SECTION B

ARRANGING LOADS ON VEHICLES

CONTENTS

Section B - Arranging Loads on Vehicles

This Section describes five important aspects in ensuring the safe carriage of any load, which are:

- Selecting The Vehicle;
- Positioning The Load;
- Recognising Unstable Loads;
- Using Dunnage;
- Loading and Unloading;
- Do's and Don'ts

To demonstrate the principles described in this Section, ***lashings have been omitted from the illustrations.***

The following are your responsibilities:

- It is the responsibility of the driver, the vehicle owner and the vehicle operator to ensure the vehicle used is suitable for the type of load.
- It is the responsibility of the consignor including the original consignor of the freight, to provide the person in charge of the loading and the driver with any available information on the weight of each load and the centre of mass of the load or each item in a load.
- It is the responsibility of the person in charge of the loading and the driver to ensure the load is correctly positioned on the vehicle.
- It is the responsibility of the vehicle operator, the person in charge of the loading and the driver to ensure any dunnage is correctly chosen, positioned and restrained on the vehicle.
- It is the responsibility of the person in charge of the unloading to ensure unloading does not present any danger to any person.

1 SELECTING THE VEHICLE

A vehicle must be of a design suitable for the type of load carried. It must have adequate load-carrying capacity and sufficient space for the load.

When a vehicle is loaded, the manufacturer's tyre and axle load capacity, the Gross Vehicle Mass (GVM) or Aggregate Trailer Mass (ATM) and, where applicable, Gross Combination Mass (GCM) must not be exceeded.

The carrying capacity of a vehicle (or trailer) is its GVM (or ATM) less its Tare mass.

The legal mass limits as required by Federal, State and Local Government jurisdictions must not be exceeded.

Vehicles carrying long loads should be long enough to avoid excessive overhang and to ensure good weight distribution for vehicle stability.

Figure B.1 shows a long load on a short vehicle resulting in excessive rear overhang, poor weight distribution and loss of steering ability.

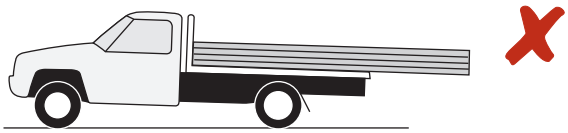

Fig. B.1 **VEHICLE TOO SMALL**

Figure B.2 shows the same long load on a longer vehicle with no rear overhang and good weight distribution.

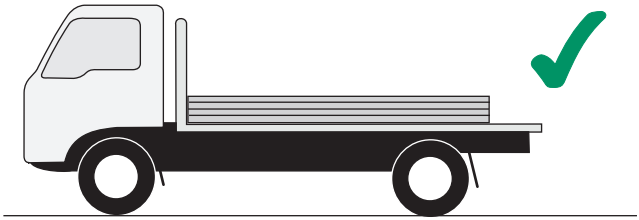

Fig. B.2 **CORRECT CHOICE OF VEHICLE**

Vehicles carrying liquids and loose bulk material must be designed to completely contain the load and to minimise the effect of load movement on the vehicle's stability. Open vehicles designed for carrying loose bulk material must be fitted with a cover, or the load must be wetted, skinned or otherwise contained, if there is a possibility of any of the load being blown off. The use of 'wetting' or 'skinning' agents can be effective for a limited time in restraining fine particles without the need for tarpaulins. Large tanks must be adequately baffled if not almost full or empty when transported.

The higher the position of the centre of mass of the load is above the ground, the lower the speed will be at which the vehicle will overturn when cornering (the centre of mass is also called the centre of gravity 'C of G').

Special precautions must be taken when carrying a load with a high centre of mass. The load should be carried on a vehicle with a low platform height (e.g. drop frame trailer or low loader) or on a vehicle with good roll stability (see Figure B.3).

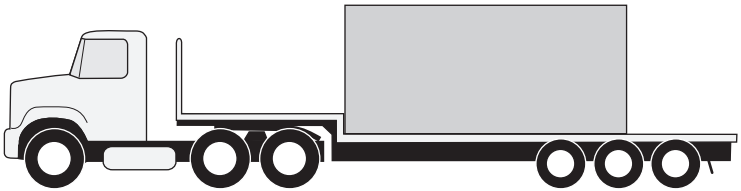

Fig. B.3 **DROP DECK TRAILER FOR MAXIMUM STABILITY**

The overall height of a loaded vehicle must not exceed the height of any obstruction (eg. bridge or overhead wire) likely to be encountered on a journey and the legal limit (generally 4.3 metres).

2 POSITIONING THE LOAD

Incorrect positioning of the load on a vehicle can result in a significant safety risk.

The load must be positioned to maintain adequate stability, steering and braking, and not overload tyres and axles.

A load should be positioned so that its centre of mass is as low as possible and not offset to one side of the vehicle. Positioning the load in this way will reduce the vehicle's tendency to overturn when cornering. This can be achieved by loading heavy objects first and placing them close to the centre-line of the vehicle (see Figures B.4 & B.5).

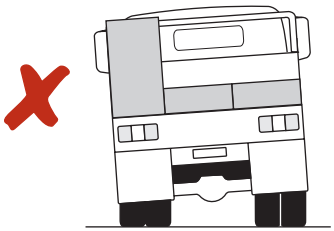

Fig. B.4 **INCORRECT POSITION**

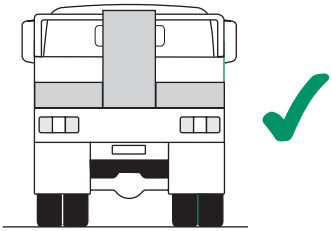

Fig. B.5 **CORRECT POSITION**

Where mixed loads are 'contained' on a vehicle, weak crushable items should be placed behind (or on top of) strong items to prevent damage during heavy braking.

A load placed against a headboard is easier to restrain, but it can place too much weight on the steer axle and can have a high centre of mass. Heavy loads should not be carried this way (see Figure B.6).

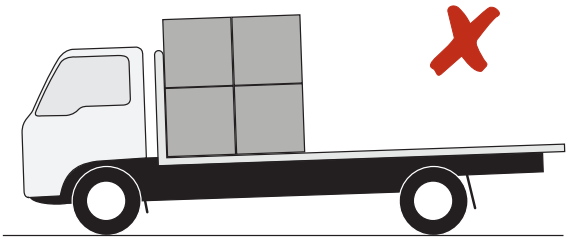

Fig. B.6 **INCORRECT LOAD POSITION** (overloads front axle)

If the front axle is overloaded, the load must be placed further back for better weight distribution and arranged so its centre of mass is as low as possible (see Figure B.7).

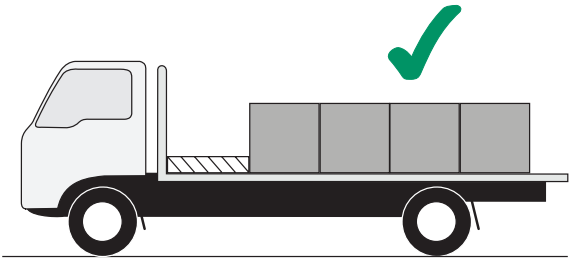

Fig. B.7 **CORRECT LOAD POSITION**

A load should be arranged so its centre of mass is in front of the centre of the rear axle or rear axle group on utilities, trucks and trailers.

This will ensure sufficient weight on steer axles to ensure safe steering and not overload the rear axle (see Figure B.8).

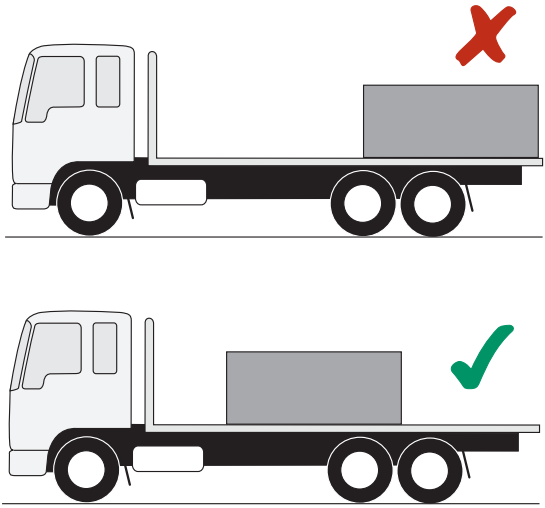

Fig. B.8 **KEEP WEIGHT ON STEER AXLES**

When loaded, the centre of mass of a drawbar trailer, including its load, must be in front of the centre of the axle group, to minimise trailer sway (see Figure B.9). This means that the trailer coupling should push down on the towbar, not exceeding the manufacturer's ratings of the coupling and towbar.

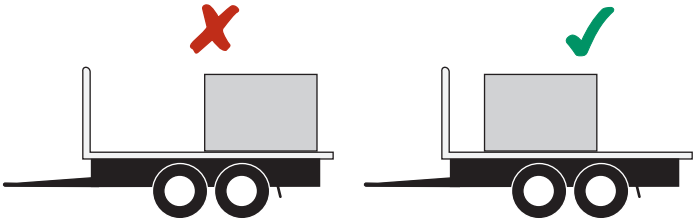

Fig. B.9 **PREVENT TRAILER SWAY**

The centre of mass of the load should be in front of the rear axle of a semi-trailer to provide enough weight on drive axles of the prime mover for traction and stability (see Figures B.10 & B.12).

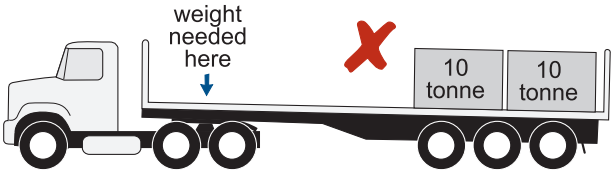

Fig. B.10 **INSUFFICIENT WEIGHT ON DRIVE AXLES**

Heavy objects should be loaded first and positioned to provide even loading across the deck and shared loading between axles. To prevent excessive flexing of the middle of long trailers, heavy items or the dunnage supporting long lengths should be placed over the axle groups, where possible (see Figures B.11 & B.12).

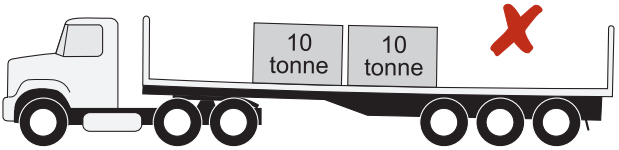

Fig. B.11 **EXCESSIVE TRAILER FLEXING**

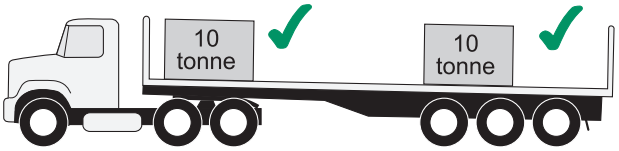

Fig. B.12 **GOOD WEIGHT DISTRIBUTION**

The vehicle's axle loads resulting from the positioning of the load may be obtained by weighing or calculation. The axle loads depend on the position of the centre of mass of the load.

Moving the bottom dunnage forward or rearward without moving the load will not change the axle loads of load sharing suspensions (see Figure B.13)

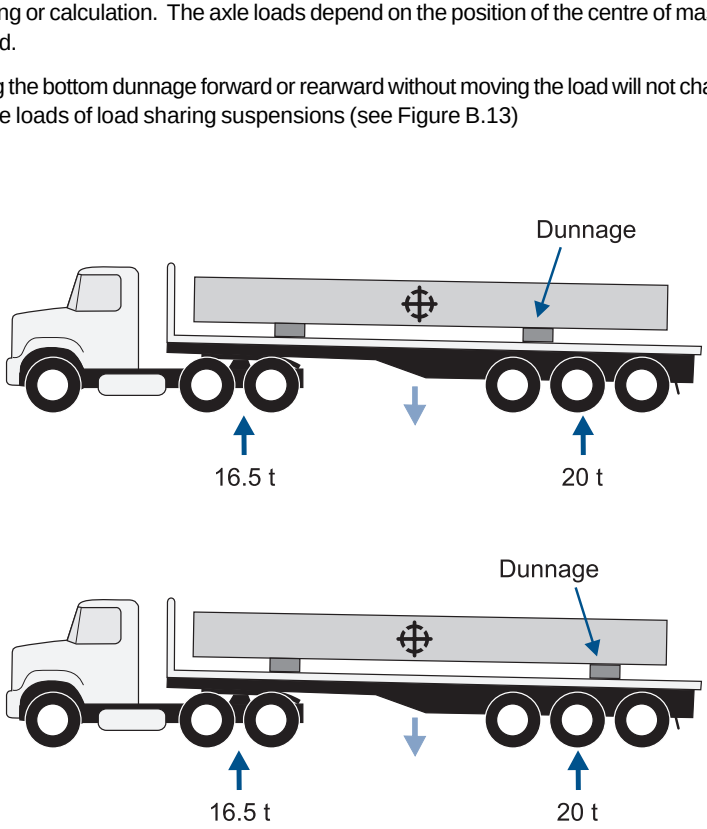

Fig. B.13 **DUNNAGE POSITION – NO EFFECT ON AXLE LOADS**

A load which has any potentially dangerous projection should be placed to minimise the risk to the driver or any other person, in the event of the load shifting during braking or a collision (see Figures B.14 & B.15).

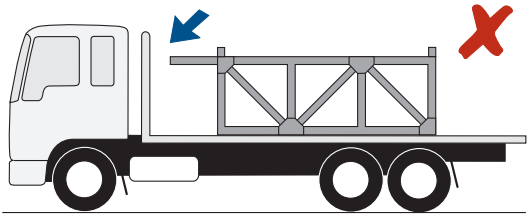

Fig. B.14 **DANGEROUS POSITION**

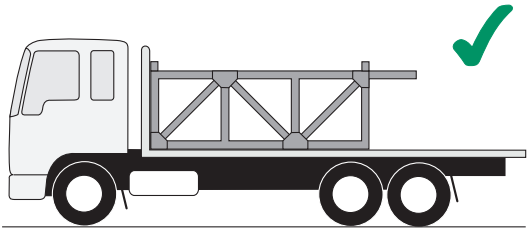

Fig. B.15 **CORRECT POSITION**

The load should not project from the front, sides or rear of a vehicle because it could cause danger to other road users or damage to property.

A load that projects beyond the rear of a vehicle by more than 1.2 metres (where Regulations permit) must be made conspicuous in daytime by fixing a brightly coloured flag or piece of material with each side at least 300mm long and at night by a red light which can be seen for 200 metres. Rear overhang limits may also apply.

3 RECOGNISING UNSTABLE LOADS

Tall loads can tip over under heavy braking or cornering. This can happen even if they are restrained properly at the base.

A load will be less stable if it is placed on a base such as timber dunnage that is narrower than the base of the load.

Tall loads are unstable in the forward direction, if the length (L) measured along the vehicle, is less than 80% of the height (H) (see Figure B.16). This applies to evenly shaped loads of the same material throughout such as paper rolls, 205 litre drums, or gas cylinders.

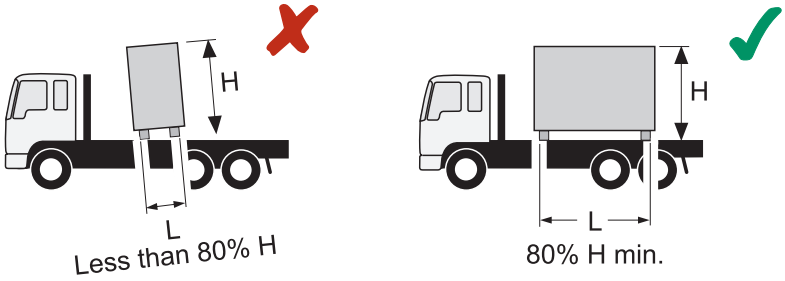

Fig. B.16 **UNSTABLE FORWARDS**

Tall loads are unstable sideways if the width (W) measured across the vehicle, is less than 50% of the height (H) (see Figure B.17).

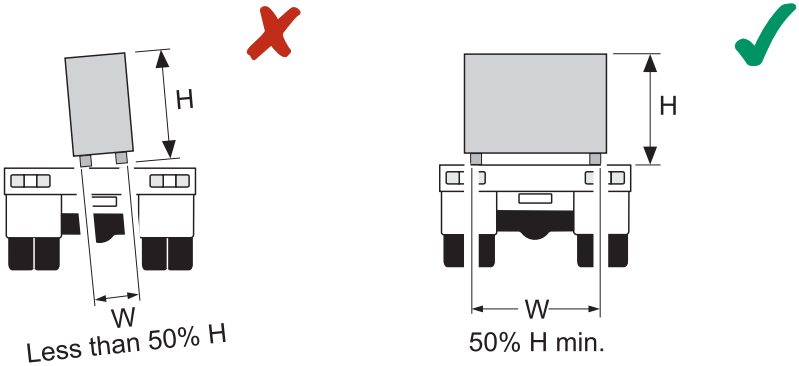

Fig. B.17 **UNSTABLE SIDEWAYS**

Fully tensioned tie-down lashings will increase the stability of the load. Care should be taken when using rope or webbing straps to stablise a load, because of the amount that these lashings can stretch. Ropes may stretch up to 20% and some webbing straps may stretch up to 13% of their length, before reaching their Lashing Capacity. This amount of stretch may allow the load to tip over. Chains are much more effective in preventing unstable loads tipping, because they don't stretch as much (about 1% of their length, up to their Lashing Capacity).

Lashings can be attached directly to the load to prevent tipping. These lashings are most effective if attached to the upper half of the load and angled no more than 60 degrees to the horizontal, in the opposite direction to tipping (see Figure B.18).

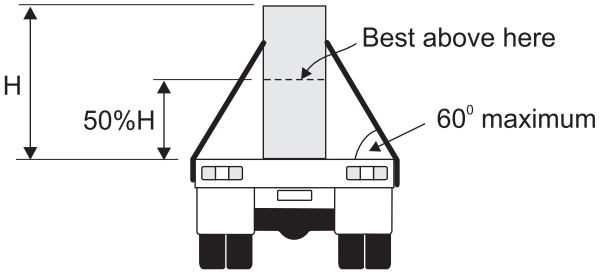

Fig. B.18 **ATTACHING DIRECT LASHINGS TO UNSTABLE LOADS**

Where a tall, unstable load is fragile or of uneven shape such as a transformer, it may not be possible to stabilise or prevent it tipping by attaching direct lashings. In such cases the load should be supported by a specially constructed frame and the frame restrained.

Unstable loads can be placed against a rigid structure, such as a headboard, to prevent them from tipping (see Figure B.19).

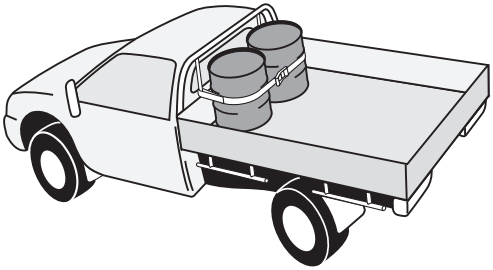

Fig. B.19 **STABILISED LOAD**

Alternatively, several unstable items of load can be strapped together to form a stable pack (see Figure B.20).

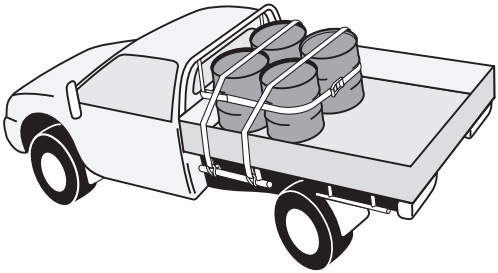

Fig. B.20 **STABLE PACK**

4 USING DUNNAGE

Dunnage is the packing placed under or between parts of the load. It is used to allow loading and unloading using forklifts or lifting slings.

Most dunnage is made from square or rectangular hardwood or softwood timber. Some loads require inter-layer packing that prevents contact between the timber and the load and acts as a moisture barrier. Inter-layer packing includes anti-slip rubber matting bonded to the top and bottom faces of the dunnage, plastic wrapping and plastic strips. These packing materials change the amount of friction between the load and the vehicle deck and other parts of the load. The use of slippery plastic wrapping means that more tie-down lashings are required than with timber alone, whilst the use of anti-slip rubber matting usually means that fewer lashings are required.

Rectangular dunnage is sometimes wrongly placed on its narrow face or stacked directly on top of itself (see Figure B.21), so that the tines of a forklift can fit under the load. This can be dangerous because the dunnage can roll under heavy braking. If the dunnage rolls, the lashings can loosen and all restraint can be lost.

To prevent the dunnage from rolling, it can be placed on its wide face. Dunnage that is placed directly on the deck can be bolted to the deck or fitted with special stablising brackets. For heavy loads restrained by tie-down chains, it is recommended that square hardwood dunnage that is at least 63 mm thick, or softwood dunnage that is at least 100 mm thick, is used.

If the height of the dunnage needs to be raised (for uneven loads) it should be stacked alternatively at right angles to keep it stable.

If the dunnage spans between support points it must be strong enough to support the weight of the load, the tie-down clamping forces and the shock from bumps. If the dunnage is not strong enough, additional supports should be added or stronger dunnage used or, alternatively, the load rearranged.

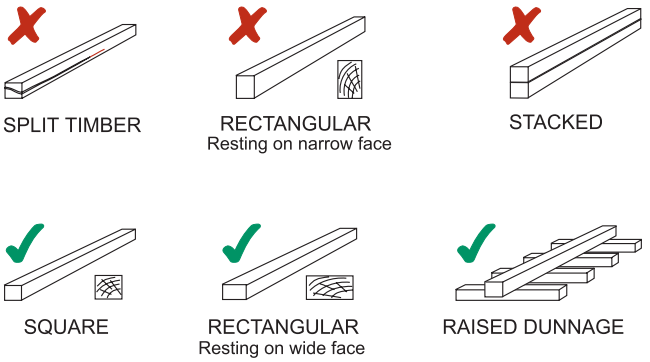

Fig. B.21 **DUNNAGE DO'S & DON'TS**

Timber which is used for dunnage should be relatively free of knots and splits. For heavy loads, such as large steel sections that are supported on small areas of contact, the dunnage should be strong enough to prevent it crushing or splitting.

If the load has multiple layers of lengths of rigid sections, the upper rows of dunnage should be placed directly above the bottom dunnage (see Figure B.22). If the dunnage is placed between lashing positions it can work loose when the vehicle and load both flex during a journey. If the dunnage works loose and falls out it could cause an accident.

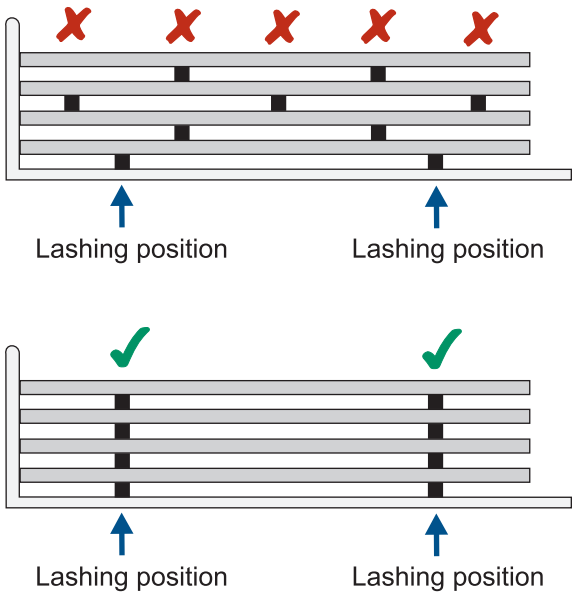

Fig. B.22 **POSITIONING DUNNAGE**

Very rigid loads, such as large diameter steel pipes and concrete beams, should be supported in only two positions to allow the vehicle to flex. If the lashings are placed between the dunnage positions they can break or loosen when the vehicle and/or the load flexes. This could allow the load to move.

Flexible loads, such as plastic pipes, require additional dunnage positions (and lashings) to be used along with their length. Individual, flexible lengths can be restrained with lashings between the dunnage positions.

Remember to secure all dunnage when the vehicle is travelling empty. Even a small piece can be a dangerous missile to other road users.

5 LOADING AND UNLOADING

The load should always be packed, located and restrained in a way that allows its safe loading and unloading.

When throwing lashings over the vehicle, be careful that no-one is standing on the other side. Before throwing the lashings, check there is no obstruction above the vehicle and electric cables that could come into contact with the lashings.

When opening doors, gates, sides and side curtains and when removing lashings and tarpaulins take care that loads that may have shifted during a journey, do not dislodge and cause injury. When releasing the tension in lashings, be careful of any sudden uncontrolled movement of handles, cheater bars, sharp steel strapping and hooks on lashings and elastic straps.

Forklift operations are a major cause of injury to drivers and loaders. When a vehicle is being loaded or unloaded by forklift, make sure that you are always in full view of the forklift driver. Do not approach a forklift whilst it is moving.

Do not stand or work on one side of the vehicle if the other side is being loaded or unloaded. Part of the load may be pushed onto you during the loading or unloading operations.

6 DOs AND DON'Ts

DO make sure that the vehicle's load space and loading deck are suitable for the type and size of the load.

DO check the weight of the load to be carried.

DO check the positioning of the load along the vehicle.

DO consider the positioning of the load after partially loading or partially unloading the vehicle.

DO position the load evenly across the vehicle.

DO provide extra restraint for tall loads.

DON'T overload your vehicle or its individual axles.

DON'T load your vehicle too high.

DON'T overload the steer axle by placing the load too far forward.

DON'T reduce the weight on the steer axle by placing the load too far back.

DON'T allow the load to project dangerously towards the cabin or outside the vehicle.

DON'T place rectangular dunnage on its narrow face.

This load of logs was not properly restrained and fell off on a corner. In this case no pedestrians or other road users were injured.

It was reported that hay bales shifting on a bumpy corner caused this rollover. It therefore was probably not restrained to meet the Performance Standards. *(Photo courtesy The Standard, photographer Leanne Gourley).*

Poor load restraint caused the heavy steel sections to move and cause the rollover.

The base of the load broke from the strapping tie-down force. The strap should have been positioned above the dunnage supporting the load. *(Photo courtesy Queensland Transport).*

This truck is carrying a concrete tank with a single chain around its base. Both ends of the chain are attached to the same point at the middle of the headboard (see photo insert). There is no tie-down to prevent the tank shifting sideways on a bumpy corner.

A few ropes and a knotted webbing strap will not hold this load of steel.

Too much weight behind the rear axle can give poor steering and braking on the front axle (see page 219).

Tall loads can be unstable and require special loading and restraint methods
(see pages 43, 44)

The shipping container bent this trailer. It is important to know the weight of the load and its centre of mass and then to position it correctly on the appropriate vehicle.

This trailer was not strong enough. Its frame broke in front of the wheel from the weight of the load.

Use a suitable vehicle. The overhanging load can reduce the weight on the front axle and steering capacity. The excessive overhang is a danger to other road users.