Battermann + Tillery Group

Flat Racks – heavy weight champions with a catch

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Marine and Cargo Surveyors

Project Cargo on Container Vessels

Agenda

1. Introduction
2. Advantages/ Disadvantages of cargoes on flat racks
3. Planning Requirements
4. Planning & Preparation
5. Stowage
6. Cargo Securing
7. Summary

Out of gauge cargo on flat racks

Introduction - Definitions

Definition **Flat Racks**:

Portable, open-topped, open-sided units that fit into existing below-deck container cell guides. Flat Racks provide high payloads and the opportunity to load cargoes from top or side.

Definition **Out Of Gauge Cargo**:

Term used to broadly describe cargo which exceeds the internal dimensions of a container either by length, width or height. OOG cargo might be loaded on an open top container or onto a flat rack.

Cargoes on Flat Racks

Introduction – what is at topic

Billions of dollars of project-critical equipment is shipped around the world annually.

High levels of risk are associated with these shipments due to the nature of the cargo, transport logistics, and tight timeframes.

(Source: http://www.agcs.allianz.com/services/marine/project-cargo/)

Cargoes on Flat Racks

Introduction – Advantages / disadvantages for the Freight Forwarder

Advantages	Disadvantages
+ Fast vessels/routes	– Knowledge in regard to safe securing is often not available and the relevant regulations are not duly observed.
+ Terminals with inland connection/infrastructure	– Not all packing facilities are able to provide appropriate lifting equipment
+ Reputable shipping lines	– Larger quantities are not economical
+ Standardised transport methods	– Usually it is difficult to get hands on the cargo during transport, e.g. in transshipment ports
+ Costs for single parts are affordable/calculable	

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Introduction – Advantages / disadvantages for the Underwriter

Advantages	Disadvantages
+ Large companies/shipping lines (terminals) → Claims handling department (worst case) / availability	– Packers need considerable knowledge of stowage and securing principles
+ Always the same structure→ easily plannable	– High risk of collateral damage to other cargo
+ Low risk of collateral damage from other cargo, i.e. containers	– Increased risk due to possible transshipment handling
	– No continuous checking of cargo possible during ocean transit

Cargoes on Flat Racks

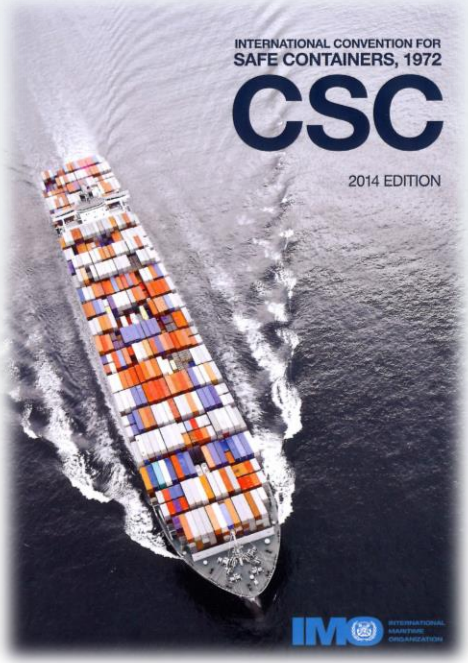
Introduction – Advantages / disadvantages for the Manufacturer/Shipper/Cargo Owner

Advantages	Disadvantages
+ Generally horizontal transport process (delivery, packing, transport)	– Almost no possibility of checking the stowage and securing arrangements during transport at sea
+ Stowage is often below deck (protective aspect)	- Limited number of units per flat rack
+ Length usually limited by flat rack length (up to 11,50 m)	- High risk of losing project critical items
+ Weekly departures	
+ Costs for single parts are affordable/calculable	

Cargoes on Flat Racks

Planning requirements – Relevant Regulations

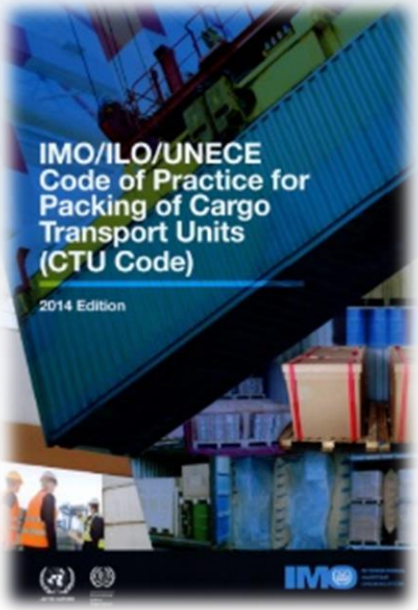
1. CSC-Code (International **C**onvention For **S**afe **C**ontainers)
   - Regulations for testing, inspection, approval, and maintenance of flat racks
   - Applies to new and existing flat racks



Cargoes on Flat Racks

Planning requirements – Relevant Regulations

2. CTU-Code (Code of Practice for Packing of **C**argo **T**ransport **U**nits)
   - Non-mandatory, global code of practice for handling and stuffing of shipping containers



Cargoes on Flat Racks

Planning requirements – Relevant Regulations

The applicable regulations provide only basic information and advice in connection with stowage and securing requirements for loading of out of gauge cargoes on flat racks.

Room for mistakes and faulty procedures

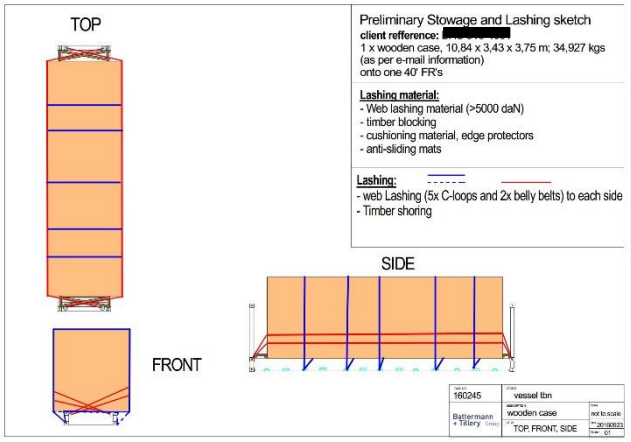
Need to look further ahead!

Cargoes on Flat Racks

Planning and Preparation – Required information

Timely compilation of information and inspection of necessary equipment is critical!

- Cargo details
  - Dimensions and weight of cargo
  - Pre-existing packaging
  - Manufacturer's requirements
- Suitability of handling equipment
- Requirements of shipping companies
- Flat Racks have to be fit for purpose



Cargoes on Flat Racks

Planning and Preparation – Inspection of flat racks

Prior to loading, the flat rack must be visually inspected in order to ensure:

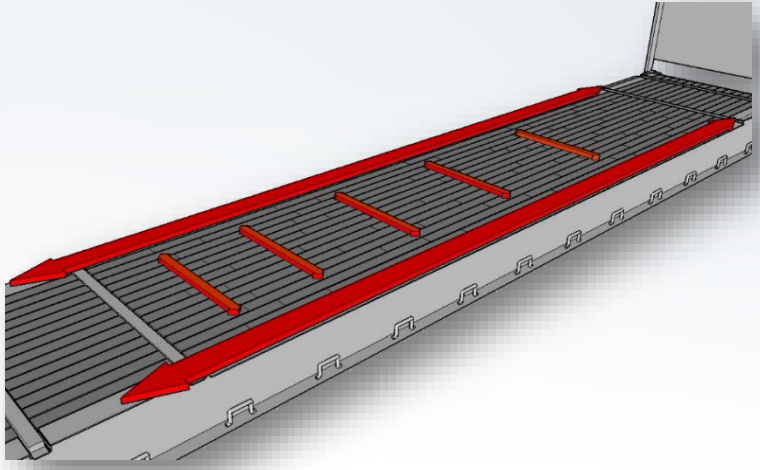
- that the flat rack is suitable/fit for purpose
- the validity of its certification status
- its structural integrity

See: **CTU CODE Chapter 8, Part 2 - Checks**

Cargoes on Flat Racks

Planning and Preparation – Load bearing components

Flat Racks are designed in such a way that the permissible payload can safely be transferred to the four corner posts under all conditions of carriage, if the payload is homogenously distributed into the entire load area.



See: CTU CODE Annex 7, Part 3.1.1 – Principals of packging

Cargoes on Flat Racks

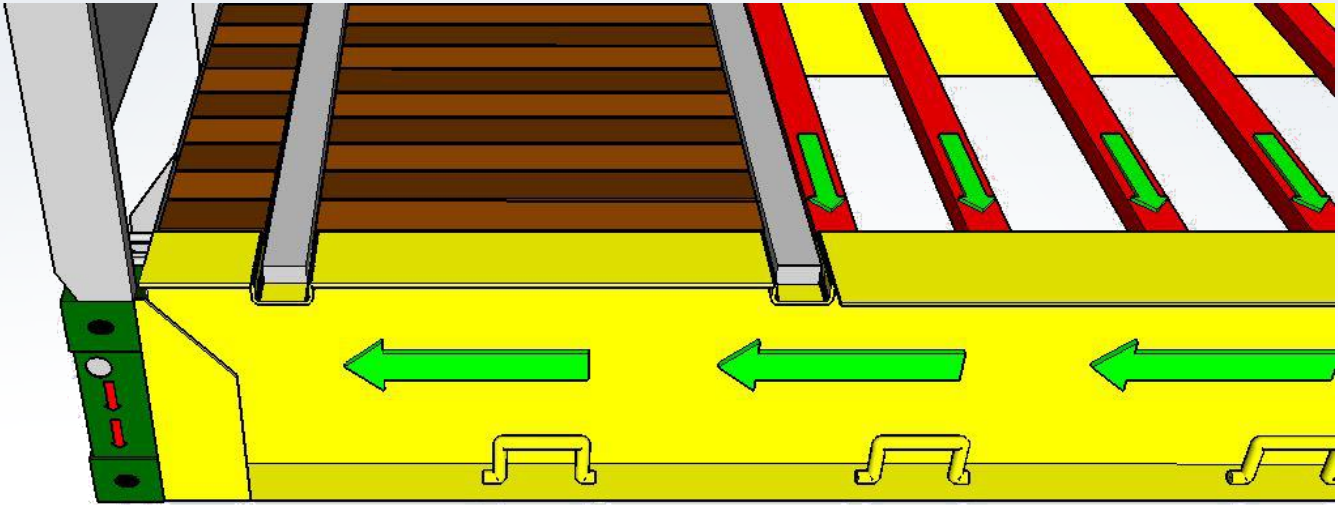
Planning and Preparation – Longitudinal Load Distribution

The shape and number of the transverse girders depends on the individual design of the respective manufacturer.

Cargoes on Flat Racks

Planning and Preparation – Load bearing components

Transverse girders underneath the wodden panelling should not be exclusively strained.



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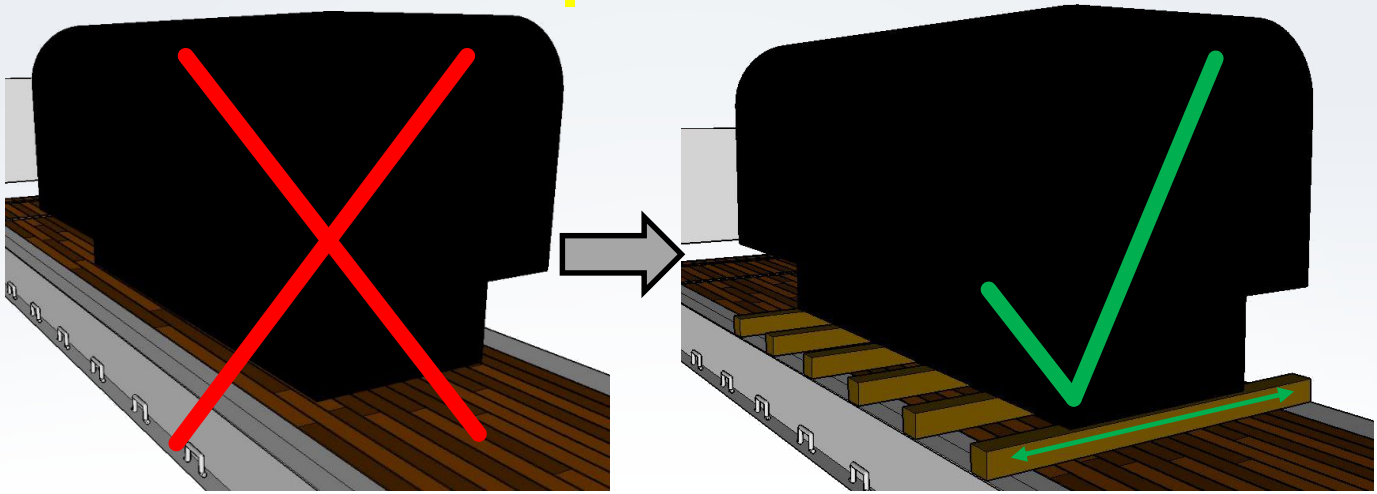
Planning and Preparation – Transverse Load Distribution

Where the nature of a cargo does not allow the distribution of weight directly into the main frame it is necessary to transfer the weight by support of suitable timber or steel beams.



The support by beams is called „bedding“.

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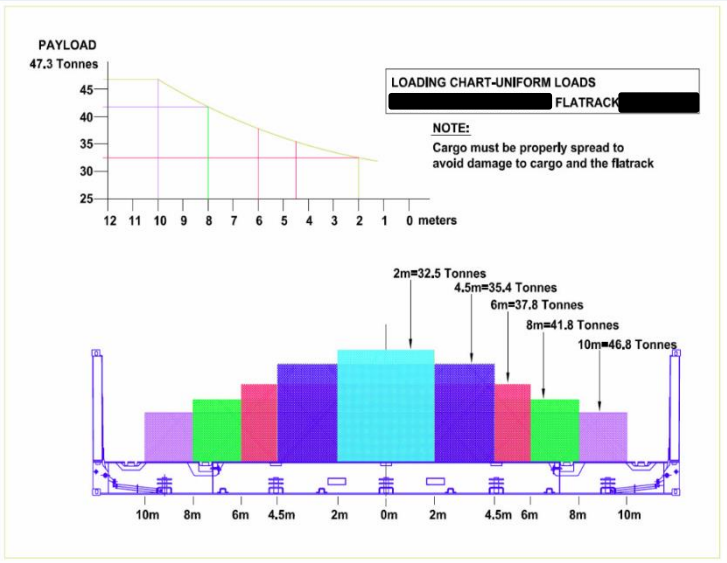
Planning and Preparation – Longitudinal Load Distribution

Individual design limits of Flat Racks



loads limits are calculated for dynamic loads

The details of appropriate load distribution are not only subject to international regulations but also to manufacturers data.

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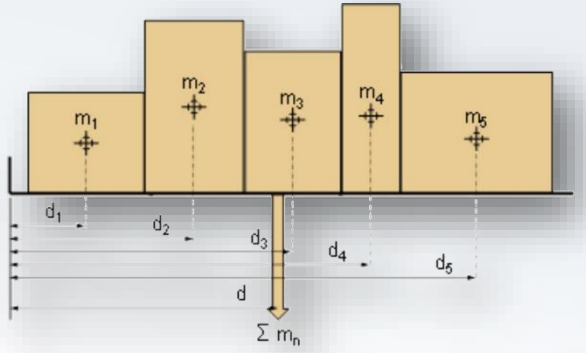
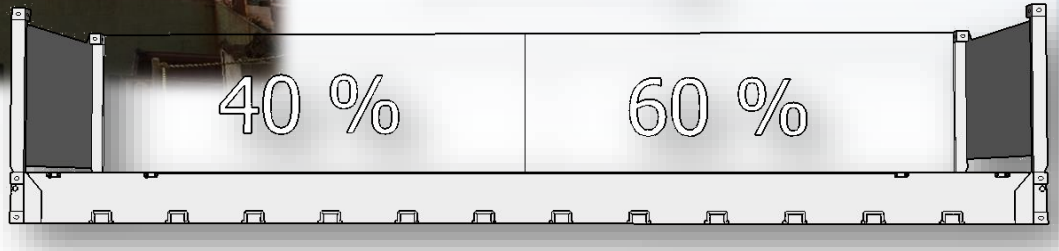
Loading – center of gravity requirements

Rule of thumb: 60 % of cargo weight is distributed over half the length





See: CTU CODE Annex 2, Part 4 - Safety and security checks prior to entry

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Loading – Examples of improper stowage

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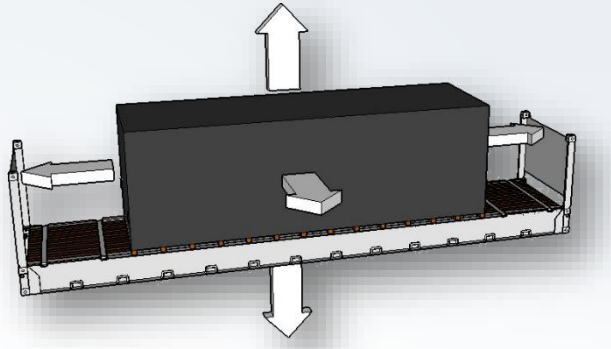
Securing – General Principles

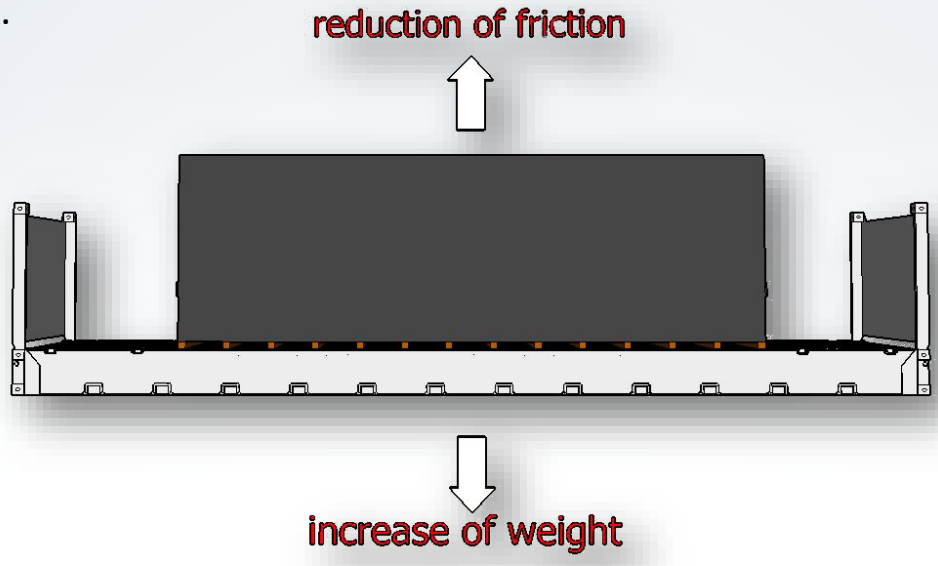
1. Flat Racks may be subjected to vertical, longitudinal and transverse accelerations that also act on the cargo unit.
2. Forces are proportional to the mass of a cargo item. Therefore, cargo units will move regardless of their weight!
3. The exerted forces may exceed restraining force provided by the cargo unit, i.e. its static friction or tilting stability. In this case, items will shift or



Cargoes on Flat Racks

Securing – General Principles

4. Simultaneously acting vertical accelerations cause either an increase of weight or reduction of friction forces, depending on the direction into which they work.



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Securing – CTU CODE requirements

Acceleration forces have to be considered according to tables of CTU Code chapter 5.3.

Sea transport					
Significant wave height in sea area		Securing in	Acceleration coefficients		
			Longitudinally (c_x)	Transversely (c_y)	Minimum vertically down (c_z)
A	$H_s \leq 8$ m	Longitudinal direction	0.3	-	0.5
		Transverse direction	-	0.5	1.0
B	8 m < $H_s \leq 12$ m	Longitudinal direction	0.3	-	0.3
		Transverse direction	-	0.7	1.0
C	$H_s > 12$ m	Longitudinal direction	0.4	-	0.2
		Transverse direction	-	0.8	1.0

0.8 g upward directed force

See: CTU CODE Chapter 5.3 – General transport conditions

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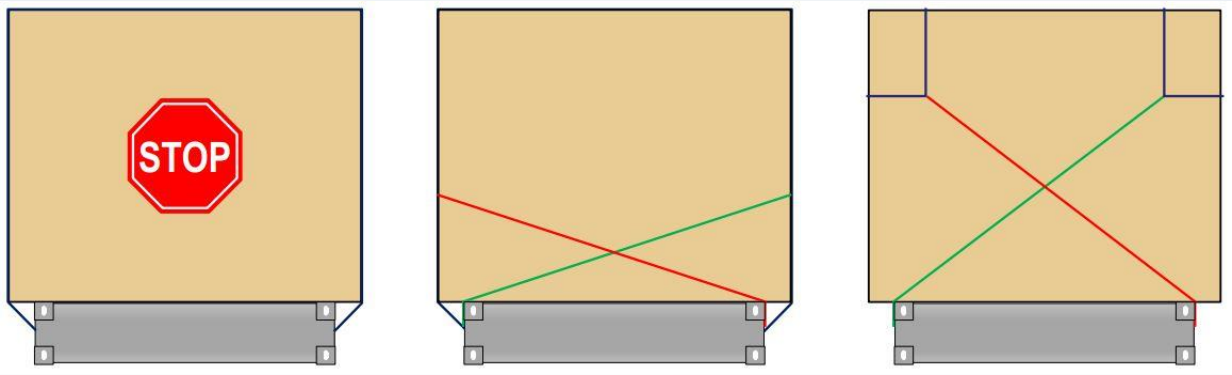
Securing – Major mistakes

Cargoes on Flat Racks

Securing – Major mistakes – tie- down lashings

The CTU Code does not recommend tie- down lashings as means of sliding prevention. Securing of cargoes with overwidth is even prohibited.



See: CTU CODE Annex 7, Chapter 4.3.5 – Securing of cargoes in CTU‘s

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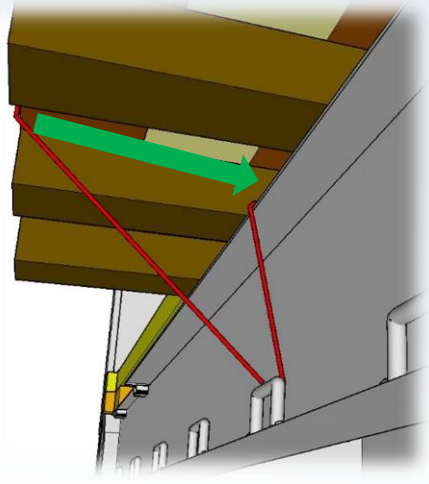
Securing – Major mistakes – improper lashing of protruding cargoes

Cargo with overwidth must not be secured with vertical half loop lashings!



Cargo is only secured by the applied pre-tension force, i.e. approx. 20% of the full lashing capacity of nylon lashings. Transversal shifting by at least protruding distance is only prevented by the increased weight generated by the half loop lashings.

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Securing – Major mistakes – improper lashing of protruding cargoes

NO: vertical half loop lashings! → **YES:** horizontal half loops lashings

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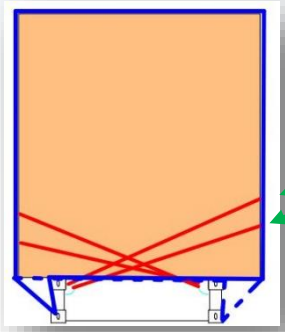
Securing – Major mistakes – improper lashing of protruding cargoes

- Where horizontal half loops are used, a means should be provided to prevent the loops from sliding down the item.
- Position of horizontal half loops shall be as low as possible



See: CTU CODE Annex 7, Chapter 4 – Securing of cargoes in CTU‘s

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Securing – Major mistakes – improper anti-slip material

Entire contact area has to be covered with anti-slip material!

Always the worst material combination must be considered!

e.g.

Static friction!
Rubber – timber = μ 0.6
Rubber – steel= μ 0.6
Timber – timber = μ 0.3
Timber – steel = μ 0.3
Steel – steel = μ 0.1

See: CTU CODE Annex 7, Appendix 2– Friction Factors

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Securing – Major mistakes – improper timber blocking

Securing in longitudinal direction can be easily achieved by timber blocking

- Loads must be introduced into load bearing components →corner posts of end walls
- Blocking must be appropriately connected by nails
- Long blockings should be devided by transverse intersections to reduce buckling loads of timbers
- Blockings must be strenghtened by dunnage or similar means

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Securing – Major mistakes – improper lashing material

Only the weakest component must be considered
in the calculation of the lashing forces.

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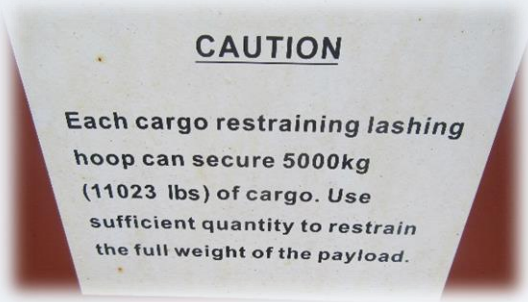
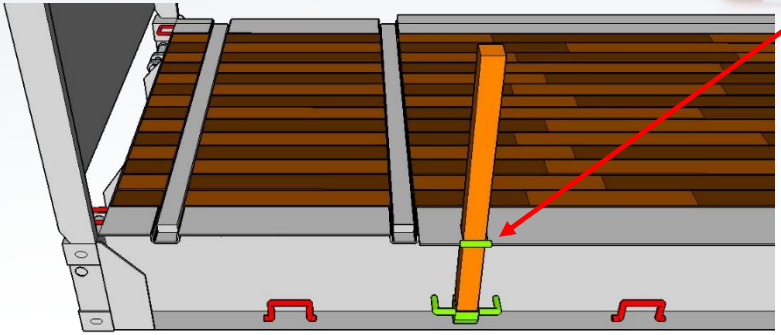
Securing – Major mistakes – limitations of flat racks are not observed





Individual limitations of flat racks must be duly observed!

Cargoes on Flat Racks

Securing – Potential risks in connection with huge cargoes

Insufficient clearance between cargo and end walls:

Flat racks might turn and/ or tilt during loading due to:

- Improper trim (> 1° - 2°) / and list (> 2°) of vessel
- Means of loading, i.e. gantry crane, mobile crane, vessels own gear
- Weather conditions, i.e. visibility, wind speed
- Experience of crane operator
- Damage cellguides

consequences

Without sufficient clearance between cargo and end walls, direct contact between cargo and cellguides cannot excluded → damage to packaging and cargo.

Cargoes on Flat Racks

Securing – Potential risks in connection with huge cargoes

Elongation of lashing materials:

Elongation depends on lashing material, e.g. nylon lashings elongate up to 7% when under load

- Length of the lashing is to be kept as short as practicable
- Direction of the lashing is as close as possible to the direction of the intended restraining effect

E.g.: a case with a length of 8 m and a width of 3 m needs to be secured by horizontal half loop lashing of a length of approx. 15 m. With an elongation factor of 7% the lashing will elongate by 1,05 m before the MSL is reached. (Remark: the pre- tension reduces the elongation partially but a major amount still remains.)

Cargoes on Flat Racks

Summary

"Failure of a shipment to arrive intact can quickly turn a $10 million cargo loss into a $100 million Delay in Start-Up (DSU) loss when factors such as re-fabrication, shipping, expenses, lost profits and other operational costs are considered."

(Source: http://www.agcs.allianz.com/services/marine/project-cargo/)

Handling of Out Of Gauge cargoes on flat racks is not daily routine, but requires specific care, expertise and meticulous attention to detail.

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Thank you very much for your kind attention!

Marine and Cargo Surveyors