taken for measures of stowage and securing cargo should be based on the most severe weather conditions which may be expected by experience for the intended voyage"



2. SELECTING THE CORRECT LASHING EQUIPMENT & LASHING ARRANGEMENTS

- 2.1. The CSS Code provide clarity on the basic principles that must be taken in consideration when stowing and securing cargoes that need to be lashed to prevent them shifting or even their loss overboard when stowed on deck. Lashing equipment and lashing arrangements must be suited to the type of cargo carried, which in turn must be suitable for the type of ship chosen to carry it, and vice versa.
- 2.2. It is compulsory for vessels to be provided with Cargo Securing Manuals (CSM), which should be approved by a Classification Society. These documents direct how cargoes onboard a vessel should be stowed and secured. They list the cargo-securing equipment on board, whether fixed or portable and indicate how they should be used to secure the different types of cargo that are carried. Therefore, the CSM outline details of the strength of the lashing equipment to withstand any adverse weather and sea conditions, together with the methods to secure the cargo. Maintenance instructions for the onboard equipment should also be available in the manual.
- 2.3. During a sea passage, with the vessel subjected to several translational and rotational motions (expressed as the six degrees of freedom), longitudinal, transversal and vertical forces are applied to cargoes. In adverse weather and sea conditions these forces can become severe.
- 2.4. As previously mentioned in this article, sailing off the South African coasts, and around Cape of Good Hope, presents important challenges in terms of weather and sea conditions. As such when selecting lashing equipment and lashing arrangements the following must be borne in mind:
 - Duration of the voyage
 - The sea conditions which may be expected



- The dimensions, design and characteristics of the ship
- The expected static and dynamic forces during the voyage
- The type and packaging of cargo units
- The intended stowage pattern of the cargo units
- The mass and dimensions of the cargo units

Therefore,

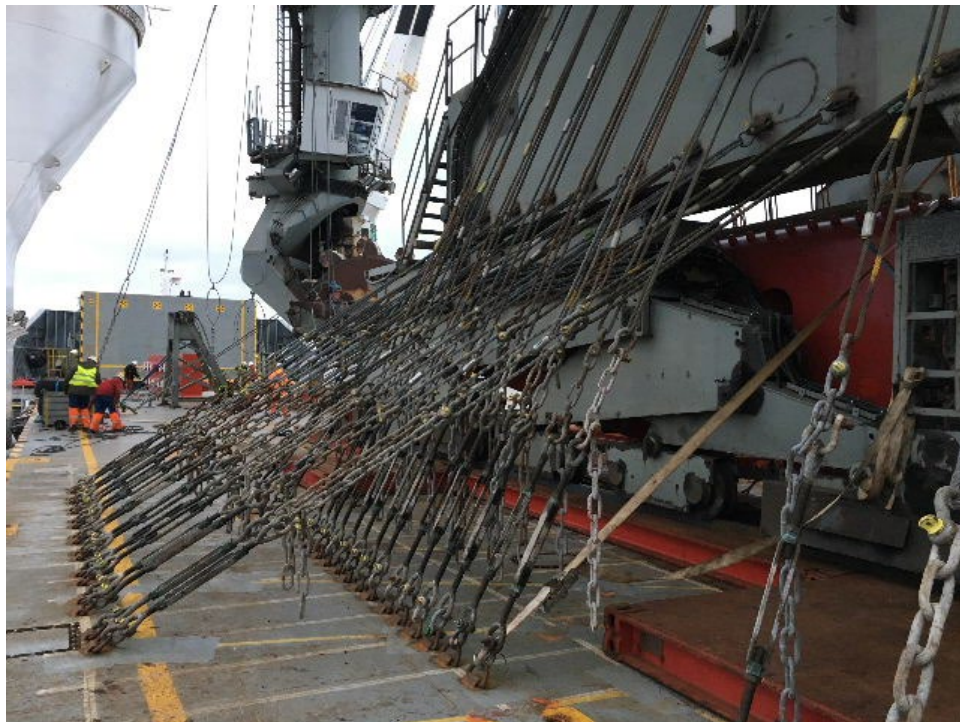
- The lashing arrangements should be verified using an acceptable calculation method.
- The securing equipment should be adapted to the cargo to be carried.
- The lashings should be kept as short as possible

3. SECURING CARGOES – LASHING EQUIPMENT AND LASHING METHODS

- 3.1. The securing arrangements must be adequate to ensure that there will be no movement which will endanger the ship. Slackening of the securing equipment must be avoided.
- 3.2. Cargoes with low friction coefficient should also be tightly stowed across the ship to avoid sliding. In this regard, suitable material such as soft boards, rubber mats or dunnage should be used to increase friction.
- 3.3. Securing equipment for break-bulk cargoes includes ropes, wires, webbings, bandings, chains, bottle screws and other approved tensioning devices having suitable maximum securing load values, to be selected basis the type of cargo that need to be lashed.



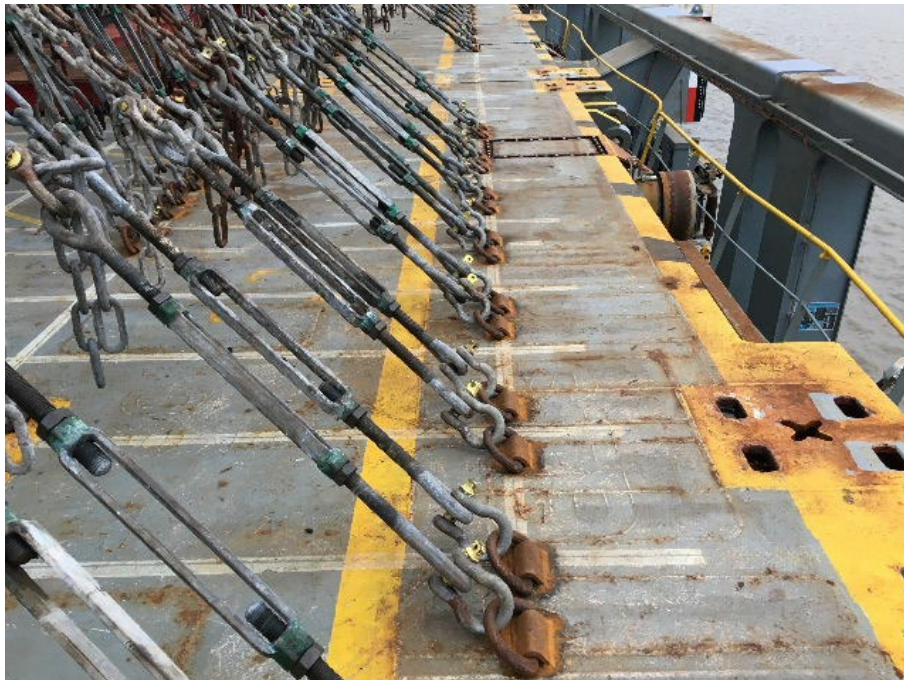
- 3.4. This lashing equipment is then connected via hooks (of suitable safety working loads) to lashing plates and D-rings welded to the deck and ship's structures. Lashing plates and D-rings must be welded on stiffened plate-fields.
- 3.5. When securing awkward shaped cargoes, the construction of supports of square section softwood frameworks, which chocks off the cargo against ship's structure may be necessary (tomming methods).
- 3.6. To achieve a suitably tight stow, the use of air bags, empty pallets, old tyres, etc. to fill the voids between items of cargo and between cargo and ship's structures, may be implemented.
- 3.7. The following photographs illustrate some of the features described above.



A combination of steel wires, chains and turnbuckles securing project cargo to the ship's deck



A closer view of steel wires, chains and turnbuckles securing project cargo to the ship's deck



Turnbuckles and shackles fitted to D-rings welded on deck



Steel pipes lashed with chains positioned athwartship and braced with softwood timber



Chains securing Windmill Blades tensioned and hooked to D-rings welded on deck structures



Steel stoppers welded to the deck and securing purposely made frames supporting project cargo
Note anti-slid plywood boards placed underneath the blue frame



Steel brackets welded to the deck securing a purposely made frame supporting project cargo
Note anti-slid timber beams sections placed underneath the frame



4. SECURING CARGOES – LASHING CALCULATIONS

4.1. Annex 13 to the CSS Code describes methods to assess the efficiency of the securing arrangements for non-standardized cargo. Chapter 1.5 of the Annex states:

“Notwithstanding the general principles contained in this Annex the adequacy of cargo securing may be demonstrated by means of detailed engineering calculations...

“..Computer programs used for that purpose should be validated against a suitable range of model tests or full-scale results in irregular seas...”

4.2. Nowadays, there exist several types of software that assist the vessels' crew to optimise and verify lashing arrangements on non-standardised cargoes. The software available calculates accelerations and balance of forces in non-standardised lashing arrangements in accordance with the above-mentioned Annex 13 to the CSS code.

4.3. It is worth mentioning that the CSS Code also refer to the seaman's basic rule-of-thumb for securing cargoes with a tendency to move during a moderate weather voyage. The rule-of-thumb states that the total of the MSL values (Maximum Securing Load) of the securing devices on each side of a cargo item should equal the weight of the item (expressed in kN). This rule though does not take in consideration the adverse effects of lashing angles and the favourable effect of friction.

4.4. It is noticeable that Section 6 of the CSS Code Annex 13 recommends that utilising weather routing services may significantly contribute to performing a safe passage although it does not eliminate the need of implementing the securing measures required in the code.



5. VEHICLE CARRIERS

- 5.1. Earlier in this article, it has been indicated that vehicle carriers are amongst those type of vessels (the other being containerships) which showed to have the highest claims frequency when it comes to heavy weather-related claims, compared to other types of vessels.
- 5.2. The CSS Code again provide specific advice for the safe stowage and securing of wheel-based (rolling) cargo with Annex 4.
- 5.3. Rolling cargo fitted with rubber wheels or tracks with friction-increasing lower surface add a positive factor when lashing and securing is performed. However, it is evident that rolling cargo not fitted with rubber wheels must be placed on anti-slid material, this being rubber mats or wooden dunnage when stowed on board Vehicle Carriers. The brakes of wheel-based cargo, if so equipped, should be set.
- 5.4. First and foremost, on board there should be an adequate supply of cargo securing gear which is maintained in a sound working condition.
- 5.5. Cars are lashed with an equal number of ratchet span sets running from the wheels and hooking onto purposely designed lashing points on the decks. In fact, where practicable, the arrangement of lashings on both sides of a vehicle should be the same and angled to provide some fore and aft restraint with an equal number pulling forward as are pulling aft.
- 5.6. The lashings are most effective on a vehicle when they make an angle with the deck of between 30 and 60 degrees. When these optimum angles cannot be achieved, additional lashings may be required.
- 5.7.



- 5.8. Steel chains are commonly used for lashing freight vehicles of more than 3.5 tonnes gross vehicle mass (GVM). When freight vehicles are being stowed on an inclined deck, the wheels should be chocked before lashing commences. During discharge, sufficient restraints should remain in place until the tractor unit has been connected, where appropriate.
- 5.9. Crossed lashings should, where practicable, not be used for securing freight vehicles because this disposition provides no restraint against tipping over at moderate angles of roll of the ship.
- 5.10. Hooks and other devices which are used for attaching a lashing to a securing point should be designed and applied in a manner which prevents them from disengaging from the aperture of the securing point if the lashing slackens during a voyage.
- 5.11. Vehicle Carriers can also carry H & H cargo (High & Heavy) on the main deck and / or lower decks. These items of cargo are usually large and very heavy and comprise agricultural equipment, construction equipment, mobile cranes, excavators, quarry equipment, military equipment etc.
- 5.12. Items of this nature, when exceeding 25 metric tonnes weight should be lashed with enough heavy lashing belts, chains and turnbuckles according to the relevant calculations.

6. CONTAINERSHIPS

- 6.1. Standardized cargo means cargo for which the ship is provided with an approved securing system based upon cargo units of specific types. Containerships falls in this category.



6.2. Class approved Cargo Securing Manuals (CSM) on containerships, specify the designing criteria which have been used in the given recommendations for the purpose of stowing and securing containers in the holds and on deck. Whilst the CSM are based on the individual Classification Societies Rules, as adopted on each vessel, typically, the criteria used are:

- Maximum securing forces in lashings*
- Maximum racking forces in containers (150 kN)
- Maximum lifting forces in containers (250 kN)
- Maximum post load on leeward side of the stacks (848 kN)

* *“these are the specifications of portable securing devices present on board”*

6.3. The CSM usually also describes how the magnitude and distribution of forces in a container stack depend on total stack mass, vertical sequence of masses in the stack, wind exposure, application of securing devices and value of GM (metacentric height – i.e. the measurement of the initial static stability of the vessel).

6.4. The CSM also report the limits of maximum stack mass, vertical sequence of masses in the stacks and how the application of securing devices should be carefully observed.

6.5. It should be noted that the distribution of container masses in bays and stacks shown in the CSM proposed stowage and securing plan is the optimum for the given loading condition and associated set of ship motions (for the specific containership for which the CSM is prepared and approved).

6.6. Any deviation from the recommended distribution will influence the magnitude and distribution of forces on the containers and securing devices. Therefore, as a rule, to



avoid exceeding the maximum allowable forces in the containers and securing devices, the following principles must be applied:

- Shifting masses down a stack is acceptable
- Shifting of masses up a stack is strictly not allowed
- When reducing mass at the bottom of a stack, the container masses above must be reduced accordingly to compensate for the rise in the stack centre of gravity
- Heavier containers should not be stowed on top of lighter containers

6.7. Furthermore, exceeding the permissible stack mass may result in:

- Overloading deck or hatch cover construction
- Overstressing stowage and securing devices
- Damaging containers
- Loss of containers overboard

6.8. Neglecting the permissible sequences of masses in stacks (e.g. heavy containers too high in the stack) may result in:

- Overloading stowage and securing devices
- Damaging containers
- Loss of containers overboard”

6.9. Usually, the container securing arrangement plans proposed in the CSM includes optimum stowage plans for Deck and Hold Bays for the various sizes containers (20ft



8'6" containers, 20ft/ 40ft mixed stows, 40ft 8'6" and 9'6" (high cube) containers, and 40ft/ 45ft mixed stows for one or more GMs, based on the ship's design, etc.

- 6.10. Furthermore, on containerships, the CSM usually includes general guidance on the effects of changes in stack weight, distribution of containers within the stack, increased GM, stack height, an increase in the weight higher up in the stack. In addition, the CSM also advises checking stack and lashing forces using an on-board lashing program.
- 6.11. At this juncture, it is therefore of the utmost importance that the settings of the on-board loading and lashing computer are properly set for the intended voyage, considering the prevailing weather patterns that can be encountered, and in accordance with the relevant applicable Class Rules.
- 6.12. Ultimately, it should not be forgotten that *"decisions taken for measures of stowage and securing cargo should be based on the most severe weather conditions which may be expected by experience for the intended voyage"* (CSS Code General Principles).
- 6.13. As far as the fixed and portable lashing equipment is concerned, it is required that regular inspection and maintenance is carried out by the crew. Additionally, it must be ensured that the vessel always carry the required number of lashing equipment. If this need replacement, the new equipment must be delivered to the vessel with the appropriate certification.

Yours faithfully,

Minton, Treharne and Davies Limited