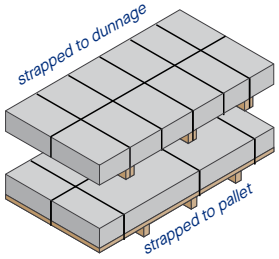
Load Restraint Guideline
Sheet Packs & Palletised Freight

SP

1. This Guideline applies for:



- Restraint of packs of sheet steel strapped on pallets or dunnage transported on a truck or trailer deck, but not a flat rack or other multi-modal device. (Excludes loose dunnage, refer to "*Plate*" LRG32).
- Individual packs acting as a unit and the packaging capable of withstanding a force equivalent to 80% of the pack weight in both longitudinal and transverse directions.
- Restraint of other general freight on timber pallets, which is suitably packed as a unit against a force equivalent to 80% of the freight weight.

2. Essential Requirements

✓ Chain restraints are preferred. All chains are 8 mm transport chain to AS/NZS 4344. Polyurethane or other approved corner protectors must be used under chains for product protection.

✓ Webbing restraints are the non-preferred option. If used, webbing must be to AS/NZS 4380 or equivalent, with a minimum 2.0 tonne lashing capacity. Knots in webbing, including tieing off at the end, are totally unacceptable. This guideline assumes fully tightened webbing, with minimum 300 kgf pretension (as per the "Load Restraint Guide - Second Edition 2004" by NTC).

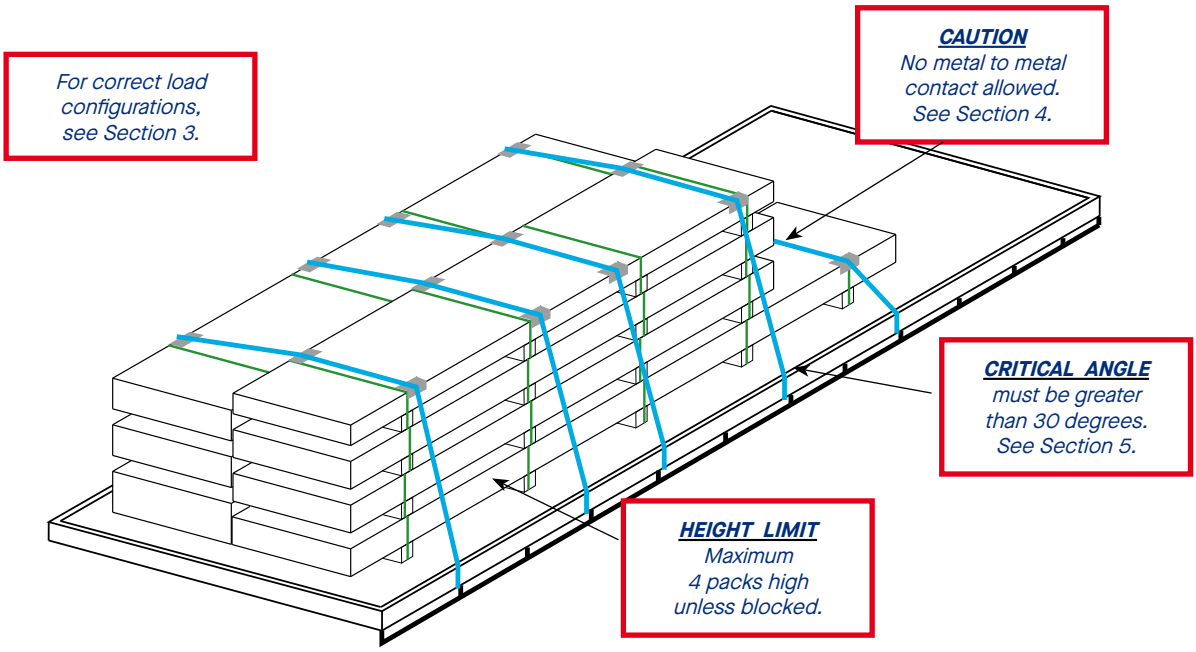
✗ **Combinations** of chains and webbing are **NOT permitted** on the same pack or stack. Either use all chains or all webbing.

✓ Maximum 4 packs high unless blocked (see Section 8 'Headboards and *SheetStop* Devices').

✓ Stack arrangements must comply with Section 3 'Loading Configuration'.

✓ The number of lashings must comply with Table 3 or 4 for no blocking method, or Table 1 or 2 for headboard and *SheetStop* devices blocking methods. These tables assume all loads are on timber dunnage, a timber pallet or a steel pallet with rubber matting between all steel surfaces (assumed friction coefficient μ_d = 0.40 between packs, and μ_s = 0.22 intra-pack).

✗ No stacks are to be loaded with a height to length ratio greater than 1.5 to 1. (The length is the maximum bearer spacing). See Section 7 'Stack Aspect Ratio' for more details.



3. Loading Configuration

- The following figures show the correct loading methods for use with Tables 1 to 4 on pages 7 & 8.

The load may be stacked packs provided there no low friction surfaces between each pack.

Rubber edge protector under chains or sleeve around webbing.

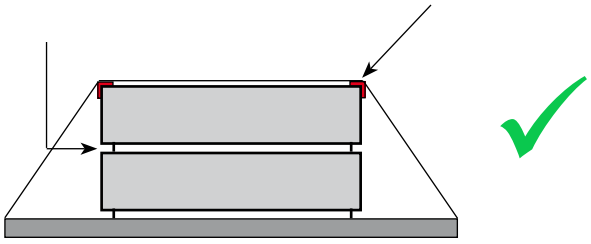


Figure 3a. The load should be placed centrally on the truck. (Cross section of load).

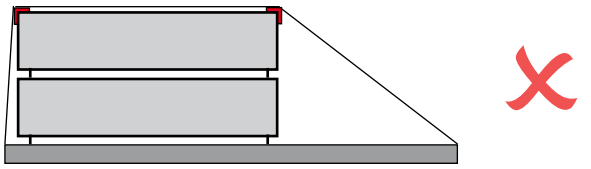


Figure 3b. An off centre load may slide towards the centre and loosen the lashings. (Only OK if pins used to stop sideways movement of packs and weight distribution OK).

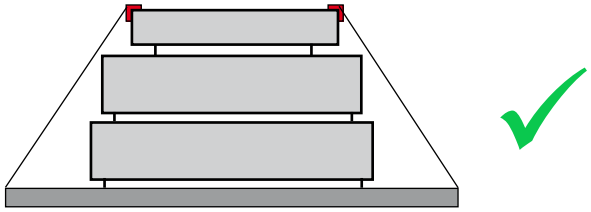


Figure 3c. Different size packs may be stacked provided their sizes are arranged with larger packs on the bottom.

Lashing angle > 30°

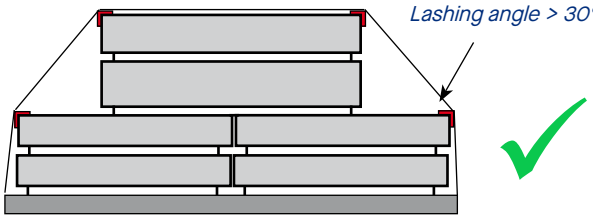


Figure 3d. Angle of lashings to be greater than 30 degrees to horizontal.

Lashing angle < 30°

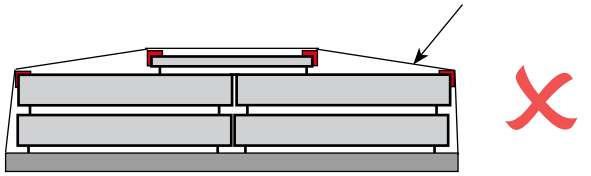


Figure 3e. Angle of lashings not less than 30 degrees.

Max 150 mm

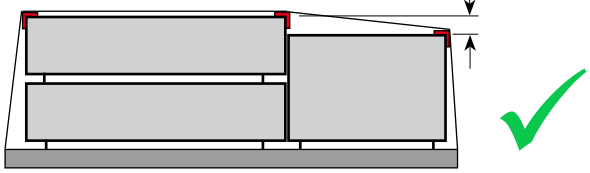


Figure 3f. Multi pack loads must be tightly grouped with some clamping action on all packs.

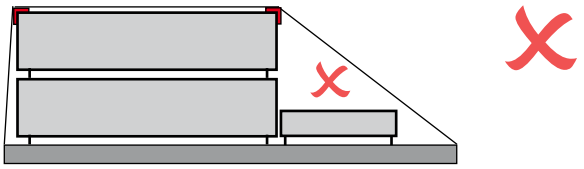


Figure 3g. The small pack on the right will have no clamping force.

Rubber corners between packs where required for product protection.

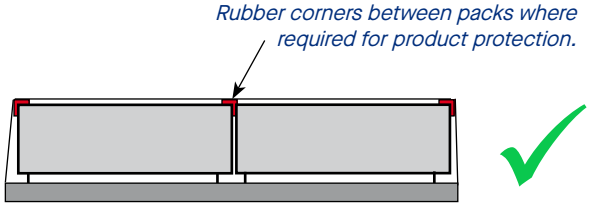


Figure 3h. Two packs (or stacks) may be carried side by side, provided they are bearing against each other .

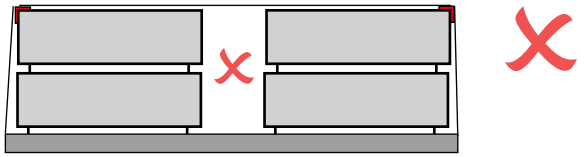
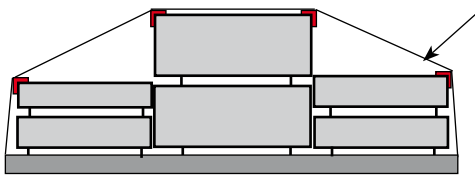


Figure 3j. Packs carried two abreast must not have a gap between them or the packs will move together and then the lashings will loosen. Alternatively load against centre pins.

Lashing angle to be > 30°



Non-Preferred

Figure 3k. Packs may only be carried three (3) abreast in limited circumstances. Note this is not the preferred option as there are more risk factors involved.

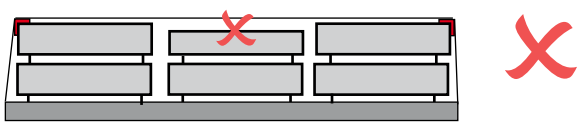


Figure 3m. Packs must NOT be carried three (3) abreast where there is no downward clamping on the middle pack.

Closely align lashings to dunnage (not mid span)
Use extra dunnage if distance is too great.

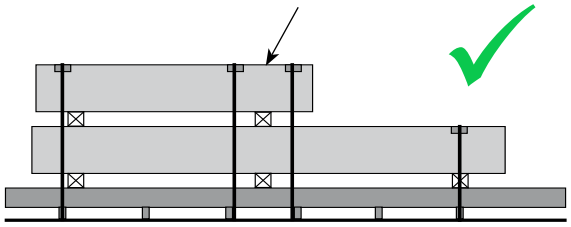


Figure 3n. Lashings should be spread along the load and aligned closely with the bearers and/or dunnage. For chains, the "2nd off 1st method" must be used if two chains are required off one tie down point (see LRG09). Packs may be different lengths but only if longer pack is on the bottom.

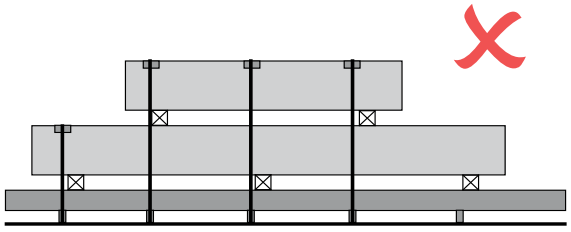


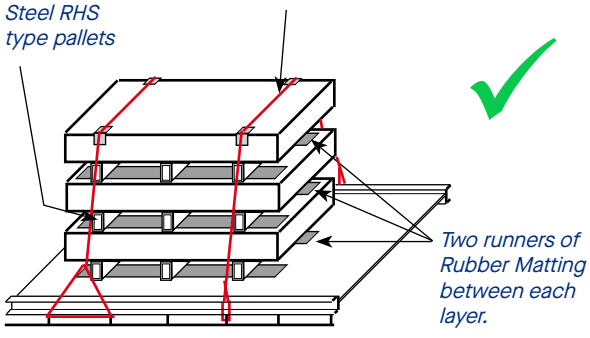
Figure 3p. In this configuration, the lower pack will be at risk of damage due to bending. The top pack is also in bending due to the central lashing.

4. Steel Pallets - Extra Care

- The friction between the pallet and the deck of the trailer is a critical factor. Tables 1 to 4 must NOT be used for Steel Pallets without using rubber matting (see below).

No. of lashings to suit Table 1 or 2.

Steel RHS type pallets



Two runners of Rubber Matting between each layer.

Figure 4a.

Steel pallets should NEVER be carried straight on a steel deck trailer. *If you have to carry steel pallets then it is extremely important that* ***Rubber Matting*** *be used* ***under the bundle*** *and* ***between each pack*** *in the stack.*

5. Lashing Angle

- To determine the correct number of lashings required the lashing angle needs to be taken into consideration.
- Use the following diagrams to find the approximate lashing angle for your case.

H < 0.5W
Angle less than 30°

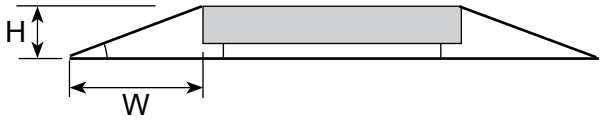


Figure 5a. ***Angle less than 30°***

If the height of load is less than half the width to the coaming rail, the lashing angle needs to be increased or the pack needs to be blocked. See Section 6 on low lashing angles.

0.5W < H < 1.0W
Angle 30 - 45°

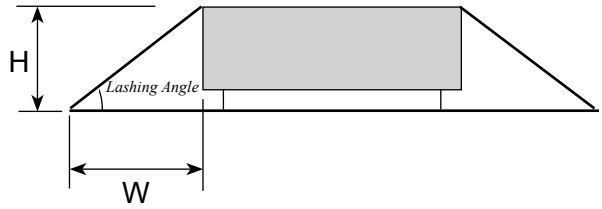


Figure 5b. ***Angle 30° to 45°***

Height of load between half and one times the width to the coaming rail.

H > W
Angle greater than 45°

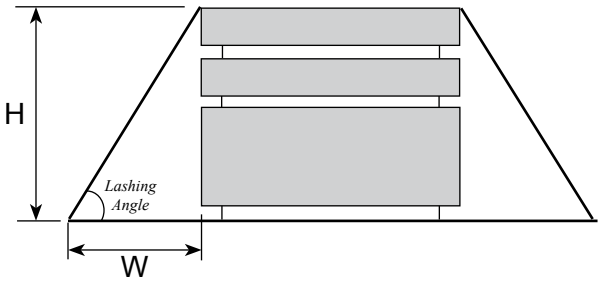


Figure 5c. ***Angle Greater than 45°***

Height of load is greater than the width to the coaming.

6. Low Angle Lashings

- When the load is low to the deck, the angle of the lashing may be less than 30 degrees. In these cases, only limited clamping action occurs and other methods need to be used.
- The most effective methods are blocking against a headboard, other restrained product cross over chain or *SheetStop* devices (provided anti-slip rubber is used under the *SheetStop* and pallet).

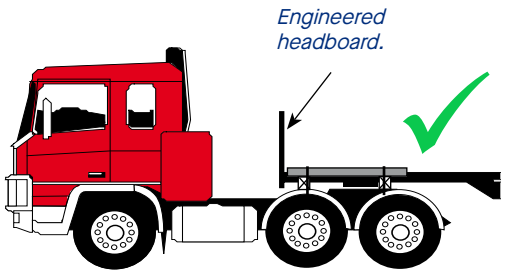


Figure 6a. Blocking against a headboard

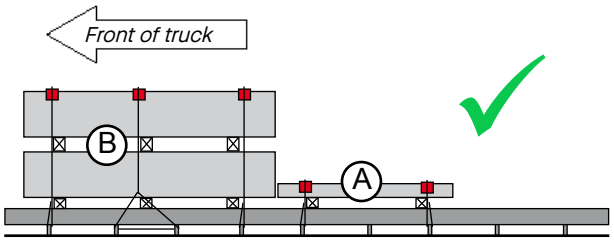


Figure 6b. Blocking against other restrained product.

- When restraining stack A, by blocking against another stack, the restraint of stack B should be sufficient to restrain the combined weight of stacks A + B.
- The restraint for stack A should be not less than that required in Table 3 or 4 based upon the mass of stack A with restraints at 30 degrees OR a minimum of 2 lashings.

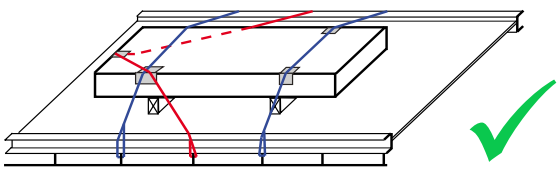


Figure 6c. CrossOver chain (shown in red, at 45 degrees to pack edge).

- The second method for securing low loads is by "belly wrapping" the restraints. This method relies on the stretch in the lashings and is only suited for chain. Webbing is not suitable due to its high stretch characteristic.

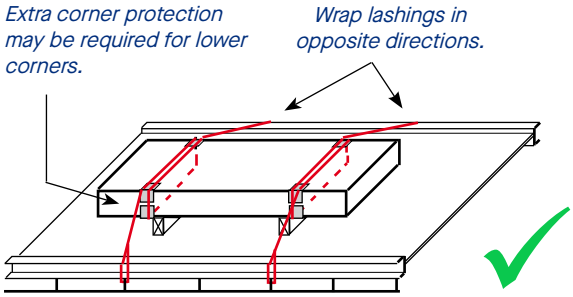


Figure 6d. Belly Wrapping around a low load

Note that belly wrap lashings should always be done with at least 2 lashings. It is generally best if they are wound in opposite directions. If only a single lashing is used the load will twist under forward forces.

Loads restrained with this method may slide up to 1200 mm forward in an incident when using chain, hence webbing is not suitable.

- If neither of the above methods are possible, try to increase the angle to at least 30 degrees with a pallet or timber dunnage.

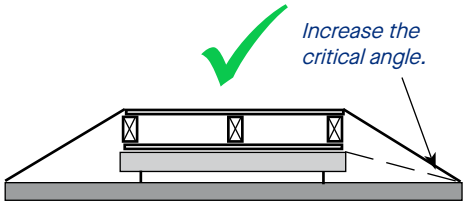


Figure 6e. One option may be to place a pallet on top to increase the lashing angle to at least 30 degrees.

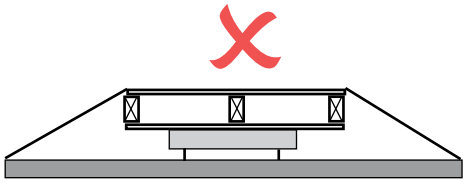


Figure 6f. Not acceptable if pallet overhangs pack, as pallet may break.

7. Stack Aspect Ratio

- Sheet packs (and blank packs) are not to be stacked above a total height of 1.5 times the outer bearer spacing, unless appropriately blocked or otherwise prevented from toppling.
- For Example, if the narrowest bearer spacing for the outside bearers was 80mm (W), the total height of the sheet packs stack cannot be more than 120mm (1.5W).

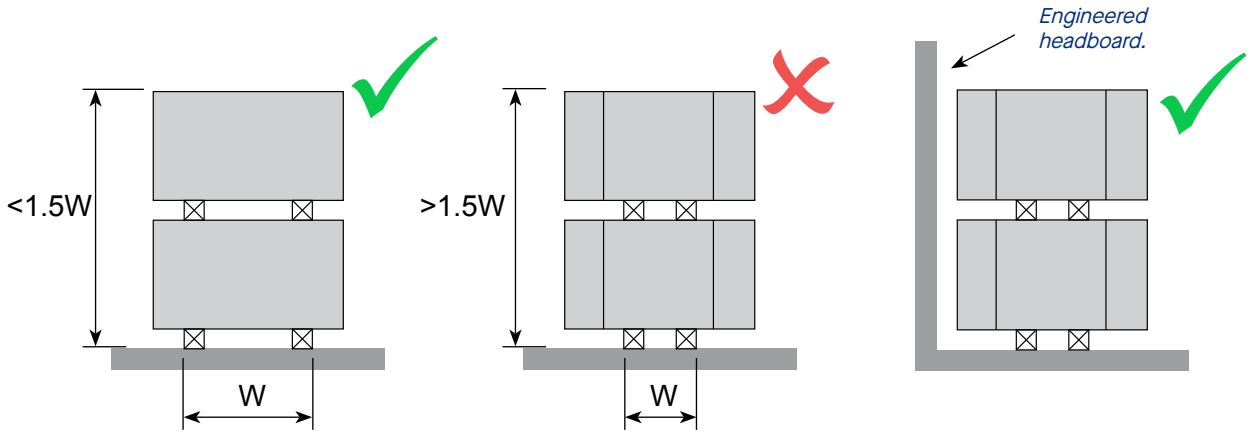


Figure 7a. No higher than a 1.5 to 1 stack height ratio (bearer space to total stack height), unless blocked.

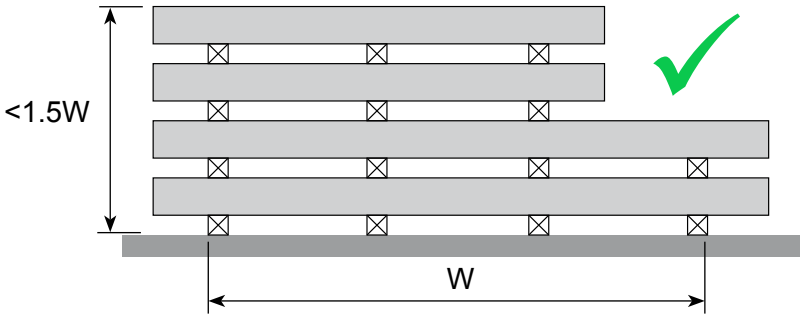


Figure 7b. For packs with multiple bearers, measurement is taken from the outer most bearers.

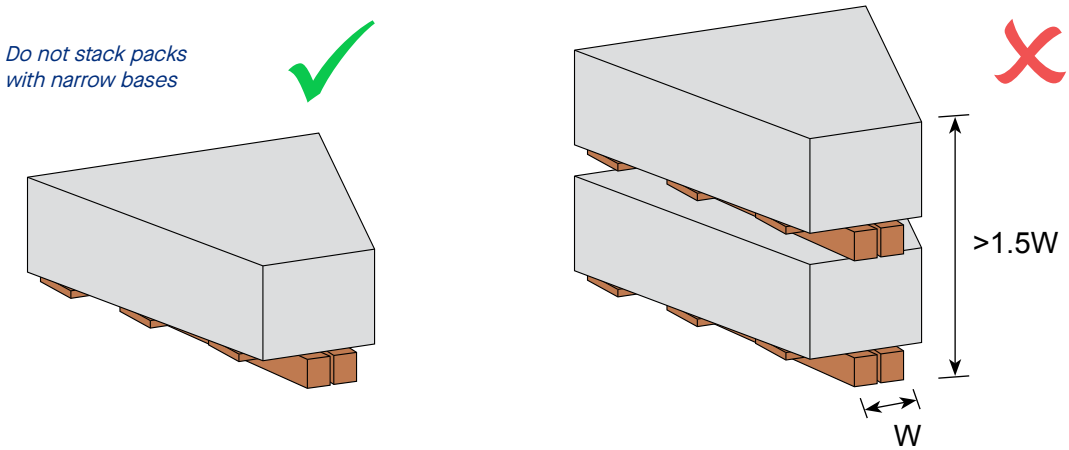


Figure 7c. For trapezoidal and other odd shaped packs, the measurements are taken from the SMALLER end of the pallet.

8. Headboards and *SheetStop* Devices

- Sheet packs should be blocked to prevent forward movement where possible.
- If an approved blocking device is used (e.g. engineered headboard or *SheetStop*), sheet packs may be stacked up to 5 high and restrained in accordance with Table 1 or 2. Loads must be within 100 mm of the headboard, or between 50 to 100 mm from the *SheetStop* devices.
- If *SheetStop* devices are used, two devices must be used per stack and they must cover the bottom two packs as a minimum. Separate sets of *SheetStops* are required for each stack on the trailer. For further details on *SheetStop* devices, contact BANZ SHR - Technical Services.
- For headboards, other packs may be blocked against the first row to allow five high stacks. The bottom two packs of each stack used for blocking must be equal length. Stacks must be within 100 mm of the stack in front. This method is not suitable for *SheetStop* devices. See figures 8c, 8d and 8e.

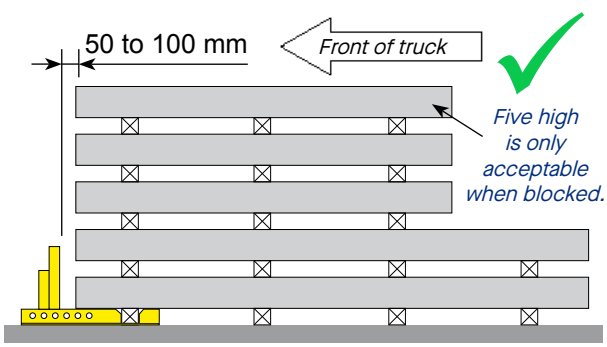


Figure 8a. Two SheetStop devices per stack, placed 50 to 100 mm from the sheet edge.

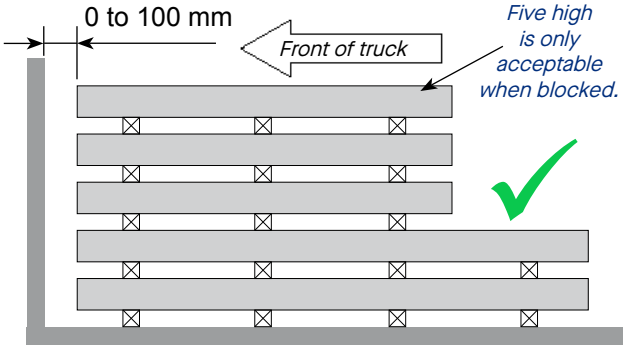


Figure 8b. Engineered headboard used.

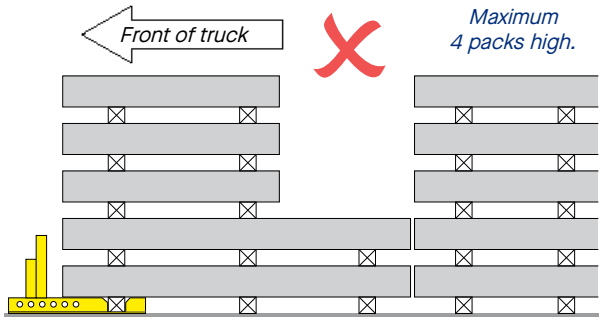


Figure 8c. Do not use SheetStop devices to block multiple stacks.

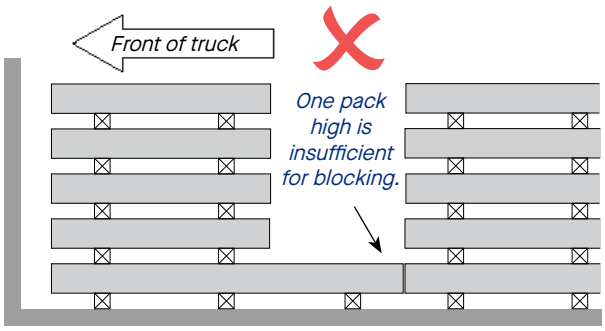


Figure 8d. Bottom two packs of the front blocking stack must be of equal length when using the blocking method.

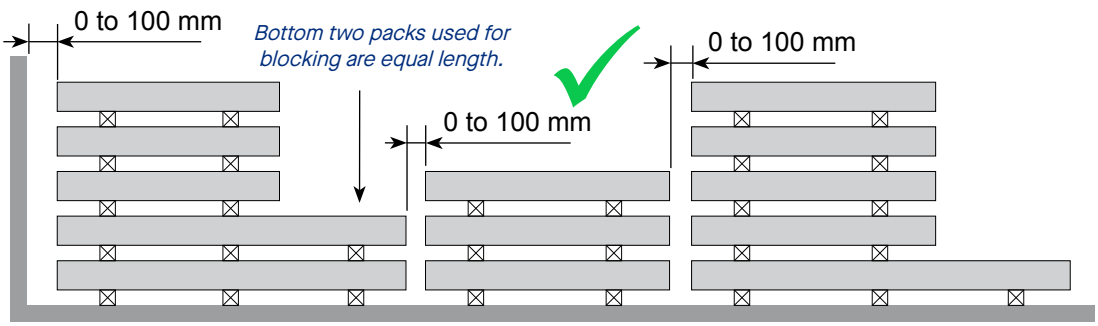


Figure 8e. All gaps when blocked less then 100 mm, and bottom two packs of blocking stacks are equal length.

9. Lashing Tables

Headboard or *SheetStop* (blocking)

LOADS MUST BE BLOCKED

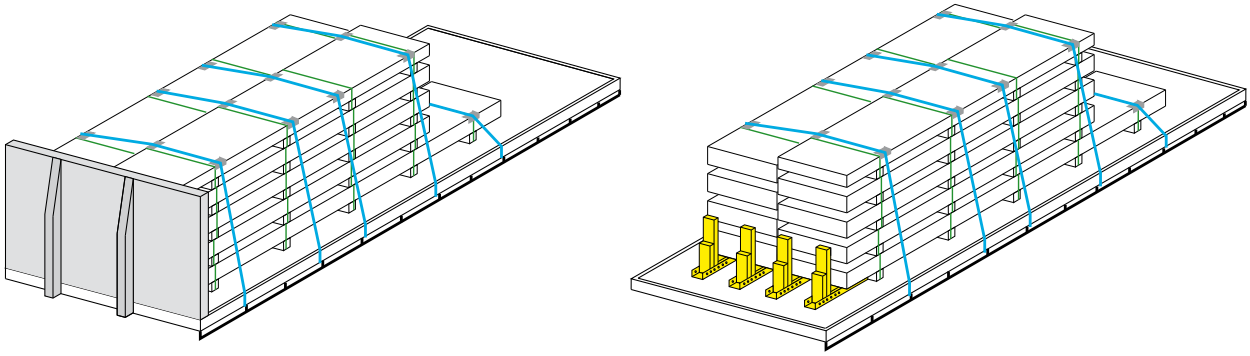


Table 1. Weight Limits for 3 and 4 Tonne Chain Systems WITH Blocking

Packs High in Stack	Greater than 45° lashing angle					30° to 45° lashing angle				
	Number of Chains					Number of Chains				
	1	2	3	4	5	1	2	3	4	5
1-3	4.2	8.4	12.6	16.8	21.0	3.0	6.0	9.0	12.0	15.0
4	2.9	5.8	8.7	11.6	14.5	2.0	4.0	6.0	8.0	10.0
5	1.9	3.8	5.7	7.6	9.5	1.3	2.6	3.9	5.2	6.5

Table 2. Weight Limits for 2 Tonne Webbing Strap WITH Blocking

Packs High in Stack	Greater than 45° lashing angle					30° to 45° lashing angle				
	Number of Straps					Number of Straps				
	3	4	5	6	7	3	4	5	6	7
1-4	2.1	2.8	3.5	4.2	4.9	1.5	2.0	2.5	3.0	3.5
5	1.5	2.0	2.4	2.9	3.4	1.0	1.4	1.7	2.1	2.4

Note: Table 2 assumes webbing strap on "under tray" drum winches or "push up" hand ratchets with an average pretension of 300 kgf throughout the strap. For superior winches with certified higher pretension of minimum 600 kgf, the weight limits in Table 2 may be doubled. For stack weights beyond these limits, use chain or contact BANZ SHR - Technical Services.

9. Lashing Tables continued

No Blocking

HEIGHT LIMIT
Maximum
4 packs high
unless blocked

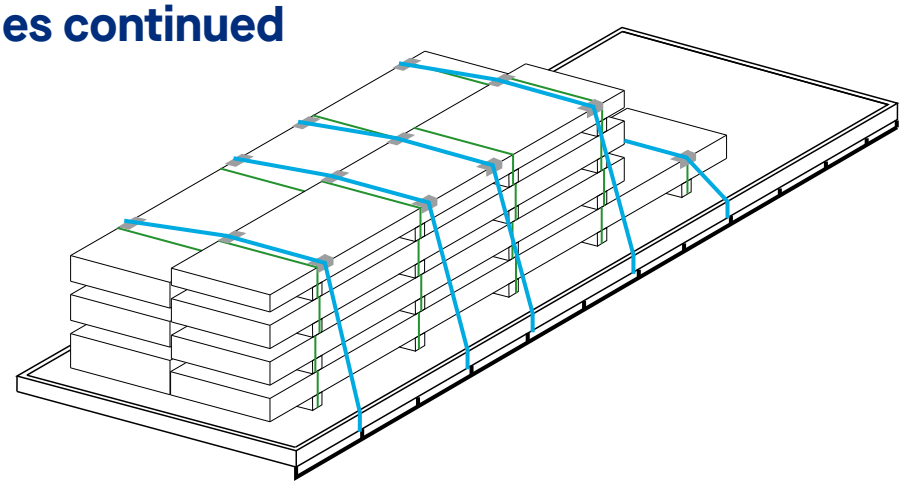


Table 3. Weight Limits for 3 and 4 Tonne Chain Systems NO Blocking

Packs High in Stack	Greater than 45° lashing angle					30° to 45° lashing angle				
	Number of Chains					Number of Chains				
	1	2	3	4	5	1	2	3	4	5
1	4.2	8.4	12.6	16.8	21.0	3.0	6.0	9.0	12.0	15.0
2	3.3	6.6	9.9	13.2	16.5	2.3	4.6	6.9	9.2	11.5
3	2.0	4.0	6.0	8.0	10.0	1.4	2.8	4.2	5.6	7.0
4	1.7	3.4	5.1	6.8	8.5	1.2	2.4	3.6	4.8	6.0

Table 4. Weight Limits for 2 Tonne Webbing Strap NO Blocking

Packs High in Stack	Greater than 45° lashing angle					30° to 45° lashing angle				
	Number of Straps					Number of Straps				
	3	4	5	6	7	3	4	5	6	7
1	2.1	2.8	3.5	4.2	4.9	1.5	2.0	2.5	3.0	3.5
2	1.5	2.0	2.5	3.0	3.5	1.1	1.4	1.8	2.2	2.5
3	0.87	1.2	1.4	1.7	2.0	0.63	0.84	1.0	1.3	1.5
4	0.72	0.96	1.2	1.4	1.7	0.51	0.68	0.85	1.0	1.2

Note: Table 4 assumes webbing strap on "under tray" drum winches or "push up" hand ratchets with an average pretension of 300 kgf throughout the strap. For superior winches with certified higher pretension of minimum 600 kgf, the weight limits in Table 4 may be doubled. For stack weights beyond these limits, use chain or contact BANZ SHR - Technical Services.