

Guide to restraining concrete panels and beams



Introduction

Safe loading of vehicles and restraint of loads are important in preventing injury to people and damage to property. These help to prevent:

- the load sliding forward into the truck cabin with serious risks to the driver;
- the load falling from the vehicle onto other vehicles or pedestrians;
- the load becoming unstable in a way that creates risk when unloading the vehicle;
- drivers and riders having to swerve to avoid fallen items; and
- vehicles overturning because of the load shifting while cornering or changing lanes.

At the very least, it avoids possible disruption to traffic flow.

As an owner and/or driver of a heavy vehicle and as a loader or consignee you are responsible for ensuring that any load carried by your vehicle is safely loaded and restrained. This means that the load:

- must not be placed in a way that makes the vehicle unsafe or unstable;
- must be secured so that it is unlikely to fall or to be dislodged from the vehicle;
- must be restrained by an appropriate method.

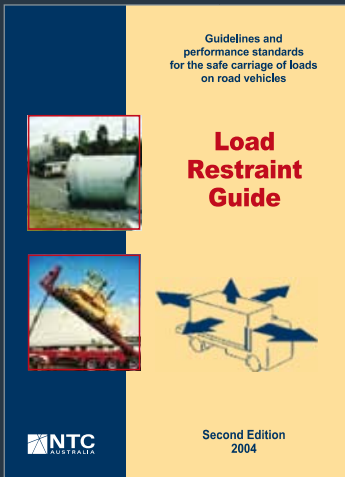
Any method of restraint used must comply with Section F (1) of the **Load Restraint Guide - Second Edition**. This section of the guide details the performance standards that any restraint system must meet. The guide also provides information on the principles of restraining loads, requirements for positioning loads, how to secure loads, and technical information and ratings on various methods of restraint.

Information in this booklet on restraining concrete panels and beams is in addition to other relevant information contained in the second edition of the **Load Restraint Guide 2004**, plus industry standards listed on page 10 of this document.

This booklet describes some of the best ways of transporting concrete panels and bridge beams.

The adequacy of a particular method of loading and restraint depends on a large number of factors, and persons using this guide must ensure that the methods used meet the above standards. VicRoads disclaims liability for incorrect use of this information.

Every effort has been made to ensure that the information in this booklet is correct at the time of publication.



The information contained in this booklet should be used as a guide only. Operators should implement loading and load restraint procedures that comply with the performance standards on page 186 of the **Load Restraint Guide** and are prepared in accordance with Section I of the **Load Restraint Guide - Second Edition**.

Why loads move

The following factors can cause movement of any load that is not adequately restrained:

- impacts in minor crashes;
- sudden braking, accelerating;
- sharp cornering;
- adverse road camber;
- hilly or rough road surfaces; and/or
- wind and airflow over the vehicle.

General principles for loading and restraining of concrete panels

1. Choose a suitable vehicle for the load

Vehicles with low loading decks (drop-deck, step-deck, low loader trailers) are recommended for all large and high panels. These vehicles lower the centre of gravity of the load, improving vehicle stability. They also provide solid “blocking” of the load against the goose neck. Concrete panels should be blocked at their front to stop any forward movement.

Vehicles should have properly designed anchor points often capable of anchoring more than one restraint, especially at the front of the loading floor.

2. Position and place the load

Keep the load weight evenly spread along the vehicle centre line, with the centre of gravity as low as possible.

3. Select suitable restraint equipment

Concrete panels “on-edge” require certified A-frames for support. These frames must be designed with sufficient strength for the application and must be adequately restrained on the vehicle, both when laden or unladen.

Tie-down lashings are normally chain or webbing. They should be selected on the basis of the required minimum pre-tension and lashing capacity (LC) for the application. Suitable chains include 8 mm or 10 mm transport chain tensioned with turnbuckle type tensioners. Suitable webbing is 50 mm tensioned with hand ratchets or truck winches.

4. Check lashings after loading

After commencing a journey the load may settle and shift a little, which can cause the lashings to loosen. Drivers should check the load and the restraint tension shortly after commencing the journey. The number of checks that should be made depends on many factors including the size and shape of panels being carried as well as the condition of road being travelled.

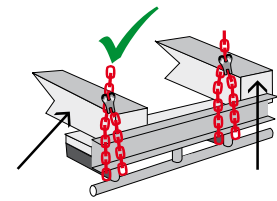
Refer to 6.7.3 - Support Frames in The National Code of Practice for Precast Tilt Up and Concrete Elements in Building Construction (Feb 2008) (Aust Govt - Aust Safety and Compensation Council).

6.7.3 Support frames

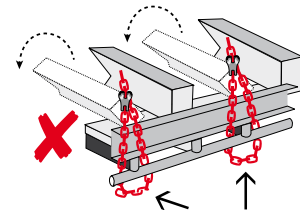
Frames used to support concrete elements during transportation whether an integral part of the transport vehicle or an add-on, need to be designed to withstand loads and forces which may act on the system during loading, transportation and unloading.

A frame system that is not an integral part of the transport vehicle or trailer should be adequately secured and be capable of withstanding any forces applied during loading, transportation and unloading. The loading of vehicles must comply with the National Transport Commission's Load Restraint Guide. This includes the certification of support frames by a suitably qualified and approved engineer.

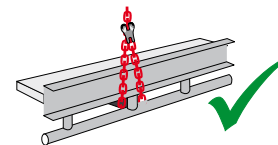
Particular care needs to be taken during loading and unloading of concrete elements from frames to ensure the support frames remain stable at all stages.



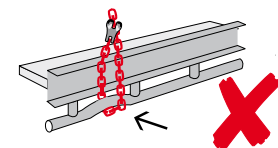
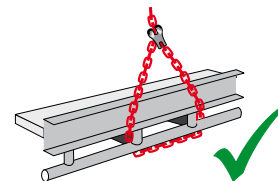
Square timbers are best for supporting the load



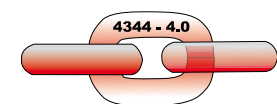
Timbers on edge can roll forward under braking releasing all restraint



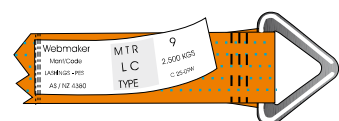
Correct, at support



Incorrect



4344 is the Aust Std No, 4 represents 4000 kg LC



A typical webbing tag with required markings, as per Aust Standard 4380

All load restraints must meet and comply with Aust Standards

Lashings

- The minimum LC specifications for lashings used for restraining concrete panels are shown in Table 1 below.

Table 1 - Recommended lashings

	Size	Minimum recommended Lashing Capacity (LC)
Webbing	50 mm	2,500 kg
Transport Chain ¹	8 mm	3.8 tonnes
Transport Chain ¹	10 mm	6 tonnes (4.5 t with grab hooks)
Transport Chain ¹	13 mm	9 tonnes (6.7 t with grab hooks)

1 Australian Standard AS/NZS4344

- The 10 mm and 13 mm chains can be used as safety chains around the front of the load. Normally a safety chain should provide 7.5 tonnes of additional restraint for a 25 tonne load (0.8 - 0.5 g from tie-down). An 8 mm looped chain at 30° to horizontal has a capacity of 3.8 t x 2 x 75% x cos 30° = 4.9 tonnes. A 10 mm chain has 7.8 tonnes lashing capacity or (LC) and a 13 mm chain has 11.7 tonnes lashing capacity.

Dunnage

- Support timbers should be made from hardwood and be a minimum of 100 mm x 100 mm.
- Dunnage timber should be in good condition and free of defects such as splits and knots.

Recommended methods: Using A-frames for carrying concrete panels

- A-frames can be individual units or a set of frames made into one large unit. Either way, the units themselves must be secured to the vehicle.
- It is recommended that A-frames be attached to the deck by positive methods using suitable bolts, pins or twist-locks. Chaining or clamping sideways is not recommended, but if used, there should be adequate friction between the frame and the vehicle deck, using rubber load mat or timber contact surfaces. Chain and clamps should apply downward force on the A-frames to increase friction forces.
- Ensure that the A-frames have a suitably qualified engineer and approved engineered design and are not twisted or carried on an uneven floor, otherwise the load may rock and move. Refer to National Code of Practice - Certification of Support Frames.
- Each frame to carry unit ID numbers.

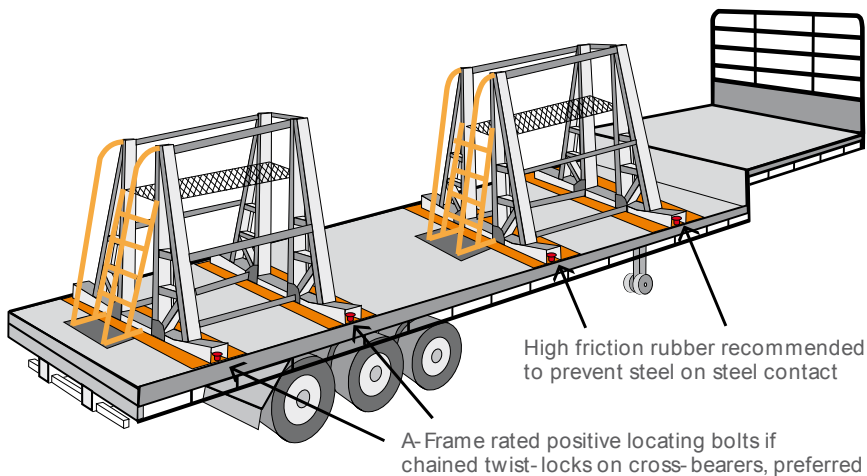
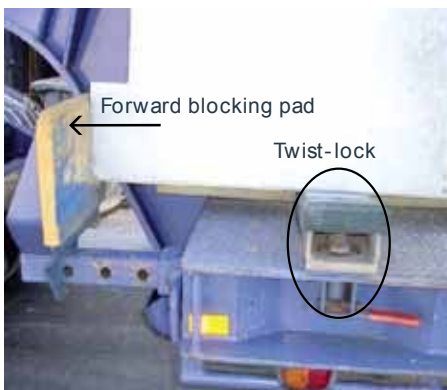
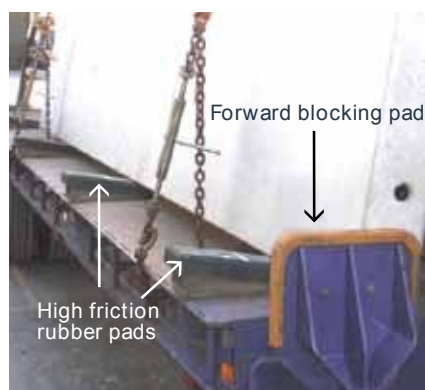


Figure 1, Typical A-frame on a step-down trailer



A-frame secured with rated forward blocking pad and high-friction rubber pad twist-locked in place.



A-frame braced and secured by chains with high friction rubber pads under the frames and a rated blocking pad at the front.

- Where panels are carried on a flat top trailer without any blocking from a goose neck or headboard, additional restraint is usually required. A safety chain should be placed around the front edge of a load (see Figure 2). These chains should have a minimum lashing capacity of at least 25 per cent of the weight of the load if angled at less than 30° to the horizontal. For example:
 - a 25 tonne load requires an additional 7.5 tonnes of restraint above sideways and rearwards restraint forces. A 10 mm transport chain at 30° provides 7.8 tonnes and has a lashing capacity of 6 tonnes
 - a 15 tonne load requires an additional 4 tonnes of restraint above sideways and rearwards restraint forces. An 8 mm transport chain at 30° provides 4.9 tonnes and has a lashing capacity of 3.8 tonnes.



Figure 2, Safety chains example: 4 chains with 2 front chains independently holding each panel.

- The safety chain should be positioned two thirds of the way up the load and angled not more than 30° to the horizontal.

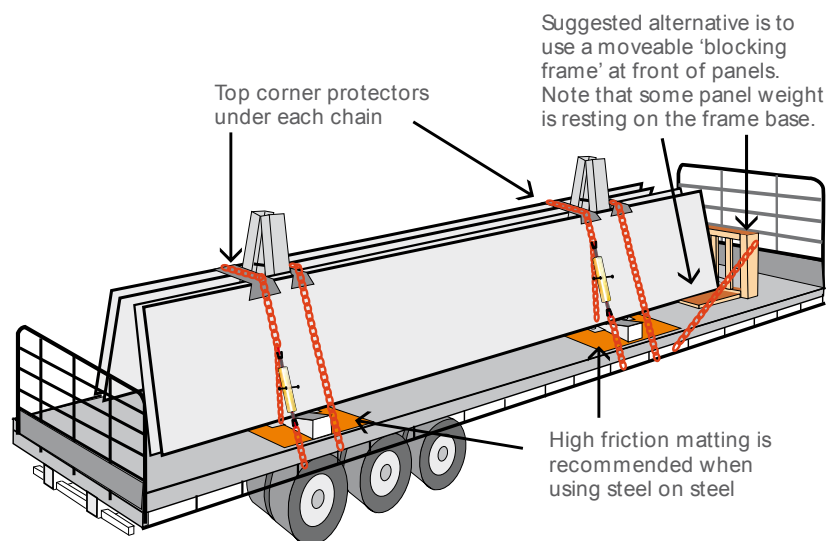


Figure 3, Restraining panels on an A-frame using a flat top trailer



Figure 4, Restraining panels on a rear-tilt frame on a flat top trailer.

- To ensure the safety chain does not slip during transport, the use of a pedestal or a small frame is recommended (see Figures 2 and 4). Alternatively a strap support over the top of the load can be used as shown in Figure 3.



Figure 5, An example of a frame at the front of flat panels. "Safety Chain" around the blocking frame as well as the load resting on the frame base.

Carrying flat slabs

- Concrete panels carried flat should be supported on the deck and on other panels on square timber bearers or rectangular bearers placed on the long side flat (see Figure 6).
- Corner protectors should be used under the chains to prevent movement and damage to the panels.
- The number of bearers required is dependent on the type of concrete panels being carried. Lashings should be applied at each bearer position.

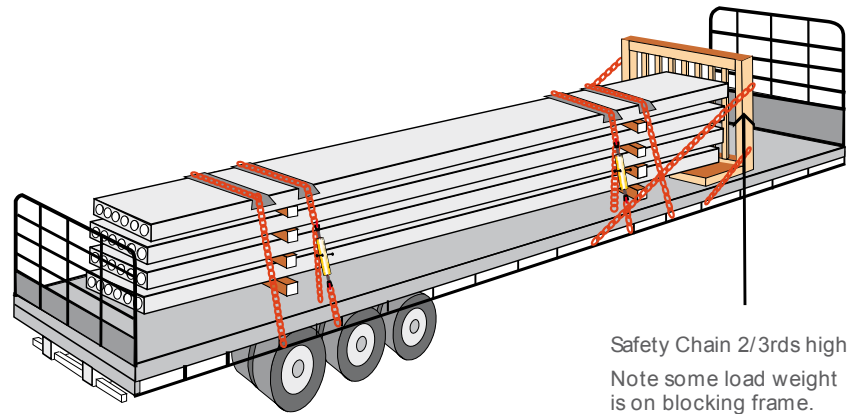


Figure 6, Restraining panels horizontally when using a flat top trailer

General principles for loading and restraining of concrete beams

Choose a suitable vehicle for the load

It is very important that the vehicle combination selection is based on an accurate beam load weight. Final selection must be supported by manufacturers engineering certification that meets all performance criteria that may be encountered for permit travel. Individual dolly groups and frames to be marked with unit ID numbers, load capacities using welded or plated markings.

Depending on the actual beam weight, vehicle configuration must be set up for appropriate axle group mass limits under permit. The vehicle platform/low loader/dolly support strength ratings are required for each of these components and must take into account all particular travel turn angles that may be encountered will need to be reassessed as being fit for service by VASS engineers or a person with appropriate skills and experience as approved by VicRoads. Additional information can be found in the WorkSafe Victoria Construction and Erection of Bridge Beams Industry Standard April 2004 (see page 10 of this document).

1. Position and placement of the load

Beam support bolsters must have a certified load ratings document that covers all likely force angles that may be encountered during travel including loading and unloading sites. Whilst the loaded vehicle beam centre of gravity (CoG) is always kept as low as possible it is recommended at least one static roll threshold (SRT) calculation be conducted for each beam group type and weight. A copy to be carried on the vehicle and to be made available on request by police or enforcement officers. A certified load restraint system must be implemented. Suitably competent persons must be engaged to conduct an assessment of the loads being carried and certify the load restraint system in accordance with Section I of the Load Restraint Guide. Certification must be obtained and carried with the vehicle carrying the load and be readily available for inspection by police or enforcement officers.

2. Certified restraint system and equipment

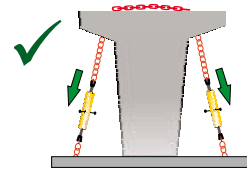
Concrete beams of varying weights (30t – 100t and over) require a well calculated and a fully assessed load restraint method. Critical areas for detailed attention include the beam support bolster material (friction available), lashing chains sizes with lashing capacities to match load weight (8 mm – 10 mm – 13 mm are typical sizes).

Annual chain strength safety checks are recommended (see tagged example right). Attention to load tie-down points is important. Alternatively all restraint equipment is to be checked in accordance with Section H of the LGR.

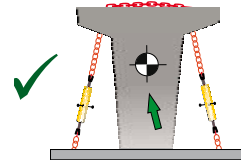
Bolster design, hi-tensile strength steel, load support area, high friction surfaces, sharp corners and known lashing pretensions are critically important details that require accurate assessment. Ratchet or sliding lever turnbuckles are recommended in lieu of regular 'chain dogs' to more reliably attain consistent pre-tension levels (This is for reducing manual handling injury risk).

3. Load and lashings check after loading and before travel

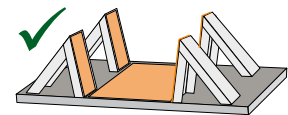
Before commencing travel, all fittings, connections, brake hoses, steering mechanism and equipment, connections are required to be thoroughly checked. For relatively complex and high risk loading of this nature, it is recommended that a comprehensive 'pre-start' checklist for the particular vehicle configuration is made available for suitably qualified responsible person and the driver to sign off on before a load leaves on its journey.



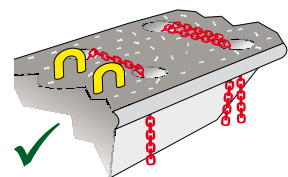
Consider 'double-dogging' makes for even clamping



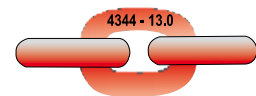
Ensure the load weight and centre of gravity has been accurately calculated



Always use or consider high friction materials at support pad. These must be blocked or adjusted to fit firmly against the beam



Correct designs must allow hooks and chains to easily go through beam restraint holes and without sharp hole edges and be clear of beam lifting lugs

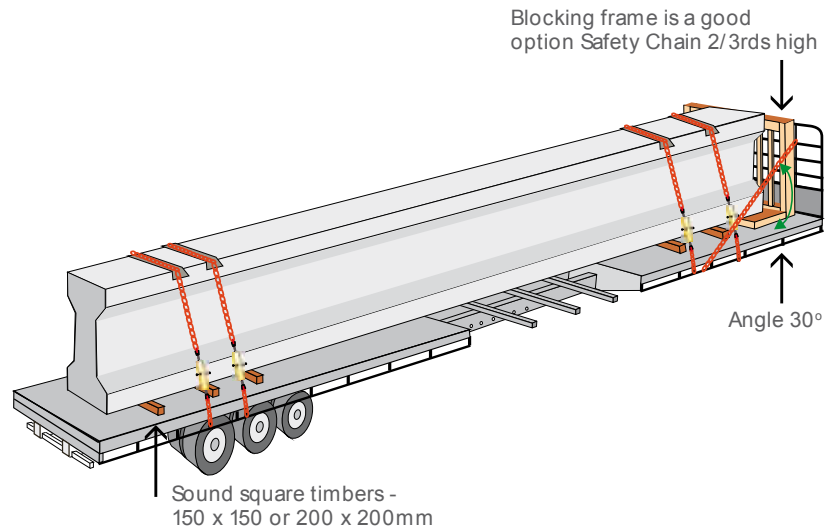


4344 is the Aust std no.
13.0 represents 13000 kg LC



Extendable trailer loading of beams

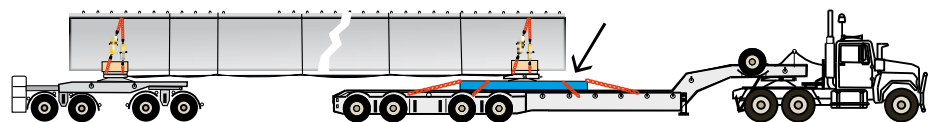
- Restraining beams on a flat top or extendable trailers. Prevent movement by always using sound and square timbers of say 200 mm x 200 mm.
- A suitable load 'blocking' system is often a worthwhile approach if available.
- Always consider 'double-dogging'. This ensures best 'load clamping' over right-angle edges of loads.



Double articulated loads

- Total load dynamic braking forces on a turntable require total restraint and or blocking capacity to be adequate for the load weight to the level required to meet the LR Performance Standards. Where possible use large blocking pins or bolt the turntable to the low loader floor.
- Place some high friction rubber between steel on steel surfaces such as a turntable shown on page 11.
- WorkSafe Victoria Construction and Erection of Bridge Beams Industry Standard April 2004. Sections 5 and 6 refer to Handling, Storage and Transportation. The Aust Standard AS 3850 for Concrete Tilt Panels. National Code of Practice for Precast, Tilt-up and Concrete Elements in Building Construction Feb 2008 - (Australian Govt Safety and Compensation Council).

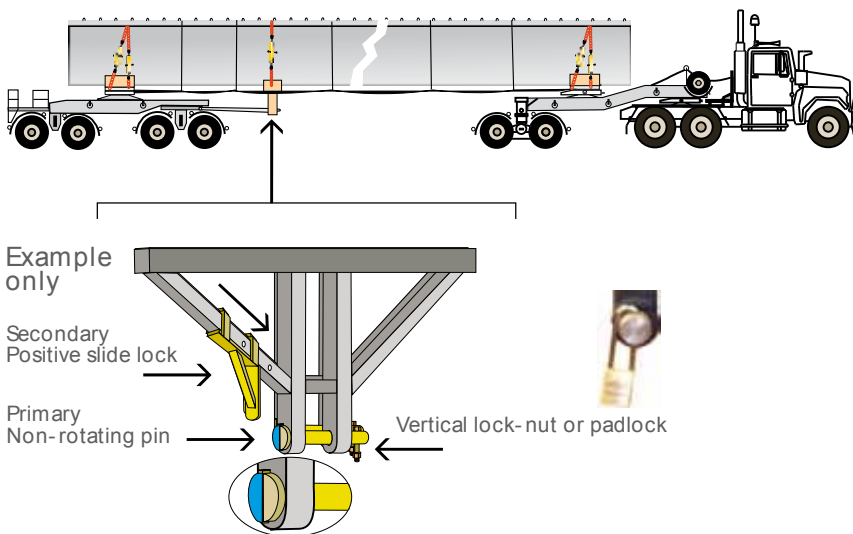
Low loader and steerable (with operator)



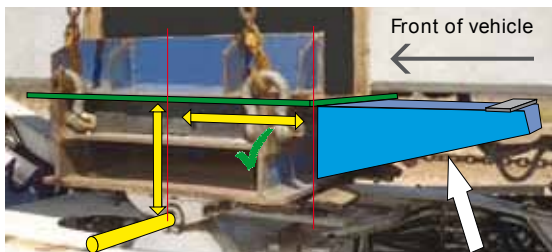
Dual-positive locking steerable

Drawbar self-steerable rear dolly combination

- Ensure the beam manufacturer has at least 4 'tie-down' holes of adequate diameter at each end of beams over 25t. The holes should also be able to accommodate suitable chain corner protectors.
- Always ensure lashing chains, hooks and tensioners are in a good serviceable condition. Double check the total load weight, load point friction and total lashing capacity for all new loads.
- Always use 'positive locking' pins in all connecting points. Most 'spring clips' fail after repeated use and can vibrate and fall out. 'Couplings' must incorporate a positive locking mechanism together with a separate means of retaining this mechanism in the locked position. The locking mechanism must be readily verifiable by visual examination.



- Heavy vertical pins are recommended with $\frac{1}{2}$ " high tensile locking bolts fitted with lock-nuts or a padlock.
- An alternative telescopic drawbar design as used in the logging industry.
- The drawbar uses a regular positive locking heavy vehicle tow coupling.



Distance rearwards from the centre transverse pivot pins to rearmost edge of the support plate.

The above distance should not be less than the height above these pivot points.

If support base is narrow then a rear facing outrigger is recommended.



Inspection and maintenance of vehicles and trailers

A daily pre-trip inspection checklist procedure must be implemented to ensure the vehicle combination are in safe and roadworthy condition for transporting loads. Inspections should also include assessment of the load restraints fitted to the load. Preventative maintenance programs must be in place to ensure all vehicles are regularly inspected and maintained by qualified mechanics in accordance with the manufacturer's design specifications for the vehicle/trailer units maintenance. Documented evidence of the inspections and regular preventative inspection and maintenance of vehicles/trailers must be obtained and records kept.

Chain Check Tag



Summary - do's and don'ts

Drivers

- Do ✓ Check you have adequate packing and protectors for the load.
- Do ✓ Remember larger panels require individual lashings.
- Do ✓ Remember that the size, height and position of your load will affect the handling of your vehicle.
- Do ✓ Check your load before moving off and during the trip. Remember it is difficult and dangerous for a driver to correct any load shift during the trip.
- Do ✓ Remember that loads can settle and shift during a journey, allowing lashings to slacken.
- Do ✓ Check your load every time you remove or add a load item.
- Do ✓ Check the load after any sharp manoeuvre or emergency braking.
- Don't ✗ Move your vehicle if any part of your load is not correctly restrained.
- Don't ✗ Take risks. Always ensure you have sufficient chains of known strength and that these are in good condition.

Consignors

- Consignors should ensure panels/beams are adequately cured and strong enough for transport, including being tightly restrained.
- Remember to advise drivers if any panels/beams for despatch are fitted with a lifting hole or have "top" markings requiring them to be carried in the "up" position.
- Advise the driver what the weight of the load is as well as the average item/panel weight to ensure regulation axle weights are not exceeded.
- Ensure pre-start inspections are carried out with good lighting and visibility.

Best practice referenced documents - Industry standards and guidance information



Worksafe industry standards

Construction and erection of bridge beams and pre-cast and tilt-up concrete for buildings

These documents set out industry-wide guidelines for establishing and maintaining a safe working environment wherever precast concrete or steel beams are being used to construct bridges and panels for buildings. These industry-standards provide practical advice about the safe design, manufacture, transportation and erection of bridge beams, panels and associated precast concrete elements.

The bridge beam document sets out seven sections covering employer responsibilities, design for construction, manufacture, handling and storage, transportation, craning and erection of the beams. The tilt-up document also refers in detail to the same or similar basic transport communication and planning responsibilities as summarized below.

Transportation

1. Before shop drawings are prepared, element sizes and transportability should be reviewed to confirm that the proposed loads are able to be safely transported to the site and be safely erected.
2. Precast elements should not be transported until the concrete is adequately cured & authorised as being ready for lifting & transport by having reached its design strength. This is typically 3 days for panels and 7 days for beams, but can vary if design strength testing has been carried out.
3. Prior to transport consideration should be given to bearing assemblies on the beams, location of support and lifting points at specified bearing positions.
4. Transport load restraint methods must comply with the National Load Restraint Performance Standards with all equipment and anchor points strong enough to hold the load. The restraint system should be certified, checked and inspected for serviceability before travel.
5. Site delivery consultation and preplanning requires good co-operation between all the various parties involved.
6. Transport vehicle position will be directed by the erector as required and could need to be stabilised prior to releasing the load restraints when the crane commences the lift.
7. Restraints should not be removed until the crane takes an initial weight of the panel or beam.
8. Under no circumstances should a vehicle be moved without the load being secured in the appropriate manner.

These WorkSafe industry-standard documents provide much practical advice and also refer to some 30+ other safety codes and related standards documents covering concrete panels and beams.

National Code of Practice and Australian Standard 3850 – Tilt-up concrete panels

The Australian Safety and Compensation Council (ASCC) are instruments of an advisory nature, except where a law other than the Australian Workplace Safety Standards Act 2005, makes them mandatory. The National standards objective is to protect persons from hazards associated with this construction work. High risk construction work as defined in the national standards includes Tilt-up and Precast concrete construction work. The standard sets out the requirements for both OHS Management Plans and Safe Work Method Statements referred to in this National Code. All the illustrations and guidance in this document primarily relate to the safe handling of wall panels, however some of the guidance information in the code is also appropriate for precast concrete beams, columns and slabs.

Key item examples

1. Safe Design, Handling, Storage, Transportation, On-Site Pre-fabrication Erection and Demolition.
2. Duty holder responsibilities are described in the context of National, State and Territory laws.
3. Clients, designers and erectors have a responsibility to consult with all parties to ensure that safety matters are considered and all hazards identified and managed.
4. Person with control of the construction project/work - has a responsibility to protect the health and safety of all persons that maybe affected by the construction work. This requires information relating to hazard identification, risk assessment and risk control processes to be compiled and recorded.
5. Person with control is to ensure adequate consultation with all persons engaged in every aspect of the construction project, assessment of risks and methods used to control those risks.

6. Handling, storage and transport - with proper preplanning, the handling of concrete elements can be minimized. The transporter should be made aware of the all site-specific hazards posed in the transporting of any concrete items.
 - a. Storage – approval and written instructions should be obtained from an engineer.
 - b. Crane selection - communication with the person in control, crane supplier, erection engineer and prefabricator must consult. Written procedures including a risk assessment for setting up and dismantling the crane for the weight to be lifted, the proximity of power lines, and ground support conditions to be covered. Advice on safe procedures and good practice for loading and unloading is also set out.
 - c. Transport - transportation must be undertaken according to State and Territory requirements as well as relevant Australian standards. Clear access to site, local streets/roads, plus checks for differential road camber that can induce torsional loads in long concrete elements and may need to be considered. Specific design aspects affecting transportation including the stability of long and/or unusually shaped elements during transportation and the concrete strength required for transportation. Route selection, travel time, traffic volumes to delivery site, vehicle combination engineers' report and permit approvals.
 - d. Load restraint and load support methods - and transport vehicle or combination vehicle needs to be designed to withstand the loads and forces that may act on the system during loading, transportation and unloading. It is imperative that the load is adequately restrained, secured and capable of withstanding any forces applied during loading, transport and unloading. This includes a certification of the vehicle and support frames by a suitably qualified and approved transport engineer which is normally covered by the permit to travel process approval requirements.
7. General preplanning - it is vital to all aspects of the transport, loading, restraint, loaded travel in an approved manner at approved times, correct load restraint, system pre-check and good safety and maintenance procedures are in place at all times. Good honest communication and timely planning with all parties involved will ensure a satisfactory and safe outcome.

VicRoads over-dimensional and over-mass permit application - example requirements

1. Vehicle details – registered owner/operator, address, vehicle make, trailer /dolly/jinker registration number, tyres per axle, distance between axles, gross mass of each axle group, tire sizes and ply ratings and overall width of each axle group. To be in properly maintained and roadworthy condition. This includes each of the component units of a vehicle combination.
2. Load detail – size of article proposed to be carried - length, width and mass in kgs.
3. Engineering certification – permit vehicle combination selection must be supported by manufacturer's engineering certification covering the vehicle platform/low-loader/dolly/jinker support strength ratings for each component taken into account and all travel performance criteria that may be encountered (Individual dolly/jinker groups and frames to be marked with unit ID numbers/load capacities using welded or marked plates). Typically a VASS engineer or a person with appropriate skills and experience as approved by VicRoads must complete this certification. In the case of some particular loads with a high centre of gravity (CoG) additional static roll threshold (SRT) calculations may be required for such a load.
4. Overall dimensions of vehicle and load, including empty travel.
5. Load Restraint certification – whilst this requirement may not be required for all loads, critical loads such as concrete beams require a fully assessed and certified load restraint method that must be carried on the permit vehicle.
6. Definitions
 - 'Permit vehicle' means the vehicle combination issued a permit.
 - 'Operator' means a person in whose name the permit is issued.
 - 'Regulations' means the road safety (vehicles) regulations 2009.
7. Operator and vehicle driver responsibility – to be aware of regulations e.g. load restraint, posted mass and dimension limits, travelling under overhead structures or bridges, distance between vehicles, low visibility, travel speeds, warning devices, regulations requiring permission of other authorities e.g. rail, tram, electricity and telecommunications for overhead wires travel permissions. When a vehicle height exceeds 4.8 m under tram wires and 5 m under railway wires, non-conductive skid rails must be attached to the top of the load.
8. Assessing routes – the operator and driver must be satisfied that a route assessment has been completed and the permit vehicle can travel along safely. In particular there must be sufficient clearance under wires, structures, trees and sufficient ground clearance at rail level crossings.
9. Local road authorities permissions – are required from the appropriate municipal councils before a permit vehicle travels on undeclared (local) roads outside the Melbourne and Geelong urban areas. The operator must obtain permission from the City of Melbourne for any travel in the central business district of Melbourne City.
10. Travel times – Metropolitan area are not to commence before 1am. Variations are only considered for approval following a detailed written application for exceptional circumstances that would not reduce road safety in any way.
 - Rural area permit condition travel is restricted to daylight hours only.

Variation to permit travel times is strictly limited and can only be considered with full and comprehensive detail of the reasons for a variation. Issues such as traffic volumes, street lighting, travel width, road width, the speed of the permit vehicle and the geographic region terrain are all critical.

Further information

For detailed information refer to the Load Restraint Guide - Second Edition.

Copies of the Load Restraint Guide - Second Edition are available from the National Transport Commission website: ntc.gov.au

Further enquiries

For further enquiries, contact VicRoads' Transport Safety Services sta□.

VicRoads Region	Area	Phone	Address
Metro North West	Metropolitan Melbourne, north-west of the Yarra River	9302 8400	Pearcedale Parade Broadmeadows Vic 3047
Metro South East	Metropolitan Melbourne, south-east of the Yarra River	9881 8862	12 Lakeside Drive Burwood Vic 3151
Eastern	Warragul, Leongatha, Traralgon, Sale, Bairnsdale, Genoa	5135 3037	87 Princes Way Morwell Vic 3840
Northern	Seymour, Kyneton, Bendigo, Echuca, Swan Hill, Charlton	5434 5000	57 Lansell Street Bendigo Vic 3550
North Eastern	Yea, Mansfield, Wodonga, Cobram, Shepparton	5761 1888	50 Clarke Street Benalla Vic 3672
South Western	Geelong, Colac, Warrnambool, Portland, Hamilton	5225 2578	180 Fyans Street South Geelong Vic 3220
Western	Bacchus Marsh, Ballarat, Ararat, Horsham, Mildura	5333 8779	88 Learmonth Road Ballarat Vic 3350

For further information please phone 13 11 71
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