BEST PRACTISE GUIDELINES FOR STOWAGE AND SECURING OF STEEL & GENERAL CARGOES

INTRODUCTION AND STANDARDS

JURONG PORT PTE LTD

Introduction

Jurong Port recognized the need for a concerted effort to address an existing safety gap in the general cargo segment.

Proper stowage and securing of cargo are critical for the safety of life at sea. Improper practices have led to numerous serious ship casualties, causing injury and loss of life—not only at sea but also during loading and discharge.

After a comprehensive review of the challenges faced by stevedores during the offloading of various cargoes, the Port issued the **Best Practice Guidelines for Stowage and Securing of General Cargo**. These guidelines were developed in close collaboration with Lloyd's Register to assist ship masters, deck officers, port agents, stevedores, charterers, and shippers when planning to load general cargo inbound to Jurong Port.

The guidelines should be read in conjunction with the respective port's stowage policy, which outlines enforcement timelines and details of any non-compliance penalties.
The primary objectives of these guidelines are to:

- Ensure the safety of all personnel engaged in cargo operations at the ports.
- Implement preventive measures to avoid damage to cargo during handling operations.
- Expedite efficient cargo discharge operations and improve efficiency at the disport.

The **Best Practice Guidelines for Stowage and Securing of General Cargo** have been prepared in alignment with recognized international industry standards and guidelines for safe cargo securing & handling.

Contents

Best Practice Guidelines – Overview

These guidelines have been prepared to address the various operational and safety challenges experienced by The Ports (TP) in particular, poor and unsafe stowage but cognizant of the lifting gears used for cargo handling in most neighboring ports.

These guidelines include, but are not limited to, the following:

- Specification of bundling or packaging methods for each cargo lot, along with minimum acceptable securing arrangements.
- Detailed guidance on dunnage type, quality, dimensions, and spacing for different cargo types.
- Clear descriptions of what constitutes good stowage, with emphasis on cargo care throughout the shipment and safe, efficient discharge operations at Jurong Port
- Consideration of cargo handling methods and equipment, with awareness of practices at other load and discharge ports.

The types of steel cargo addressed in these guidelines are:

- Rebars
- Wire rod in coils
- Steel plates
- Steel pipes
- Steel coils
- Structural steel (Beams, Flats, Angles, Round & Squares, Billets, Channels)
- ‘I’ & ‘H’ Beams
- Combined stows

The types of general cargo addressed in these guidelines are:

- Machinery Parts
- Project vehicle/equipment

Each guideline is presented in a structured and sequential manner, offering a general overview of the respective cargo types, supported by schematics and photographs under the following conditions:

- Open Hatch
- Under-coaming Area
- On Deck

These guidelines aim to present a storyline, in pictures where possible, which showcases the good, the bad and the ugly, with respect to the various cargo stows.

Stowage Guidelines

1. Guidelines for Cargo Stowage and Securing (IMO CSS Code). All cargo shall be stowed in accordance with the IMO Code of Safe Practice for Cargo Stowage and Securing (CSS Code). Stowage begins with planning and cargo distribution. While lashing and dunnage are important, the correct stowage of cargo is the primary factor that ensures the effectiveness and efficiency of securing arrangements. Effective careful and proper stowage, dunnaging, lashing and securing of the cargo and proper planning regarding dealing with damages which might arise during the actual loading and stowage operation can ensure efficient unloading operations at disport. Good stowage aims to achieve the following:

    - Proper cargo distribution considering geographical rotation and loading/unloading sequence.
    - Correct load distribution across the entire vessel.
    - Correct load distribution within each cargo compartment.
    - Prevention of damage or deformation to the cargo.
    - Prevention of damage to the vessel's cargo compartments.
    - Effective segregation of various parcels/ cargo types.
    - Adequate ventilation of cargo on board.
    - Adequate provision of drainage in the cargo hold
    - Efficient loading operations.
    - Stability of the stow at sea under various weather conditions.
    - Efficient unloading operations.
    - Safe cargo handling at both loading and unloading ports.
    - Delivery of cargo to receivers in the same apparent good order and condition as when loaded.

2. Regulatory references and Safety Access. The IMO CSS Code and MSC Circular 1353 (Revised Guidelines for Cargo Securing Manual) include provisions for Cargo Safe Access Plans for vessels carrying containers on deck. Regulation 25-1 of the International Convention on Load Lines 1966 (as amended by the 1988 Protocol) requires safe crew passage on board. Each vessel must:

- Ensure safe access to cargo stows in compartments at sea and in port.
- Prepare a ship-specific plan based on cargo parcels
- Present and discuss access points with vessel and shore personnel before unloading operations.

Under-Coaming Stowage Guidelines

1. All under-coaming cargoes at the port must be off-loaded using vertical lifting to ensure safety and prevent damage. If vertical lifting is not possible, lifting wires of cranes may get damaged by contact with coamings and their edges. The cargo may swing while lifted, causing harm to the cargo, ship structure, or stevedores. To avoid these risks, forklift trucks are used to move cargo from under-coaming areas into the hatch square, where plumb-lifting by crane can be performed safely.

2. Cargo units and bundles in under-coaming areas must be stable and have adequate dunnage between tiers and depending on the type of cargo as outlined in the specific guidelines. Specific cargoes may need to be pre-slung. Appropriate stowage orientation should also be considered to allow direct access to cargo. All cargo specific guidelines are developed to ensure safe and efficient discharge operations.

Bundling Guidelines

1. Bundling plays a key role in cargo handling operations at ports, particularly for steel cargo such as rebars, wire rod coils, small-diameter pipes, cold-rolled steel plates, steel coils, and certain structural steel units (e.g., H-beams, I-beams). Bundling steel cargo allows for faster handling, though not necessarily safer operations.

2. For bundling steel cargo units, wires with bulldog grips, bundling wires, and flexible metal bands (straps) are commonly used. When using bundling wires, the ends must be properly twisted by at **least four turns**. Care should be taken during twisting to avoid injury, and wires must be sufficiently tightened to form a compact secured unit. Slack bundles pose risk of cargo slipping during handling. Improper bundling can cause units to loosen during transit, leading to unstable stowage, prone to shifting.

3. When high-tensile flexible metal bands are used in cargoes, they should be secured and tightened with pneumatic tools such as tensioners or sealers. Bands must

never be tightened by hand. The strap ends should be sealed pneumatically using compressive metal joints. Metal bands vary in width and thickness. These specifications must be known to calculate their breaking strength. For heavy steel coils exceeding 15 tonnes, the number of straps may need to be increased to five or more in a transverse orientation with two to three circumferential straps. Coils with insufficient or broken straps should not be accepted for loading.

4. High-strength polyester straps may also be used for bundling ingots and billets due to their higher elongation properties compared to steel bands. The breaking strength of polyester straps should match that of metal straps—approximately 2.5 kg/cm². Whether using steel or polyester strapping, ensure they remain within their working load bearing range when applied.

5. For high-quality steel products such as steel coils and plates, all cargo edges must be properly protected to prevent mechanical damage. Bundling also facilitates the use of tipping hooks during off-loading, allowing lifting slings to pass underneath cargo units. Unless specifically certified, bundling wires must never be used for overhead lifting.

6. The number of bundling wires should be sufficient to create a compact cargo unit for secure stowage. Wire rods in coils (WRICs) are typically bundled with four steel wires or occasionally strapping bands. These wires or bands are not designed for lifting and should not be used for that purpose. Regional port regulations require each WRIC to be bundled with five equally spaced double wires, each secured with at least four twists. This prevents crushing of lower tiers and ensures a tight stow without risk of collapse. If straps are used, five bundles should also be applied.

7. Steel pipes of various diameters may be bundled with dunnage to form a single cargo unit for easier stowage and handling. Detailed schematics are provided in individual steel cargo guidelines. Bundling small-diameter pipes is usually done with steel strapping which must be tightly applied to avoid loose bundles. Alternatively, square-shaped bundles may be formed using dunnage between tiers.

Dunnage Guidelines

1. Dunnage plays an integral role during the loading and off-loading of cargoes. Dunnage is required for the following:

- Increases the friction between cargoes and prevents shifting.
- Distributes the weight of cargo on the tank top.
- Secures the cargo into one block.
- Protects and secures cargo units.
- Prevents deformation of long cargo units.
- Protects ship's plating, structures and frames.
- Levels the cargo on the tank-top and subsequent tiers.
- Segregates cargo units.
- Assists ventilation throughout the cargo hold.
- Allow sweat drainage to the tank top level.
- Assists in the slinging of the cargo for off-loading.
- Allow access for the tangs of forklift trucks without causing damage.

2. To meet the above expectations in accordance with industry best practices[1], dunnage wood must be in the following condition:

- Free of bark, oil, and moisture.
- Uniformly shaped and formed.
- Fumigated and pest free
- Not mixed between hardwood and softwood
- Certified in accordance with ISPM 15 Regulations of Wood Packaging material in International Trade.

3. Hardwood dunnage should be used on the tank top and throughout the first six tiers of rebars, primarily to withstand the cumulative weight of all tiers above.

4. Different cargo types require specific dunnage in terms of size, shape, and structure. These requirements are addressed in the respective sections for each type of cargo.

[1] Lloyd's Practical Shipping Guides – Steel: Carriage By Sea, 5th Edition 2009 (A. Sparks & F. Coppers).

5. Timber dunnage must be laid athwartships or in the fore-and-aft direction but always perpendicular to the cargo units. Before loading, dunnage should be placed on the tank top in sufficient quantity to effectively support the cargo weight and evenly distribute it. Dunnage should be spaced at intervals depending on the type of steel cargo loaded. The size of the dunnage boards also depends on the cargo being loaded. Dunnage must always be used on sloped areas of hopper tanks and on the bulkheads of cargo compartments.

6. The guidelines refer to softwood and hardwood dunnage. The basic rule of thumb is that hardwood should not crush under the weight of cargo units. Dunnage must be fit for purpose. The distinction between softwood and hardwood depends on the wood's geographical origin and density. For example, the National Wooden Pallet and Container Association has issued Uniform Standards for Wood Pallets, describing five types of wood by hardness for North America and Europe. For the Asian region, wood used as dunnage should also be certified as softwood or hardwood, or classified by density (high, medium, or low).

7. Steel cargoes tend to shift if not correctly dunnage as there is very little friction between steel products stacked directly on top of each other. This can result in cargo shifting at very small angles of roll. The use of dunnage increases friction between surfaces and therefore reduces the tendency of cargo to shift during the sea voyage. Certain steel cargoes such as steel coils, steel pipes, and structural steel may require additional dunnage constructions to prevent shifting during heavy rolling periods. These constructions require planning and schematics to ensure proper fabrication.

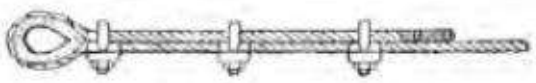
8. Certain steel cargoes such as wire rod in coils, ingots in bundles, and T-ingots, are better stowed using plywood boards. The respective guidelines provide further details. If dunnage is not dry, it may introduce moisture into the cargo compartment. Dunnage with a moisture content above 14% should not be used. When loading heavy cargo units, dunnage may be damaged and causing cargo to shift or sustain damage. At the discharge port, crushed dunnage poses a safety hazard for stevedores and complicates cargo handling during off-loading.

Lashing Guidelines

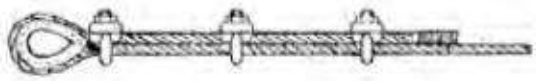
1. The primary purpose of lashing is to prevent cargo from shifting and compromise the safety of the voyage. When properly stowed, cargoes should be secured as a single unified block and fastened to the vessel's hull or designated securing points when possible. Bulk carriers typically lack securing points within cargo holds; therefore, lashing steel cargoes on these vessels requires additional care and scrutiny.

2. Lashing practices are generally consistent across all cargoes guided by globally accepted industry principles. All lashings must comply with the vessel's Cargo Securing Manual and the CSS Code. A comprehensive lashing and securing plan should be prepared prior to loading, including calculations of maximum expected forces during the voyage where required.

3. According to the American Club's publication *Transport Guidance for Steel Cargoes*, 16 mm (6x12) wires with bulldog clips, turnbuckles, and shackles are commonly used for lashing steel cargoes. For wires up to 19 mm in diameter, a minimum of three bulldog grips should be applied at intervals approximately six times the wire diameter, with an allowance of five times the diameter between the last grip and the loose end. The saddle of each grip must be placed on the live (load bearing) wire, and wires should be tightened using rigging screws (UK P&I Club *Best Practice: The Application of Bulldog Grips*).



Right way of applying bulldog grips



Wrong way of applying bulldog grips

Diameter of wire ropes (mm)	**Bulldog grips** (Number)
Up to and including 19	3
Over 19: up to and including 32	4
Over 32: up to and including 38	5
Over 38: up to and including 44	6
Over 44: up to and including 56	7

4. The 7th edition of the Thomas Stowage guidelines suggests that the minimum number of bulldog grips is as follows:

- For wires between 12mm to 17mm: a minimum of 4 grips.
- For wires between 19mm to 24mm: a minimum of 5 grips.
- For wires of 25mm and above: a minimum of 6 grips.

5. It is strongly recommended that the lashing and securing plan be drafted and discussed with all parties prior to loading. The master and crew involved in cargo operations must be familiar with the plan's provisions. All lashings should be executed to the master's satisfaction, relevant documentation, and certification for lashing equipment must be provided before and after completion of the activity.

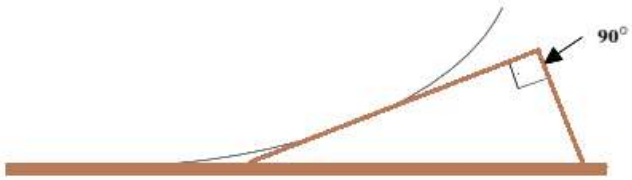
Hot and Cold Rolled Steel Coil Guidelines

i) **General**. Coils are generally of two types – hot rolled coils (HRC) and cold rolled coils (CRC). The HRCs are unfinished products without packing, which will be further processed. The CRCs are finished products ready for direct use when uncoiled. The CRCs are shipped fully wrapped, packed and protected to avoid damage by handling and moisture ingress. Both types of coils are normally secured by metal strapping bands. The coils are secured by several straps (usually four for the HRCs and usually five to six for the CRCs), which are transversely passed through the core. In addition to the transverse straps, coils are also secured by circumferential straps of not less than three for both types of coils. These strapping bands are not designed for lifting and should not be used for this purpose. Coils presented for loading with broken, loose or missing metal straps should not be accepted.

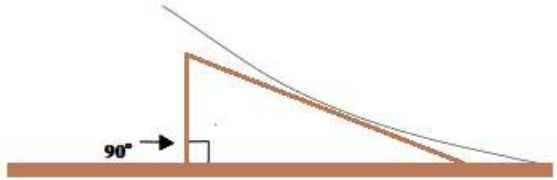
Coils come in various sizes and grades. The weight varies and, generally, coils are more than 7 tonnes and may be up to 30 tonnes per unit. Coil sizes vary from between 1.50 metres and 2.00 metres in length with a maximum outside diameter of approximately 1.50 metres. The lower tier of coils on the tank-top or 'tween deck should be stowed on bark-free dunnage (boards / timber planks). Similarly, timber dunnage should be used on hoppers, in way of side frames or vertical bulkheads. Regardless of the number of tiers, a minimum of two lines per row of coils should be laid on the tank-top for coils of 7 to 15 tonnes in weight and a length of 1.5 metres.

For single-tier coils of between 15 tonnes and up to 22 tonnes in weight and a length of between 1.5 and 2.00 metres, three lines should be used. Where two tiers of coils are stowed, four wood planks should be used. For heavier coils of up to 30 tonnes, four planks are to be used. The cross-section of the planks should be 150mm x 25mm (6" x 1"). The length may vary; however, it is usual for the wood to be approximately 1 to 1.5 metres in length.

Each coil should be resting against an outboard adjacent coil. Dunnage wedges should be placed and nailed on the timber planks pointing to the ship's side to lock in the coils. The right angle of the wedge should be on the top, as indicated on the schematics below. Where one coil from the first tier is locked with two second-tier coils on both sides, there should be wedges on both sides of the first-tier coil.

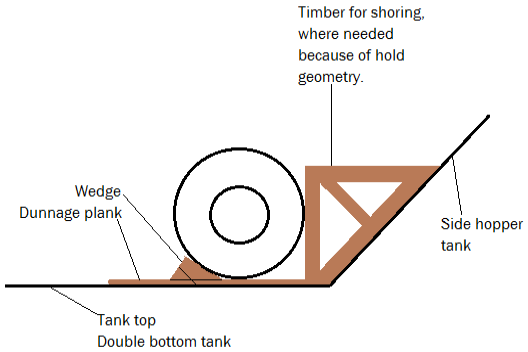


Correct use of the wedge with the right angle on top



Incorrect use of the wedge with the right angle on the plank.

If the coils rest against side frames, proper dunnage must be used, and care must be taken to ensure that the load on the coils is evenly spread along the length to avoid the coil deforming around the frames. This is particularly relevant on the lower tiers, where the weight from the upper tiers pushes the first-tier coils sideways. Timber shoring should be considered for cargo holds with different geometry.



As a result of the geometry of the cargo compartments, dunnage for shoring should be used at the ship's hopper side.

The lashing of the coils is usually carried out with the use of steel strapping bands and dunnage of size between 25mm and 40mm. The safe working load of these strappings is usually approximately 4 tonnes. Steel strapping bands should always be tightened with pneumatic tools and never by hand. Consideration should be given for coils of weight above 15 tonnes to be doubled. The crimp seals of strapping bands can cause damage to the material when pressure is brought upon them, such as when the coils turn in stow or are pressed in stow. When securing coils the lashings should be applied in such a manner as to prevent turning in stow. The lashing of coils stowed in one, two and three tiers in a box-shaped cargo compartment, is shown below:

25mm steel strapping bands for securing coils

Tightening of steel strapping bands with a pneumatic tool. For coils of the size in the photograph, double metal straps should be used for lashing

Coils should be handled with care to prevent scoring, scratching, localised sharp bends and/or damage to the packing of the CRCs. Braided wire slings, nylon slings, clamps, tongs, 'C' hooks and magnets are normally used for this purpose. The handling of CRCs with braided wire slings requires the use of spreaders. Nylon web slings may be used without spreaders.

Nylon web sling

Braided wire sling

When coils of differing dimensions and weights are being stowed, the lighter, smaller coils should be given a top position. Precautions should be taken to ensure that the smaller coils cannot work down too far into the cantlines of the rows of larger coils underneath, as this may cause them to become deformed. Avoid mixing coil widths within the same row, if possible. Coils with failed or insufficient straps must be loaded with the problem rectified. Each first-tier coil should rest against another coil or the adjacent bulkhead. The maximum number of coil tiers is subject to the weight of the coils.

For coils with a weight of 15 tonnes and more, the maximum number of tiers is usually two. Where the coils are lighter, the stow can comprise more tiers; however, the maximum tiers may not exceed three. For coils more than 25 tonnes, one-tier stowage should only be considered. In any event, the maximum uniform loading of the tank-top should never be exceeded.

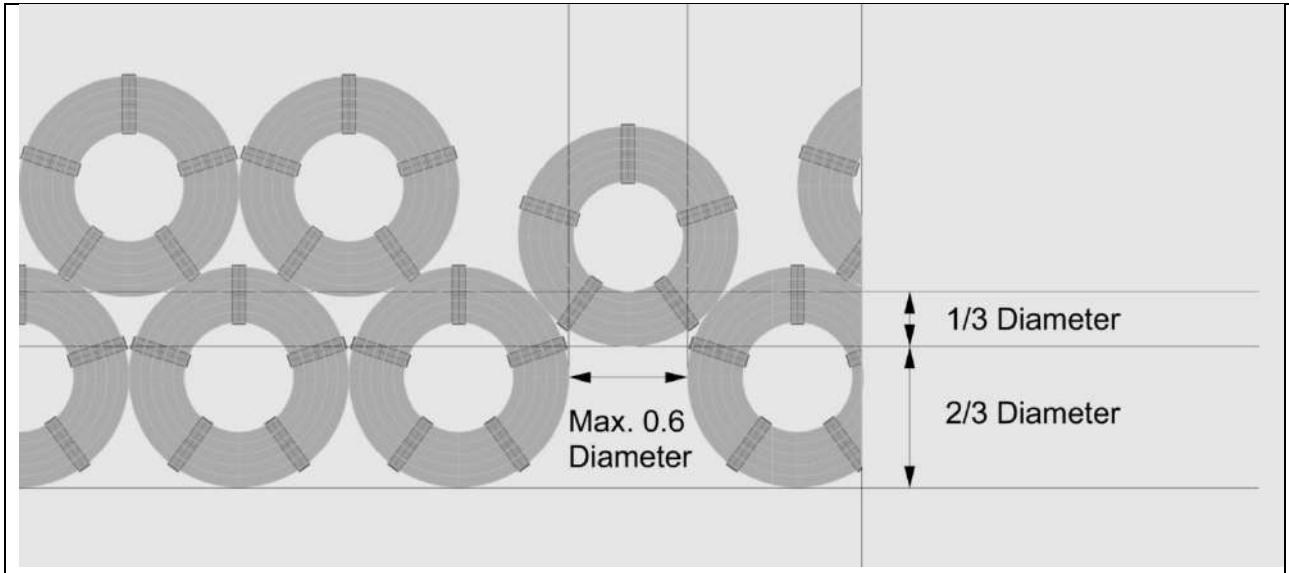
When the stow is not spread across the whole tank-top area, but loaded together with other cargoes, a stow of coils is preferred to be loaded in the aft of the hold. This is because the seagoing trim of a ship is usually by the stern, and the effect of this will manifest itself upon certain aspects connected with the preservation of the stowage as the voyage progresses. When more than one tier of coils is to be loaded in the forward holds (No.1 or No.2) of a bulk carrier where the effects of pounding and pitching are more pronounced, and where the cargo is not a full stow throughout the tank-top, the coils are to be stowed in the aft part of the hold. This will prevent the stow to collapse because of the vessel's movement in adverse weather.

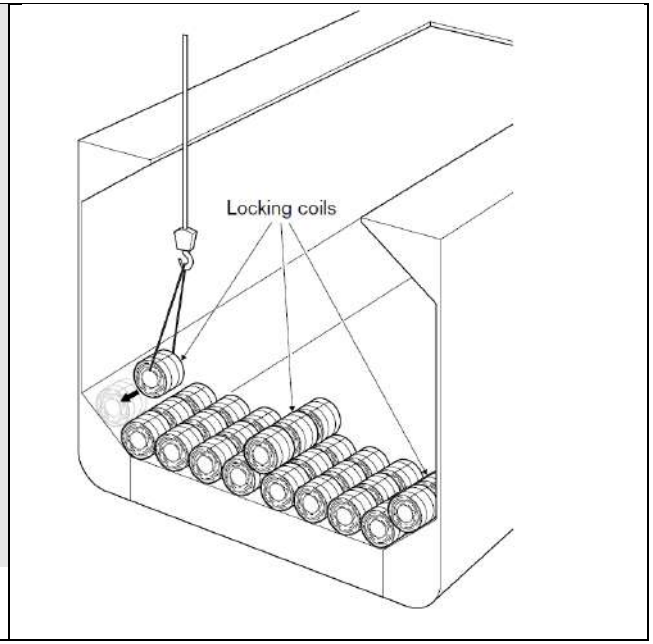
It is preferred to stow coils at least 2 tiers high. A single tier of coils nearly always allows movement and, as result, the stow may work loose. If there are insufficient coils to make 2 complete tiers over the whole surface of the hold, the hold should be partially floored out with 2 tiers of coils so that the stow ends in a brow or wall across the hold. However, this is subjected to the allowed tank top loading. The face of the coils should be protected by a minimum gap of 300mm. And strong timber fence when other cargo, such as constructional steel, is stowed adjacent to them.

The first coils loaded are placed in the wings against the bulkhead and then the row is extended inwards towards the centreline of the ship. Invariably, a gap will be left on the centreline and the first coil of the second tier in that row will be placed in that gap. The next coils of the second tier will be placed in the wing above and outboard of the extreme wing coils of the first tier and these three coils, ie the one on the centreline and the one in each wing, will effectively jam and block off the first tier of that row. These three coils are known as the locking coils. The remainder of the second tier in that row will be placed in the cantlines of the coils beneath them. The same procedure is followed for each further tier until the first row has been built up to the required number of tiers

If the coils are to be stowed in a single tier only, the last coil to be placed into stowage should be positioned as a locking coil, at a higher level so as to act like a wedge, in the space remaining in the middle of the row that must be of breadth about one-third of the diameter of the coil such that the locking coil will tend to force the coils to port and to starboard outboard. The locking coil will sink a little as the stowage settles during the voyage. The locking coil should be lashed to the two coils supporting it.

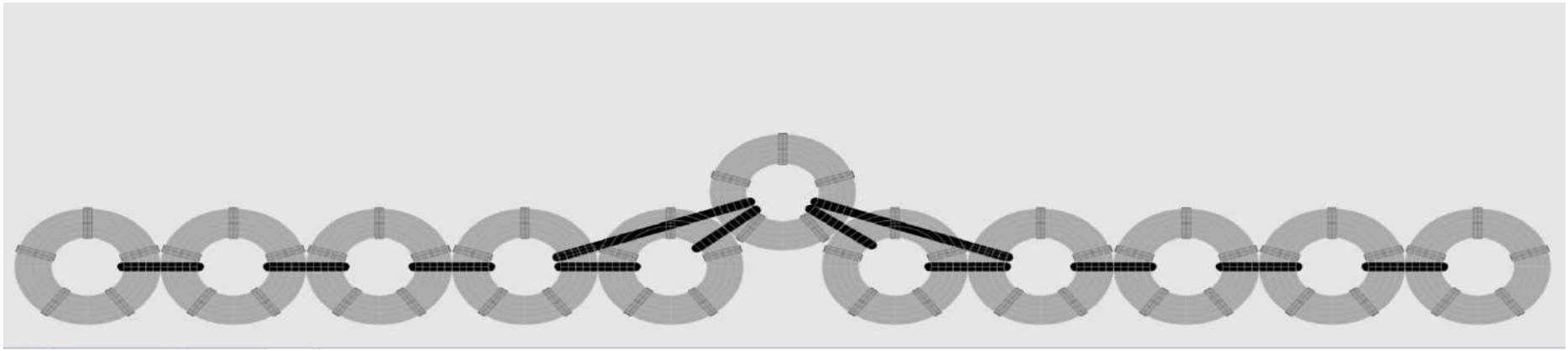
Where there is no space for a locking coil to be used, chocking timber dunnage should be used or shoring between the two adjacent coils in the middle of the row. As a rule of thumb, the use of a locking coil should be considered when the space between two adjacent first-tier coils should be between 30% and 60% of the locking coil width. Another rule is the lower inner edge of the locking coil is to be within the outer and inner edges of the first-tier coils. If there is a longer space left in the middle of the row then that space should be split in two by moving middle coils and then two locking coils should be fitted and lashed in place. Void spaces within the upper tiers should be avoided but, if spaces are unavoidable, then more proper choking with minimum 100mm x 100mm solid wood should be put in place to ensure that the coil stowage is ridged and such that the timber chocking will not be displaced during the voyage.

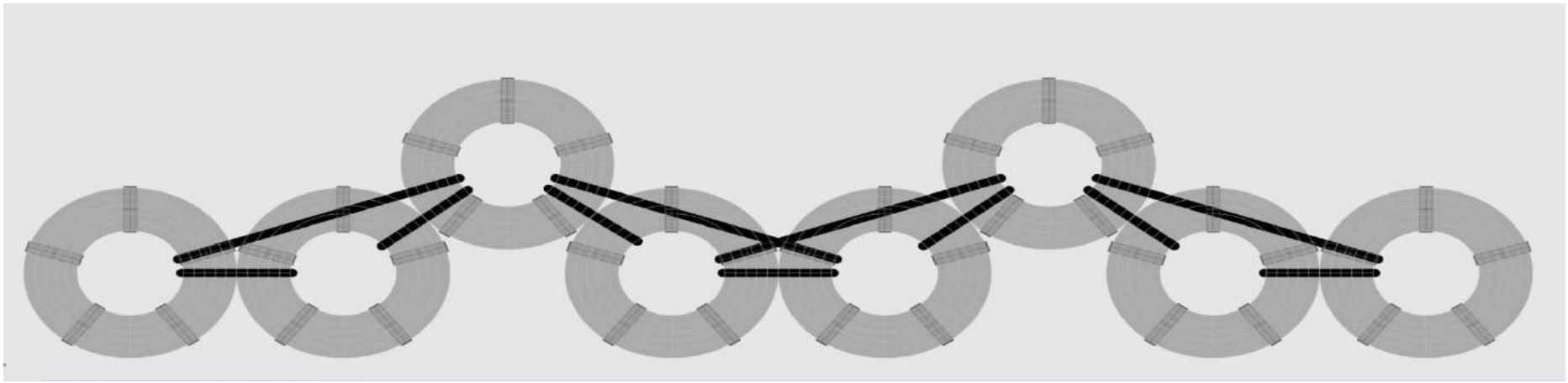




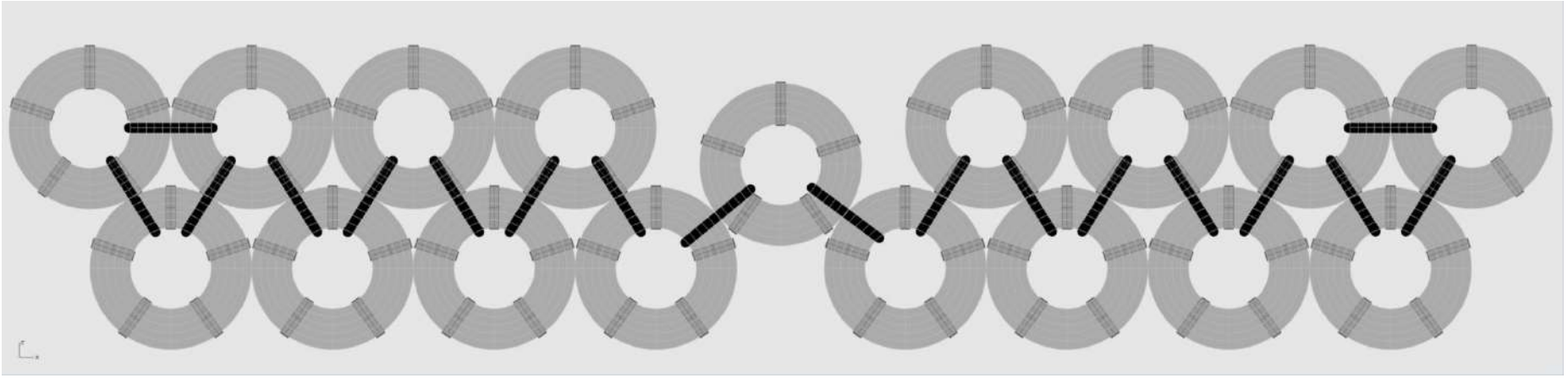
ii) **Open Hatch Condition**. Coils are generally stowed with their axis in a fore-and-aft direction. An athwartships stow should be avoided and is not recommended. According to the industry accepted publication, Thomas' Stowage, coils must be stowed across the full width of the cargo hold and arranged so that the coils are tightly and compactly stowed. Coils may be also stowed with their axis in a vertical direction. The stowage must be uniform and compactly arranged to avoid breakdown of the stow and subsequent crushing and/or disintegration of coils. There should be always spacing of between 150mm and 250mm between two adjacent rows to prevent contact between coils in adjacent rows because this would cause damage:

Stowage and lashing of a single tier of heavy coils with one and two locking coils. Medium heavy and heavy coils between 15 and 25 tonnes can be loaded in one to two tiers. Coils of weight more than 25 tonnes should be loaded in one tier only with one or two locking coils or dunnage structure.

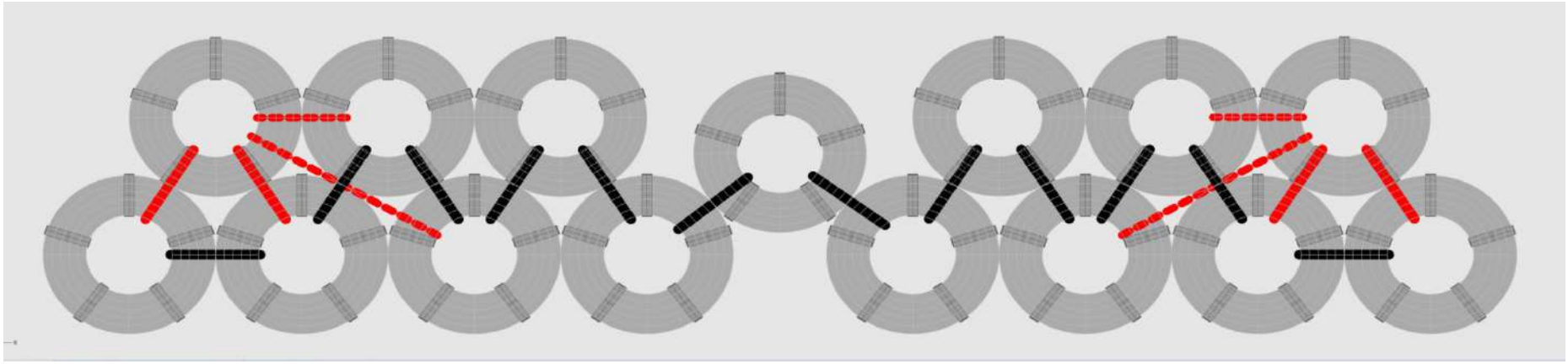




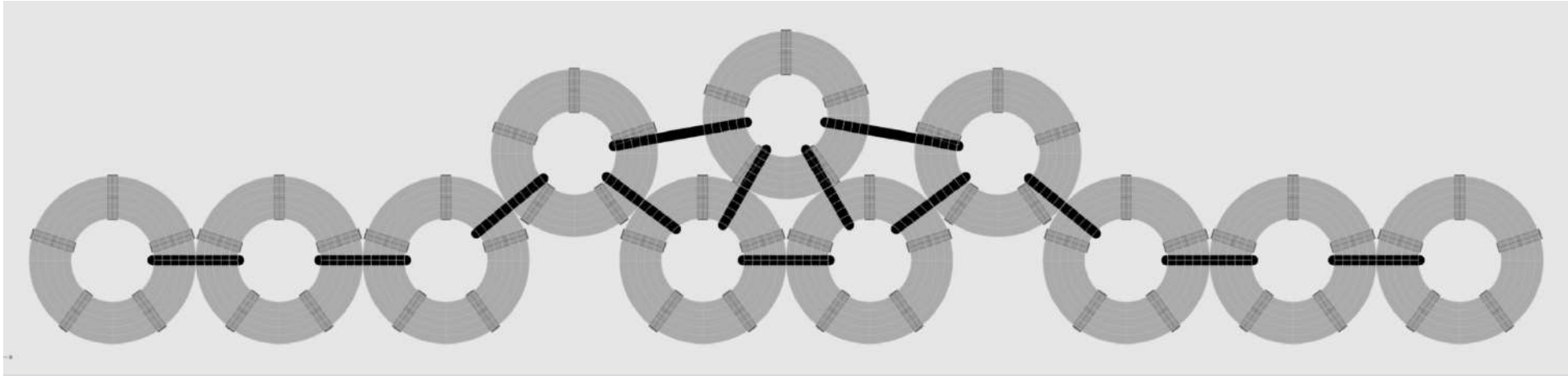
Stowage and lashing of two tiers of coils. Inverted pyramid stow in hopper-type cargo holds.



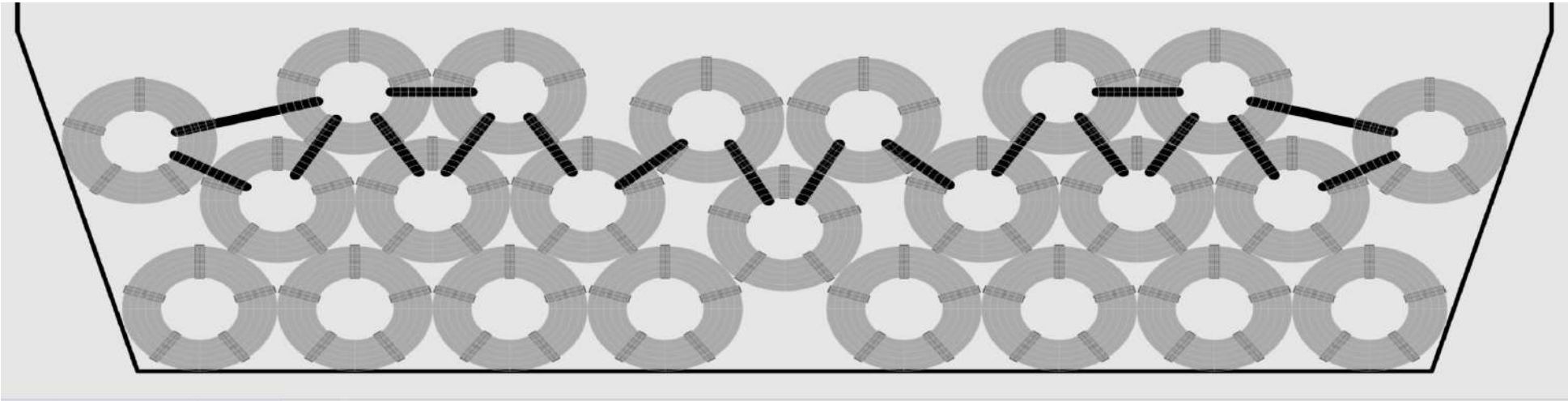
Pyramid stow in hopper-type cargo holds. The two end coils from the second tier must be secured to three adjacent coils from the first and second tier, or three coils from the first tier only. The red-dotted line indicates that only one lashing is required and not both.

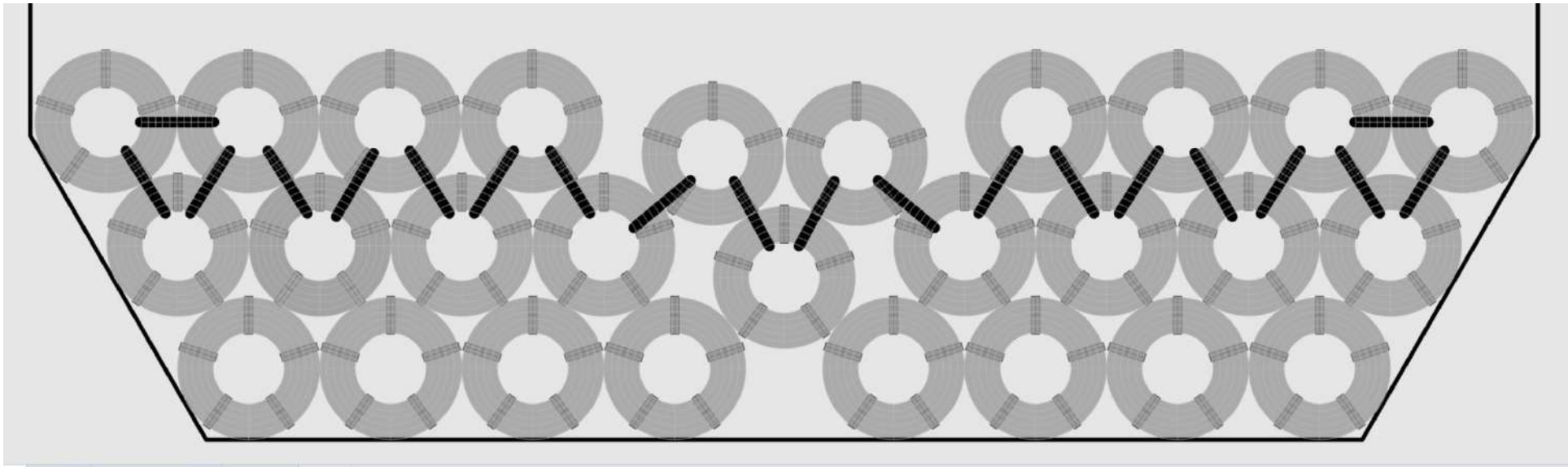


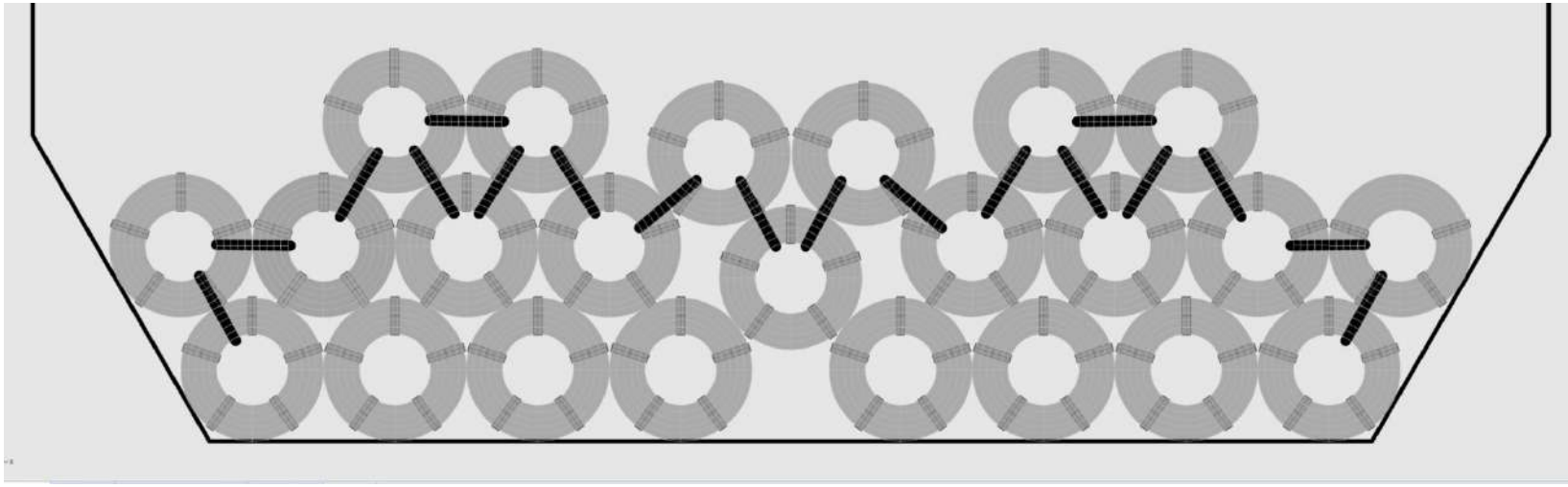
Stowage and lashing of an incomplete second tier of coils with two locking coils.



Stowage and lashing of three-tier coils. This loading pattern is to be applied for light and medium light coils of up to 15 tonnes of unit weight.







			
CRCs stored in a warehouse prior to the loading.	✓	✓	HRCs stored in a warehouse prior to the loading.
			
CRCs alongside vessel prior to shipment.	✓	✗	CRCs delivered by a barge.

First tier of coils. Correct place of the wooden wedge on the dunnage plank. Incorrect positioning with the right angle down.

First tier of coils. Correct place of the wooden wedge on the dunnage plank. Incorrect positioning with the right angle down.

First tier of coils. Incorrect place of the wooden wedge on the tank-top.

First tier of coils. Correct place of the wooden wedge on the tank-top. Correct positioning with the right angle up.

			
Dunnage used for shoring of HRC. The shoring structure should be as one block with the front and aft parts. Incorrect use of the bottom wedge.	✗	✗	Dunnage used for shoring of CRC. The shoring structure should be as one block with the front and aft parts. Incorrect use of the wooden wedges.
			
Insufficient securing of the dunnage for shoring in one block. Shifted dunnage during the passage.	✗	✓	Correct loading and pyramid stowage of CRCs in fore-and-aft direction in hopper-type cargo hold with flaring of the coils.

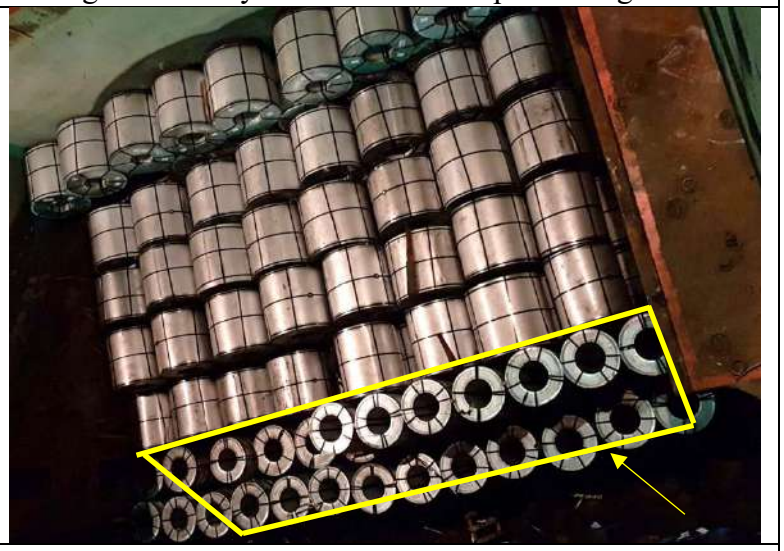
			
First row of HRCs loaded with a locking coil. The locking coil is not positioned in the middle of the row because of the access ladder.	✓	✓	One tier of HRCs with a locking coil in the middle of the row.
			
The first tier of coils is loaded too close to the forward bulkhead without dunnage.	✗	✗	Missing dunnage between the coil and the bulkhead.

			
Use of forklift truck with a pole to stow the coils.	✓	✓	Homogeneous stow of HRCs prior to the lashing. Sufficient space between the rows allowing for the slings to be passed through the coils.
			
The HRCs have irregular and insufficient transverse metal straps. Such coils should not be accepted for loading.	✗	✗	Box-type cargo compartment. A single-tier stow of HRCs without locking coils. The second tier is not complete.

A good pyramid stow of CRCs in the aftmost part of a hopper-type cargo hold.

Pyramid stow of CRCs with a third tier of coils with good lashing. The heavy coils are not on top of the lighter ones.

Locking coils or chocking dunnage must be placed on the first-tier coils in the centre.

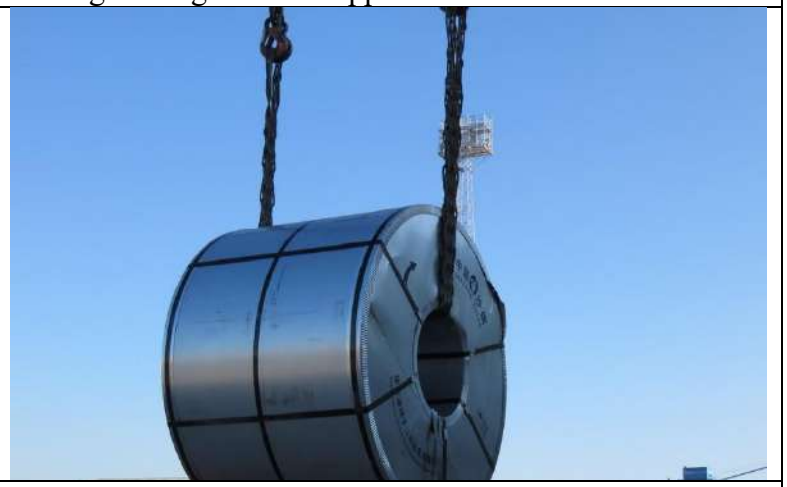


Eye to the sky stowage of coils requires extensive securing and dunnaging.

Correct securing of the locking coils for homogeneous cargo stow in one hold.

Properly stowed coils with the lighter coils on top of the heavier coils. However, no use of wooden wedges and shoring dunnage on the hopper tanks.

Handling of HRCs with long braided wire slings without a spreader, which is acceptable. This is not acceptable for CRCs.

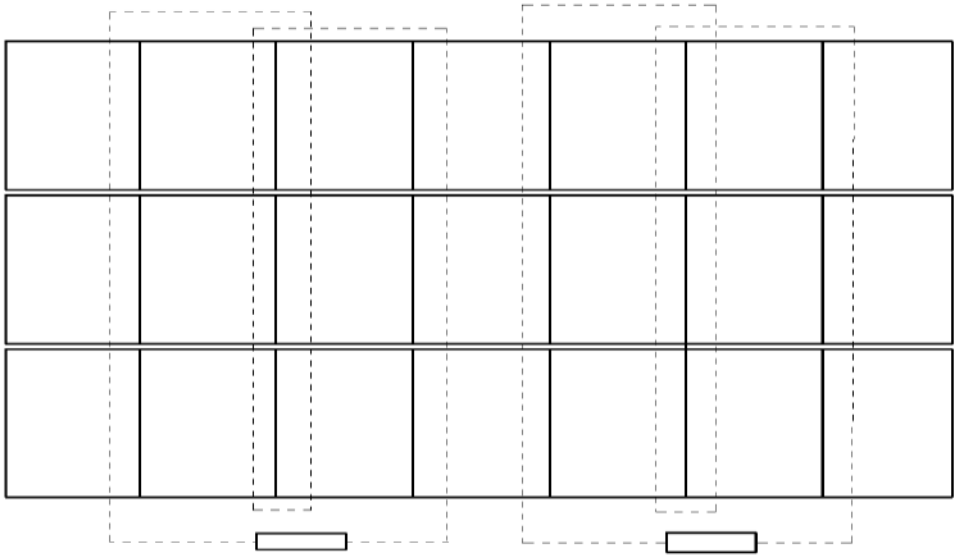


Handling of CRCs with braided wire slings and a spreader.

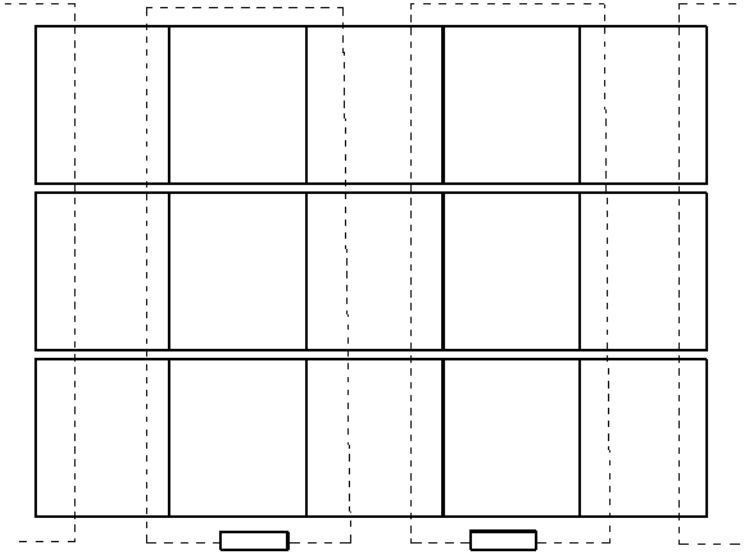
iii) **Under-Coaming Area**. For homogeneous cargo loaded throughout the cargo hold in bulk carriers, coils stowed under the coamings cannot be directly lifted by using the vertical plumb of the crane's wire. These coils need to be pulled into the hatch square using forklift trucks, manoeuvring on the tank-top within the hatch square, layer by layer. For coils stowed with the axis in a fore-and-aft direction in the hopper areas, there is no direct lift for the forklift trucks and the possibility of damaging the cargo is increased. In this situation, the forklift truck should use nylon web or braided wire slings to handle and re-position the coils.

When the cargo does not form a full load in one hold, to prevent fore-and-aft shifting of the coils, the upper tier of coils must be lashed using one of the following two arrangements:

- Two and three coils from the second or third tiers in adjacent rows should also be lashed together to prevent the coils from shifting longitudinally.
- Wires with turnbuckles or rigging screws are used. Alternatively, metal strap banding with pneumatically tightened clamps is the more usual option.
- Two and three coils from the second or third tiers in adjacent rows should also be strapped together to prevent the coils from shifting longitudinally.



Olympic method of lashing with wires or metal strap bands.



Group method of lashing with wires or metal strap banding.

iv) **On Deck Area**. Coils are primarily designed to be stowed in a vessel cargo hold and not on the open deck. This practice is a standard safety and cargo preservation measure to prevent damage to the cargo and ship stability. Hence, it is **not recommended** to stow coils on deck.

v) **Summary.**

S/N	Description	Remarks
1	The maximum number of coil tiers will be determined by the maximum uniformed loading of the tank top.	
2	Cargo of coils should not be overloaded with other cargoes. Coils should not be loaded on top of other cargoes.	
3	Two adjacent coil tiers should have space to allow for passing the slings through the coils.	
4	Depending on the width of the coils, two, three or four wooden planks should be laid on the tank top. The size of the planks should be 150mm x 25mm (6" x 1").	The length of the planks should allow for locking wooden wedges to be placed under the coils.
5	Wooden wedges must be used to lock the coils from the inboard side of the coils.	
6	Each end coil on the first tier should rest on dunnage placed on the side bulkhead and the adjacent coil. The other coils should rest on two adjacent coils.	Dunnage between tiers is not required.
7	The first tier of coils must be locked with one or two locking coils, depending on the space. Where a locking coil cannot be used, proper timber dunnage between two adjacent coils should be used.	
8	For second-tier coils, each end coil must be lashed to three adjacent coils, one from the second tier and the two lower-tier coils. Alternatively, the coil should be lashed to the three lower-tier coils.	

Ingots, Billets, Blooms, and Slabs Guidelines

i) **General**. Ingots are an unfinished product that is usually shipped in various sizes and weights. Ingots may be made of steel, Zinc, aluminum, lead, copper or combination of various alloys. Billets and slabs are semi-finished products made from ingots.

Billets are normally shipped as unwrapped and unprotected cargo units. Their usual size is about 150mm x 150mm and can be up to 12 metres long. A single billet weight may be up to 1 ton. The billets may be bundled with the use of wire rod, thus forming heavy units with a small stowage factor.

Blooms may be of square or circular cross-section. These are also shipped, unwrapped and unprotected. The usual size is 230mm x 230mm. A single bloom may weigh up to 2.5 tonnes and up to 6 metres in length. Each bloom is heavy and should be handled with care. Circular aluminum blooms may be bundled together with the dunnage, for ease of handling with forklift trucks. Bundling is usually made with high-tensile metal strapping or high-strength polyester strapping of approximately 19mm wide and 1 tonne breaking strength.Slabs are usually made to a pre-determined specification. The unit size is typically 250mm thick and 2500mm wide. The length varies and a unit weight may reach 20 tonnes. Slabs are not bundled.

Billets

Square Blooms

Slabs

Ingots, billets, blooms and slabs tend to shift, if dunnage is not provided correctly, as there is very little friction between units laid directly atop each other. T-ingots and slabs are typically carried loose. Smaller ingots, blooms and billets may be strapped in tight bundles or packages. In accordance with industry good practice, good, dry, hardwood dunnage should be used throughout, as softwood dunnage is too easily crushed or damaged.

Dunnage should be laid in rows on the tank-top in an athwartships direction under each row. Generally, 150mm x 150mm is the minimum preferred cross-section to be utilized at the tank-top to provide resistance to the weight of the stow. Dunnage should be placed between individual tiers. Wooden chocks should also be placed between the units and bundles/packages on every tier. The cargo is generally heavy and, therefore, care must be exercised for the tank-top strength. Dunnage may also compress in transit and cause the cargo stow to loosen and shift.

Because of the size and weight of the ingots, these should preferably be loaded in a box-type cargo compartment only, and across its full width. Where there are gaps between the cargo units, proper dunnage choking should be applied. Similar dunnage should be placed against the inner shell plating and bulkheads and the internal vertical frames. The higher or heavier the intended stow, the more dunnage should be used on the tank-top and in the lower tiers.

For the loading of T-ingots, thick plywood dunnage may be used on the tank-top for the first tier of cargo. The reason for this is to provide sufficient friction between the cargo units and the tank-top, while the weight is distributed over a large surface area and not only on dunnage boards. It is also recommended that plywood sheets are used for the subsequent tiers.

For the loading of ingot bundles and because of their size, it is usually easy to make a compact stow throughout the width of a box-type cargo compartment. Dunnage should be used to protect the bulkheads and frames. If the stow is not tight, dunnage chocking should be applied where necessary to avoid loose bundles and prevent shifting.

For the loading of billets, blooms and slabs, plywood dunnage sheets should not be used. For bulk carriers, dunnage must be placed on the hopper tanks and should be sufficient to provide effective protection for ship and cargo in the event of heavy weather on voyage.

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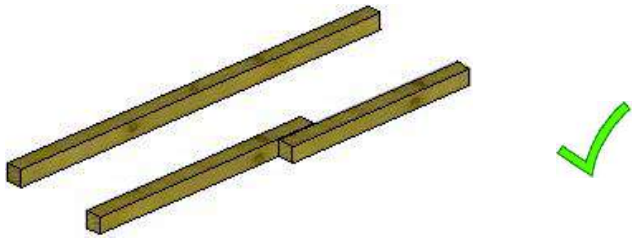
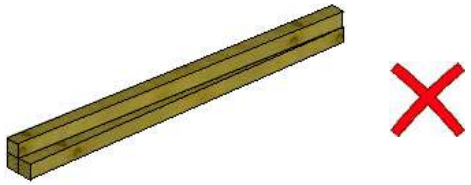
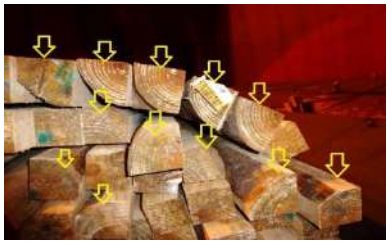
<tr>
<td>  </td>
<td> 
  </td>
</tr>
<tr>
<td>Square one-layer dunnage should only be used.</td>
<td>Double- stacked, rectangular dunnage or 1 on 2 stack dunnage arrangement should not be used. Rounded timber, timber with damaged or crushed corners, or non-square face dunnage should not be used.</td>
</tr>
</table>

When the cargo of ingots is stowed across the full width of the cargo hold, the stow is prevented from shifting by the friction resistance of the timber dunnage used and chocking timber dunnage used to block the top tier. Wire or chain lashings may not be used for a stow of ingots if loaded throughout the width of a box-type cargo compartment.

For stows of billets, blooms and slabs, this type of lashing is important to secure the stow in a single block and prevent the initial movement. All lashings must be tight and well made. The Master should be supplied with certificates for all the lashing equipment used. Steel billet and bloom should be stowed in a fore and aft direction.

Metal strapping bands for steel slabs should not be encouraged as they are used in block stowage of bundles of steel slabs by direct loading into the hatch squares of bulk carriers, leaving the space above the sloping lower wing tanks free of cargo. Whatever lashing or securing is used in these circumstances, there is still the potential for a shift of cargo. It is of paramount importance that the stowage extends out to the ship's sides and that the top of the stowage is level. The only alternative would be to construct, and weld in position, substantial steel framing between the ship's side and the cargo above the sloping lower wing tanks. There is no objection to using block stowage methods in ships with box-shaped holds as long as the stowage extends to the full width of the ship and again the top of the stowage is level.

An appropriate number of lashing wires or chains should be laid in an athwartships direction on the tank-top in preparation for being passed back over the stow to secure the cargo in one block. Metal steel straps are not recommended to be used for lashing, particularly for heavier units. Because of their weight, the dunnage tends to compress and to loosen the ingots' stow (UK P&I Club "Carefully to Carry").

All cargo should be stowed in accordance with the IMO Code of Safe Practice for Cargo Stowage and Securing (CSS Code). Bundled or palletised ingots may be stowed athwartships to suit the loading requirements. Where individual or bundled ingots are to be stowed over the sloped hopper tanks of bulk carriers, proper dunnage foundation structure should be built to protect the structural integrity of the tanks and to keep the stow upright. T-ingots may gradually wing over the hopper tanks. The stowage should start from the sides towards the middle of the cargo holds.

Steel is a heavy cargo, and the cargo hold tank-top loading limits must be considered when loading. The maximum height of the stow will depend on the allowable cargo compartment load limit determined by the shipyard and confirmed by the Classification Society when the vessel was built. It should be remembered that this limit was calculated when the vessel was new; for older ships, with normal wear and tear on the tank-top plating and associated under-deck stiffening, it is prudent to allow a safety margin.

ii) **Open Hatch Condition**. Slabs, billets and blooms may be loaded in the fore-and-aft direction, as well as athwartships. The weight should be evenly distributed throughout the cargo compartment. Overhung first-tier cargo units, slabs must be supported underneath by solid dunnage constructions to allow proper weight distribution and allocation. Any timber structure built to support the stow must be free-standing and sufficiently robust to survive the rigours of the voyage. The following describes the recommended images of slabs, billers, and blooms:

Bundled, long round aluminium billets handled with forklift truck and prepared for loading.

Billets stored at the quay, ready for loading.

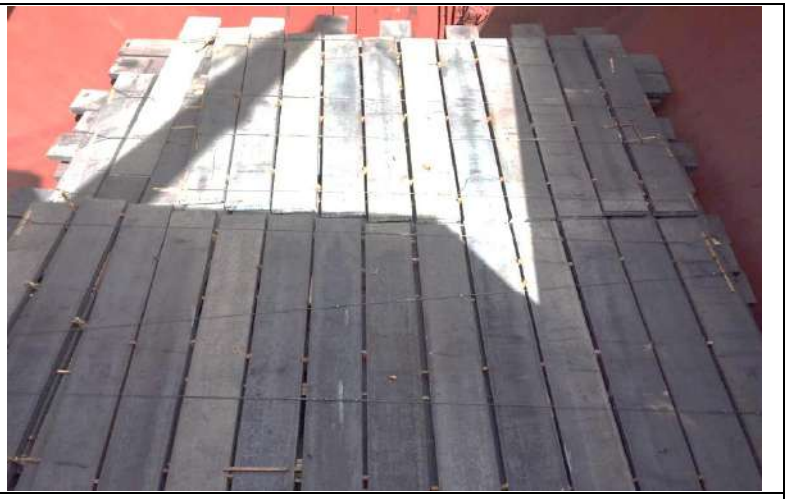
Loading of slabs in progress. Good, square, hardwood dunnage is used between the tiers.

Loading and stowage of slabs in a hopper-type cargo hold. Proper dunnage should be used on the tank-top. The spacing should be a maximum of 2 metres.

An athwartships stow of slabs. Proper use of dunnage.

A fore-and-aft loading of slabs. Proper use of dunnage.

An athwartships stow of slabs. The second tier of slabs is not supported with proper dunnage structure underneath for good weight distribution.



Completed stow of slabs being laid in an athwartships and fore-and-aft directions. The stow is properly lashed with wires, bulldog grips and turnbuckles.

A final stow of long slabs with dunnage and parcel segregation marks. The slabs are winged out over the hopper tanks.

A properly chocked full stow of slabs in a box-type cargo compartment. This stow does not need wire lashing.

Loading billets in a box-type cargo compartment. Hardwood dunnage is laid on the tank top. The spacing does not exceed 1.5 metres. Lashing is prepared.

Loading billets with the use of a single chain-leg basket lift under a spreader.

Dunnage is used between each tier of billets to ensure level tiers and ease of handling with a forklift truck during off-loading.

Loading billets with a spreader and chain slings. Square hardwood dunnage should be used for each tier of billets.

Handling of small-size palletized aluminum ingots. The tiers are segregated by wide wooden planks as dunnage. Each tier is individually levelled. Dunnage is used for gaps.

Proper use of dunnage between the tiers. Dunnage is also used on the side frame construction to ensure proper protection of bulkheads and frames, as well as ensuring vertical stow of the ingots.

Off-loading small-size palletised ingots with the use of a forklift truck.

Handling pre-slung, bundled medium-size ingots.

			
Handling pre-slung, bundled medium-size ingots.	✓	✓	Box-type cargo compartment. Handling pre-slung, bundled medium-size ingots.
			
Handling pre-slung, bundled medium-size ingots. Loading on a trailer for further storage in a warehouse.	✓	✓	T-ingots handled with chain slings at Jurong Port.

Handling of unbundled heavy T-ingots at Jurong Port with the use of a chain sling.

Jurong Port. Pre-slung T-ingots for first off-loading. Once the first units are removed, the remaining units are handled with a forklift truck.

Jurong Port. The use of a forklift truck for the off-loading of T-ingots from a box-type cargo compartment. The stow is full and compact.

Jurong Port. Preparation of chain slings for off-loading of ingot bundles.

			
Poor stowage. Cargo stow is not levelled.	✗	✗	No poor choking to fill the gaps.
			
Poor dunnage. Wood dunnage was not used in every tier.	✗	✗	Improper bundling. Ingot bundles loose in the warehouse.

			
Loose bundling straps for ingots.	✗	✗	Bundling straps not tensioned adequately and rounded at the point about half the height of the ingot stow.
			
Loose bundling of ingots.	✗	✗	Collapse of poorly bundled ingots.

iii) **Under-Coaming Area**. All cargoes are off-loaded by vertical lift only. Jurong Port does not use the lifting gear to drag cargo from the wing spaces to the open hatch square. To facilitate the off-loading of such cargo, forklift trucks are utilized. This requires that the units in the centre of the cargo hold be level and the timber dunnage under the plate sufficiently strong to withstand the movement of the forklift truck as it pulls the cargo clear from the wing space to be off-loaded.

Small-size bundled ingots and T-ingots being handled, by a forklift truck, from the wing space.

iv) **On Deck Area**. Stowage of Ingots, Billers, Blooms, Slabs of a vessel is generally discouraged as the ideal stowage position is in the cargo holds because steel is a high-density cargo. Such cargo must not exceed the deck's structural limitations and does not compromise lashing integrity during voyage. Hence, it is **not recommended** to stow Ingots, Billers, Blooms, Slabs on deck.

v) **Summary.**

S/N	Description	Remarks
1	Plywood sheets of dunnage should be used for the loading of T-ingots and ingots in bundles and pallets on the tank-top and between the subsequent tiers.	Wood planks of size 200mm x 20mm may be also used between the tiers of bundled ingots.
2	The tank-top to be prepared with appropriate hardwood dunnage to prevent the billets, blooms and slabs from shifting. The size of the dunnage should be, as a minimum, 150mm x 150mm.	The spacing of the dunnage should not exceed 2 metres.
3	In the cargo compartments, where possible, safe passage shall be provided directly from the ladders to the top of the cargo stow. In bulk carriers, this access shall be provided directly from the Australian ladders	Safe access needs to be provided from tank-top to the top of the cargo stow
4	Lashing wires at a spacing not more than 3 metres to be positioned on the tank-top in preparation for the final lashing of a stow of billets, blooms and slabs.	Where the slabs are loaded across the full width of a box-type cargo compartment, and proper chocking is made, lashing may not necessarily be used.
5	The full stow of ingots may not require lashing; however, proper vertical dunnage for chocking and preventing the stow from shifting should be applied.	
6	All tiers of ingots, billets, blooms and slabs should be stowed level.	

Steel Pipes Guidelines

i) **General**. Steel Pipes are long circular hollow section tubes used for transfer of liquids and gases. They are typically shipped in all sizes, and configurations from bundles of finished steel small-bore pipes to large, cladded pipes. The ends of the pipes may be threaded, beveled, swaged, all of which are prone to damage. Pipes are frequently shipped with protective end covers, which are sometimes supplied loose and, if so, should be fitted prior to loading. Small to medium diameter steel pipes often bundled and usually takes a hexagonal shape depending on the finishing of the pipes. Only pipes of the same diameter should be bundled together. The bundling may also take a square shape, where dunnage is then used between the tiers of the stow. Furthermore, Large diameter pipes will usually be in an unbundled form and loaded as single units.

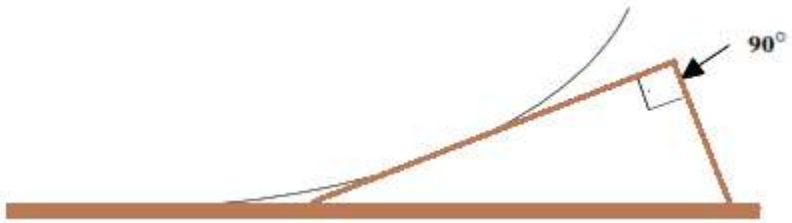
Steel Pipes are strictly stowed **fore-and-aft**, extending across the full width of the cargo hold. However, it is acceptable to stow pipes athwartships in the middle of the stow or across the ends of box-shaped holds, provided that the pipes are of a similar length to the width of the hold. Steel or timber constructions is be required to fit the slope of the hoppers on bulk carriers, particularly in the forward and aft cargo holds where the tank-tops taper – it is not acceptable to fan-out the stowage of pipes to fit with the shape of the hold. JP recommends that Steel Pipes be stowed **EITHER** in dunnage between every layer **OR** pre-slung (arranged with lifting slings before shipping out).

Pre-slung is mandatory and dunnage shall comply with the recommendations specified in the Guideline. Only new slings shall be used for pre-slung, and each sling must be permanently marked with its Safe Working Load (SWL) with an inspection certificate valid for one year by an inspection body accredited to ISO 17020:2012 for lifting equipment inspection or by a certification body recognized under the Mutual Recognition Arrangement (MRA) scheme. Slings certified under these requirements shall only be used once for lifting from vessel to wharf, and for any subsequent lifts, they must be recertified by an Authorized Examiner appointed by the Singapore Ministry of Manpower (MOM). For detailed certification requirements of lifting gear used in Jurong Port, refer to JP Circular No. 45 of 2022.

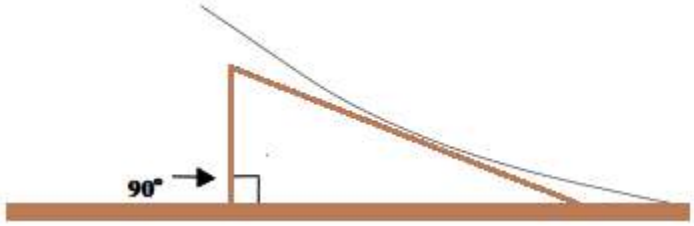
In the ship's hold, bark-free hardwood dunnage must be laid on the tank-top in preparation for loading. The dunnage should be of 25mm x 150mm [1" x 6"] cross-section and laid athwartships, in rows of up to a maximum of 3 metres apart. The first and

last rows should be no more than one metre from the pipes' ends. The dunnage should extend onto the hoppers and side bulkheads. Where the pipes have flanges, bell ends, swaged ends, bevelled ends etc., the dunnage laid at the tank-top should be of square cross-section, of sufficient size, to protect the pipes' ends from damage because of contact with the tank-top. As with other steel products, timber dunnage should be laid athwartships on the tank-top or deck plating so far as possible in line with under-deck athwartships stiffening members.

The exact arrangement for dunnage will depend on the type and weight of the pipes and the number of tiers in the stack. If the stow consists of 8 tiers and more, then the dunnage at the tank-top and between the first 3 tiers should be of hardwood. Softwood dunnage boards must also be laid against the vessel's side structures to prevent steel-on-steel contact and to prevent movement. Dunnage between tiers is a requirement for bundled pipes without certified pre-slung. For single loose pipes, dunnage wood is not always required if pre-slung and pipe hook is acceptable. The top tier requires dunnage between the individual pipes and between the stow and the side bulkheads to prevent horizontal shift. The first tier of large diameter pipes will additionally require wooden wedges on both sides of each pipe to be nailed on the dunnage planks. Such wedges must be positioned at both ends and in the middle of the pipe. No dunnage will be required between the subsequent tiers, as the pipes are stowed in the cantlines of the lower tiers.



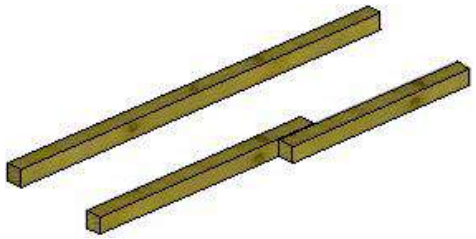
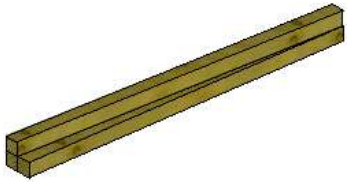
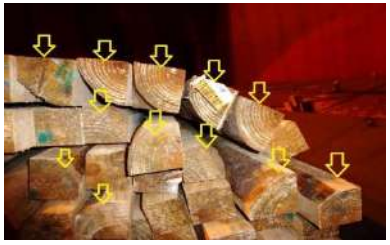
Correctly positioned wooden wedge



Incorrectly positioned wooden wedge

Steel pipes will be stowed in a number of tiers. Second-tier pipes will normally be stowed in the cantlines of the lower-tier pipes. Subsequent tiers are similarly stowed, such that a sort of brick pattern is formed. Number of tiers should be determined based on tank top loading requirements and bottom tier pipe load bearing capacity, as the weight can deform the pipes in the bottom tiers. Dunnage is required between the tiers of single, small to medium diameter pipes, where these are loaded in the under-coaming spaces. This should be 75mm x 75mm square cross-section. Bundles in rectangular or square cross-section form, usually have dunnage within the bundle, allowing for proper stowage. Where no such dunnage exists, dunnage laid athwartships, between the tiers, should be used.

Large diameter pipes usually have bevelled ends, which are highly susceptible to denting or nicking. Extra dunnage and padding must be used at the ends to prevent damage during transit.

<table>
<tr><td>  </td><td>Generally, a minimum of 75mm x 75mm of cross-section dunnage should be used between tiers. At the tank-top, 150mm x 25mm hardwood dunnage should be used.</td><td>  </td></tr>
<tr><td>Good, dry, dunnage should be used for the loading of steel pipes up to the third tier of the stow. ✓</td><td colspan="2">✓ The dunnage is placed as continuous rows spaced at approximately 3 metres.</td></tr>
<tr><td>  ✓</td><td colspan="2">  ✗
  ✗</td></tr>
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</table>

Whenever possible only pipes of the same diameter should be stowed together. This will ensure that the stowage is tight and neat and without any space between pipes in each tier. Such a stowage of same size pipes will, however, require timbering outboard to port and to starboard and such timbering should be substantial and strong. Skimping of such chocking is likely to lead to collapse of the stow.

Where pipes of different diameter have to be stowed together, all gaps between adjacent pipes should be chocked by the use of ample quantities of timber dunnage.

All lashings should conform with the requirements of the vessel's Cargo Securing Manual and the CSS Code. When the cargo is stowed across the full width of the cargo hold, the pipes are prevented from shifting by the friction resistance of the timber dunnage used in the stow and the additional timber dunnage against the bulkheads. Metal straps or nylon web lashings are used to secure the stow in a single block and prevent the initial movement of the pipes. All lashings must be tight and well made. The Master should be supplied with certificates for all the lashing equipment used.

An appropriate number of lashings should be laid in an athwartships direction on the tank-top in preparation for being passed back over the stow to secure the cargo in one block. There are no specific requirements for the minimum number of metal straps to be used; however, For pipes of 6.1m or less, minimum two rows of vertical lashings is considered reasonable. For pipes of 6.1 to 12.2 m or less, a minimum of three rows of vertical lashings shall be placed. Timber or manufactured pipe edge protectors should be used to protect the pipes from damage and reduce the likelihood of chafing.

Metal strapping used for securing of pipes. The tightening should be made with the use of pneumatic tools.

Nylon web strapping used to lash a stow of medium size pipes. The lashing is made only on the top tier of pipes in a box-shape cargo compartment.

For non-coated pipes, wires may be used for lashing. The American Club, in their publication "*Transport Guidance for Steel Cargoes*", consider that, for ease of use, 16mm (6x12) wire rope with bulldog clips, turnbuckles and shackles would normally be used to lash steel cargoes:

.

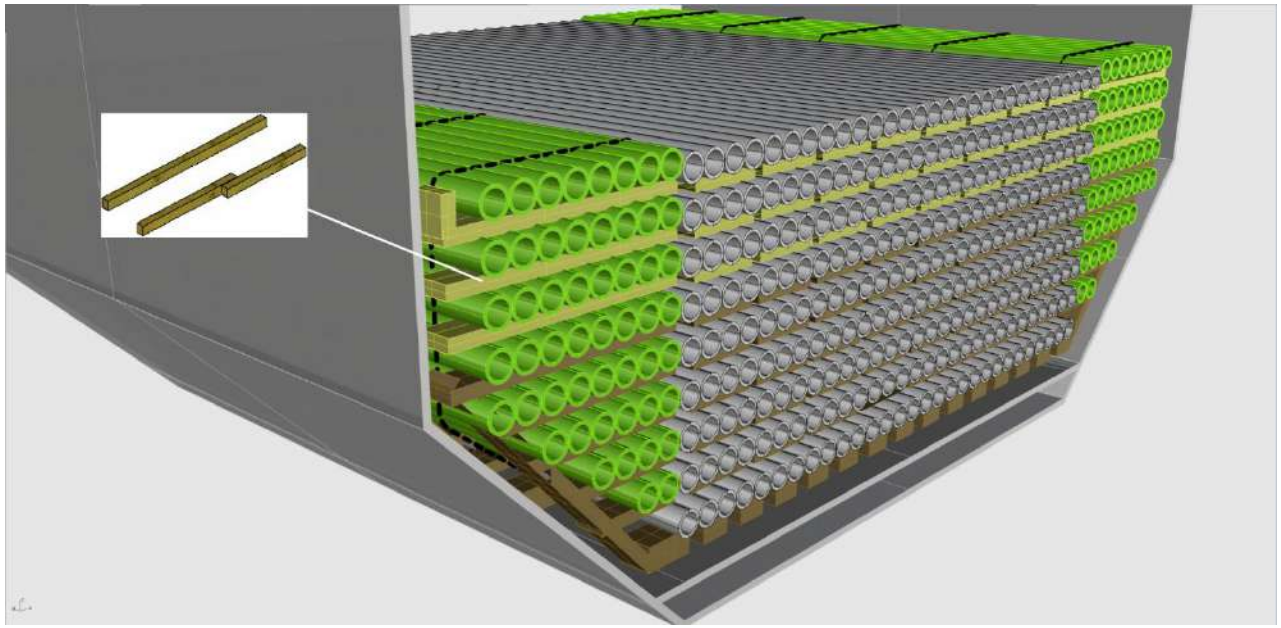
16mm wire rope supplied for lashing cargo.

Bulldog grips and additional 'D' rings for cargo lashings.

Bundled pipes can be discharged using nylon straps, in a basket hitch, and pipe hooks. These are sometimes rigged beneath a spreader, depending on the length of the pipes, or whether the pipes are loose or bundled. For bundled pipes, pre-slinging shall be in place for shifting during the discharging operation. Bundling straps cannot be used for shifting, and sorting hooks cannot be used for overhead lifting. Pipe hooks can also be used for the discharge of medium to large diameter pipes.

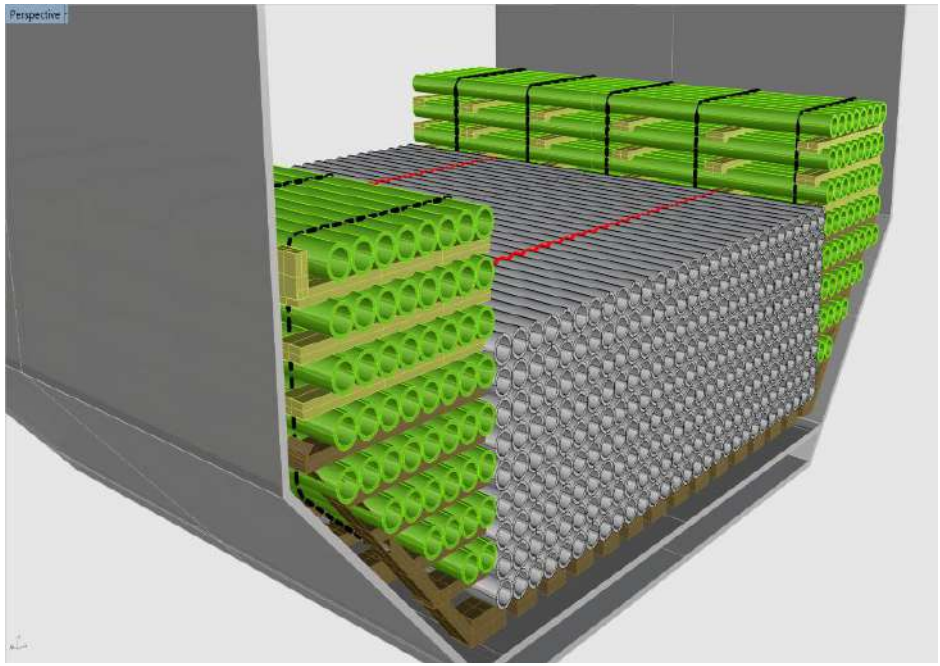
	
• Using pipe hooks to discharge 12in diameter open steel pipes.	• Pipe hooks used to discharge bundled pipes.

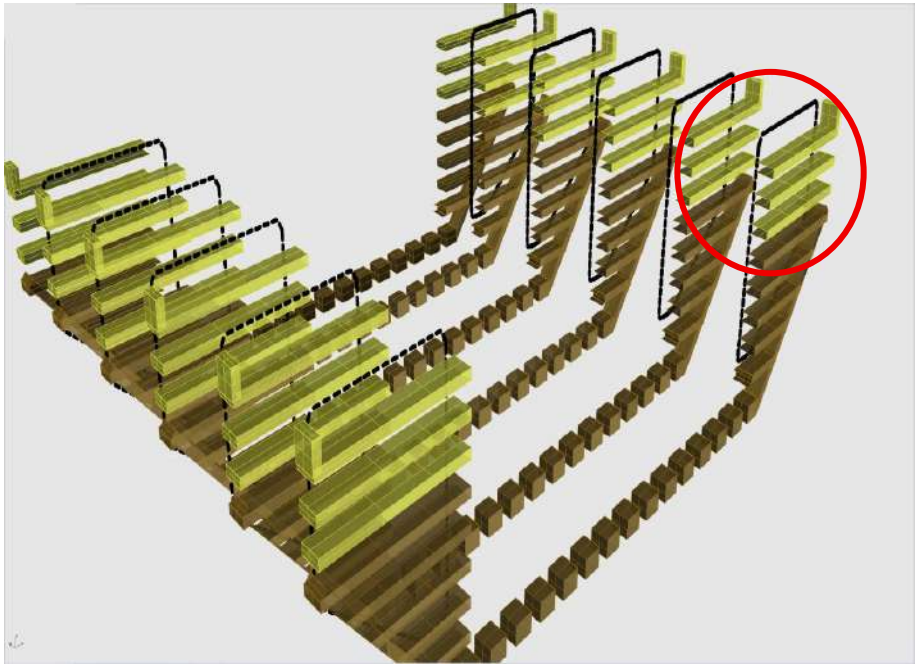
ii) **Open Hatch Condition**. Loose Steel Pipes for every 2 meters of width, softwood dunnage with a minimum thickness of 100 mm is to be placed to maintain adequate spacing with adjacent pipe. One piece of dunnage is to be placed every 3 meters along the length of the pipes. The following describes the recommended schematic and images of steel pipe stow:



	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

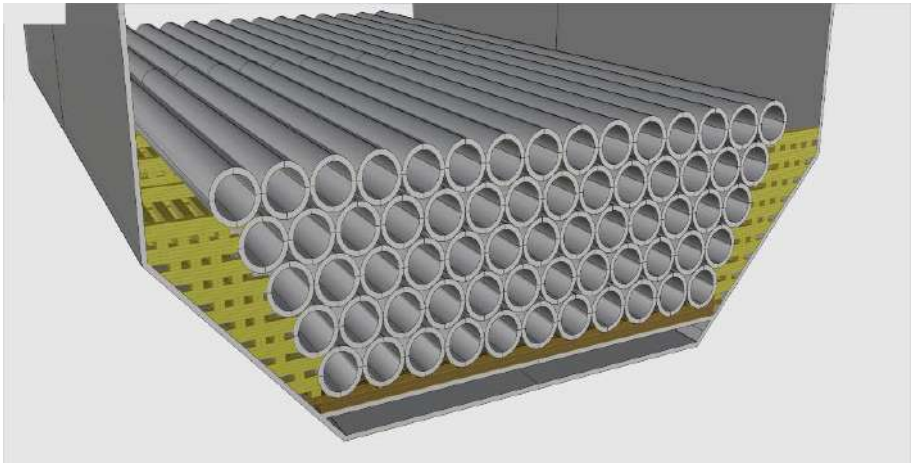
- The first layer of tank-top dunnage should be hardwood of size 150mm x 25mm.
- The subsequent 3 tiers followed by other tiers dunnage should be hardwood of 75mm x 75mm.
- A minimum of two wires or nylon web straps should be positioned on the tank-top and passed athwartships at a spacing of approximately 3 metres.

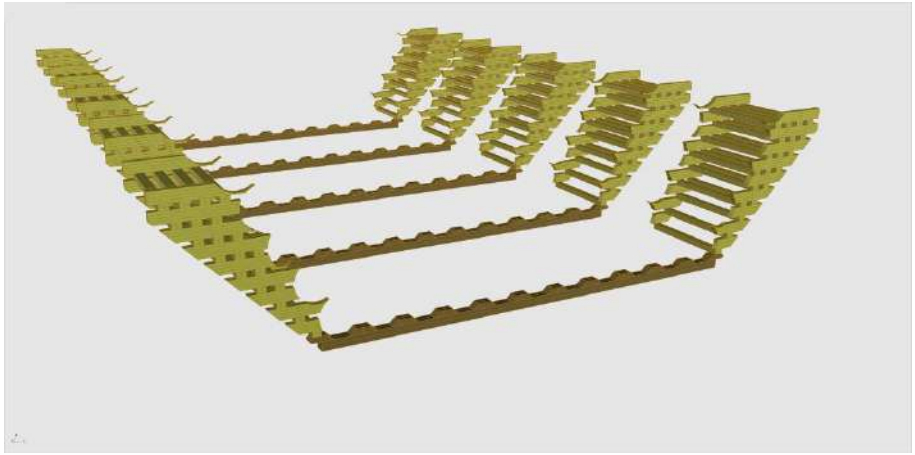




	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

- The stow under the open hatch is lashed separately and does not require dunnage except for the first tier to avoid contact with the tank top.





	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

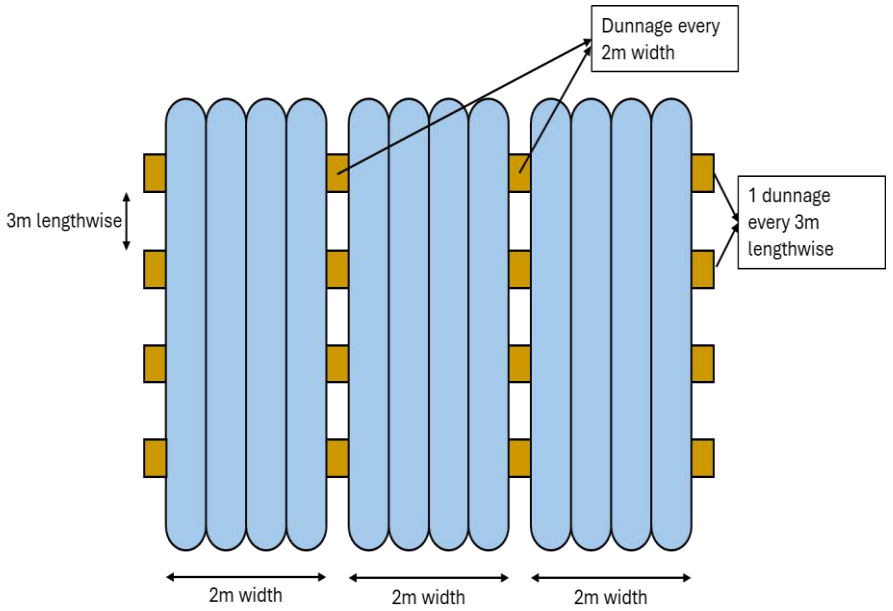
- Indicative schematics of medium or large diameter pipes loaded as a homogeneous stow. Construction of dunnage stool between the stow and the bulkheads.
- Wooden wedges must be used on both sides of each pipe from the first tier. For long pipes, three sets of wedges will be sufficient.

	
Pre-slung bundled and packaged pipes on the quay prior to loading. Note: the pre-slings are for shifting only.	12” diameter pipes, bundled in pairs, pre-slung for shifting and using nylon slings for a basket lift of 8 pipes [4 pairs].
	
Good-quality softwood dunnage boards and wedges to be used on the tank-top or hatch cover. Ideally, the boards would be of 150mm x 25mm cross-section.	Dunnage laid on the tank-top and on subsequent layers of medium size pipes.

	
Pipes being loaded over the ship's rail, using a single wire-leg basket lift under a spreader.	Bundled pre-slung pipes being loaded by basket lift.
	
Loose and badly secured pipes.	Pipes strap-bundled into a hexagon shape, which makes a tight, efficient stow. The bundles, however, should be pre-slung for shifting and discharge.

- No dunnage every 2m width
- No gap to allow sling access

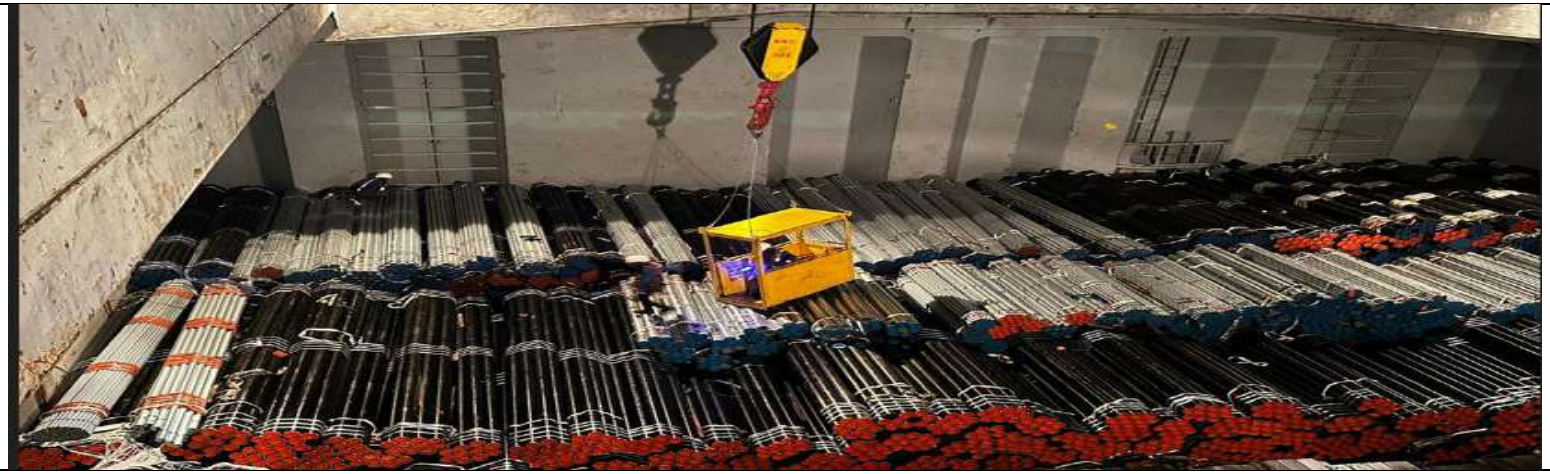
- (Red callout) Dunnage between pipes for sling access



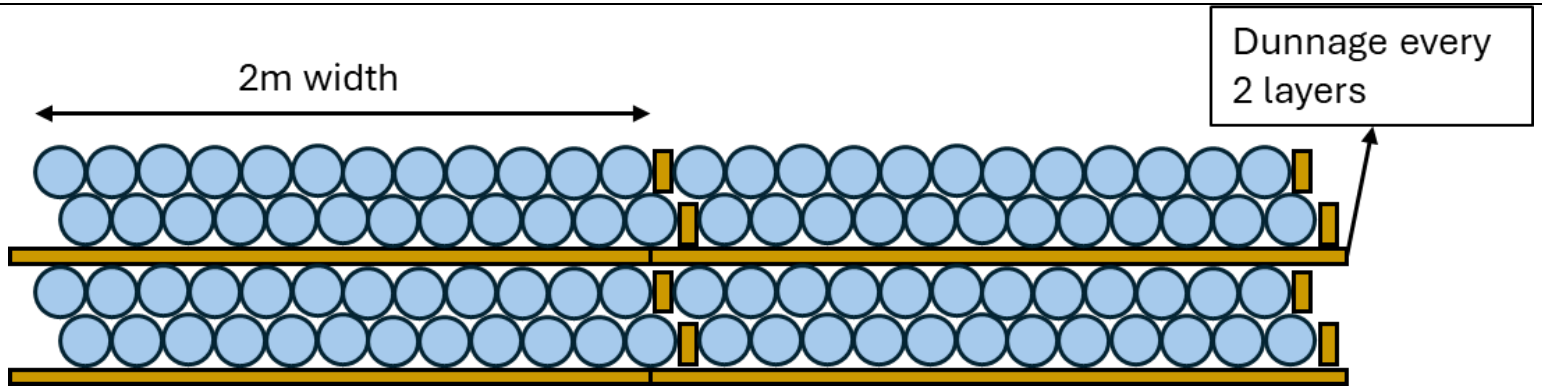
Top View of Loose Pipes

- Typical Loose Pipes Dunnage Arrangement
- 100mm gap every 2m width for sling access

For pipes with an outer diameter (OD) of 10 inches or less, hardwood dunnage of at least 100 mm thick is to be placed between every 2 layers.



- No dunnage every 2 layers
- No gap to allow for sling access



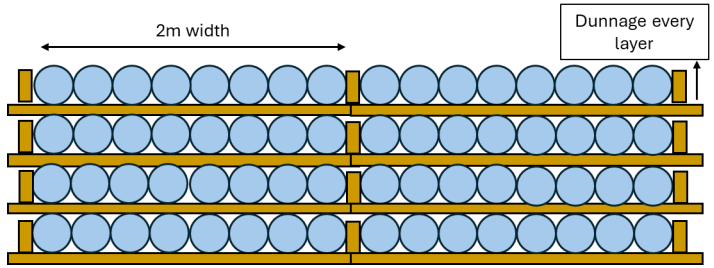
Side View of Loose Pipes (OD ≤ 10in)

- Typical Loose Pipes Dunnage Arrangement
- 100mm gap every 2 layers

For pipes with an OD greater than 10 inches, hardwood dunnage of at least 100mm thickness is to be placed between each layer.

- No dunnage every layer
- No gap to allow for sling access

- (Red callout) Dunnage between every layer for sling access



End View of Loose Pipes (OD > 10in)

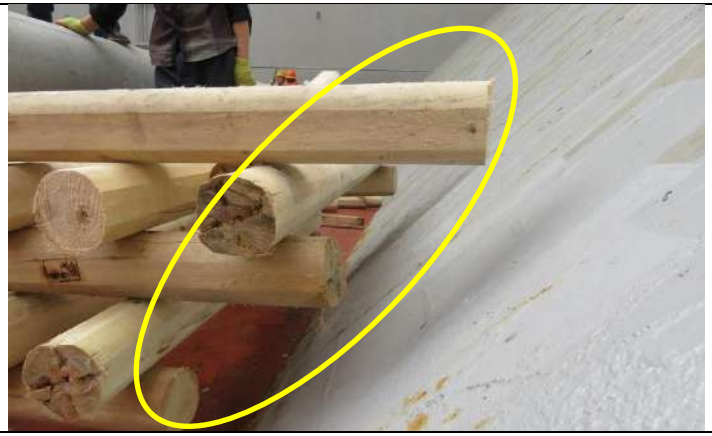
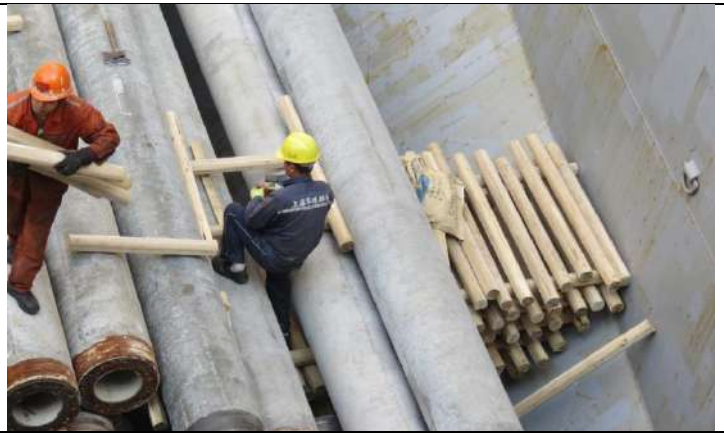
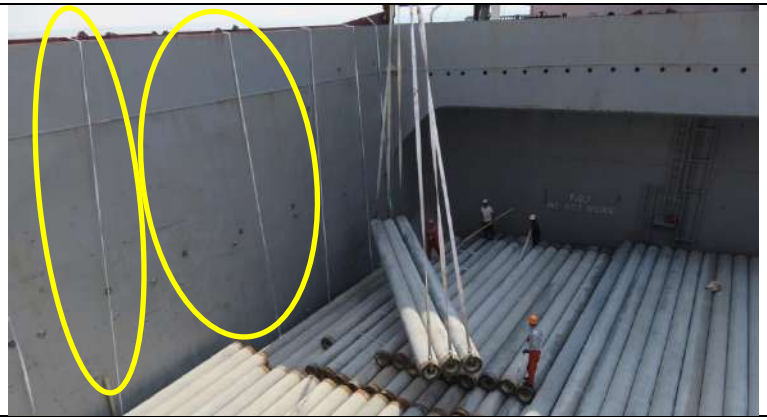
- Typical Loose Pipes Dunnage Arrangement
- 100mm gap every layer

For bundled pipes, there are 2 methods of stowage based on the shape of bundle it is in. For bundles that take on a hexagonal shape, softwood dunnage with a minimum thickness of 100 mm is to be placed to maintain adequate spacing with adjacent pipe. Hardwood dunnage of same thickness is to be placed between each layer.

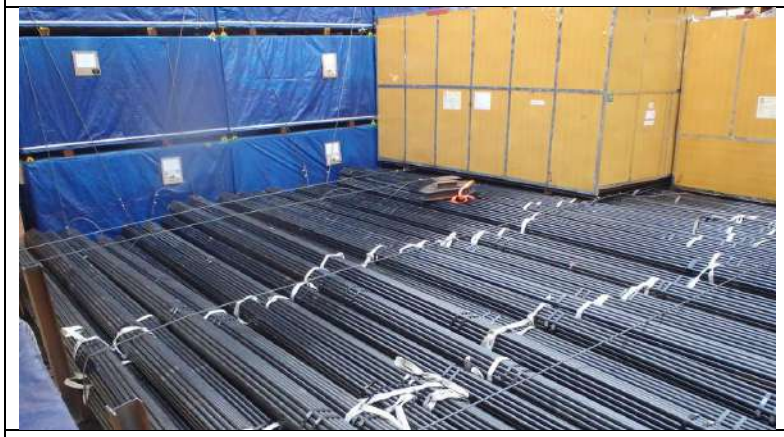
<table>
<tr>
<td>  </td>
<td>  </td>
</tr>
<tr>
<td>• (Red callout) Dunnage between every layer and adjacent bundles for sling access</td>
<td>• (Red callout) Dunnage between every layer for sling access</td>
</tr>
</table>

			
A forklift truck is used to push the pipes to the end of the hold. At the discharge port, the crane may not be able to be correctly plumbed; the pipes will swing when lifted.	✗	✓	It would be more appropriate and ultimately safer to stow alternative cargo under the overhanging 'tween deck before loading the pipes.
			
The tank-top space being used efficiently – shorter pipes are stowed in the narrower tank-top area, with the longer pipes in the open hatch area.	✓	✓	Pipes stowed evenly and tightly across the width of the hold, with timber dunnage used against the port and starboard bulkheads.

	
Dunnage laid on the tank-top and against the bulkhead in preparation for the second row of pipes. Chocks have been used between the pipes for protection.	Stows being built up in a safe and efficient manner.
	
Wooden wedges used to secure the pipes horizontally.	Dunnage structure in progress for the hopper area and the first tier of pipes. The structure must be continued vertically for the next tiers of pipes.

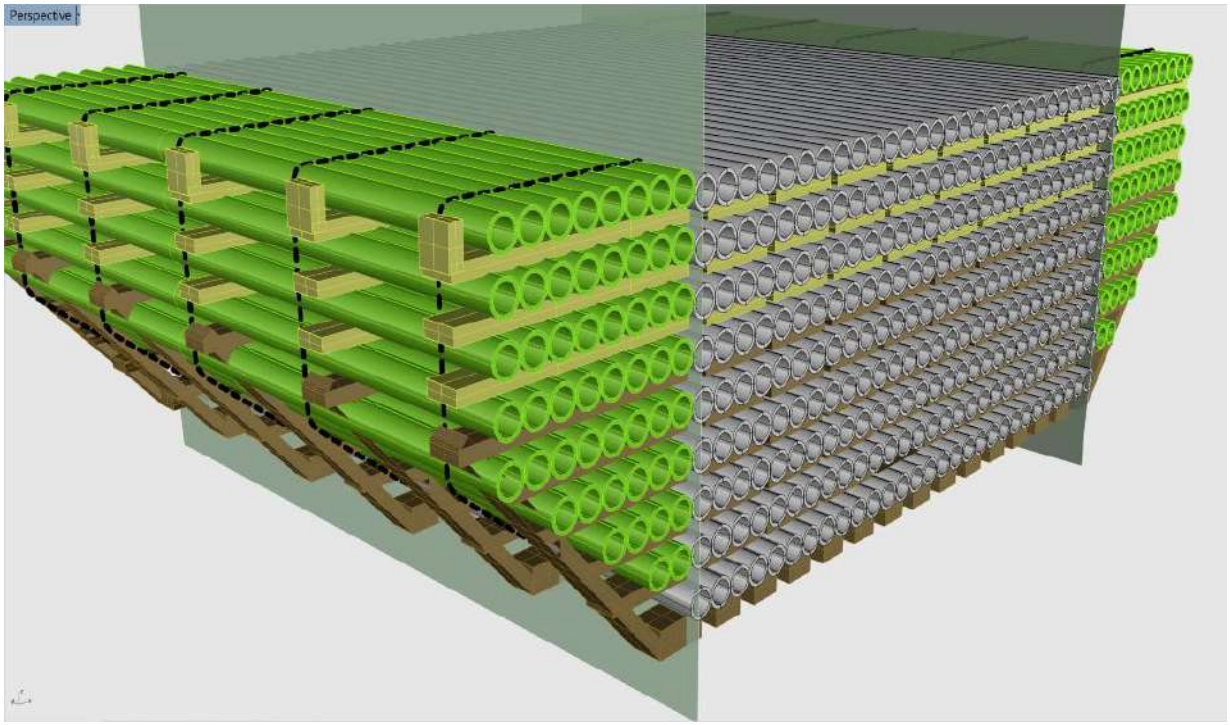
	
This dunnage is likely to slide if left as it is, should there be any movement of the pipe.	More substantial chocking against the bulkhead; each element is nailed. More dunnage is added between subsequent layers of pipes.
	
Loading in a box-shape cargo hold. The web lashing was laid on the tank-top and is prepared for the final securing of the stow.	Bundles stowed on dunnage, with timber used as protection around one edge, but not all. Wires can damage these small-bore pipes.

	
Protection material used should be suitable. Rags will wear through quickly by wire lashings.	Web lashings being rigged across bare steel pipes. Dunnage used correctly between the upper tier and the bulkhead.
	
Web lashings used across the upper layer of coated pipes.	Incorrect application of the wire lashing. The wire lashing is not tight and it will cut the sling.

	
Ineffective wire lashings; the bundles appear to have spread out, damaging an adjacent wood crate.	Stanchions were fabricated to permit partial block stowage on the tank-top, adjacent to other cargoes.
	
Pre-slung bundles lashed into a “pen” created by fabricated stanchions. Lengths of timber should have been used to protect the pipes from the steel wire used.	All lashings should be tight and well made, with provision for adjustment of the turnbuckle during the passage.

	
Pre-slung pipes being discharged. ✓	✗ A loose stow of mixed size and bundled pipe, making discharge difficult, dangerous and slow. For mixed size pipes, pre-slinging is required.
	
Pipe being discharged by pipe hook at Jurong Port. ✓	✗ A loose stow of mixed size and bundled pipe, making discharge difficult, dangerous and slow.

iii) **Under-Coaming Area**. For steel loose or bundled pipes that are stowed in the forward or aft under-coaming areas at least half of the pipe's length should extend beyond the under-coaming area to position it's Centre of gravity (CG) outside. The following describes the recommended schematic and Images:

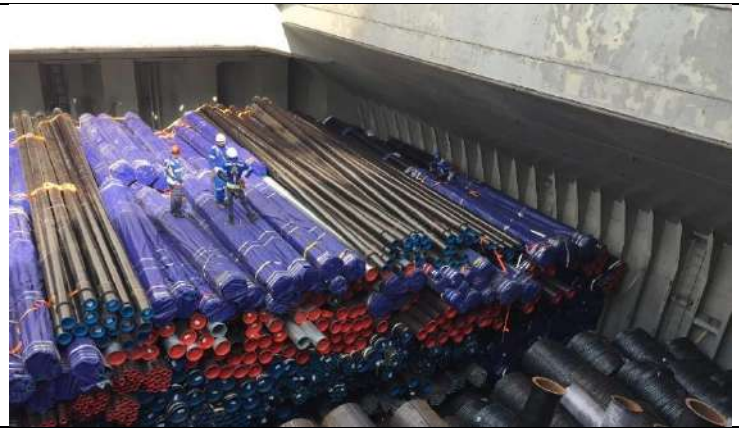


	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

- The under-coaming stow is lashed separately to prevent collapse of the stow during off-loading.

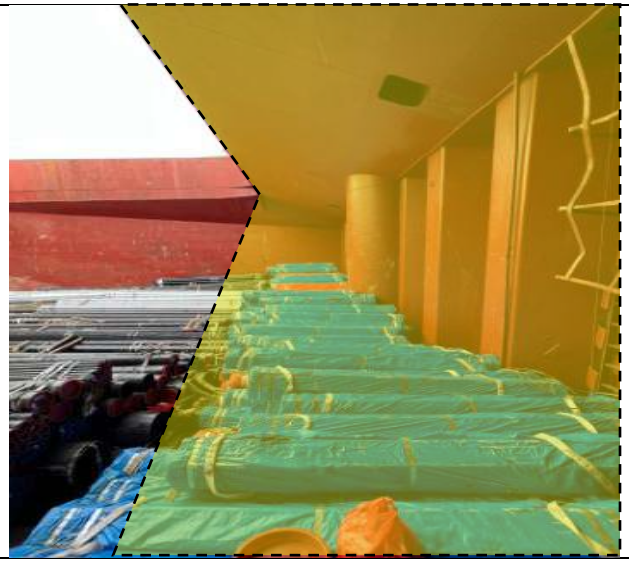
Pre-slung pipes at Jurong Port. The stevedores use pipe hooks to prepare the single basket lift for off-loading.

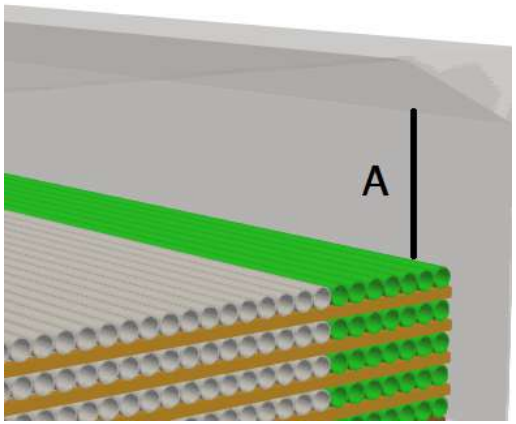
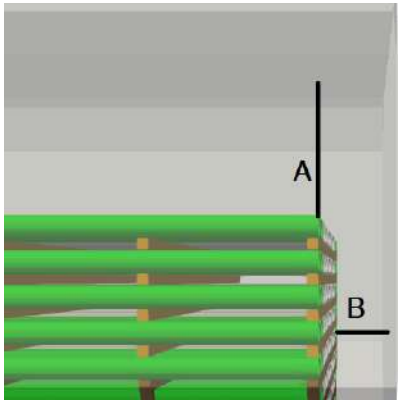
Pipes not pre-slung. No dunnage was used.



Stow of various bundled and single pipes. The stow is not level. No dunnage is used. Pre-slung condition with nylon web slings is required for such stow.

Lashed stow of various diameter pipes. Wires used for lashing. Note the dunnage between the tiers.

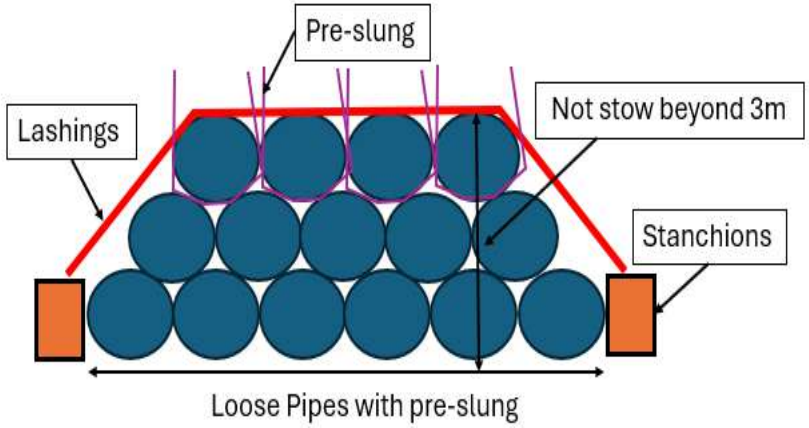
	
• (Yellow shaded area) Pipes stowed within undercoaming area does not allow for vertical lifting	• (Red shaded area) Pipes stowed within undercoaming area has more than half of pipe length protruding out with sufficient clearance at the undercoaming area.

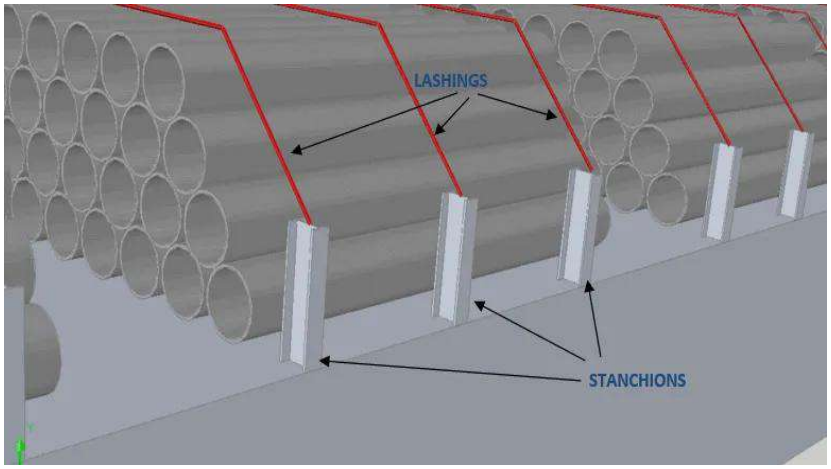
 Port/starboard under-coaming areas	 Forward/aft under-coaming areas
• Schematics showing recommended vertical clearance A from top of cargo to underside of overhung obstruction (e.g., undercoaming port / starboard). • This arrangement will ensure sufficient safe clearance for riggers to attach pipe hooks (without resorting to crawling) for discharge or equipment to handle the cargo units. A = 2m (minimum)	• Schematic showing recommended vertical clearance A from top of cargo to underside of overhung obstruction (e.g., undercoaming area forward / aft) • This arrangement will ensure sufficient safe clearance for riggers to attach pipe hooks (without resorting to crawling) for discharge. A = 2m (minimum) B = 300mm (minimum), to ensure sufficient gap for proper dunnage between cargo and vessel bulkhead/sides for safe cargo stowage and utilization of pipe hooks and slings.

iv) **On Deck Area**. Stowage of steel pipes on the deck of a vessel requires deliberate planning to prevent shifting, damage, and potential loss. Stanchions need to be present on deck as securing point by using appropriate lashing to secure the pipes to the Vessel/Barge deck structure. Alternatively, sufficient dunnage can be used on deck for every layer bundled pipes.
For deck stowage of large-diameter pipes, stowage must be secured in accordance with the provisions of annex 13 of the CSS Code.

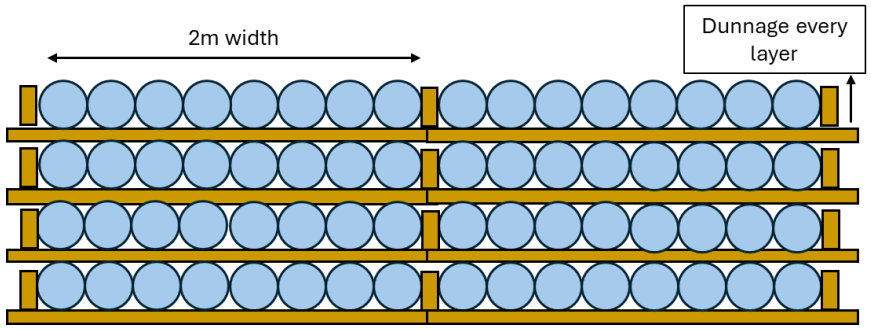
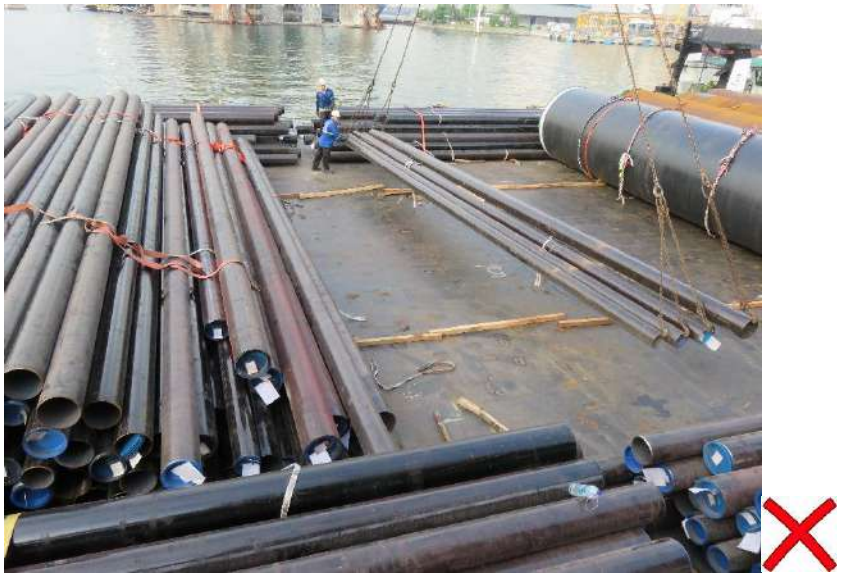
Pipes should be stowed in the fore-and-aft line of the ship on lines of soft timber dunnage laid athwartships on the hatch top, preferably laid above hatch-cover transverse stiffening members.

Each pipe should be stowed hard up against the adjacent pipes and wedges should be inserted against the inboard and outboard bilge of each pipe, and nailed to the base-timbers, to prevent rolling.





- Pipes stowed above 3 metres on deck would requires a permit-to-work (PTW) and control measures need to be implemented when working on deck.

	
• Typical loose pipes dunnage arrangement on deck of vessel.	• Loose pipes are not secured in a bundle.

v) **Summary.**

S/N	Description	Remarks
1	The pipes for loading should be of the same size and length in a stow	
2	Tank top dunnage to be boards with typical cross-section 150mm x 25mm.	
3	When loading large-diameter pipes, dunnage between tiers may not be necessary. Vertical dunnage between the last layer pipes should be considered.	Dunnage stool may be required to be built between the stow and the side bulkheads of the hold.
4	When loading small-diameter pipes in bundles, dunnage should be used between the cargo tiers. Alternatively, the bundles should be pre-slung.	
5	Pre-slung Certificate & Slings need to be marked	• SWL/Serial number tally with cling certificate • Sling Certificate test date is within 1year from use. • Testing Centre certificate has accreditation to ISO 17020
6	Slings to be positioned approximately 25% of Pipes length from COG	
7	No mixing of lashing arrangement.	

Rebar Guidelines

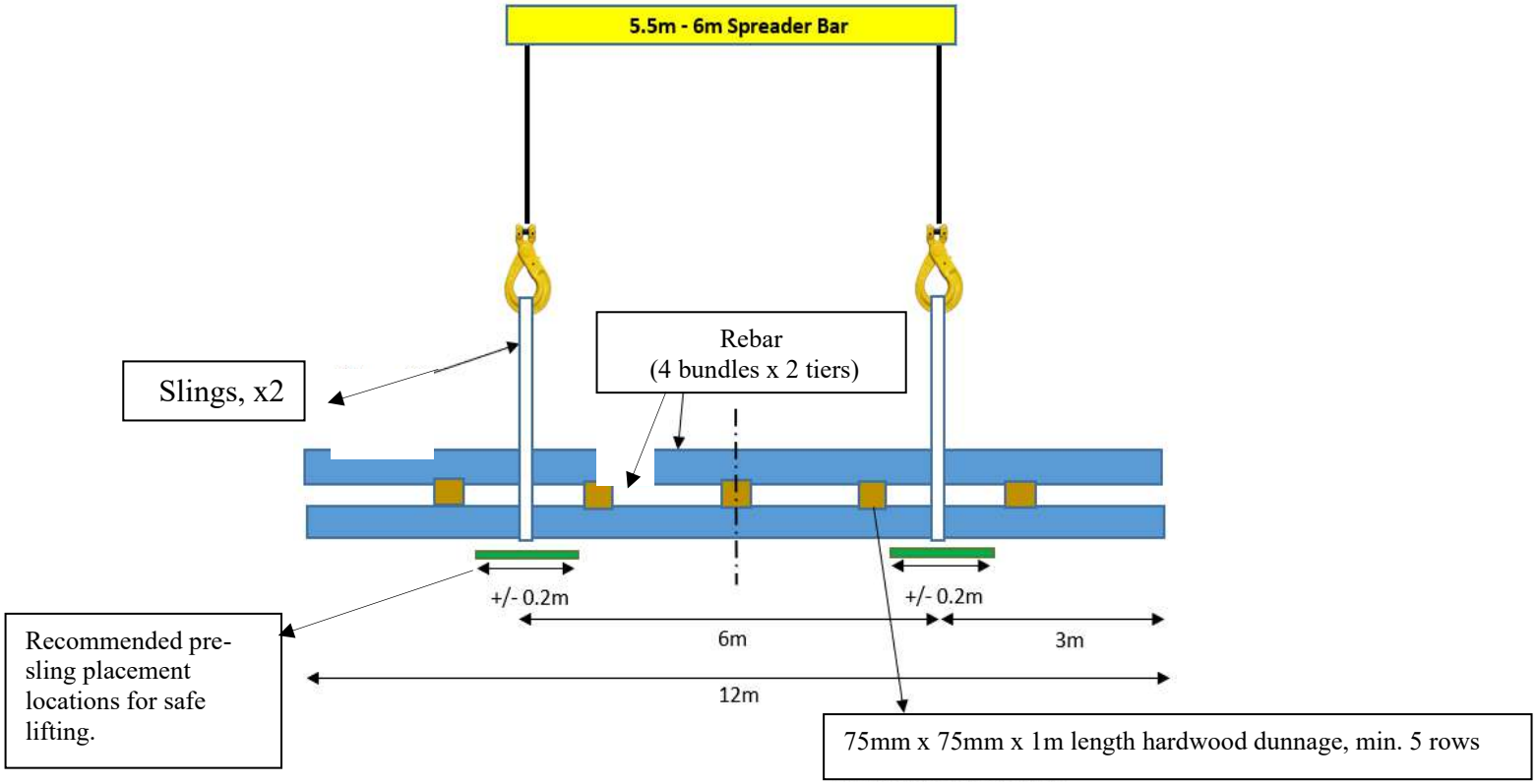
i) **General**. Rebar is considered deformed high-tensile steel bars which are hot-rolled and typically stored outdoors. It is shipped in unprotected bundles secured with steel bundling wire bands wrapped at intervals with the ends twisted together. These bundling wires do not provide structural strength and should not be used for overhead lifting. However, the bundling arrangement may be used for tipping bundles with tipping hooks. The number of bars per bundle varies according to the bar diameter. Standard bundle lengths are 6 m, 9 m, or 12 m. The 12 m bundle, which is the most imported length at Jurong Port, weighs approximately 2 tonnes.

Rebar bundles are typically stowed **fore-and-aft**, extending across the full width of the cargo hold. In some cases, partial stowage may occur within the hatch square when other cargo occupies the wing spaces. It is common for alternate layers of rebar to be stowed **athwartships**. A combination of fore-and-aft and athwartship stowage is often observed in the first and last cargo holds due to the flaring of hopper tanks. JP recommends that rebar be stowed **EITHER** in cross stowed manner **OR** pre-slung (arranged with lifting slings before shipping out).

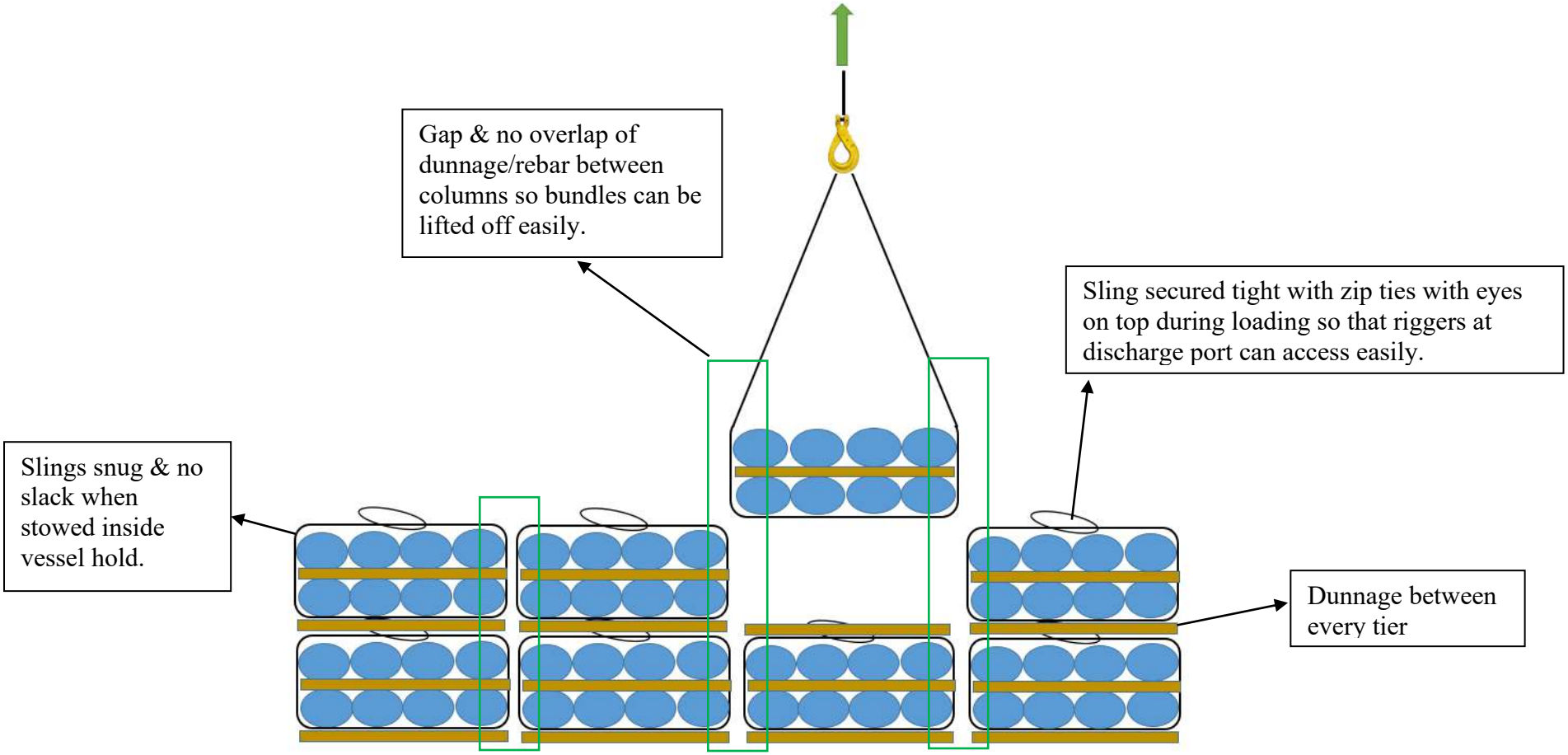
For rebar cargo that is not cross-stowed, pre-slung is mandatory and dunnage shall comply with the recommendations specified in the Guideline. Only new slings shall be used for pre-slung, and each sling must be permanently marked with its Safe Working Load (SWL) with an inspection certificate valid for one year by an inspection body accredited to ISO 17020:2012 for lifting equipment inspection or by a certification body recognized under the Mutual Recognition Arrangement (MRA) scheme

Slings certified under these requirements shall only be used once for lifting from vessel to wharf, and for any subsequent lifts, they must be recertified by an Authorized Examiner appointed by the Singapore Ministry of Manpower (MOM). For detailed certification requirements of lifting gear used in Jurong Port, refer to JP Circular No. 45 of 2022.

Rebars are recommended to be pre-slung at Load Port's wharf before being loaded into the cargo hold, arranged in a 4 bundles x 2 tier configuration, separated by dunnage as shown in sketch below. Sling locations are recommended not to deviate more than +/- 0.2m (green zone) from their ideal position for safe lifting, and slings of minimum SWL = 5t x 6m length, eye to eye type to be used, with minimum breaking load to follow ISO or equivalent standard for the different type of slings used, for example fabric/metal mesh/flexible wire rope. (if fabric slings are used, they need to be at least 2 ply in construction). Sling eyes to be unobstructed/clearly accessible.



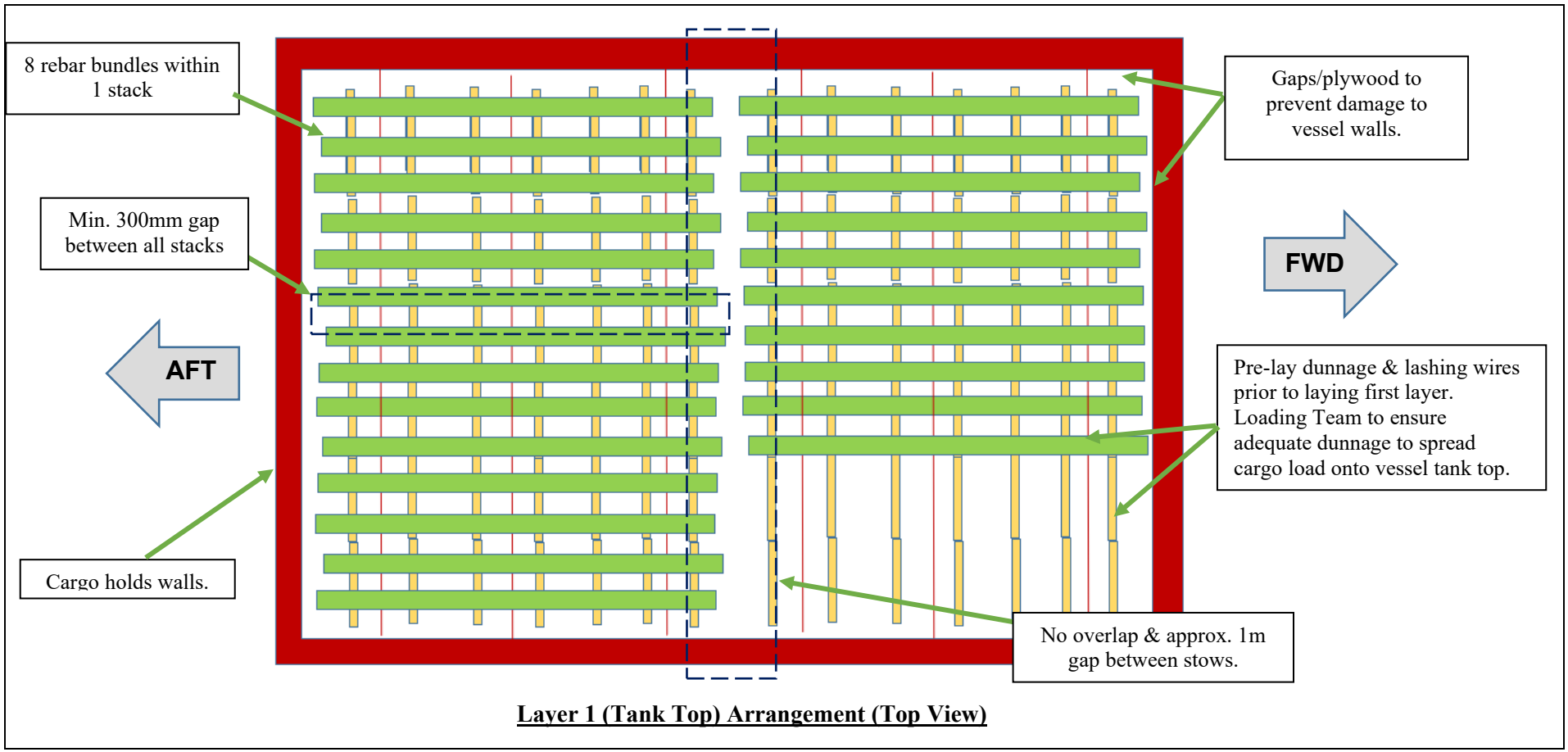
Side View of rebar with pre-slung & dunnage



End View of Preslung Rebar Stowed in Vessel Hold

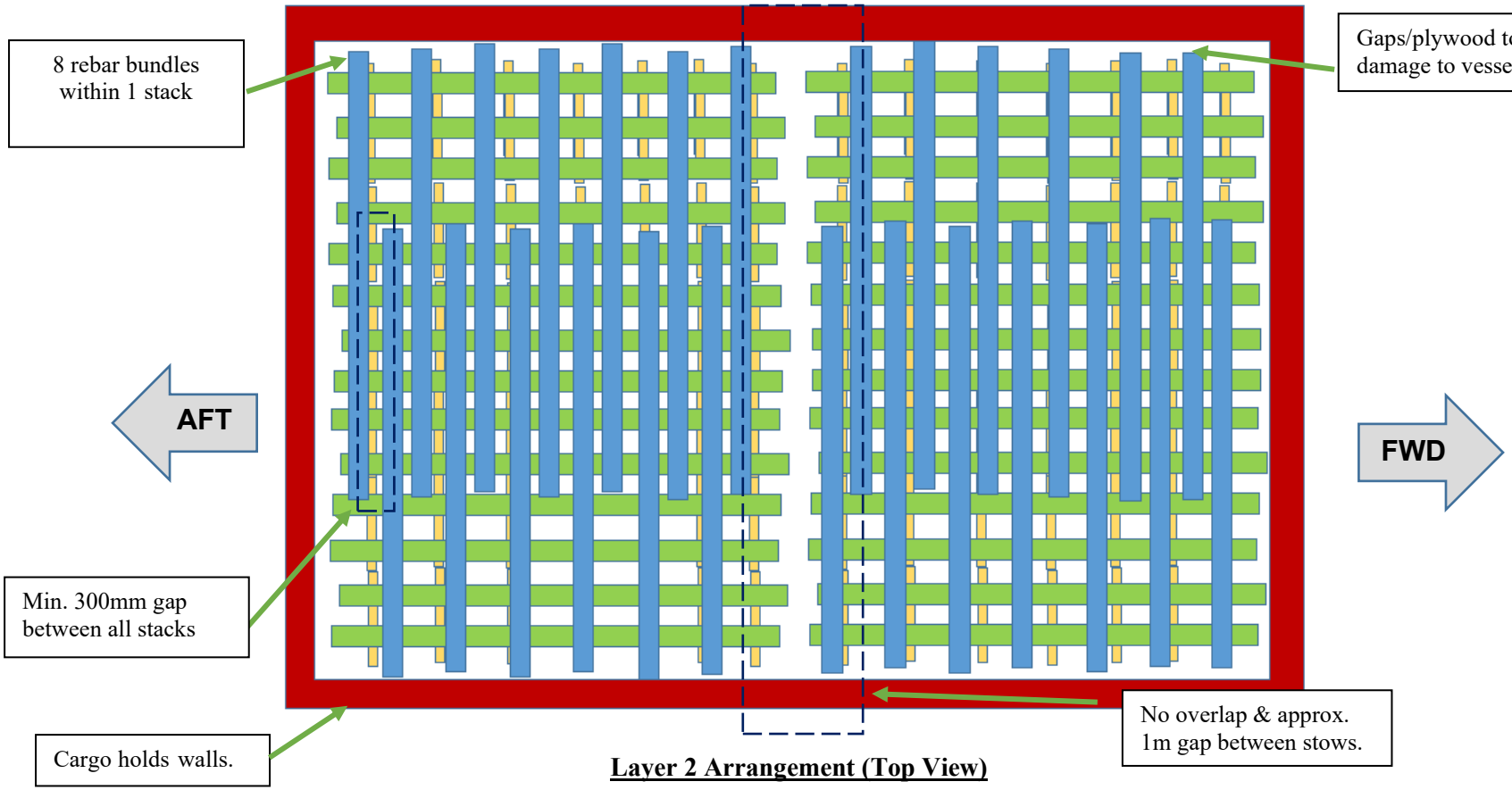
		
A sling combining 6 bundles of rebar ready for loading.	✓	✓ The slings for pre-slinging shall be certified and properly marked.
		
Pre-slung 6 m long bundles about to be loaded. Pre-slinging reduces the time needed for discharge operations.	✓	✓ Pre-slinging of two tiers of rebar in preparation for loading.

ii) **Open Hatch Condition**. Rebar bundles will be loaded in a cross stow arrangement, where alternate layers of rebar to be stowed athwartships in combination with a fore-and-aft stow. Dunnage placed between each tier of rebar, preferred at 2.4 metre intervals. The placement of bundles against the vessel walls must be distance of minimum 50cm for access as well as preventing the bulkheads etc from any damage. The following describes the recommended schematic and Images of the rebar cross stow:



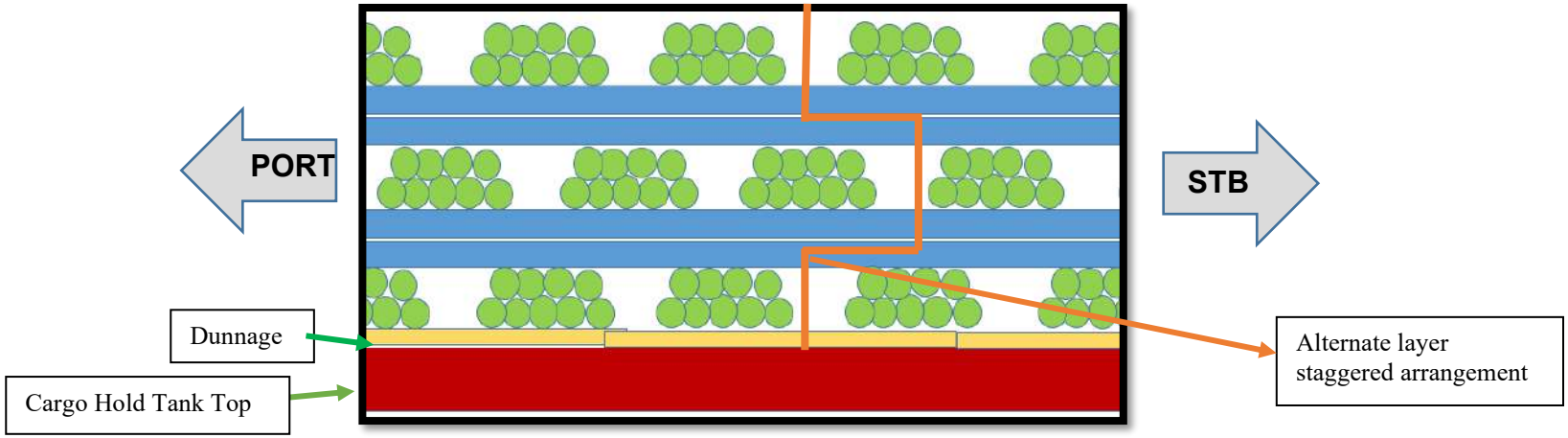
Layer 1 (Tank Top) Arrangement (Top View)

- Typical crosses stow arrangement for Layer 1 (tank top) within cargo hold.
- Each green rectangle represents one stack; each stack has min 8 – max 9 rebar bundles of the same diameter.
- Each stack to be maximum of 2 tiers, with width not exceeding 5-6 bundles across.

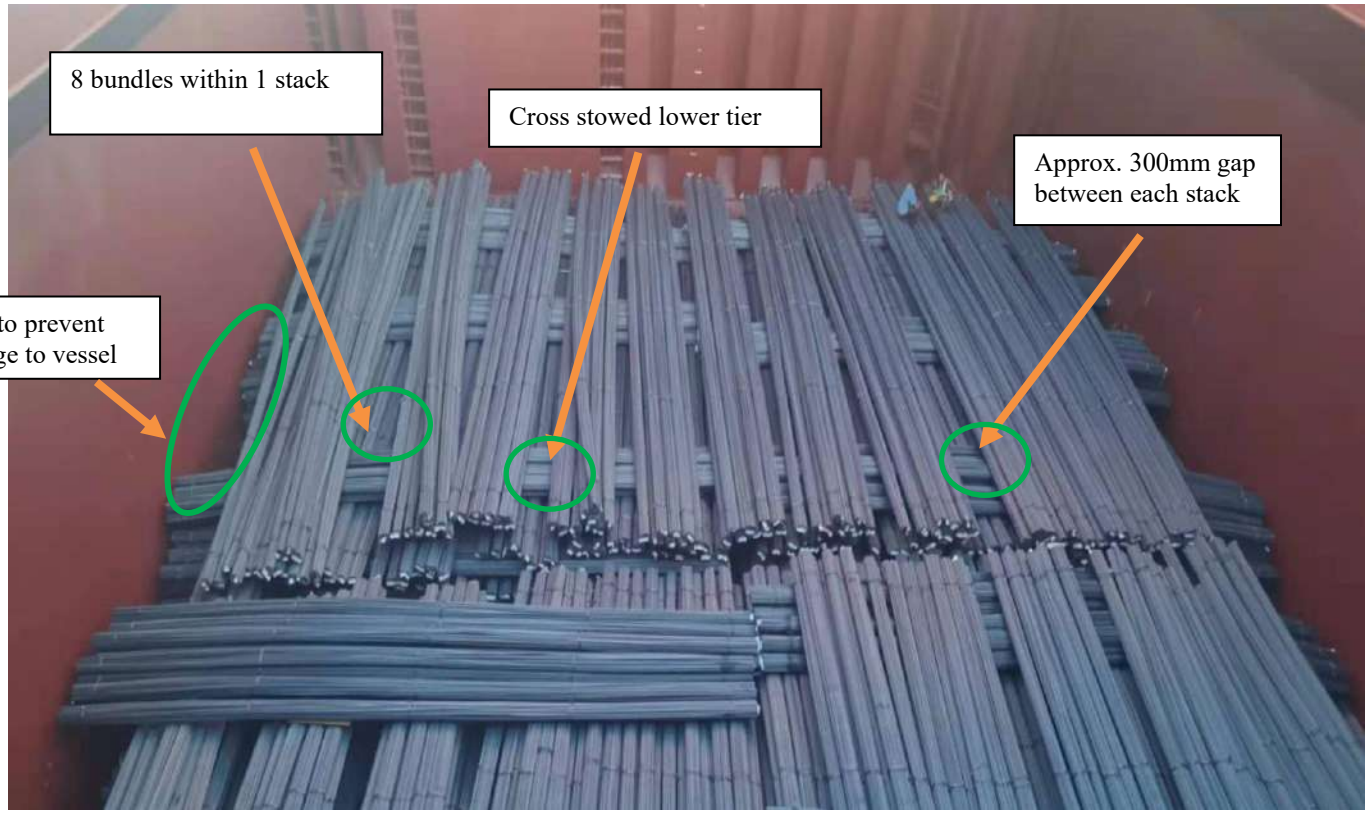


Layer 2 Arrangement (Top View)

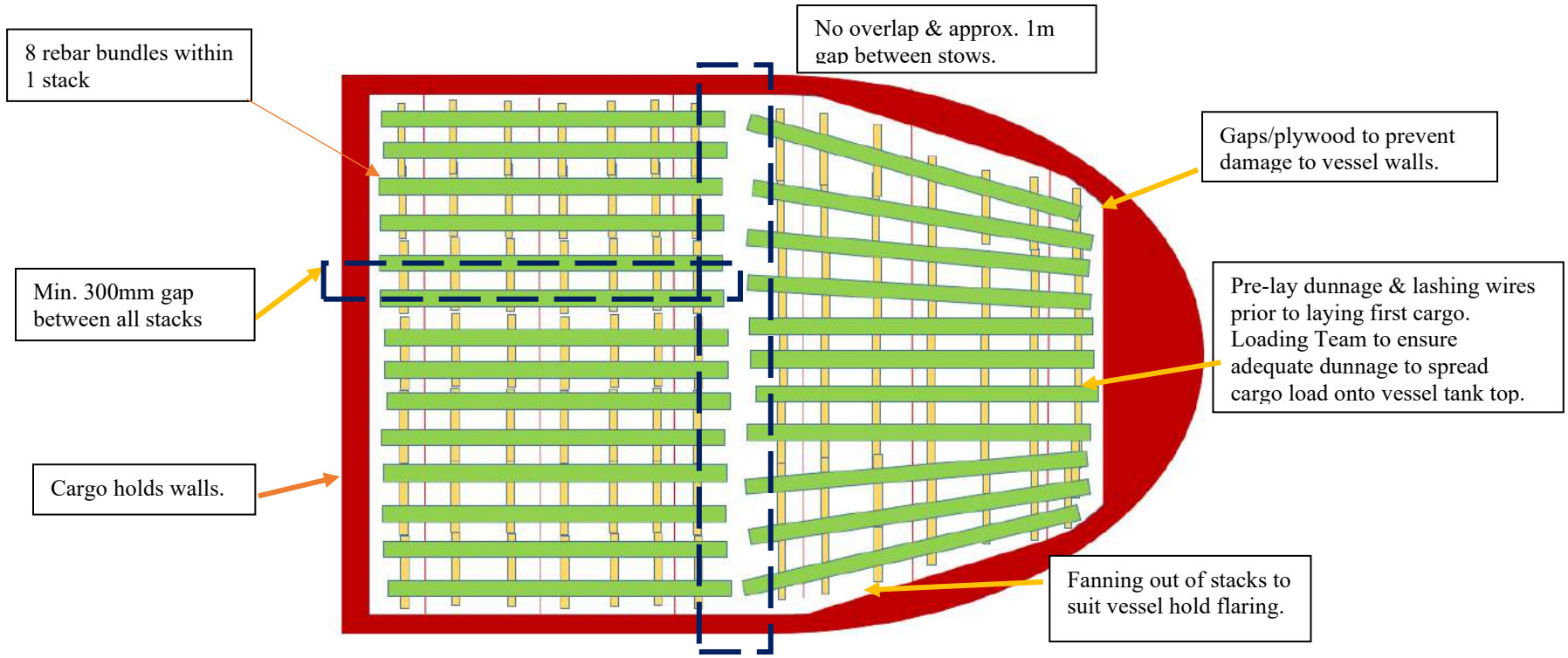
- Typical cross stow arrangement for layer 2 within cargo hold.
- Blue stacks (Layer 2) are identical to green stacks (Layer 1) in configuration. Layer 3 and higher: repeat Layer 1 & 2 arrangements.



- Cross Section View of cross stowed rebar.
- Alternate layer staggered arrangement – no falling hazard and ensure sufficient space for rigging.

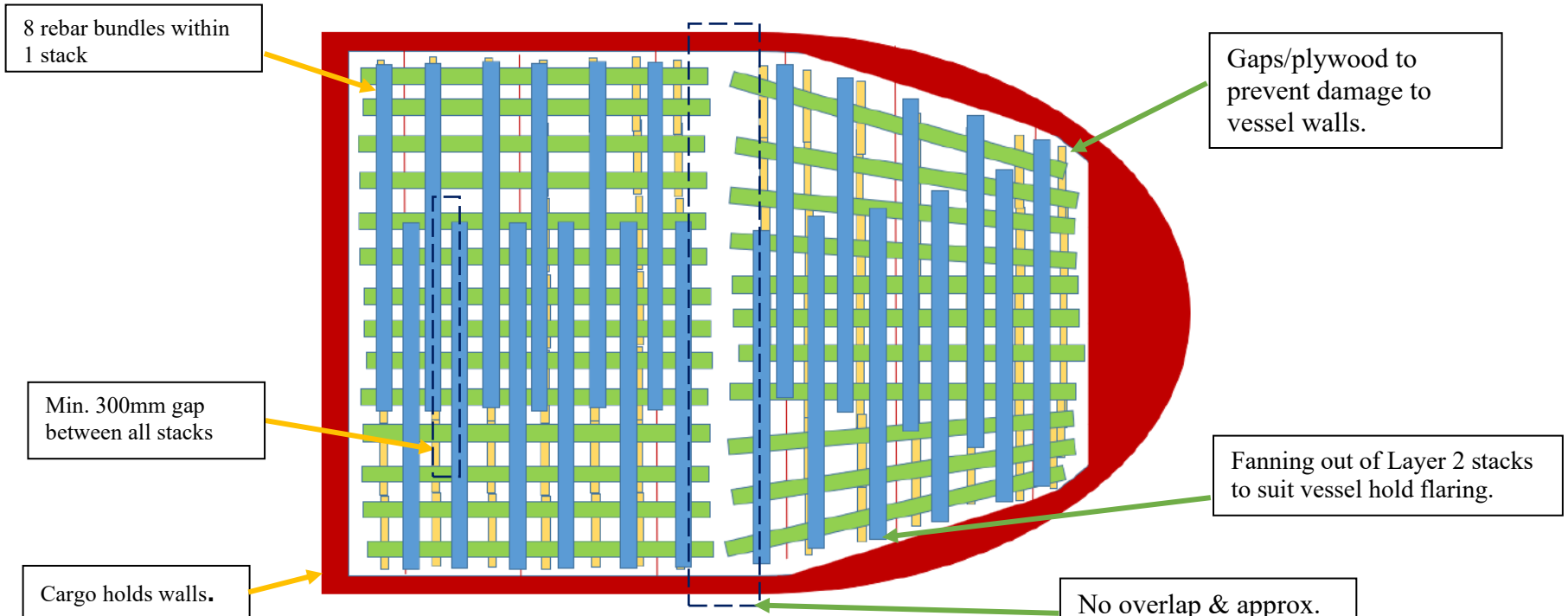


- Typical Cross Stow Arrangement
- Cargo to be levelled & no over-lapping.
- 300mm gap between stacks for chain sling access and eliminate the need for handling via bundling wire and removing the safety hazard.



Layer 1 (Tank Top) Arrangement (Top View)

- Actual layout may differ due to variety of shape & size of first/last cargo hold.
- Each green rectangle represents one stack; each stack has min 8 – max 9 rebar bundles of the same diameter.
- Each stack to be maximum of 2 tiers, with width not exceeding 5-6 bundles across.



Layer 2 (Tank Top) Arrangement (Top View)

- Typical cross stow arrangement for Layer 2 (tank top) for first/last cargo hold.
- Actual layout may differ due to variety of shape & size of first/last cargo hold.
- Blue (layer 2) rectangles are identical to green (layer 1) rectangles.
- Layer 3 and higher: repeat Layer 1 & 2 arrangements.

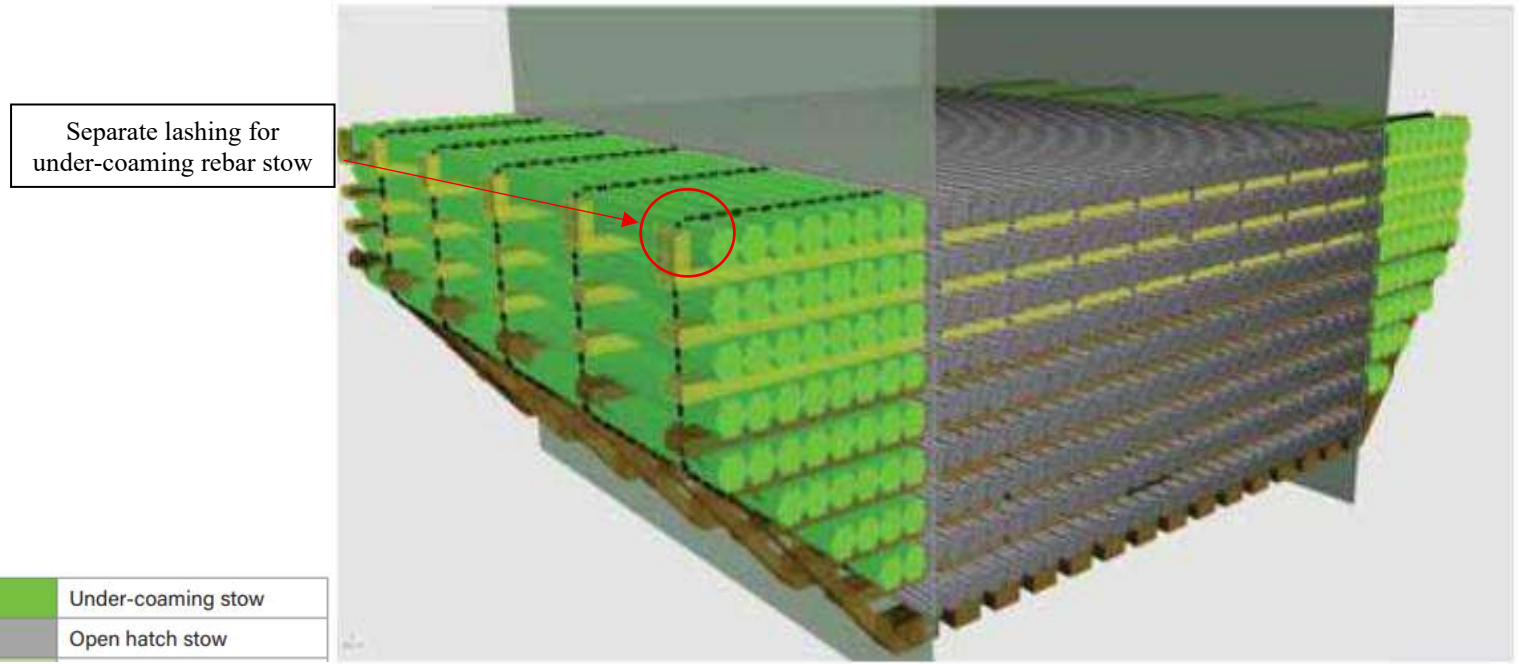
- Staggered arrangement between top & bottom tiers.
- Sufficient gaps for sling access for handling.

The face of the stow shall be kept as level as possible. No dunnage was used between tiers. The rebar was not pre-slung to assist the offloading. 1 metre clearance is required between the two stows.

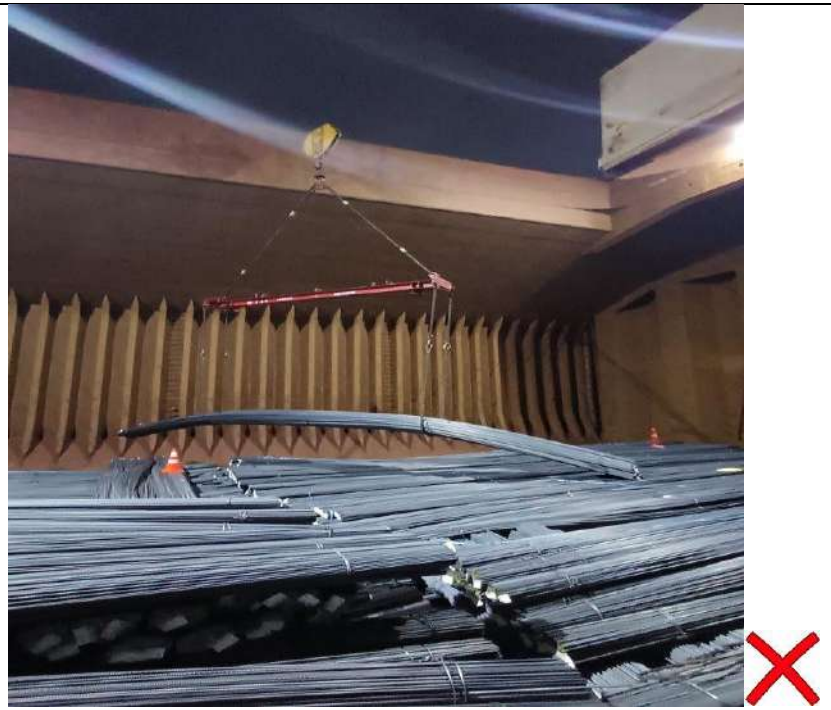
Rebar stowed in an athwartships direction because of the higher tiers. The higher tiers are formed because of the tapered end due to the flaring of the hopper tanks.

If insufficient space is left between adjacent cargoes, discharge becomes very slow and damage to both cargoes is likely.

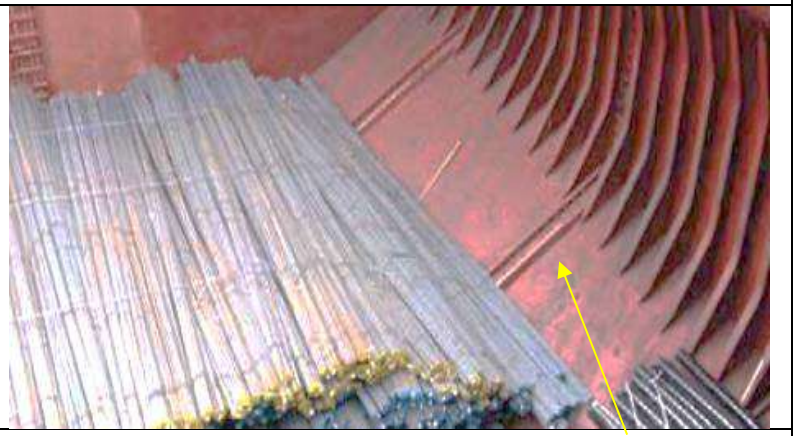
iii) **Under-Coaming Area**. Rebar under-coaming stow is lashed separately every 2 meters in height to prevent collapse of the stow during cargo handling. Separate lashing of the under-coaming stow is required to prevent collapse of the stow because of the ship's movement during voyage . If the stow under open hatch is pre-slung with wire rope, there isn't a need to use dunnage for the open hatch cargo. Dunnage shall be used for the under-coaming stow. The following describes the recommended schematic and Images of the rebar stow:



- First layer of tank-top dunnage shall be 100mm x 100mm, then subsequent 6 tiers shall be 75mm x 75mm of Hardwood.
- Dunnage for subsequent tiers shall be 75mm x 75mm of Softwood.



- No Dunnage wood placed in the under-coaming area.

			
Rebar stowed athwartships in the under-coaming area requires a forklift truck for it to be discharged. No pre-slinging and no dunnage between the tiers was used.	✗	✗	Under-coaming cargo of rebar. No dunnage and no pre-slinging. Difficult access to the upper tiers and handling by forklift trucks.
			
Shifted cargo at the discharging port. Bad pyramid stow of 12 m long rebar without dunnage. Shifting of the rebar inside the under-coaming space.	✗	✗	Shifted cargo at the discharging port. Under-coaming sloped stow of rebar. The hopper tank flares out to the middle of the hold.

iv) **On Deck Area**. Stowage of rebar on the deck of a vessel is generally discouraged as the ideal stowage position is in the cargo holds because steel is a high-density cargo. Rebar cargo must not exceed the deck's structural limitations and does not compromise lashing integrity during voyage. Hence, it is **not recommended** to stow rebar on deck.

v) **Summary.**

S/N	Description	Remarks
1	Tank-top to be prepared with appropriate dunnage to prevent steel-to-steel contact.	Lashing to be pre-positioned on the tank-top
2	Maximum distance between rows of timber dunnage not to exceed 2.4meters	
3	Minimum distance between bundles and the vessel walls to be 50cm.	
4	All tiers to be stowed level, the face of the stow to be as straight as possible, with sufficient clearance from the adjacent stow to prevent virtual over stows.	
5	In the cargo compartments, where possible, safe passage shall be provided directly from the ladders to the top of the cargo stow. In bulk carriers, this access shall be provided directly from the Australian ladders	Safe access needs to be provided from tank-top to the top of the cargo stow
6	**Cross stow** – Sufficient space (<300mm) between rebar stack	Chain sling should be able to access
7	**Cross stow** – 8 bundles per rebar stack	
8	Pre-slung Certificate & Slings need to be marked	• SWL/Serial number tally with cling certificate • Sling Certificate test date is within 1year from use. • Testing Centre certificate has accreditation to ISO 17020
9	Slings to be positioned approximately 25% of rebar length from COG	

Steel Plate Guidelines

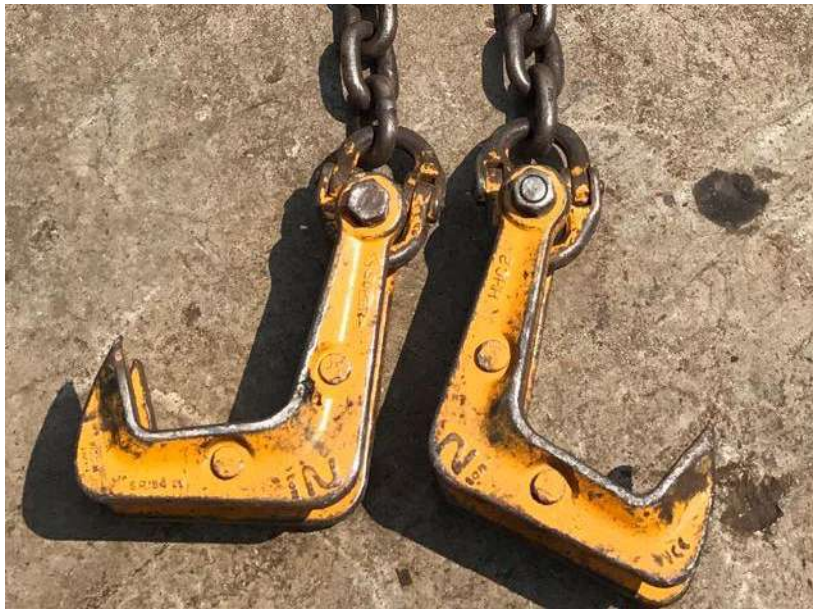
i) **General**. Steel plate is thick, flat-rolled steel, produced from slab or ingot, and is supplied in various sizes and grades. Generally, the thickness can range from 5mm to 80mm. Sizes range from 2,000mm x 1,000mm up to 12,000mm x 3,000mm. Larger plates may be supplied to suit the end user's requirements. Loose steel plate is rarely bundled; however, smaller plates of similar dimensions may be bundled with steel strapping. Steel plates are typically carried loose, although they may be strapped in bundles or packaged.

All cargo should be stowed in accordance with the IMO Code of Safe Practice for Cargo Stowage and Securing (CSS Code). Loose plates are typically stowed with their longest axis aligned fore-and-aft. However, plates may also be stowed athwartships in the middle of the stow if necessary. Bundled or packaged plates can be stowed athwartships to achieve a tighter and more efficient stow and to meet specific loading requirements. Plates or packages should always be loaded over the hopper slopes on bulk carriers and must not be arranged as a California block.

Steel plate is classified as heavy cargo; therefore, the tank-top loading limits of the cargo hold must be considered during loading. The maximum stowage height depends on the allowable tank-top load limit, which is determined by the shipyard and verified by the Classification Society at the time of construction. It is important to note that this limit was calculated when the vessel was new. For older ships, where normal wear and tear may have affected the tank-top plating and associated underdeck stiffening, a prudent safety margin should be applied. The stow should be kept level throughout, with timber dunnage used to fill any gaps in the stow.

Jurong Port uses 'C' clamps to off-load steel plates, four clamps per lift. The jaw opening of the clamps is 125mm. The maximum permitted combined plate thickness (or a bundle), which can be lifted with these clamps is 110mm. No single tier of loose plates should exceed this height. The typical weight calculation for a steel plate with dimensions 9.145m x 2.438mm x 0.011m is approximately 1.86 tonnes (given a stowage factor of 7.6 tonnes per m^3).

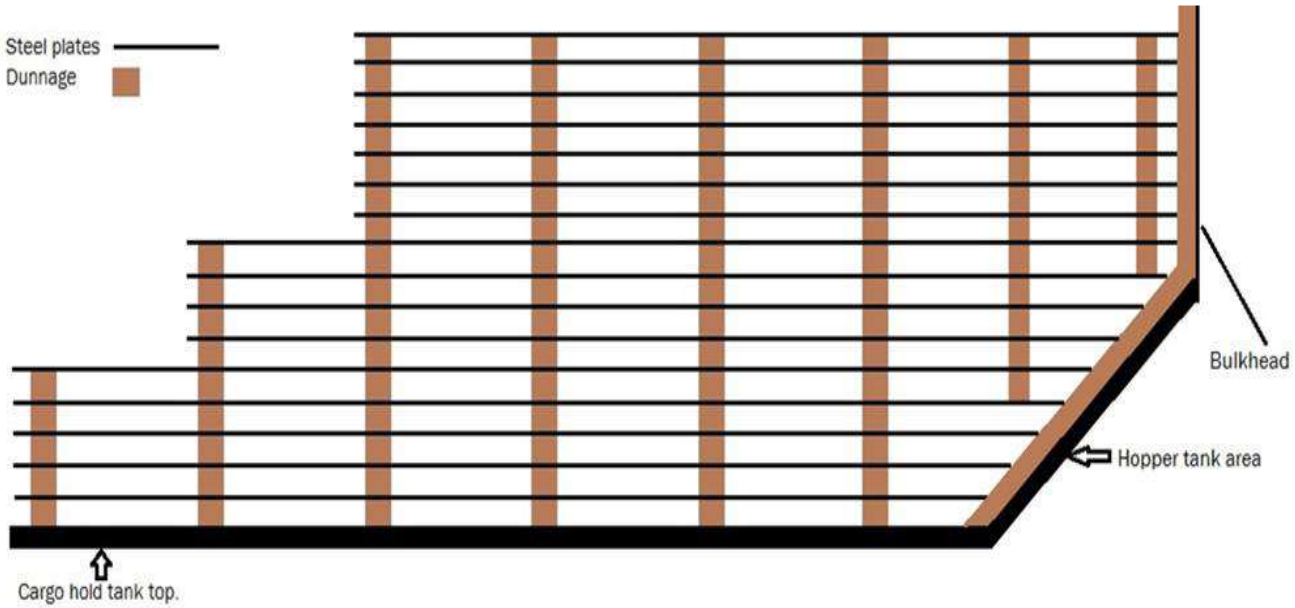
The SWL of each clamp is 5 tonnes; to allow for a sufficient safety margin, the maximum weight for each lift is 18 tonnes, for plates below 9m, within 100mm thickness. For standard steel plates, with dimensions of 9.145m x 2.438m x 0.011m, and a density of 7.6 tonnes per m^3, the maximum number of plates to be lifted at one time would be 7.



'C' Hooks used for off-loading of steel plates.

'C' Hooks and a spreader used for off-loading of steel plates.

Dunnage should be laid in rows on the tank-top in an athwartships direction under each row of plates. As a rule, the maximum distance between each row should not exceed 2.6 metres under each plate; however, sufficient rows should be laid to fully support the plates. One international steel manufacturer requires a minimum of 8 timbers to support a thin 12-metre-long plate. Generally, 75mm x 75mm is the preferred cross-section to be utilised. Dunnage should be placed between individual tiers, and chocks placed between plates/packages on every tier. Long plates are more susceptible to buckling/sagging if insufficient dunnage is used. Similar dunnage should be placed against the hopper, inner shell plating and bulkheads and the internal vertical frames in cargo ships. The higher or heavier the intended stow, the more dunnage should be used on the tank-top and in the lower tiers.



Dunnage between tiers must be arranged such that the rows of dunnage are vertically aligned. This might not be possible in way of the hopper tanks but should be adhered to wherever possible.

If dunnage is not vertically aligned and properly horizontally spaced the possibility of permanent plate deformation during transit can occur.

Plates may be stowed either athwartships or longitudinally but in such a manner as to produce a tight, even and level stowage with a minimum of void space.

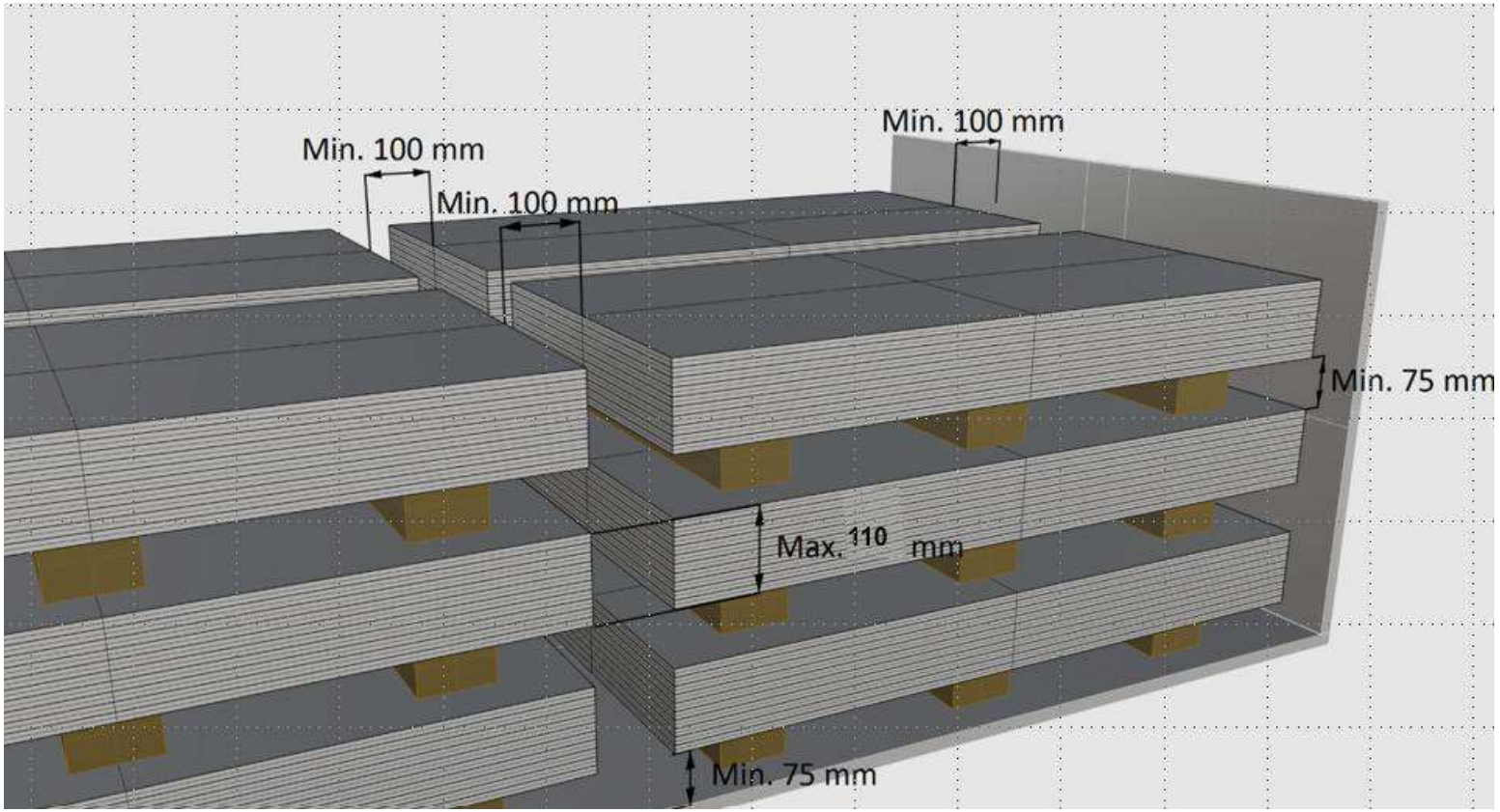
Stacks of plates should be avoided unless such stacks are surrounded and supported by other stacks of plates that can be tied together by timber dunnage at intermediate levels. Staggered stowing with plates overlapping each other will produce a tight and secure block of cargo that is more stable and therefore less likely to shift during the voyage.

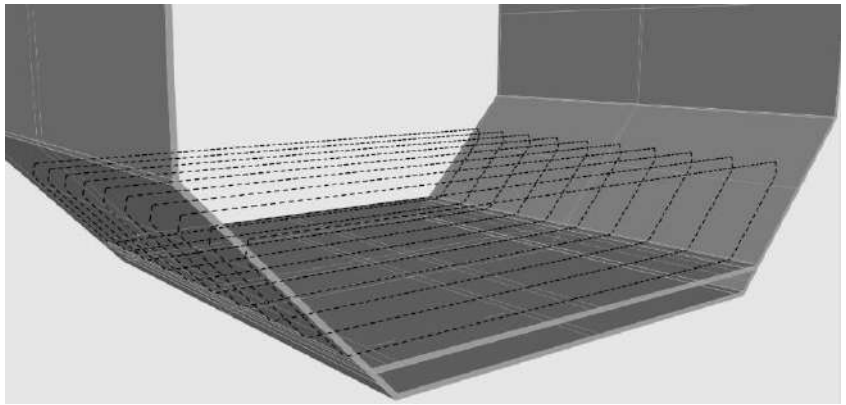
All lashings should conform with the requirements of the vessel's Cargo Securing Manual and the CSS Code. When the cargo is stowed across the full width of the cargo hold, the steel plate is prevented from shifting by the friction resistance of the timber dunnage used in the stow and the additional timber dunnage used to block the top tier. Wire or chain lashings are used to secure the stow in a single block and prevent the initial movement of the steel plates. All lashings must be tight and well made. The Master should be supplied with certificates for all the lashing equipment used.

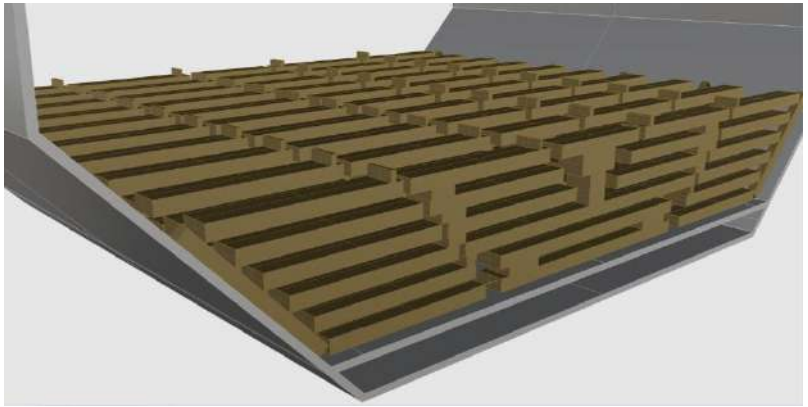
An appropriate number of lashing wires or chains should be laid in an athwartships direction on the tank-top in preparation for being passed back over the stow to secure the cargo in one block. There are no specific requirements for the minimum number of wires or chains to be used; however, a minimum of two per row would be considered reasonable. Intermediate lashings can be applied to longer plates to bundle the steel together to create a tighter block stow.

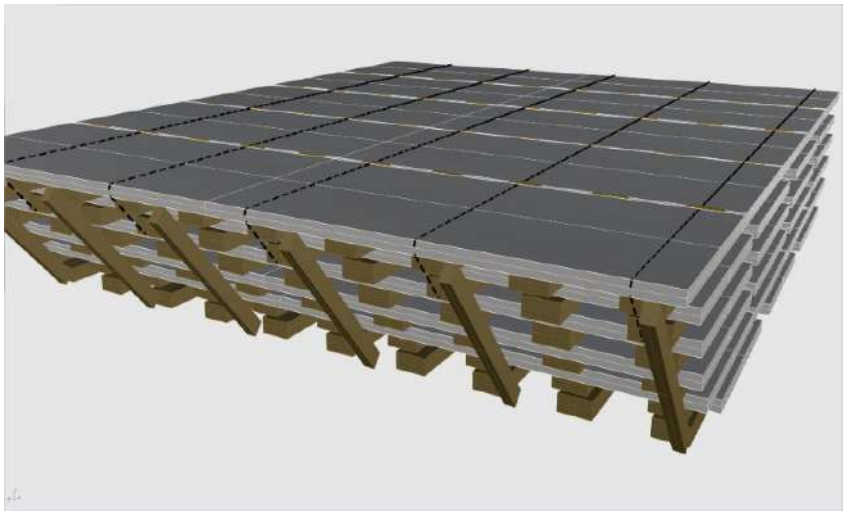
	
Incorrect use of bulldog grips	Incorrect use of bulldog grips with grips on the live wire. Insufficient number of grips used.

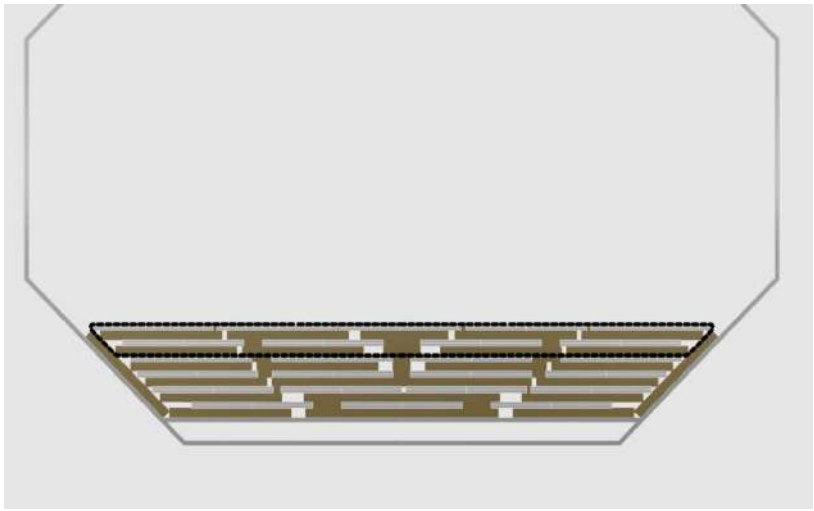
ii) **Open Hatch Condition**. Steel plates are ideally stowed in the same way where suitable lengths of dunnage should be inserted between each tier of plates or tier of lifts of plates. The dunnage must be kept in line vertically, close enough together to stop the plates bending, where there are gaps between dunnage. To allow the stevedores to correctly position the clamps, a minimum distance of 100mm clearance must be left around the steel plates and at least 75mm between tiers. The thickness of the bundle or the number of plates stowed in one tier should not exceed 110mm. Refer to the schematic below for steel plate stowage reference:











- Lashing of the steel plates stow starting from the tank-top. The wires spacing should be approximately 2.6 metres.
- The spacing of dunnage should not exceed 2.6 metres.

 Unbundled, long steel plates.	Delivering of the cargo at the jetty prior to the loading.	 Bundled steel plates, ready for shipment. Only bundles of 110mm height are accepted for handling at Jurong Port.
 Unbundled, long steel plates loaded with a spreader.		 It is recommended to use suitable edge protection when wire slings are used for handling the cargo.




- General Cargo Vessel with Box-type cargo compartments. Lower hold and tween deck, athwartships loading.
- Dry bulk carrier with hopper-type cargo holds. Dunnage should be used on the tank-top, side hopper tanks and bulkheads.

Bundled steel plates ready for loading. Choke hitch chain sling in use.

Bundled steel plates. Broken steel straps. Incorrect choke hitch application.

Good stowage and use of dunnage for steel plates.

Insufficient dunnage thickness used. 25.4mm (1 inch) thick dunnage used instead of the 75mm minimum.

The stow lashing should be prepared prior to the first tier being loaded.

Lashing wires for securing the final stow must be prepared on the tank-top prior to the loading of the plates.

The horizontal dunnage on the tank -top and between the tiers must be vertically aligned.

The stow block may be interlocked with alternate longitudinally and athwartships-oriented steel plates.

Plates should be loaded longitudinally. The illustration shows the aftmost hopper-type cargo compartment of a bulk carrier.

The longitudinally oriented plates may be locked in with athwartships-oriented plates for compactness of the stow.

	
Dunnage must be placed between the stow and the bulkheads.	Incorrect use of dunnage.
	
The dunnage between the tiers should generally be of whole piece square cross-section dunnage, although it is not unusual to use well-aligned small pieces of dunnage.	Chocking of the last two tiers should not be done this way. The dunnage in the photo is not sufficient and may slip.

<table>
<tr><td>  </td><td>Proper dunnage structure should be formed between the stow and the bulkheads. Vertical wood must exist on the side of the bulkheads and stow.</td><td>  </td></tr>
<tr><td>Incorrect use and securing of dunnage. The wood may easily slip from the bulkhead and fall from its place during voyage.</td><td></td><td>Incorrect use of dunnage and lashing. There is no vertical dunnage on the side of the stow to support the horizontal wooden beams. No protector on the wire.</td></tr>
<tr><td>  </td><td></td><td>  </td></tr>
<tr><td>Good use of dunnage between the stow and the hopper-type bulkhead.</td><td></td><td>Poor use of dunnage between the stow and the hopper-type bulkhead. The dunnage contacting the plate edge should be flat.</td></tr>
</table>

Improper stow, alignment and use of dunnage.

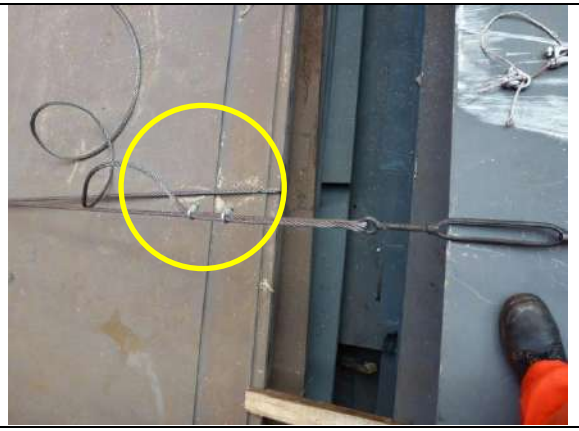
Vertical alignment of the dunnage is important. Any loose ends of tiers should be properly supported underneath.

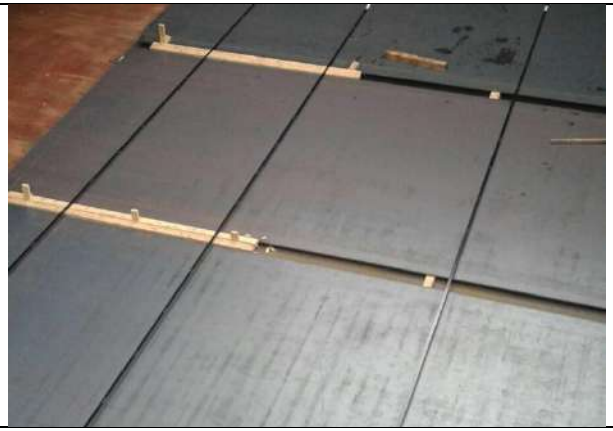
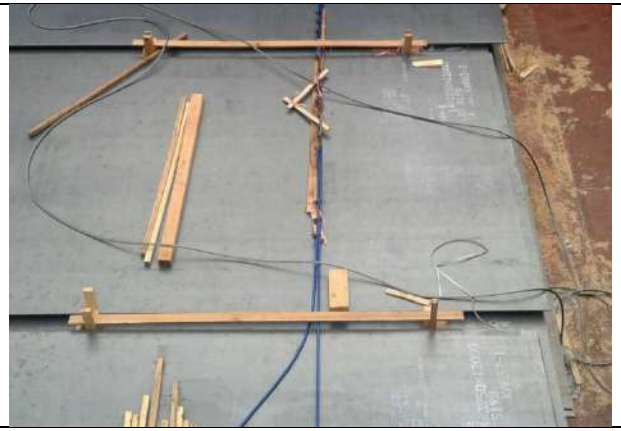
Missing dunnage at the bulkhead.
Incorrect use of dunnage to support tiers.

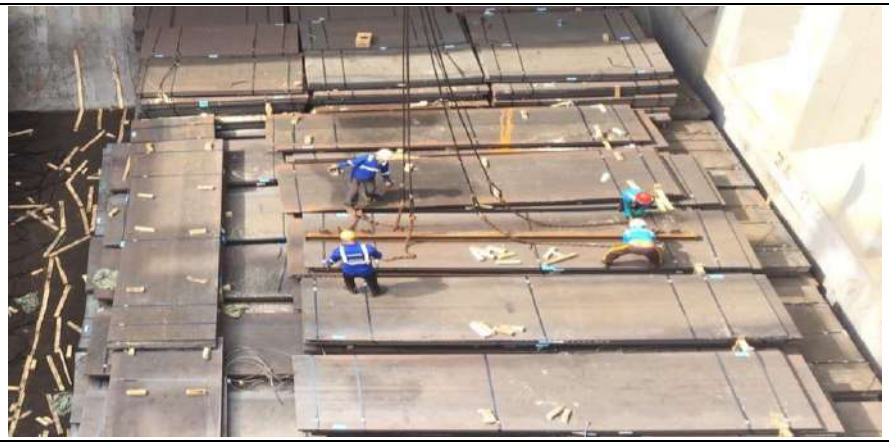
Incorrect use of bulldog grips on the left wire.

Dunnage must be used for securing the existing gaps on the upper tier of plates. Strong solid horizontal compact arrangement should be made.

Incorrect use of dunnage.
The pieces of wood are prone to collapse.

	
The stow must be secured. Generally, wire rope lashing is used.	The wire clips are insufficient and are also incorrectly placed. The grips should be on the live wire and a minimum of 3.
	
Stow of steel plates loaded athwartships. Stow prior to the final lashing.	Stow of steel plates in longitudinal and athwartships direction. The upper tiers only are lashed with steel bands.

	Condition of steel plates on arrival at Jurong Port.	
Good stow, lashing and use of dunnage. ✓		✓ Good stow; removal of the lashing.
		
Off-loading of unbundled, unpacked steel plates at Jurong Port. Use of 'C' hooks and a spreader. ✓		✓ Off-loading of unbundled, unpacked steel plates at Jurong Port. Use of 'C' hooks and a spreader.

	Use of a forklift truck for the discharging of steel plates in hopper-type cargo hold. Handling of steel plates underneath the coamings with missing tier dunnage.	
Shifting of steel plates out from undercoaming area by forklift	✓	✓ The steel plate is to be lifted with forklift to allow for assisting dunnage to be placed under the plate.
		
The steel plate is pulled out of the under-coaming space for a direct access with the crane.	✓	✓ Discharging of bundled steel plates at Jurong Port. Use of 'C' hooks and a spreader.

iii) **Under-Coaming Area**. All cargoes are off-loaded by vertical lift only. Jurong Port does not use the lifting gear to drag cargo from the under-coaming spaces to the open hatch square, as it overloads the lifting gear and equipment, which can lead to catastrophic failure. In order to facilitate the off-loading of such cargo, forklift trucks are utilised. This requires that the steel plate in the centre of the cargo hold be level and the timber dunnage under the plate sufficiently strong to withstand the movement of the forklift truck as it pulls the cargo clear from the wing space to be off-loaded.

Steel plate being lifted, by a forklift truck, from the wing space of a bulk carrier.

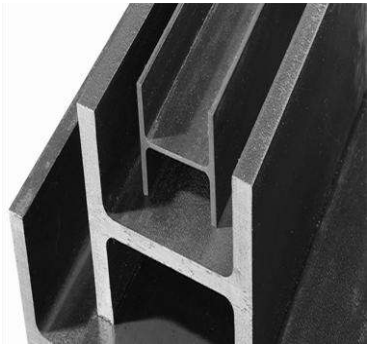
iv) **On Deck Area**. Steel Plates are primarily designed to be stowed in a vessel cargo hold and not on the open deck. This practice is a standard safety and cargo preservation measure to prevent damage to the cargo and ship stability. Hence, it is **not recommended** to stow steel plates on deck.

v) **Summary.**

S/N	Description	Remarks
1	Tank-top to be prepared with appropriate hardwood dunnage to prevent the steel plate bending or buckling. The spacing of the dunnage should not exceed 2.6 metres.	
2	Dunnage to be of hardwood with minimum cross-section 75mm x 75mm.	
3	Dunnage between tiers should be laid in a vertical line to prevent waviness in the steel plates	
4	Lashing wires at a spacing not more than 3 metres to be positioned on the tank-top in preparation for the final lashing of the stow.	
5	The full stow may be lashed in one block. Alternatively, the last two tiers or the last tier of steel plates should be lashed.	
6	Separate tiers or bundle heights (between horizontally placed dunnage beams) must not exceed 110mm.	
7	A minimum clear distance of 100mm is required between edges of the steel plates and adjacent cargo or bulkheads.	This distance should have proper dunnage.
8	In the cargo compartments, where possible, safe passage should be provided directly from the ladders to the top of the cargo stow. In bulk carriers, this access should be provided directly from the Australian ladders.	Safe access should also be provided from the tank-top to the top of the cargo stow.

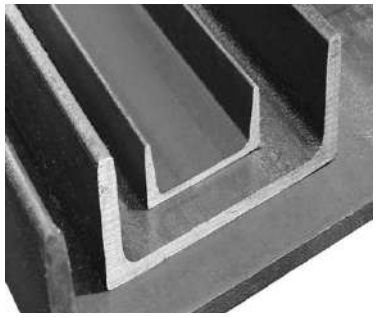
Structural Steel Guidelines

i) **General**. Structural steel is a generic term for manufactured, shaped steel and includes beams, flats, rails, channels, angles, rounds, half rounds, squares, profiles and others used in the construction industries, amongst others. The cargo is generally shipped in unprotected bundles secured by lengths of steel band or thin wire rods wrapped around the bundles at intervals. These bands or wire rods hold no strength and must not be used for lifting. The number of units per bundle will vary with their size and shape within the bundle. Bundles are typically 6 and 12 metres in length; however, longer units of 18 metres may also be transported. The weight of a bundle will vary.



Beams

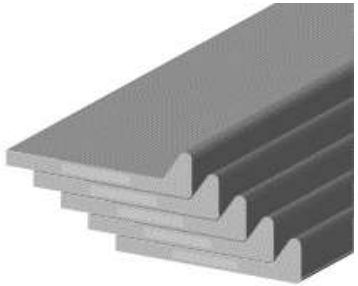
Flats



Channels

Angles

Rounds and squares



Bulbs

Structural steel comes in both bundle and loose. 6mm size Wire rod or steel bands are used for bundling purposes. Each bundle should be double and spaced depending on the length of the structural steels at intervals of approximately 2 to 3 meters. The two ends of the wire bands must be securely twisted at least four times to provide strength for tipping of the bundles. Proper and effective bundling helps to maintain tight bundles of structural steel, when handled with slings and forklift trucks.

The using of dunnage throughout the stow is mainly for two purpose. 1) The first consideration is to bind the mass of steel into a solid block within the cargo space. 2) The other purpose of using dunnage is to facilitate slinging of the material at the port of discharge. In order to avoid warping or bending of the long lengths of steel the dunnage must be kept vertically directly in line throughout the stow.

Timber dunnage must be laid athwartships on the tank-top prior to loading. Dunnage should be spaced at intervals of not more than 3 meters. The first and last dunnage row should be placed approximately 1 meter from the end of the units, to allow for passing of the slings underneath.

The dunnage used with structural material has to be fairly robust as many profiles have sharp edges and there is always a degree of compression involved, which causes weak dunnage to break. Ideally, 75mm x 75mm of robust dunnage should be placed on the tank-top and between all the tiers. Structural steel should be stowed in level tiers, with dunnage between each tier. The dunnage between tiers should be aligned vertically.

Dunnage must also be placed between this cargo and any adjacent cargo to assist with slinging during off-loading. Dunnage should also be placed on hoppers and against bulkheads. Flat pieces of timber to be used to hold the steel clear of ship side frames and tank sides, and in no instance the cargo to be in contact with any component parts of the vessel’s structure—this is particularly so with regard to the ship’s shell plating.

It is normal practice to stow bundles of structural steel aligned in a fore-and-aft direction, across the full width of the cargo hold, although it may occasionally be partially stowed in the hatch square where different cargo has been loaded under the

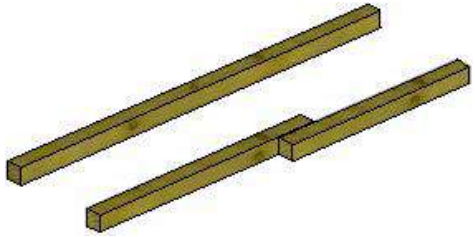
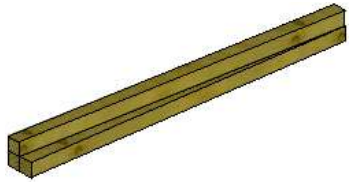
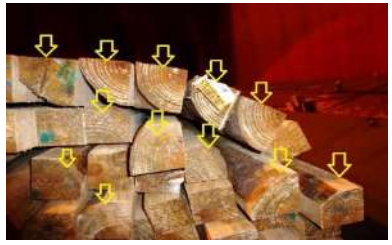
coamings. The stow should form a solid block within the cargo space. This is to ensure that there is no pile up of the steel through rolling of the ship or movement in a fore and aft direction.

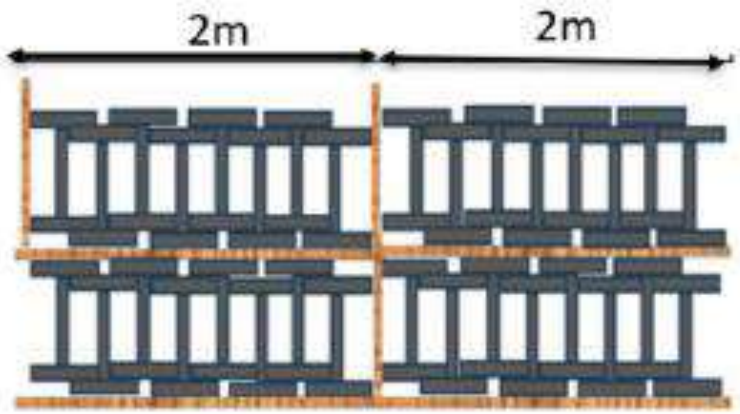
It is not uncommon for alternate layers of structural steel to be stowed athwartships, but care must be taken to ensure that the cross layer is of identical size and type and that there is no steel-to-steel contact with the ship's structures. The ends of athwartship units must not be in direct contact with the ship's shell plating or bulkheads. It is important to stow the ends of the bundles in a neat line as overhanging bundles can cause difficulties when discharging adjacent cargoes stowed in the same hold. For two horizontally separated stows, the clearance between the stows, where possible, should not be less than 1 meter.

Jurong Port typically uses two chains, under a spreader bar, in a basket lift configuration. In this manner, they can handle six or seven bundles per lift of a maximum cumulative weight of approximately 14 tonnes. If the bundles are tightly packed, there are no slings pre-fitted, and there is no timber dunnage separating the tiers, smaller chains are used to shift the bundles sufficiently to rig the lifting chains. This process takes time and ultimately delays the discharge operation.

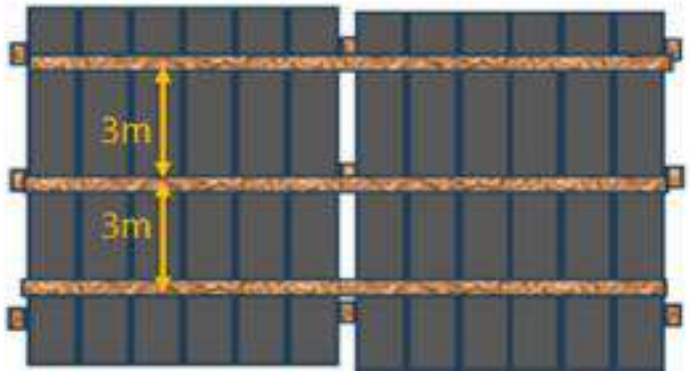
Basket lift of channels with 2 chains under a spreader bar

Basket lift of channels with 2 chains under a spreader bar

<table>
<tr><td>  </td><td>Generally, a minimum of 75mm x 75mm of cross-section dunnage should be used between tiers.</td><td>  </td></tr>
<tr><td>Good, dry, dunnage should be used for the loading of steel pipes up to the third tier of the stow.</td><td></td><td>The dunnage is placed as continuous rows spaced at approximately 3 metres.</td></tr>
<tr><td>  </td><td colspan="2"> 
  </td></tr>
<tr><td>Square one-layer dunnage should only be used.</td><td colspan="2">Double- stacked, rectangular dunnage or 1 on 2 stack dunnage arrangement should not be used. Rounded timber, timber with damaged or crushed corners, or non-square face dunnage should not be used.</td></tr>
</table>



Front view

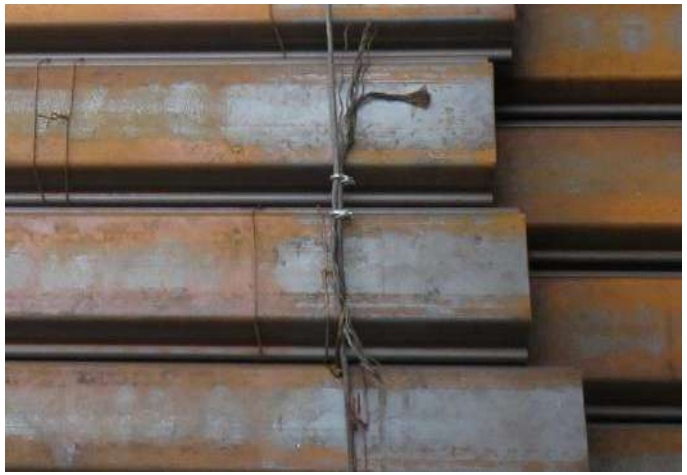


Top view

All lashings should conform with the requirements of the vessel's Cargo Securing Manual and the CSS Code. When the cargo is stowed across the full width of the cargo hold, the structural steels are prevented from shifting by the friction resistance of the timber dunnage used in the stow and the additional timber dunnage against the bulkheads. Wire lashings are used to secure the stow in a single block and prevent the initial movement of the bundles, particularly if the stow is not across the full width of the hold. All lashings must be tight and well made. The Master should be supplied with certificates for all the lashing equipment used.

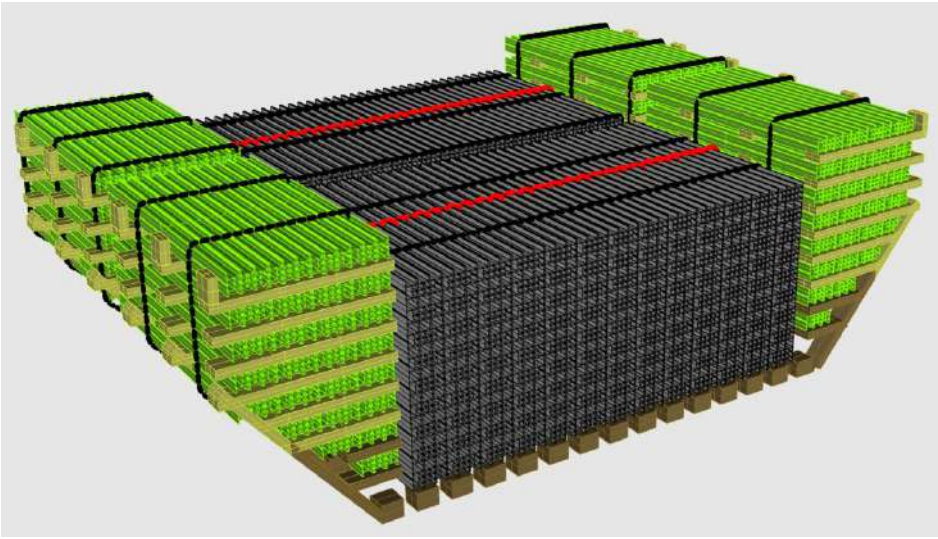
An appropriate number of lashings should be laid in an athwartships direction on the tank-top in preparation for being passed back over the stow to secure the cargo in one block. There are no specific requirements for the minimum number of metal straps to be used; however, minimum of two per 6-metre length or 3 per 12-metre length of bundle would be considered reasonable.

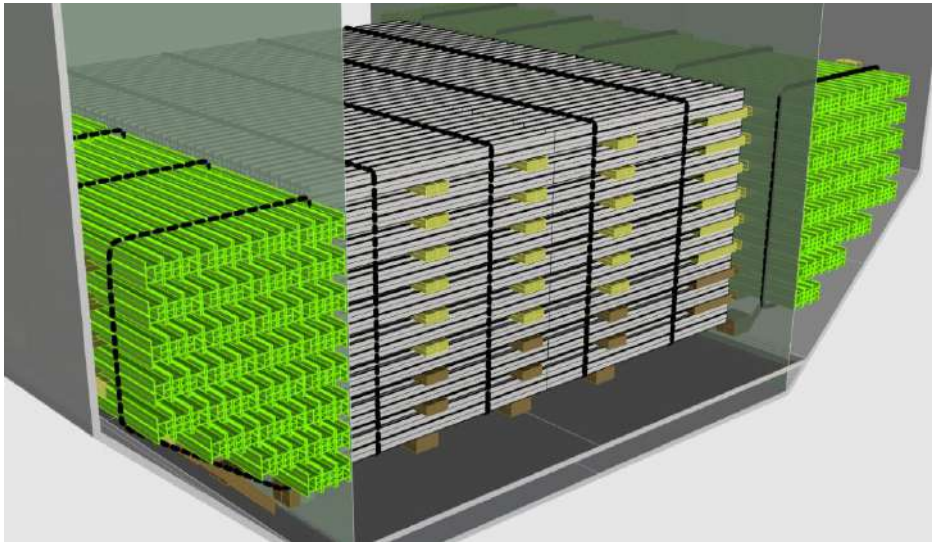
The American Club, in their publication 'Transport Guidance for Steel Cargoes', consider that, for ease of use, 16mm (6x12) wire rope with bulldog clips, turnbuckles and shackles would normally be used to lash steel cargoes.



Incorrect method of connecting two wires and using bulldog grips. Insufficient number of grips used.

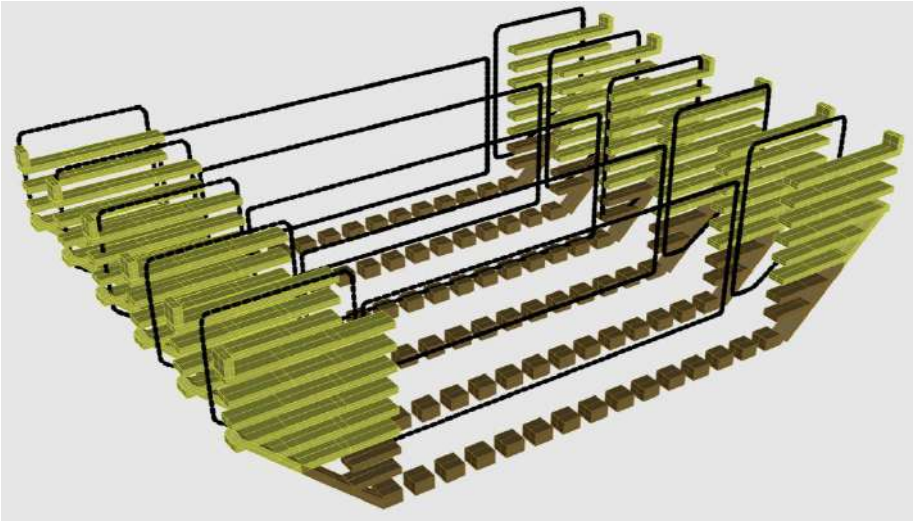
Open Hatch Condition. For structural steel units, under-coaming and open hatch cargoes are lashed separately:

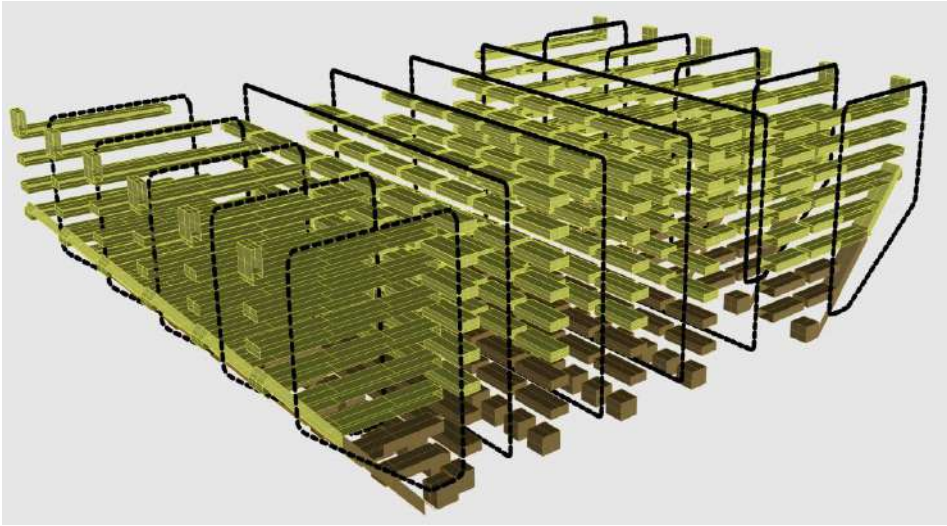




	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

- The pre-slung stow (red colour) under the open hatch is lashed separately. It does not require dunnage except for the first tier to avoid contact with the tank top.
- The stow in under the open hatch area is stowed in an athwartships direction. Dunnage and lashing is used for all stows.





	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

- Dunnage and lashing schematics for a longitudinal stow of structural steel. If the stow under the open hatch is pre-slung, dunnage may not be used for this part of the stow.
- Dunnage and lashing schematics for an athwartships stow of structural steel under the open hatch area.

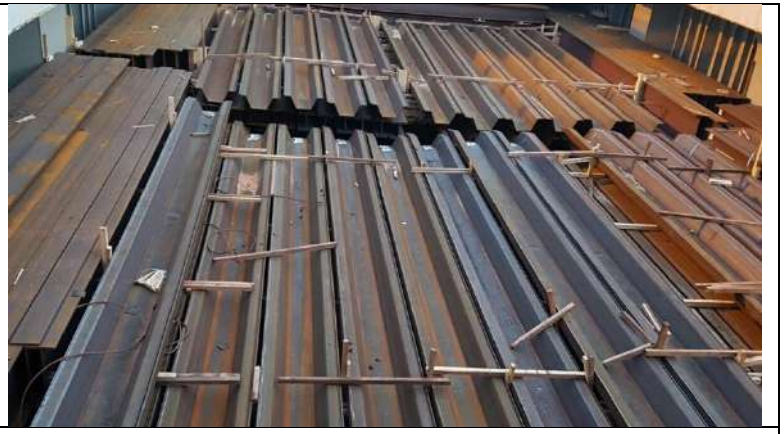
Units are sometimes stowed athwartships due to the constraints of the space available for loading.

Units stowed athwartships forward of the hatch square require a forklift truck for them to be discharged.

Units should not be fanned out in way of the hopper tanks, but

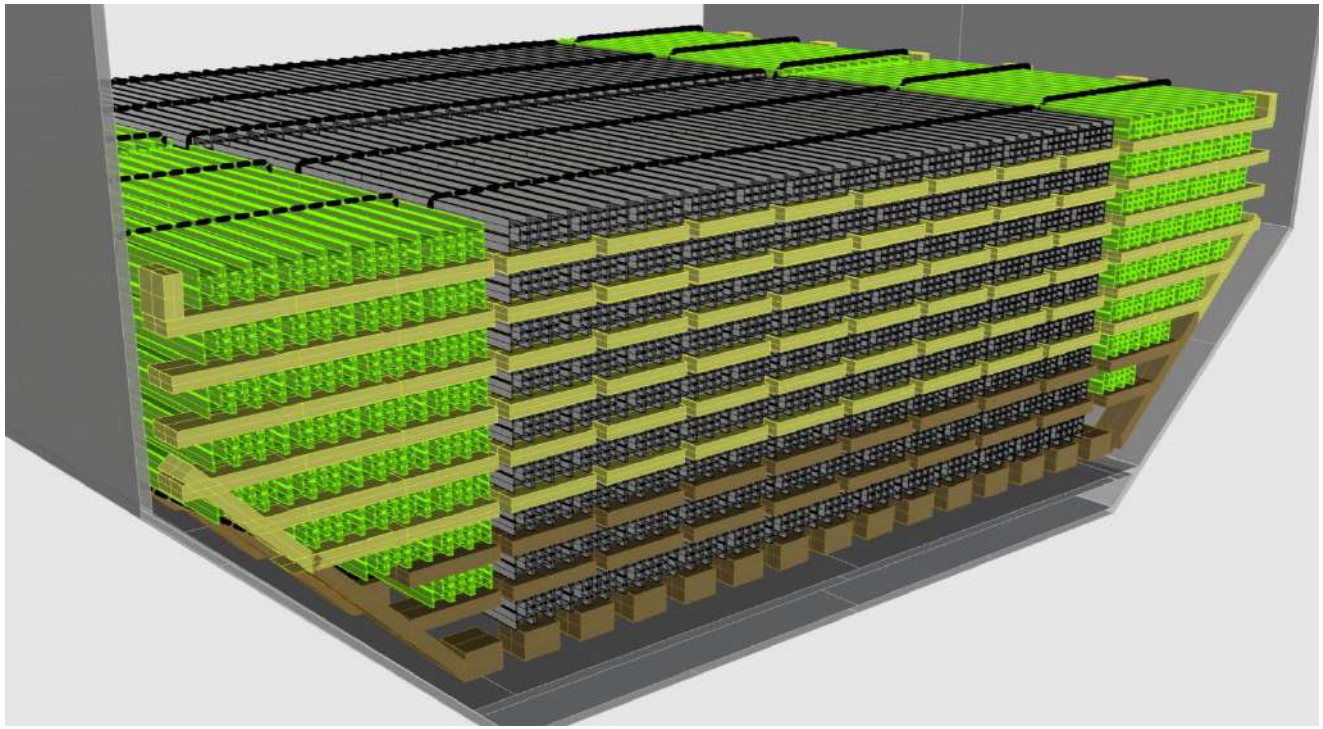
60mm x 60mm section dunnage being laid between layers of structural steel.

			
No protective dunnage placed on the bulkheads to prevent damage to the coating and bulkhead.	✗	✗	Missing dunnage on the side bulkhead of the stow.
			
The longer structural steel units are stowed above the shorter units.	✗	✓	Lashings being tensioned on the completed stow.

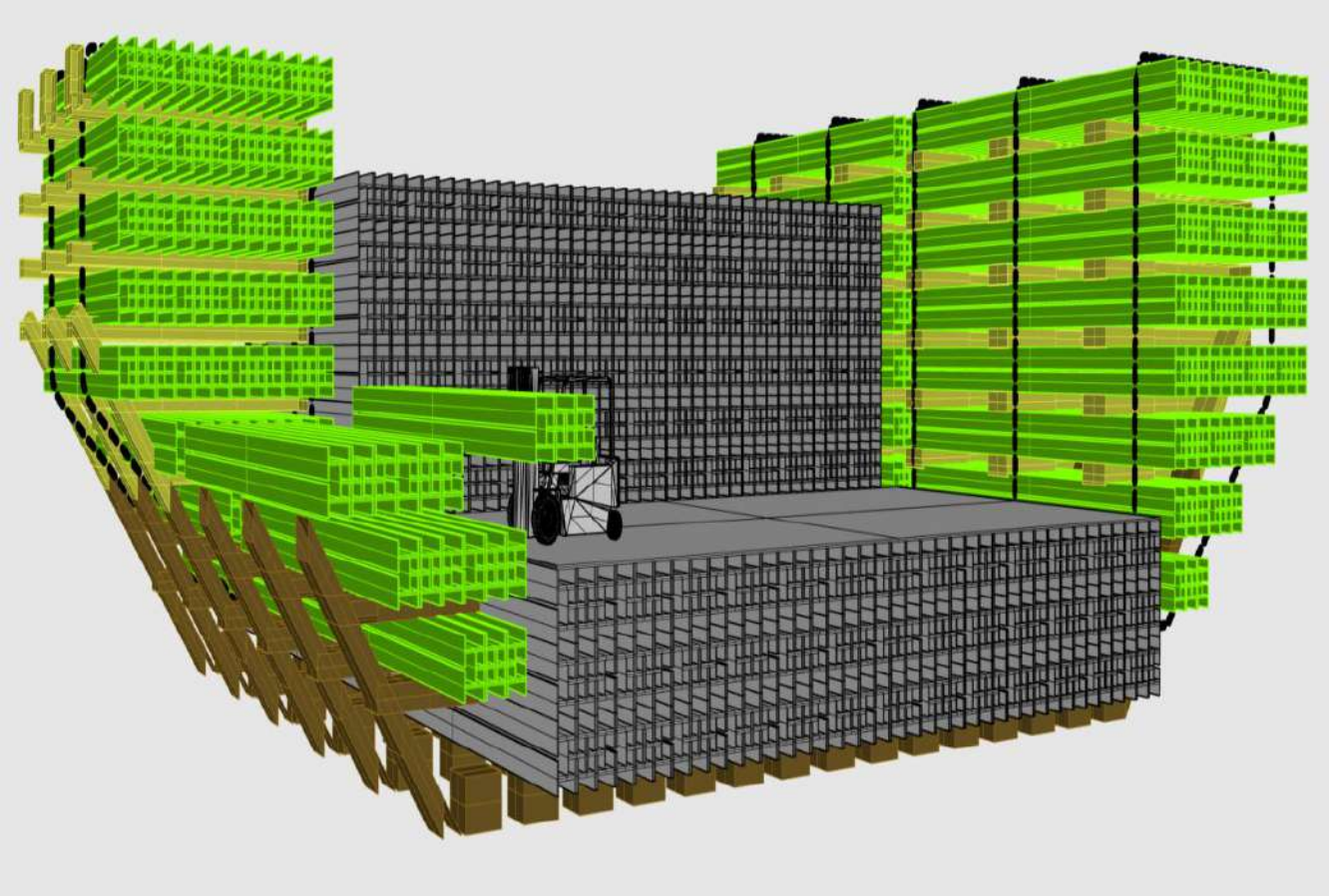
			
Vertical dunnage wood required.	✗	✓	Good level stows with vertical dunnage wedges.
			
H-beam hook is acceptable for single loose piece without vertical dunnage wood.	✓	✗	Bundled beams stowed in different directions both longitudinal and athwartships without vertical dunnage wood. The lower stow is covered with longer longitudinally oriented beams.

		
Insufficient space was left between adjacent cargoes. The discharge rate was reduced and cargo damage likelihood was increased.	✗	✓ The longer units should be loaded under the shorter units.
		
No vertical dunnage wood placed for the adjacent cargo.	✗	✓ Where the bundles are strong and tight, the off-loading can be carried out by the use of beam clamps placed at both ends of the units.

ii) **Under-Coaming Area**: Structural steel cargos are lashed separately to prevent collapse of the stow during off-loading.



	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage



	Under-coaming stow
	Open hatch stow
	Next 6 tier dunnage
	Bottom 3 tier dunnage

- Handling of under-coaming stows with a forklift truck. The stow under the open hatch may need to be loaded/discharged together with the under-coaming stows. Steel plates should be used for the forklift truck for manoeuvring. The under-coaming stow lashing is independent to prevent collapsing of the stow.

			
An athwartships stow of beams. The length is identical to the width of the hold. No dunnage is used for the bulkheads. This may cause damage to ship and cargo.	✗	✓	Under-coaming stow in an athwartships direction.
			
Well-secured and dunnaged upper tier of structural steel products.	✓	✓	Use of beam clamps for off-loading at Jurong Port.

	Using a forklift truck to position the bundles under the hook.	
Forklift trucks are used to assist with the wing access and slinging of the bundles. ✓		✓ The bundles are then maneuvered into position for the stevedores to attach the slings.
		
Once off-loaded at Jurong Port, the structural steel units can be handled by side-loading forklift truck. ✓		✓ Once off-loaded at Jurong Port, the structural steel units can be handled by conventional forklift truck.

iii) **<u>On Deck Area</u>**. Stowage of Structural steel on the deck of a vessel is generally discouraged as the ideal stowage position is in the cargo holds because steel is a high-density cargo. Structural steel cargo must not exceed the deck's structural limitations and does not compromise lashing integrity during voyage. Hence, it is **<u>not recommended</u>** to stow structural steel on deck.

iv) **<u>Summary.</u>**

S/N	Description	Remarks
1	The loading of structural steel is normally in the fore-and-aft direction. Sheet piling and some units allow for loading in an athwartships direction.	
2	The tank-top is to be prepared with appropriate dunnage to prevent steel-to-steel contact. Lashing wires are to be pre-positioned on the tank-top.	Dunnage on the tank-top is to be robust hardwood with a minimum cross-section of 75mm x 75mm.
3	The maximum distance between rows of timber dunnage is not to exceed 3 metres. The first and last rows of dunnage should be positioned approximately 1 metre from the ends of the cargo units.	
4	Dunnage between tiers is to be laid to assist with slinging at Jurong Port. 60mm x 60mm dunnage may be used between the layers, with robust hardwood dunnage between the first 6 tiers and softwood dunnage for the subsequent tiers.	Vertical dunnage inclusive
5	All tiers to be stowed level. The face of the stow is to be as straight as possible, with sufficient clearance from the adjacent stow to prevent virtual over stows.	Longer units are to be stowed under shorter units.
6	When the stow is complete, a sufficient number of wire lashings are to be used for the securing of the whole block of cargo units.	

Wire Rod in Coils (WRIC) Guidelines

i) **General**. Wire Rod in Coils (WRIC) is typically supplied in a semi-finished, hot-drawn condition without external packaging. However, finished products such as galvanized wire rod are wrapped and protected to prevent damage during handling and to minimize moisture ingress. WRIC is available in various sizes and grades. For example, Chinese wire rods are manufactured in accordance with standards such as GB/T 14981 for general-purpose hot-rolled rods and other specifications for specialty grades. Typical diameters range from 5.5 mm to 19 mm, with common sizes including 5.5 mm, 6.5 mm, 8 mm, and 10 mm; specialty and stainless-steel grades can reach up to 40 mm. Coils generally weigh 1,000–2,200 kg, with outside diameters up to 1,250 mm and heights between 1,300–1,700 mm.
The coils should be stowed in athwartships rows with their axes in the fore-and-aft line of the ship upon timber dunnage laid on the tank-top or deck plating in the athwartships line.

Unprotected Wire Rod in Coil (WRIC) shall be formed into bundles and typically secured with four steel wires, or strapping bands while finished and protected coils shall be bundled using strapping bands. These securing wires or bands are not designed for lifting and must never be used for this purpose. Each WRIC bundle shall be fastened with five equally spaced double wires, each secured with a minimum of four twists to prevent crushing of lower tiers and ensure tight stowage without risk of collapse. When strapping bands are used, five bundles shall also be applied. All bundling wires shall have a minimum diameter of 6 mm. Prior to loading, each individual wire rod coil from the stow is required to be pre-slung for safe off-loading operation at Jurong Port.

The lower tier of WRICs stowed on the tank-top or ’tween deck shall be placed on plywood dunnage sheets to prevent steel-to-steel contact with the ship’s structure. Similarly, timber dunnage or plywood sheets shall be used in hoppers adjacent to side frames or vertical bulkheads. When timber planks are employed for hoppers or vertical bulkheads, a minimum of two lines of planks per row of coils shall be provided to ensure adequate separation and stability.

When WRIC is stowed homogeneously across the full width and length of the cargo hold, lashing is generally not required. However, if the cargo occupies only part of the hold and has an open face, the coils in the upper tiers must be secured. If the block

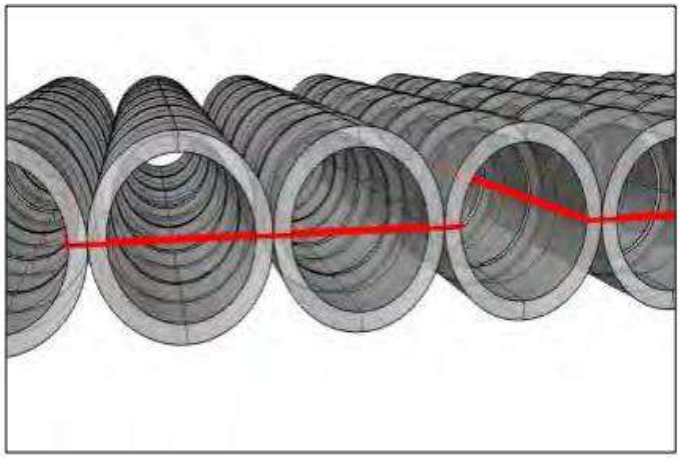
of coils does not fill the cargo compartment and an open face is left, that face must be secured by the use of wire lashings in conjunction with timber, pallets or fencing in a fashion similar to that used to secure blocks of break-bulk cargo. Care should be taken when lashing with chain because chain can damage steel. Damage can be prevented by placing dunnage at the point where the chain contacts the steel. For partial loads, each tier of WRIC stow shall be lashed using wire ropes to the aft or forward bulkheads as follows:

- The stow should preferably be positioned in the aft section of the hold, utilizing the aft bulkhead for securing.
- appropriate lashing points must be prepared on the bulkheads, avoiding structural components, and fitted with properly welded and inspected D-shackles and rims.
- lashing wires shall pass through every third or fourth coil in each tier and be secured to the bulkhead, a method particularly critical for high stows.
- strapping bands shall not be used for securing to the vessel's bulkheads.
- All lashing wires must be evenly tensioned to prevent shifting during transit and discharge.

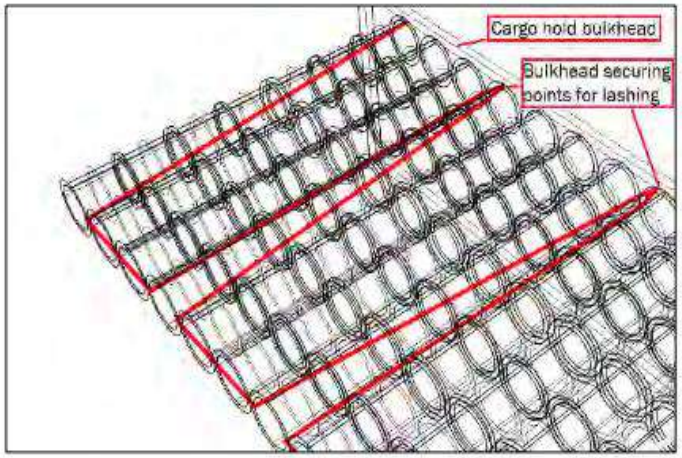
Wire coils may be stowed atop other steel cargoes (plate, pipe, section, H-beam, etc.) but shall not be over-stowed by other cargo as WRICs themselves can easily be deformed. Prior to the loading, confirmation shall be sought and obtained from the manufacturer of the maximum allowed number of tiers in one stow. If such advice is not provided, the stow shall not normally exceed 8 tiers.

For partially stowed cargo, the front rows adjacent to the face are to be pre-slung. This will assist with off-loading in the event of the stow collapsing in transit.

In the cargo compartments, where possible, safe passage shall be provided directly from the ladders to the top of the cargo stow. Safe access shall also be provided from the tank-top to the top of the cargo stow.



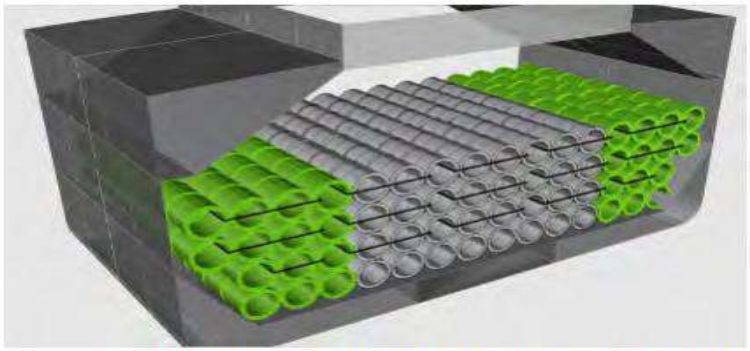
Lashing and securing arrangement of one tier of WRICs to the bulkhead. A view from the front

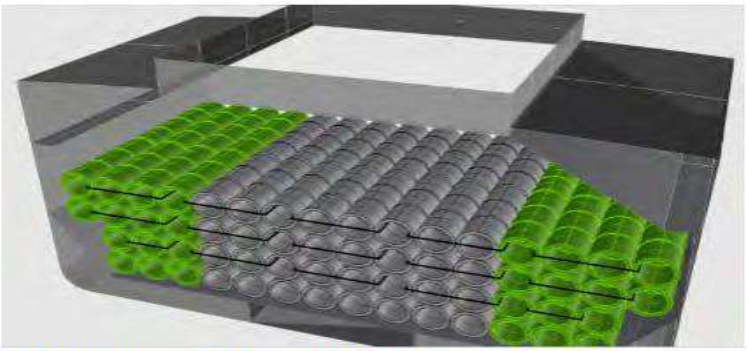


Lashing and securing arrangement of one tier of WRICs. A view from the top showing the securing points on the bulkhead

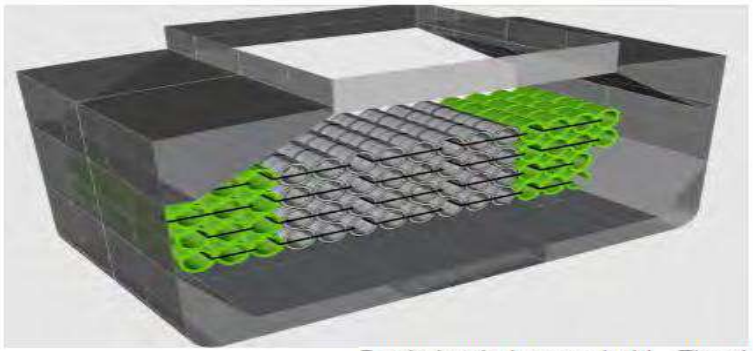
ii) **Open Hatch Condition**. Coils are generally stowed with the axis in a fore-and-aft direction, although they may be stowed athwartships under the large wing spaces on bulk carriers to facilitate discharge. According to the industry accepted publication Thomas' Stowage WRIC shall be stowed across the full width of the cargo hold and arranged so that the coils are tightly and compactly stowed:

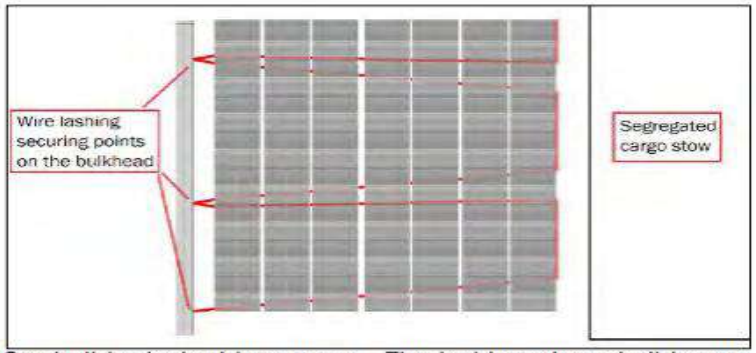
SCHEMATICS FOR CORRECT STOWAGE AND LASHING (the pre-slinging is not indicated in these schematics)





Fully loaded cargo hold. The under-coaming coils shall be lashed separately from the open hatch cargo stow.
Lashing of WRICs is normally not required for a full stow. The top three tiers may be lashed to prevent possible shifting.





	Under-coaming stow
	Open hatch stow

Partly loaded cargo hold. The tiers of WRICs shall be lashed in a group. The lashing wires shall be run through the third or fourth coils and secured to the bulkhead. Ideally, all tiers from the tank-top should be lashed.

- Wire rod coils should be stowed with staggered tiers to avoid vertical faces and must never overhang.
- If staggering is not possible, two lengths of dunnage placed in the cantlines bridging two rows will help bind them when over-stowed.
- When the stow does not cover the entire tank-top and other cargoes are present, a high stow of coils should be positioned aft to prevent collapse during excessive stern trim.
- For partial loads with a high vertical face coils at the forward edge must be pre-slung and each tier additionally secured with lashings to the bulkhead to ensure stability and safety during transit.

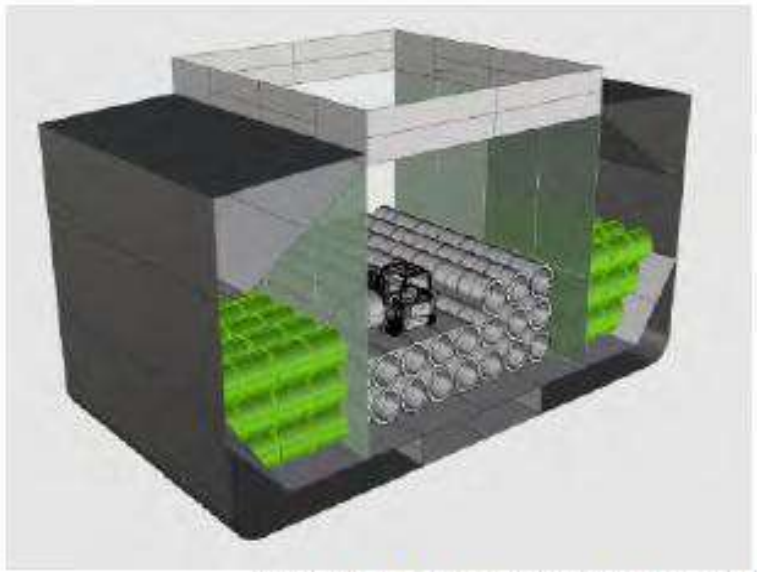
	
An athwartships stow in the under-coaming space. While this type of stow makes offloading by forklift truck easier and quicker, it should be lashed individually.	Two stows of WRIC and rebar that are too close together. No lashing on the WRIC. Rebar offloading is in progress and collapsing of the WRIC was observed during offloading.
	
Combined stow of rebar and WRIC. Collapse of the WRIC in the under-coaming spaces. Difficult and unsafe access for offloading.	Improper stow. Access to the lower tiers of the vertical face is hazardous.

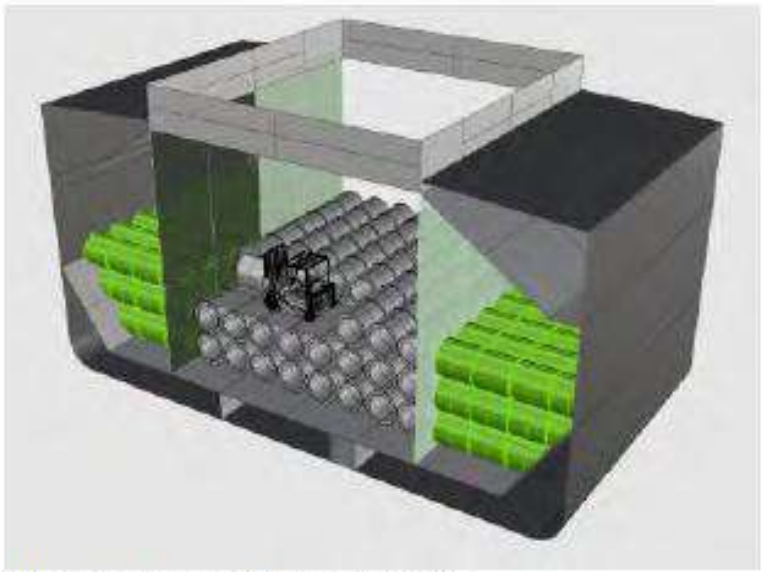
	
No timber dunnage between the sloping plate and the coils. Steel-to-steel contact means there is no friction to restrict the outer coil from moving forward.	Cargo stowed above WRIC, which shall not be considered. In addition, the lashings for this cargo are attached directly to the wire rod. The hook will either fall out or deform the wire rod, resulting in loose lashings.
	
Cargo stowed above a high, loose, stow of WRIC. The face of the stow is in imminent danger of collapsing. The cargo on top will fall onto the steel coils below.	Heavy crane counterweights and blocks stowed at the front edge of a high stow.

	
Lengths of structural steel stowed on top of coils. The WRICs stow collapsed and had to be off-loaded. Many of the coils were damaged.	Collapsed stow and deformed coils due to loading cargo above the coils.
	
Completing a stow in the aft part of the cargo hold. The forward-facing vertical wall will require to be lashed.	Lashing the vertical face. Note the lack of safety harnesses. No safety access to the vertical part of the stow.

	
No part of a coil shall be used for securing any other cargo. The wire coil rod will be pulled out, which will damage the cargo and also result in loose and ineffective lashings.	Ports have experienced poorly stowed and secured WRICs. Here, the face of a vertical stow has partially collapsed. This is extremely dangerous for the stevedores when releasing the lashings.
	
This stow of coils has partially collapsed, with damaged and loose coils. Cargo in this condition is time-consuming and hazardous to off-load.	Another reasonable stow. However, the coils in the wing space are stowed longitudinally. There is safe access to the cargo direct from the Australian ladder.

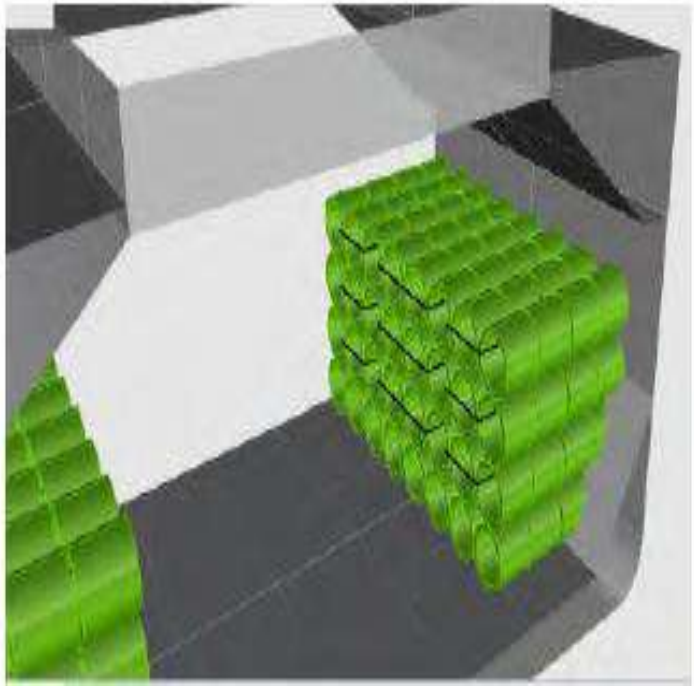
iii) **Under-Coaming Area**. For a homogeneous cargo loaded throughout the cargo hold in bulk carriers, WRICs stowed under the coamings cannot be directly lifted out from the hatch square. These WRICs need to be pulled into the hatch square using light forklift truck manoeuvring on steel plates placed over the coils stowed in the hatch square layer by layer. For WRICs stowed with the axis in a fore-and-aft direction, there is no direct lift for the forklift trucks and the possibility of damaging the cargo is increased. To limit the potential damage to the WRICs, It is recommended that the WRICs in the under-coaming spaces are stowed with the axis in a transverse direction as shown in the schematics below.





Suggested stow for wire rod coils on bulk carriers with hopper-type cargo compartments.
Note: vertical shadow is for plumb-line reference only.

	Under-coaming stow
	Open hatch stow



	Under-coaming stow
	Open hatch stow

- Under-coaming WRICs loaded in an athwartships direction. The WRICs stow under the coaming shall be lashed separately from the stow under the open hatch.
- The usual group lashing is to be applied by lashing in a group three to four side coils from the rows together. The top three tiers shall be lashed in this way.
- The lashing wires shall be secured to a bulkhead. The stow under the open hatch may not be lashed, if the stow extends to the full surface of the tank top. However, the top three tiers shall be lashed in a group of three or four.

	
The coils are landed in the hatch square before being positioned in the under-deck areas by forklift truck. The WRICs are loose and will collapse when stowed in height. ✗	✗ Timber dunnage on the tank-top/'tween deck is positioned on the tank-top. Plywood dunnage sheets are required.
	
Plank-type, timber dunnage for WRIC. 15x100mm cross-section is a typical size. The dunnage in the photograph bears the ISPM15 stamp. The dunnage is to be used for the bulkheads only, and not tank-top. ✓	✗ No plywood dunnage under the coils. The bottom of the coil is in direct contact with the tank-top. Any moisture collecting on the tank-top will directly affect the coils.

	
No timber dunnage between the coils and the cargo hold bulkhead. Only four wire bundles in use instead of five.	After the under-coaming areas are stowed, the coils are loaded into the hatch square, and forklift trucks are used to ensure that the coils are tightly stowed across the hold. No plywood dunnage is used.
	
Steel plates are used on top of the lower tiers to enable a forklift truck to stow the upper tiers under the coaming area.	The coils are landed on the steel plate…

	
…and positioned under the deck area.	Near completion, the coils are stowed directly into position. This often leads to poor stowage. The above shows a row of coils that has partially collapsed.
	
These coils have been randomly stowed and will be time-consuming to off-load. Crew supervision is essential to stop this standard of loading.	Collapsed stow of WRICs.

	
Unwound and damaged coils. These shall not have been loaded as they may be rejected by the receivers and will be difficult and dangerous to off-load.	The stow of coils is not tight across the hold due to the unwound coils.
	
One coil has fallen off the stow and is sitting vertically, and unsecured.	Poorly stowed outer coils in a bulk carrier. Although the tiers are lashed, the outboard coils are leaning forward and will likely collapse on the voyage.

iv) **On Deck Area**. WRIC are primarily designed to be stowed in a vessel cargo hold and not on the open deck. This practice is a standard safety and cargo preservation measure to prevent damage to the cargo and ship stability. Hence, it is **not recommended** to stow WRIC on deck.

v) **Summary.**

S/N	Description	Remarks
1	Plywood dunnage of at least 10 mm thickness shall be used on the tank top. Wooden planks of approximately 15 mm × 100 mm cross-section shall be used for the bulkheads and, if required, between tiers.	
2	For the face of a part stow as minimum, the upper 3 tiers shall be secured to the aft bulkhead.	
3	Lashing of the top 3 tiers is not required for a full stow of WRIC.	Safe access needs to be provided from tank-top to the top of the cargo stow
4	When the under-coaming WRIC are stowed athwartships, the top 3 tiers shall be lashed in a group. This stow is not to be lashed to the open hatch stow.	It is recommended the top 3 tiers to be lashed in a group.

Combined Stowage of Different Steel Products Guidelines

i) **General**. When loading different steel cargoes in the same compartment, proper planning and correct stowage are essential. If horizontal segregation of cargo parcels is not possible, vertical segregation to be considered. Where horizontal segregation can be achieved, cargo units should ideally form a single stowage block or parcel. In such cases, the principles and guidelines applicable to loading that type of cargo in a homogeneous form should be referenced and applied.

As a basic rule of thumb and industry best practice, heavier cargo units should be loaded under lighter cargo units. Heavier cargo parcels should also be loaded under lighter cargo parcels. By heavier cargo, it is understood that the cargo unit has a smaller stowage factor. Similarly, the lighter cargo is the one with a higher stowage factor. The maximum allowed uniform loading allowance of the tank-top should never be exceeded by any combination of cargoes. It should be borne in mind that the hopper areas may have smaller maximum loading allowance than the tank top. The requirements of the Cargo Stowage and Securing Code and the vessel's Cargo Securing Manual should always be complied with.

Combined vertical loading of steel cargoes may involve some, or all, of the following products:

- Steel Plate in Sheets.
- Reinforced Bars (Rebar).
- Wire Rods in Coils (WRIC).
- Steel Plate in Coils.
- Steel Pipes.
- Structural Steel Products.

The matrix below outlines which cargoes may be loaded on top of others, provided that the combined weight of the upper stow does not create a risk of shifting, collapse, or damage to the lower stow. It also identifies cargoes that must never be placed on top of other cargoes.

		Cargo in Upper Tier					
		Steel Plates	Reinforced Bars	Wire Rods in Coils	Steel Coils	Steel Pipes	Structural Steel Products
Cargo in Lower Tier	Steel Plates						
	Reinforced Bars						
	Wire Rods in Coils						
	Steel Coils						
	Steel Pipes						
	Structural Steel Products	prefabricated units H-beams, I-beams and other sections					
		The loading is possible.					
		Special considerations are required.					
		The loading is not allowed.					
		Homogeneous loading and stow.					

If the lower stow are parcels of rebar, pipes or structural steel products, these should be loaded in a fore-and-aft direction over the full width of the cargo compartment. Whereas if the lower stow is of steel plates, these may be loaded and stowed in both longitudinal and athwartships directions. The lower stow must be properly levelled prior to the loading of an over stow.

Some common stowage practice for steel cargoes on vessels:

- **Steel coils and WRICs (Wire Rod in Coils)**: These are heavy, dense cargoes typically stowed longitudinally (along the length of the ship) to maintain stability and even weight distribution. They are usually treated as homogeneous stows, meaning the entire section consists of similar cargo.
- **Lighter steel cargo parcels on top**: It's acceptable to place lighter items (like steel pipes or structural sections) above the coils, but this must be done carefully to avoid damaging the coils and to maintain stability. Adequate dunnage to be provided.
- **Stowing in the coils' cantlines**: The cantline refers to the groove or space between adjacent coils. Placing pipes longitudinally in these spaces helps prevent rolling and ensures a snug fit, reducing the risk of shifting during transit.
- **Avoid stacking heavy or unstable items on top of coils or WRICs**: Steel plates, structural steel, and rebar should not be placed on steel coils or WRICs. Steel coils and pipes should not be placed on WRICs.
- **WRICs can be loaded on top of most structural steel products** (except prefabricated structures) because of their higher stowage factor.
- **Avoid overhangs**:
  - Longer products should not be loaded on shorter ones.
  - If unavoidable, use **dunnage or other supports** to prevent damage or instability.
  - Pipes, rebar, and structural steel often create overhangs and need proper support.

Hardwood dunnage is to be placed on the tank top as softwood dunnage is too easily crushed or damaged. The dunnage used for the lower stow should always be in accordance with the relevant guidance for the loading and stowage of that specific cargo described in the relevant guidelines. Depending on the total combined weight of all cargo on the cargo hold tank top, hardwood dunnage should be considered for use throughout the lower stow. Softwood dunnage may be used for the upper areas of the stow, depending on the bearing weight. If the upper stow is not sufficient in quantity to cover the whole width of the cargo compartment, it must be loaded, lashed and secured within the open hatch area, and not in the under-coaming areas.

Steel coils and non-bundled pipes shall be securely positioned using wooden wedges to prevent movement, with additional wedges placed between tiers of pipes for stability. Dunnage structures must be constructed beneath any overhanging parcels, particularly when structural steel products or pre-fabricated units are over stowed on shorter parcels.

For WRICs (Wire Rod in Coils), plywood dunnage sheets shall normally be employed, especially when these coils are stowed atop steel coils or large-diameter pipes, to protect surface coatings from getting damaged. Where WRICs are loaded into the cantlines of hot rolled coils, dunnage may not be required. All dunnage materials must be robust, dry, and properly distributed to prevent concentrated loading. Prior to departure, a comprehensive safety inspection shall be conducted to confirm that all wedges, dunnage, and supports are correctly installed and secure.

Where shoring is required to be built between the stows and the bulkheads, it must be constructed in such a manner that there is no risk of it slipping or loosening-up. This is particularly relevant for hopper-type cargo holds, where the contact between the dunnage and the hopper-plating may not be perpendicular, because of the slope of the hoppers.

When two different steel products are loaded as a combined vertical stow, the lashing in general is made in accordance with the guidelines for loading a homogeneous cargo of the individual cargo types. The two stows should be lashed individually. This is particularly important when the lower stow is not off-loaded with the upper stow in the same port. In this situation, it must be confirmed that the remaining stow(s) are properly secured and lashed prior to the departure of the vessel from that offloading port.

For multiple cargo type stowed in the same cargo hold as homogeneous block, the horizontal separation between the cargo type should be the used as higher of the two adjacent cargos as outlined in the specific guidelines.

The lashing materials for specific cargos are described in the relevant guidelines. The most used lashings are wires of up to 19mm size, turnbuckles, rigging screws, bulldog grips, steel strapping bands (for coils). Pneumatic tools must be used for the tightening of the steel strapping bands.

Copies of all certificates of the lashing materials are to be requested and presented to the master prior to the vessel's departure. For details of the lashing and the materials used, reference should be made to the relevant guidance for homogeneous loading of steel cargoes.

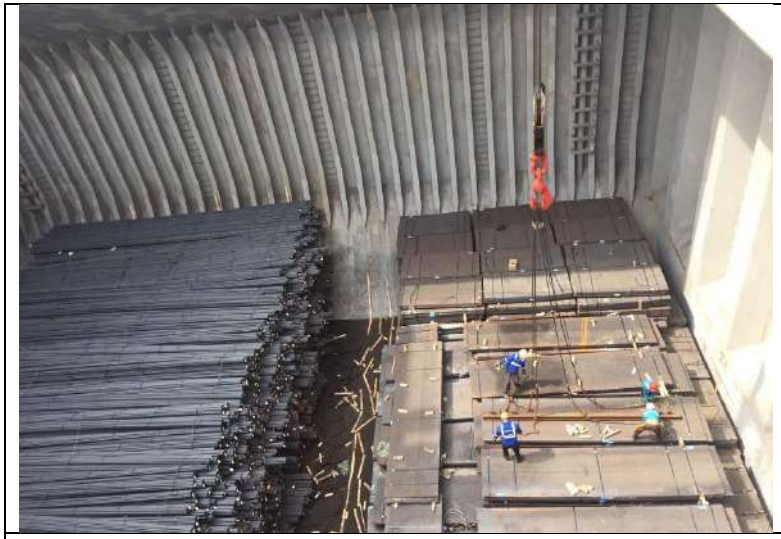
When loading combines stows of various steel types, lashing is required and used for a variety of reasons:

- To assist in the building of a single stowage block.
- To prevent the cargo from shifting in transit.
- To protect the ship’s structures and cargoes with dunnage.
- To segregate the individual parcels from one another to facilitate segregated discharge operations.

Steel cargo units may be bundled together for easy handling and stowage. Various sizes of pipes, rebar and structural steel may need to be pre-slung for ease of the off-loading. The bundles and slings should be certified.

Steel plates in packaged or unpackaged form atop of:				
Reinforced Bars	Wire Rods in Coils	Steel Coils	Steel Pipes	Structural Steel Products: prefabricated units
				Structural Steel Products: H-beams, I-beams and other sections

Steel Plates over Reinforced Bars



The horizontal segregation of steel plates and rebar stows will be recommended to be at least 1 metre.

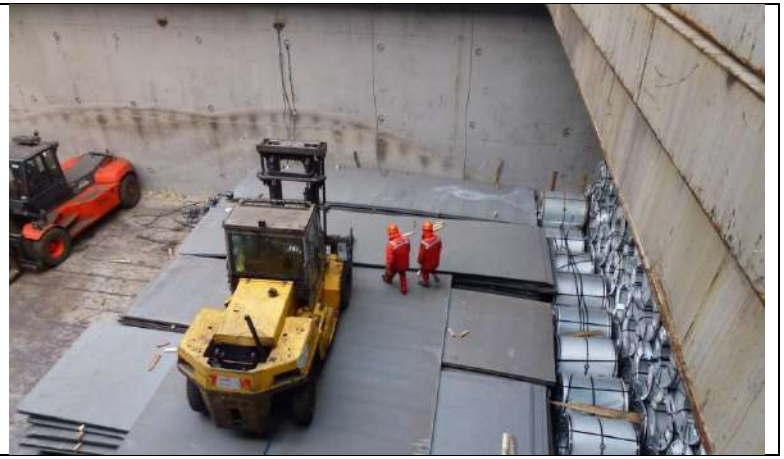
Steel plates loaded over rebar. The rebar can easily settle during the voyage and cause the dunnage to loosen and plates to shift.

		
The rebar and steel plates are both heavy cargoes. It is strongly recommended that these are stowed horizontally apart and not one over the other. There should be sufficient clearance between the stows of at least 1 metre, where possible.	✓	✓ Easy use of a forklift truck for the unloading of the steel plates.

Steel Plates over Wire Rods in Coils (WRIC)

	Steel plates should not be loaded on top of WRICs. The stow under the plates will settled down, causing compressing or ovalizing of the coils.	

Steel Plates over Steel Coils (HRCs and CRCs)

	Steel plates should not be loaded on top of coils. The two cargoes can only be loaded next to each other, because of their weight.	

Steel Plates over Steel Pipes

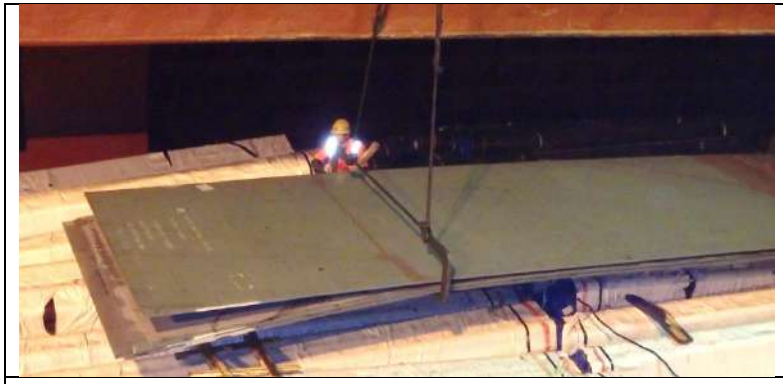
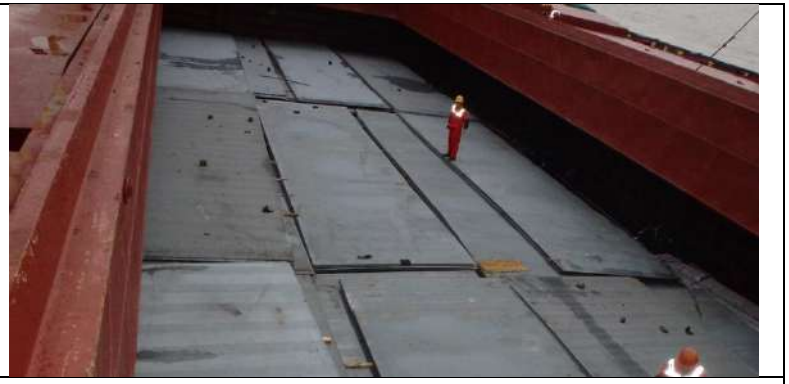
STOWAGE

Light pipes should not be over-stowed with steel plates as they can easily be crushed and deformed in transit. Light pipes are typically supported from inside with the use of wooden crosses, which prevents them from deformation. The lower stow of steel pipes must be loaded in a fore-and-aft direction over the full width of the cargo compartment. Where the steel pipes are of big size and not in bundles, special attention and consideration should be paid to prevent damage to the pipes because of the weight of the steel plates. The steel plates should then be loaded in a fore-and-aft direction and in accordance with the relevant guidance for this cargo. When the cargo of pipes is not loaded throughout the whole length of the cargo compartment, the upper cargo of steel plates should not extend longitudinally over the end of the pipes. Longer plates should not be considered for loading on top of the pipes.

When handling steel plates, care should be taken for the plates not to hog at both ends prior to stowing them over the pipes and lifting them during unloading. This will present a risk of damage to the pipes and plates' ends.

DUNNAGE

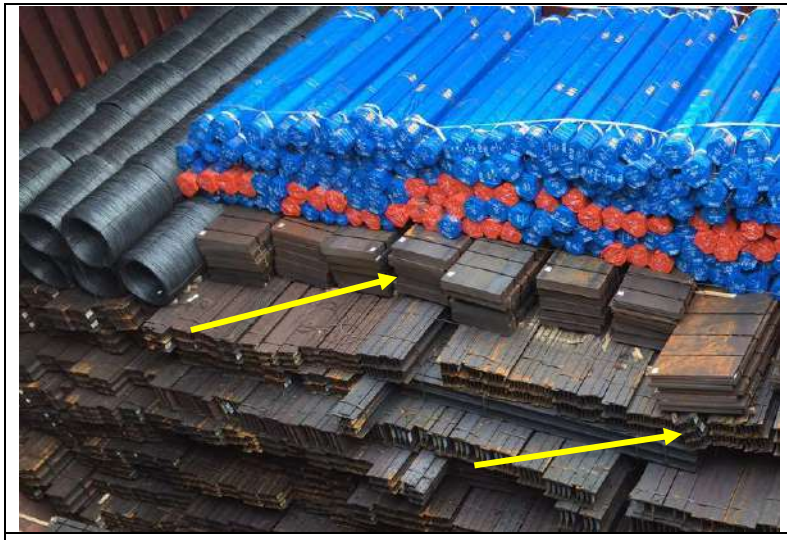
The layer of dunnage before the steel plates are loaded must be at a smaller spacing so that the pipes are protected from scratching. Ideally, spacing not exceeding 1500mm should be considered. Upon completion of loading operation, there should be no direct contact between the steel plates and the pipes upon which they are stowed.

			
Prior to the loading of plates over pipes, the stow of pipes must be levelled and properly dunnaged. Insufficient dunnage. Risk of damage to the pipes and packaging.	✗	✓	Stow of plates loaded over a stow of pipes. The plates must be dunnaged and lashed.
			
The lashing of the plates stows in progress. A stow of pipes are underneath.	✓	✓	Additional general cargo is loaded over the two stows of pipes and plates. The stow of plates is levelled and lashed. Dunnage is used for the general cargo units.

Steel Plates over Structural Steel Products, such as prefabricated units

Steel Plates over Structural Steel Products, such as H-beams, I-beams and other sections.

Steel plates can be considered for loading over H-beams, I-beams and other sections. It should be born in mind that the beams and sections may be coated. Proper and sufficient dunnage and lashing materials are to be used for stowing segregation and securing.

<table>
<tr>
<td>  </td>
<td></td>
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</tr>
<tr>
<td>Bundled steel plates loaded over structural steel products. Structural steel products collapsed. Insufficient or no dunnage was used between the stows.</td>
<td>✗</td>
<td>✗ Bundled steel plates loaded over structural steel products. Incomplete top tier of steel plates. Insufficient or lack of dunnage for the top tier of plates.</td>
</tr>
</table>

REINFORCED BARS atop of:				
Steel Plates	**Wire Rods in Coils**	**Steel Coils**	**Steel Pipes**	**Structural Steel Products**

Reinforced Bars over Steel Plates

Ideally, the rebar and steel plates should be stowed as separate adjacent stows. Where this is not feasible, the stow of rebar over the plates is possible.

LASHINGS

When rebar are loaded on top of steel plates in full width and sufficient depth, no lashing may be required for the steel plates stow depending on the amount of rebar to be so loaded.

Rebar over bundled steel plates.
No dunnage was used between the two stows.
Dunnage is used on the side.

The rebar and steel plates are both heavy cargoes.
It is strongly recommended that these are
stowed horizontally apart and not one over the other.

Reinforced Bars over Wire Rods in Coils

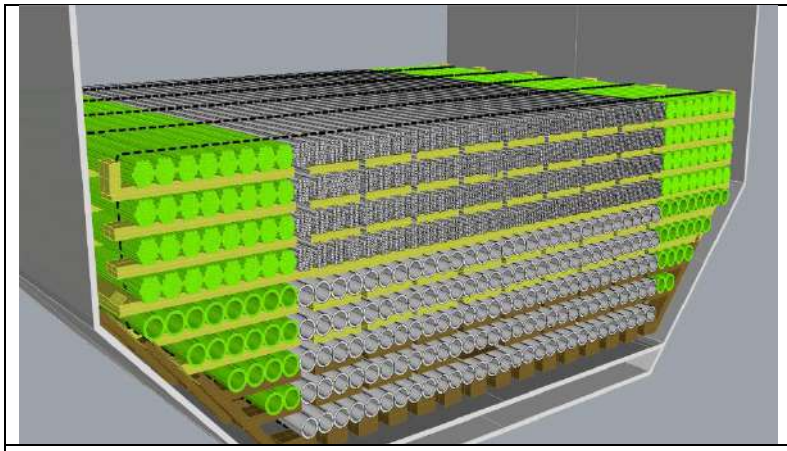
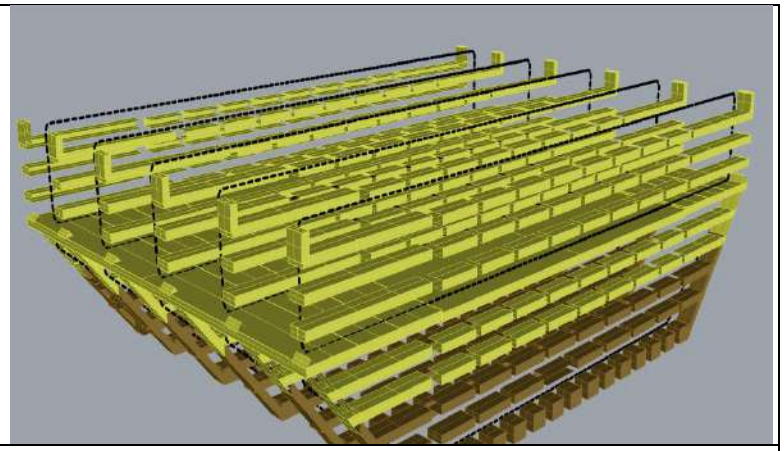
Rebar should not be loaded on top of WRICs. The WRICs will settle down, causing compressing or ovalizing of the WRICs.

Reinforced Bars over Steel Coils

Rebar should not be loaded on top of steel coils. The combined weight of the stows may exceed the tank-top strength.

Reinforced Bars over Steel Pipes

Rebar may be considered for loading over pipes if the pipes are not coated and in packaged form. The length of the rebar should not exceed the pipes. The rebar and pipes must be loaded in a fore-and-aft direction. The schematics below are indicative and for demonstration purposes only for a combined stowing of rebars over steel pipes. The sizes of the rebar's bundles are identical with the pipes' bundles. When different sizes of pipes are loaded under a stow of rebars, the dunnage and lashing for the stow of pipes should be reconfigured accordingly, to provide a levelled and stable stow of pipes. Wooden wedges should be considered for use for big diameter pipes. The dunnage between the two stows should be at least 100mm x 100mm of softwood, provided that the stow of rebars is not significant in weight.

		
Schematics of the stowing rebars over pipes. Hardwood dunnage for the first tiers of pipes and softwood dunnage for the subsequent tiers of pipes and rebars.	✓	✓ Schematics of the stowing rebars over pipes. Hardwood dunnage for the first tiers of pipes and softwood dunnage for the subsequent tiers of pipes and rebars. The two stows should be lashed separately.

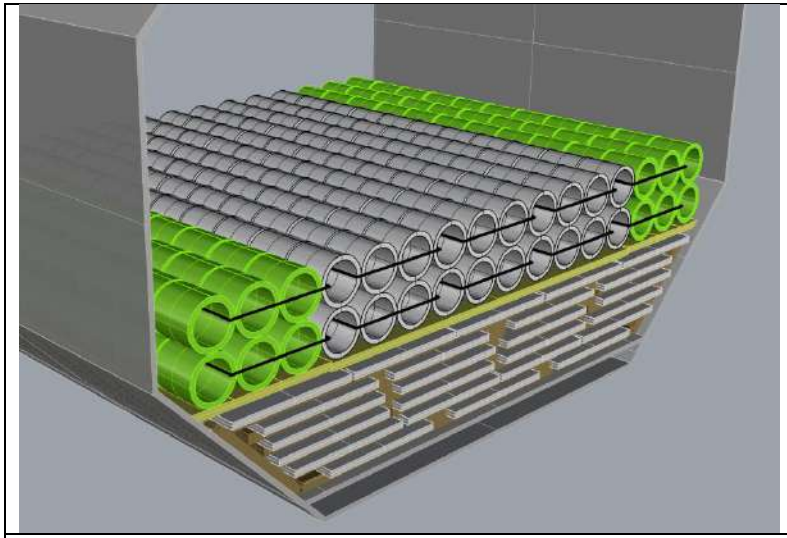
Reinforced Bars over Structural Steel Products – prefabricated sections or units

Rebar should not be loaded on top of any structural steel product. Various structural steel products are coated; others may be prefabricated sections which could be damaged or destroyed if rebar are loaded on top. The rebars are flexible and tend to bend, which may cause the structural steel products to be damaged.

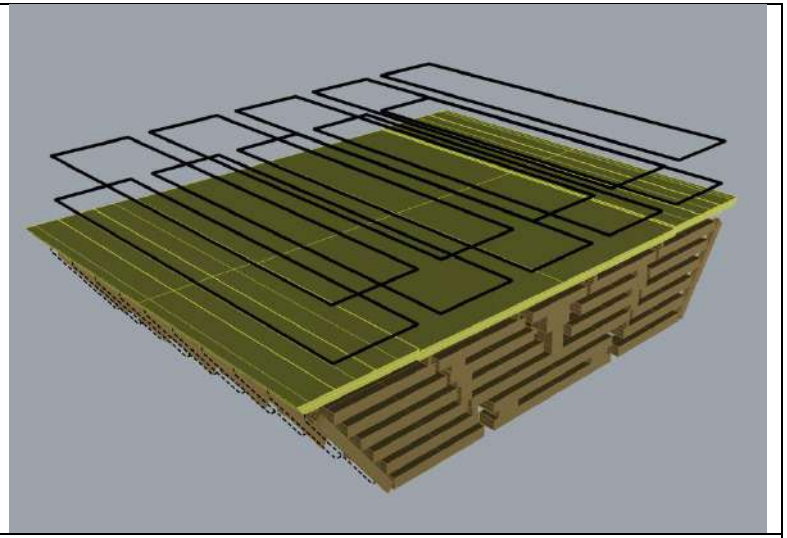
WRICs atop of:				
Steel Plates	**Reinforced Bars**	**Steel Coils**	**Steel Pipes**	**Structural Steel Products**

WRICs over Steel plates

The schematics below are indicative and for demonstration purposes only for a combined stowing of WRICs over steel plates. The dunnage between the two stows should be of plywood sheets to protect the plates and their coating, in the event of bundled and packaged plates being stowed underneath the WRICs.



WRICs loaded over steel plates. Plywood dunnage should be placed on top of the steel plates stow. The plates should be lashed, if not off-loaded at the same port as the WRICs. The WRICs stow should be lashed separately.



Schematics of the dunnage and lashing approach for the two stows.

WRICs over Rebar

Warning: Because of the nature of the rebar, the stow may shift or settle and the lashing may become loose. Loading of WRICs on top would require additional lashing for a firm stow of WRICs to be formed.

LASHINGS

For higher stows of WRICs, for the first tier on top of the rebar, the four adjacent coils in athwartships and longitudinal directions should ideally be lashed together. This will prevent shifting and collapse of the WRICs stow during the voyage, in the event of settling of the rebar.

<table>
<tr>
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<tr>
<td>Plastic sheets used to segregate the rebar from the WRICs. ✓</td>
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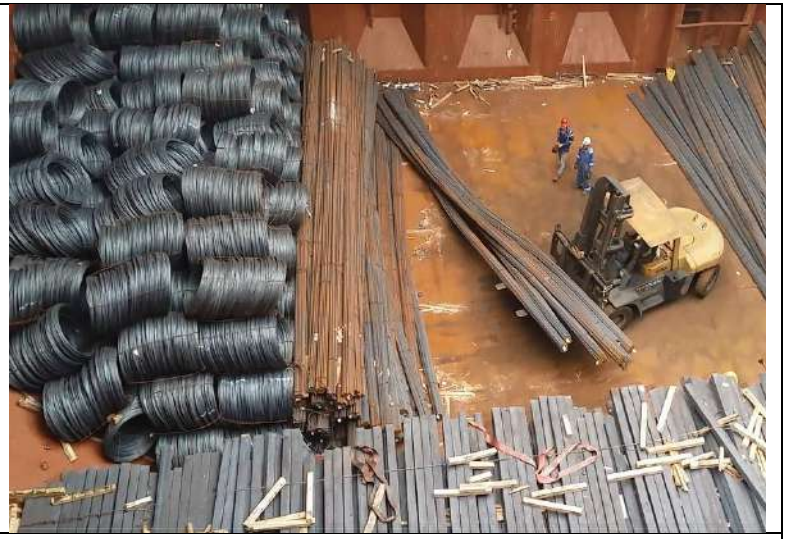
<td>✓ It is important to level the rebar stow prior to the loading of WRICs atop.</td>
</tr>
</table>

			
Discharging of WRICs. The dunnage used to segregate the two stows is noted to have been crushed. It is recommendable to lash the first rows of WRICs together prior to the loading of the subsequent tiers.		WRICs loaded athwartships under the coaming with adjacent rebar in the open hatch area. Lack of dunnage and lashing. Improper stow for the WRICs and rebar.	

WRICs over Steel Coils

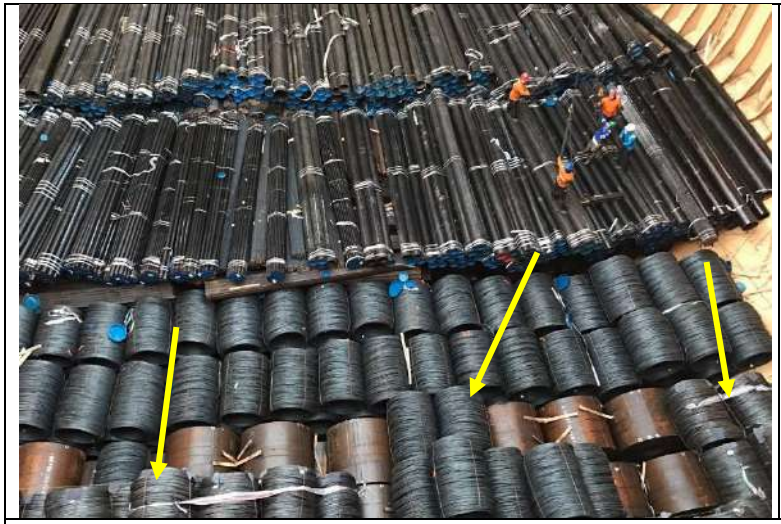
STOWAGE

Warning: WRICs should not be stowed over CRCs because of the risk of damage to the packaging and the cargo. WRICs may be stowed on top of HRCs only.

The lower stow of HRCs must be loaded in accordance with the relevant guidance and over the full width of the cargo compartment. Generally, the HRCs have a low stowage factor and may contain heavy units of up to 30 tons. Ideally, the HRCs should be in one tier with one or two locking coils. WRICs may be loaded as a second, third and more tiers, provided that the structural integrity of the tank-top is not exceeded.

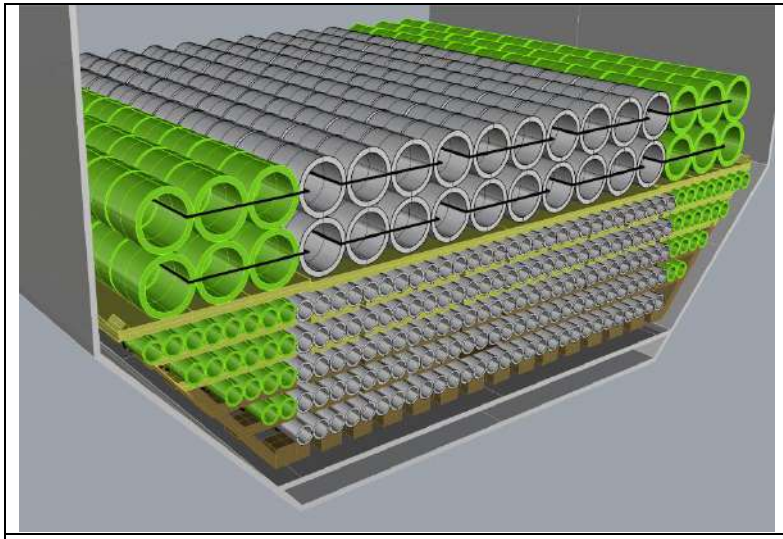
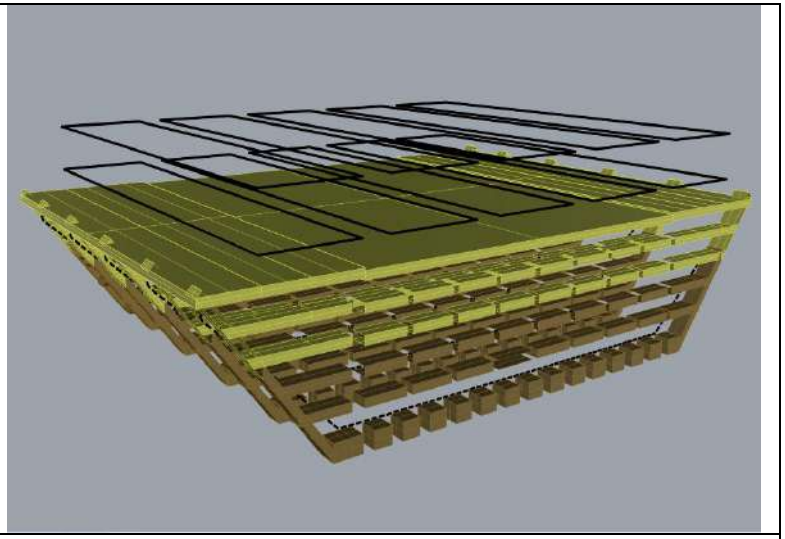
LASHINGS

The first tier of WRICs may be lashed to the HRCs units using steel band straps.

			
WRICs are normally loaded in the cantlines of the coils. The subsequent tiers of WRICs should follow the same pattern. Proper WRICs lashing will be required.			The under-coaming stow of WRICs will be impossible to access with a vertical plumb of the crane. A forklift truck to provide access to the WRICs cannot be utilised.

WRICs over Steel Pipes

The schematics below are indicative and for demonstration purposes only for a combined stowing of WRICs over steel pipes. When different size of pipes are loaded under a stow of WRICs, the dunnage and lashing for the stow of pipes should be reconfigured accordingly, in order to provide a levelled and stable stow of pipes. Wooden wedges should be considered for use for big diameter pipes. The dunnage between the two stows should be of plywood sheets to protect the pipes and their coating.

			
WRICs loaded over steel pipes. Plywood dunnage should be placed on top of the steel pipes' stow. The two stows should be lashed separately.	✓	✓	Schematics of the dunnage and lashing approach for the two stows.

WRICs over Structural Steel Products

Insufficient dunnaging and lashing of the WRICs stow over the structural steel stow.

Insufficient dunnaging and lashing of the WRICs stow over the structural steel stow.

WRICs over structural steel products over steel plates. The WRICs should be properly stowed, dunnaged and lashed when loaded in the under-coaming area.

Off-loading of WRICs, stowed over structural steel products.

STEEL COILS atop of:				
Steel Plates	**Reinforced Bars**	**Wire Rods in Coils**	**Steel Pipes**	**Structural Steel Products**

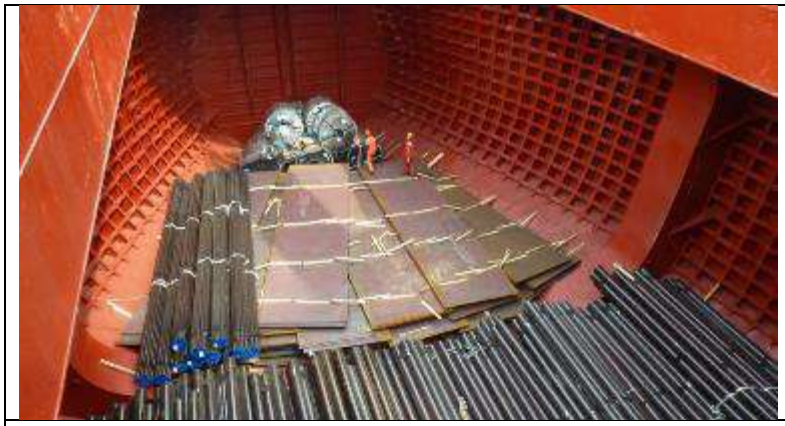
Steel Coils (HRC and CRC) cannot be loaded on top of other steel cargo products.

STEEL PIPES atop of:				
Steel Plates	**Reinforced Bars**	**Wire Rods in Coils**	**Steel Coils**	**Structural Steel Products**

Steel Pipes over Steel Plates

DUNNAGE

For large-diameter unbundled pipes, dunnage may not be required between the tiers. Dunnage is required to be used for small-diameter pipes in bundles.

			
The plates must be level. Dunnage must be used between the two stows. Nylon web lashing must be laid before the pipes are loaded.			The pipes should be pre-slung for ease of off-loading. Proper stool dunnage between the pipes and the side bulkheads must be used.
			
Pre-slung and bundled pipes loaded on top of steel plates.			Bundled pipes in packages loaded over bundled steel plates, loaded over structural steel. The pipes are staggered from the face of the stow. No dunnage was used. The three stows are lashed individually.

Steel Pipes over Rebar

Various sizes of pipes. The pipes are pre-slung. No dunnage in use between the rebar tiers. The rebar stow is not level. Pipes loaded without dunnage.

Pipes loaded over steel plates. Similar dunnage arrangement should be adopted when pipes are loaded over rebar.

Pipes loaded longitudinally over an athwartships stow of rebar. This arrangement requires a lot of dunnage to separate the stows and to make the rebar stow levelled.

The dunnage in use is not sufficient. It will sink in between the rebar' bundles.

Steel Pipes over Wire Rods in Coils

Steel pipes should not be loaded over WRICs. The WRICs stow, in general, may easily shift fore-and-aft, even when properly lashed.

Steel pipes should not be loaded on top of WRICs.

Pipes and WRICs are usually stowed horizontally segregated and not one over the other.

Loading of WRICs adjacent to a stow of pipes.

Full stow of WRICs over the whole tank-top area of a cargo hold. A stow of pipes atop of the WRICs.

When there is a full load of WRICs, a minor stow of pipes over the WRICs may be considered. A stow in the under-coaming space is not allowed, as it may not be accessed by a forklift truck or a vertical plumb of the crane.			Off-loading of pipes loaded over WRICs in progress. Difficult access to the pipes in the under-coaming area.

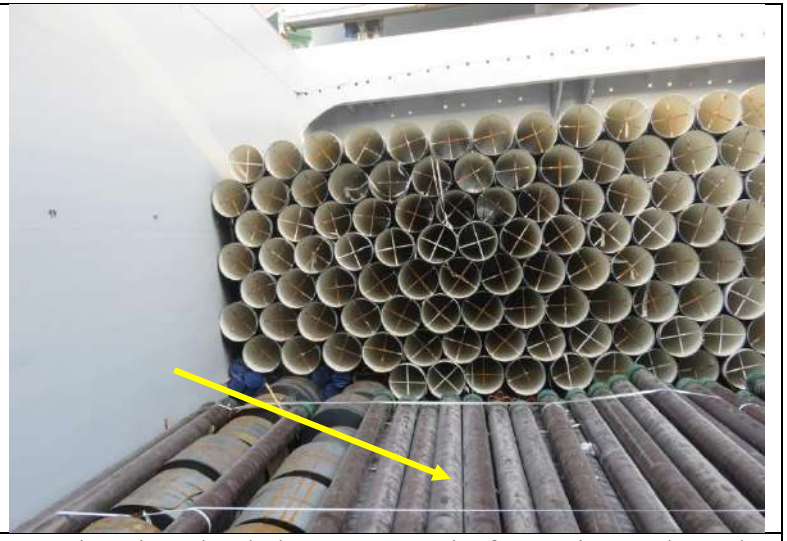
Steel Pipes over Steel Coils

STOWAGE

Stowage of pipes over CRCs should not be considered. However, stowage of pipes over HRCs may be allowed, provided the tank top is not overloaded. The lower tier of HRCs must be stowed in a fore-and-aft direction and across the full width of the cargo compartment.

Due to the size and shape of the coils, the stow cannot be level in preparation for over stowing pipes. Typically, large-diameter pipes are placed in the cantlines of the coils until a level surface is formed for subsequent tiers of pipes or bundles. The type of dunnage used will depend on the size and weight of the pipes. Pipe bundles should either be pre-slung without dunnage or, if not pre-slung, have dunnage placed between the tiers.

Heavy steel pipes should not normally be loaded on top of heavy steel coils.



Light-weight pipes loaded over HRCs in a lower stow. The vessel does not have side under-coaming areas.

Heavier pipes loaded over HRCs in fewer tiers only. The vessel does not have side under-coaming areas.

Steel pipes should not normally be loaded on top of heavy steel coils.

Pipes loaded over HRCs. This creates a high risk of overloading the tank-top and human injury. No dunnage is used.			Pipes loaded over HRCs. Risk of overloading the tank top. Dunnage is not sufficient and is collapsing in the cantlines.

Steel Pipes over Structural Steel Products

The lower stow of structural steel products (steel sections, H-beams, etc., not prefabricated units) must be loaded in a fore-and-aft direction and in accordance with the relevant guidelines and over the full width of the cargo compartment.

	
Pipes may be loaded over some structural steel, such as H-beam, I-beam. In this photograph, the H-beams are also loaded on top of steel plates. ✓	✓ Pipes loaded over structural steel cargo in a box-shape cargo hold.

			
Pipes loaded over structural steel products. Some of the pipes are too close to the adjacent stow of rebar and there is a risk of damage in the event of shifting and discharging.			Pipes in packages loaded over structural steel. Lashing has been removed. No dunnage to level the first tier of pipes was used. The bundles are pre-slung.

STRUCTURAL STEEL PRODUCTS atop of:				
Steel Plates	**Reinforced Bars**	**Wire Rods in Coils**	**Steel Coils**	**Steel Pipes**

Structural Steel Products over Steel Plates

Loading of palletised structural steel over steel plates. The stow of plates is properly levelled.

Dunnage and lashing properly prepared for the stow of structural steel products.

			
Various general cargo products are loaded over steel plates. The stow of steel plates is properly levelled.	✓	✗	General cargo stowed over steel plates with lack of lashing, securing, and dunnage that appears crushed.

Structural Steel Products over Rebar

			
Lack of dunnage. The stow of rebar is not levelled.	✗	✗	Lack of dunnage. Dunnage should be positioned under the container corner posts, not the bottom side rail.
			
Loading of various general cargo pallets over rebar. The rebar stow is not even and properly levelled.	✗	✓	Containers loaded over a well-levelled stow of rebar. The containers must be lashed in a uniform block of stow.

Structural Steel Products over WRICs

Structural steel products should not be loaded on top of WRICs. There is risk of deformation or ovalizing of the coils.

			
Structural steel products may be heavy and difficult to be lashed. The WRICs stow underneath is unstable.			Light structural steel products loaded atop of full stow of WRICs.

Structural Steel Products over Steel Coils

Structural steel products should not be loaded on top of steel coils (HRCs and CRCs).

Structural Steel Products over Steel Pipes

DUNNAGE

The layer of dunnage between the two stows must be at a smaller spacing so that the pipes are protected from scratching and deformation. Ideally, spacing not exceeding 1500mm should be considered to ensure there is no direct contact with the pipes. The upper tier of structural steel products should be properly dunnage vertically and horizontally to prevent the cargo from shifting.

Bundled palletised steel cargo loaded over pipes. Proper use of dunnage. No lashing preparation for the stow above the pipes. Proper use of lashing for the pipes.	✓	✓	Loading of general cargo units over pipes. The cargo unit must be lashed. Proper use of dunnage.
			
Loading of general cargo units over pipes. Proper dunnage and protection must be used to prevent damage to the pipes and to support the overhanging end of the prefabricated units. Their weight must be verified.	✗	✓	Various project cargoes may be loaded over pipes. Proper dunnage to level the stow is required. The stow of pipes must also be levelled.

General Cargo Guidelines

i) **General**. General cargoes items include all classes of cargo that do not come under a specific heading as heavy-lift items and ro-ro cargo therefore do not have specific requirements in terms of stowage. Despite not having certain rules on the safe carriage, the CSS code principles should be adhered during loading and discharging operations. One key aspect is that specialist knowledge and experience in shipment of project/ general cargoes is required to fully plan and engineer such cargo shipments safely. The CSS Code sets this out in Section 1.8, Special Cargo Transport Units: "The shipowner and the ship operator should, where necessary, make use of relevant expertise when considering the shipment of a cargo with unusual characteristics which may require special attention to be given to its location on board vis-a-vis the structural strength of the ship, its stowage and securing, and the weather conditions which may be expected during the intended voyage." There are two things in common during handling of General Cargoes: (1) **No dedicated lashing points**; and (2) **Cargoes have a limited over-stow load**.

Contrast to Cargo stowed in modern intermodal containers, General cargo generally shipped unpackaged and in large quantities into the ship's hold or on-deck condition. Following items can be included as part of general cargo categorization:

- **Heavy machinery and Equipment**: Excavators, bulldozers, cranes, turbines, and modular factory machinery.
- **Vehicles**: Trains, locomotives, trams, yachts, boats, and aircraft fuselages.
- **Infrastructure materials**: Bridge Parts, Cable wire pipe parts, windmill blades, and tower sections.
- **Odd-shaped structure**: Silos, tankers, boilers, presses, tubes, and cylinders.

The stowage of general cargo is guided by the following principles which allow riggers to reach the cargo without resorting to crawling, have a stable work area without danger of cargo rolling & collapse, and connect lifting gear to lifting points without blockage.

- Safe access to cargo
- Safe working platform
- Unobstructed and well-defined rigging points

Drawing from these principles, the below guidelines serve to create a conducive work environment for the discharge of the cargo safely.

- Minimum 2m vertical clearance from top of cargo to undercoaming port/starboard & forward/aft
  (Note: Minimum 2m vertical clearance is for 2m long undercoaming to maintain a minimum of a 45-degree angle between the sling and the cargo at the undercoaming area when the lifting point is at the end)
- 1m between 2 different cargo types
- Undercoaming cargo to be separately lashed
- Different cargo stows are to be separately lashed

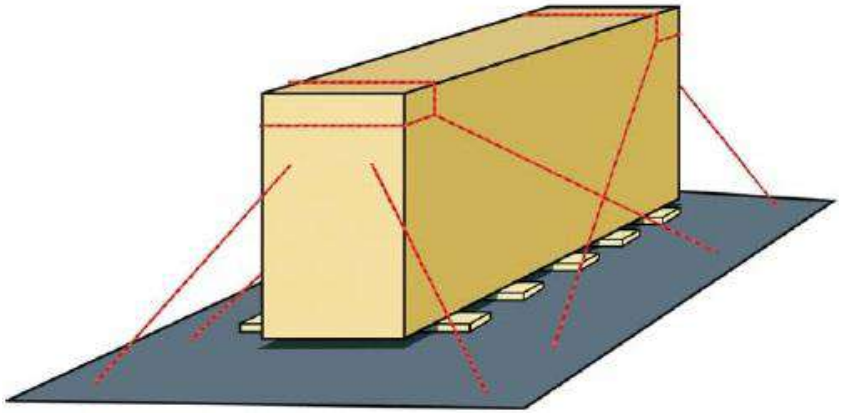
The cargo lifting/securing points should be assessed to confirm that they are strong points and are they intrinsically part of the unit. They should also be checked to see that they are structurally sound and that they are in plane to the principal forces to which the cargo is going to be subjected, taking due account of the unit's position and orientation in the stow.

Each general cargo unit should be supplied with appropriate documentation that provides the necessary information to ensure safe transportation. The general standard for cargo information should always be 'comprehensive and accurate'. The documentation must include the accurate weight of the cargo unit, the accurate location of its centre of gravity (particularly important for heavy lifts and possible off-centre units), its dimensions, and details of the safe slinging, lifting and securing points,

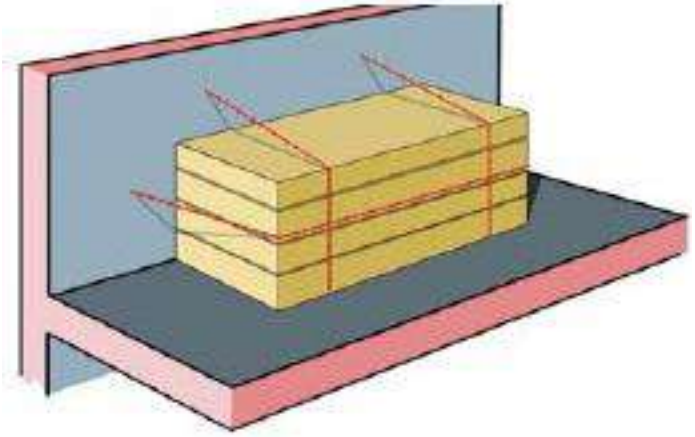
as well as the nature of the cargo. The CTU Code (IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units, 2014) should be referred to. The code provides guidance and measures for ensuring the safe packing of cargo in containers and other cargo transport units (CTUs)

Ensure lashings address both sliding (lateral movement) and tipping (overturning) forces. Avoid mixing different lashing materials (e.g., chain and fiber webbing) in the same direction. The optimum angle between lashing and deck is 25° to 45° to prevent slippage. When the angle is greater than 60°, the lashing can prevent tipping but will do little to prevent sliding.

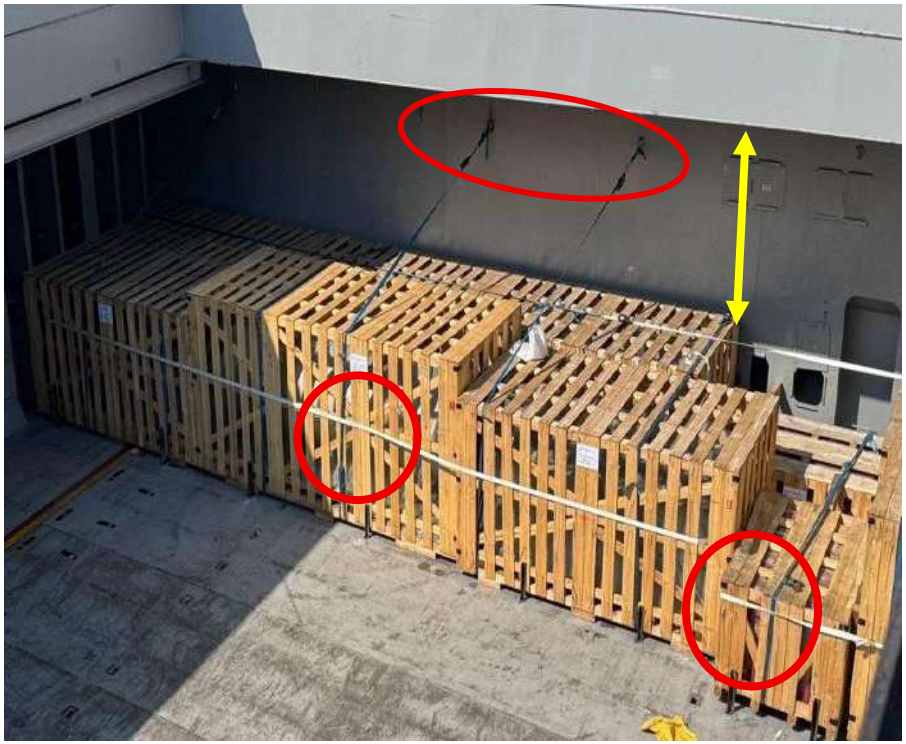
The securing points fitted to the vessel should be located such that there is adequate room for the securing device to operate effectively. For wire lashings, the lashing should have a clear line between the cargo unit and the securing points on the vessel and must not run around corners of the vessel structure or other cargo units.

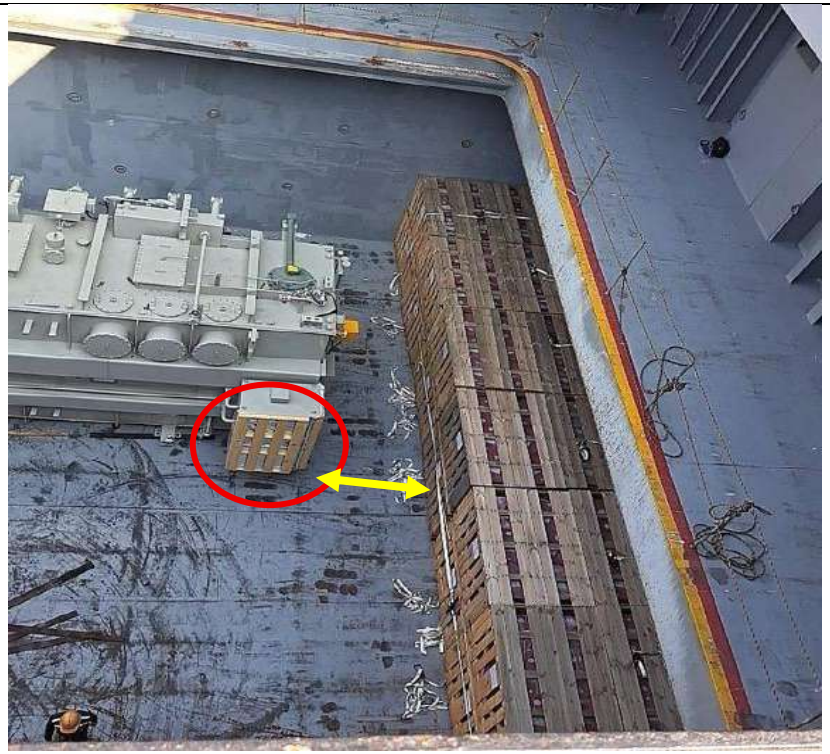


Schematic of Single equipment secured using lashing and dunnage in the hold.

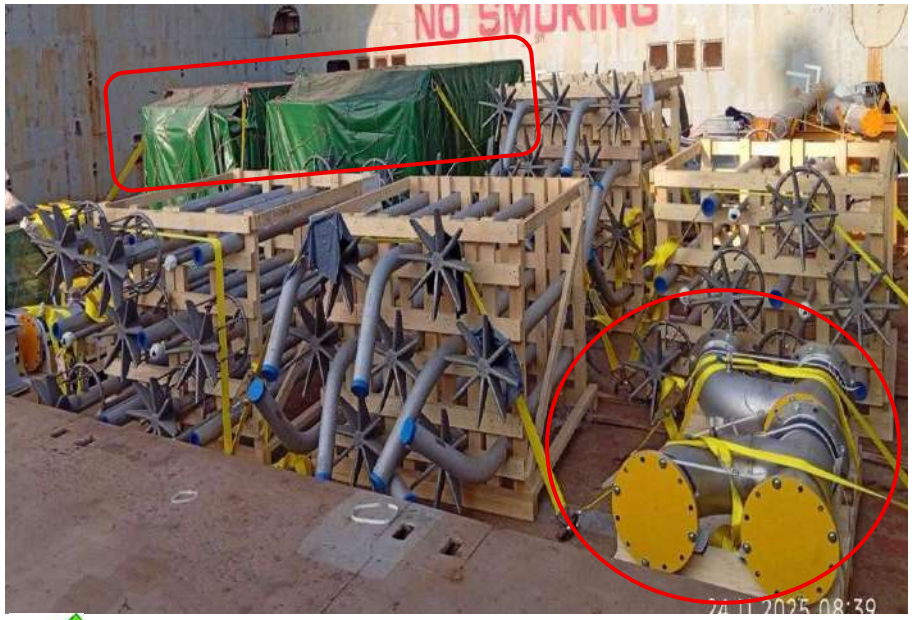


Schematic of Equipment secured using lashing under-coaming conditions.





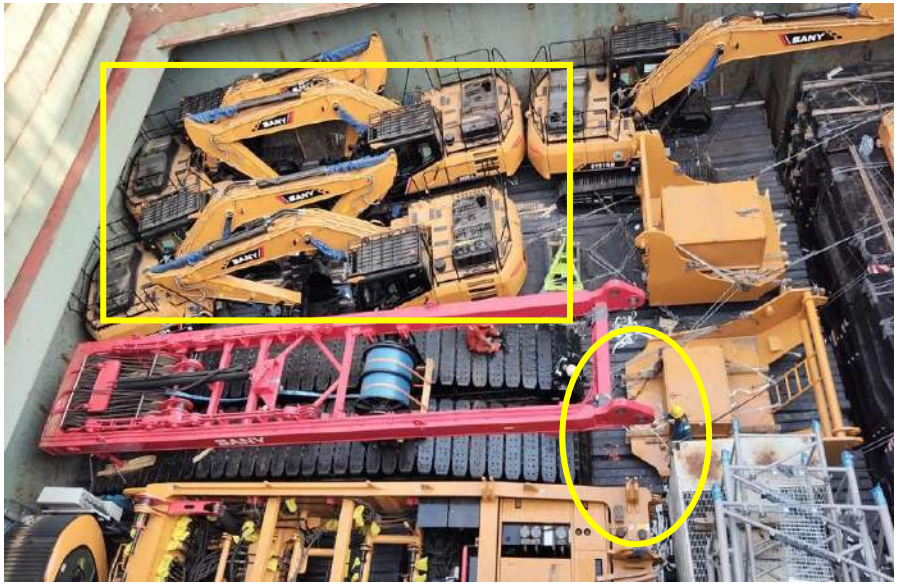
- Loose general cargo is packed inside wooden pallet and lashed at the tank top. Pallets are positioned for forklift discharging in under-coaming condition.
- Dunnage is attached to the machine equipment to prevent cargo to cargo contact.
- 2m vertical clearance from top of cargo to undercoaming port/starboard & forward/aft
- 1m of space between two different cargo types for riggers or ship crew to access.

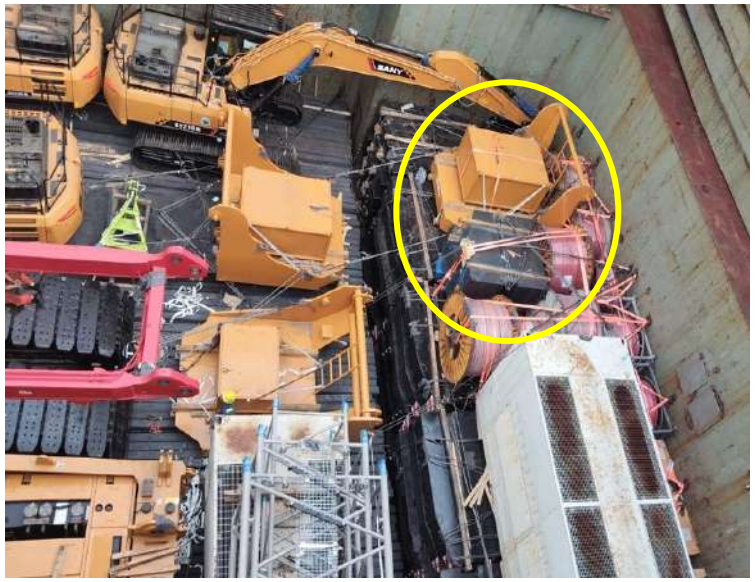


- Cargo has been lashed down to the tank top anchor points
- Dunnage wood has been used to construct multiple loose general cargo and able to lift in one bundle.
- Protective sheets are used to protect the equipment layer and secure with lashing.
- Dunnage wood is used as a platform base for odd-shape metal pipes.

- Odd shape General Cargo without anchor/lifting point requires to be placed in a lifting structure.
- General Cargo is in athwartship direction to facilitate lifting operations.

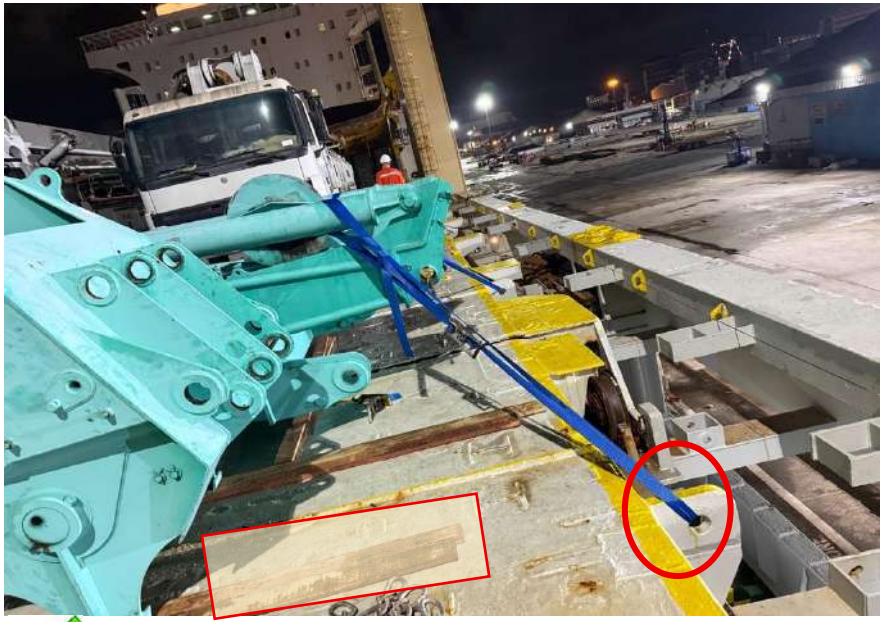
- Machinery Equipment and Crane parts are deployed on top of steel pipes and lash onto each other.
- No safe access towards the cargo hold and no safe distance between cargoes for rigging operations.
- General Cargo should be packed in accordance with the cargo type (Longitudinal or Horizontal) to facilitate lifting operations.
- Small to medium sized general cargo should be placed together.





- Machinery Equipment and Crane parts are deployed on top of rebar.
- Sufficient safe access for riggers to perform unlashing and rigging within the cargo hold.
- Small to medium sized general cargo are placed together.

- Dedicated cargo hold for longitudinal general cargo and position in athwartship direction for lifting operation.
- Safe access platform on top of the longitudinal cargo and packed togethers.
- Ensure sufficient gaps within cargo for rigging and lifting operations.
- When necessary, dunnage should be placed in between cargoes to ensure cargo integrity and allows gaps for lifting.



- On deck general cargo requires on deck anchor points for lashing.
- Dunnage or choke should be placed to prevent the general cargo shifting during voyage.
- 1m safe access should be catered for rigging and lifting operation.

- Cargoes are lashed to other cargo.

- Cargoes must be lashed securely to the vessel.
- Adequate access for riggers to walk through unhindered

ii) **Summary of General Cargo.**

S/N	Description	Remarks
1	Ensure Safe access to rig cargoes.	Non-compatible equipment or parts of different items should be packed separately.
2	Ensure Safe access to Cargoes or Vessel under-coaming	
3	Cargoes should be stowed levelled for access.	
4	Unobstructed and well-defined rigging points	
5	Cargo information should always be 'comprehensive and accurate'	
6	Lashing must be tied and secured.	
7	Inter lashing between cargoes only allowed under the following conditions: • Cargo items have similar size, weight, and structural strength. • Surfaces allow safe contact without risk of damage or slippage. • Compliance with IMO CSS Code and SOLAS regulations is confirmed.	
8	Small to Medium size cargo bundling must be secured without breakage	
9	Dunnage should be used when necessary, between cargoes or cargoes to vessel.	Dunnage should be used when there is no safe lifting method can be carry out or no access to cargo.