

CASE 2: TIE-DOWN RESTRAINT WITH WEBBING STRAPS

Load:

- 5 rows of pallets that are unblocked (the rear portion – [Figure 488](#)).
- Each pallet weighs 700 kg. A row of pallets weighs 1,400 kg (2 pallets per row).

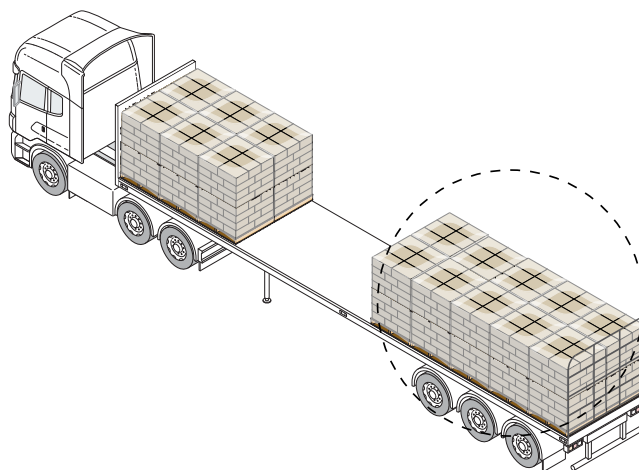
Vehicle:

- A prime mover and flat-tray semitrailer combination.

Equipment:

- Straps: 50 mm webbing straps.
- Tensioner: truck winch (average pre-tension 300 kgf).

Figure 488 Unblocked pallets – rear portion of the load



IDENTIFY THE LOAD, VEHICLE AND EQUIPMENT:

Step 1:

Which part of the load do I want to restrain?

I want to restrain the 5 rows of pallets at the rear of the truck.

Step 2:

What vehicle will I use?

A prime mover and flat-tray semitrailer combination.

Step 3:

What restraint equipment will I use?

Webbing strap (50 mm) and truck winch (average pre-tension: **300 kgf**).

- ✓ Check what level of tension you can get with your equipment.
- ✓ Check your equipment is rated.
- ⚠ Unrated equipment should not be used for restraint purposes.

CHOOSE A SENSIBLE RESTRAINT METHOD:

Step 4:

What restraint methods may be suitable for my combination of load, vehicle and equipment?

For this example, **tie-down restraint** is a suitable restraint method based on the load type, the vehicle and the equipment available.

- ✓ Check the load type.

This is a load of pallets – see [Packs, pallets and stillages](#) for more information on suitable restraint methods.

See the [Loads module](#) for information on other load types.

- ✓ Check how to use the equipment correctly.

See the [Vehicle and equipment module](#) for more information.

Step 5:

Can I block the load?

In this case, the rear portion of the load is **UNBLOCKED**. Tie-down needs to provide all the restraint.

- ⚠ Unblocked loads will need a lot more lashings because the tie-downs need to resist the potential forward forces (equivalent to 80% of the weight). The lashing count may be double or more than of blocked loads in many cases.

WORK OUT THE NUMBERS:

Step 6:

What is the mass of the load?

The mass of a row of pallets is **1,400 kg** (2 pallets at 700 kg each).

- ✓ Restrain each row **separately**.

- ⚠ Simply restraining the front and rear rows **WILL NOT** provide adequate restraint to meet the Performance Standards.

- ⚠ If you underestimate the mass, you are likely to put yourself and others at risk due to insufficient restraint. Double-check your calculations!

Step 7:

How much friction?

The load is **timber** pallets on a **steel** flat-tray truck.
The friction level is **MEDIUM**.

- i For a list of typical friction levels see [Table 1: Typical friction levels](#).

- ⚠ Friction levels within a load can vary. You need to design your tie-down restraint system for the lowest friction level. This is where the load is most likely to fail.

Tips:

- 💡 If your friction level is low you can improve the friction by using higher friction rubbers/load mats or interlayer packaging material.

- i See [Interlayer packaging](#) for more information.

Step 8:

How many lashings do I need?

EASY OPTION – USE THE TABLES

Recheck the following to make sure the calculation is correct:

Lashing pre-tension amount (Step 3)	300 kgf
Blocking (Step 5)	UNBLOCKED
Load weight (Step 6)	1,400 kg
Friction level (Step 7)	MEDIUM

For this example, assume you can get a **lashing angle greater than 60°**.

The table below outlines the number of lashings needed to restrain the **load weight** when using 50 mm webbing straps with a lashing pre-tension of **300 kgf** if the load is **UNBLOCKED** and a **MEDIUM** level of friction.

Lashings:		Tensioner:		Pre-tension:		
50 mm webbing straps		Push-up hand ratchet or truck winch		300 kgf		
UNBLOCKED (RESTRAINED TO 0.8G)						
Number of lashings		Lashing angle (from horizontal)				
		At least 75° AE > 0.95	At least 60° AE > 0.85	At least 45° AE > 0.70	At least 30° AE > 0.50	At least 15° AE > 0.25
MEDIUM FRICTION	Static friction: 0.4		Example: Smooth steel on timber			
	1	570 kg	510 kg	420 kg	300 kg	150 kg
	2	1,100 kg	1,000 kg	840 kg	600 kg	310 kg
	3	1,700 kg	1,500 kg	1,200 kg	900 kg	460 kg
	4	2,300 kg	2,000 kg	1,600 kg	1,200 kg	620 kg
	5	2,800 kg	2,500 kg	2,100 kg	1,500 kg	770 kg
	6	3,400 kg	3,100 kg	2,500 kg	1,800 kg	930 kg
	7	4,000 kg	3,600 kg	2,900 kg	2,100 kg	1,000 kg
	8	4,600 kg	4,100 kg	3,300 kg	2,400 kg	1,200 kg
	9	5,200 kg	4,600 kg	3,800 kg	2,700 kg	1,300 kg
	10	5,700 kg	5,100 kg	4,200 kg	3,000 kg	1,500 kg

The load weight is **1,400 kg** (per row of pallets). Based on a **lashing angle greater than 60°**, when a load is **UNBLOCKED** and the friction level is **MEDIUM**, 3x 50 mm webbing strap can restrain **1,500 kg**. Therefore, **3 straps for each row of pallets** is needed.

⚠ Note that each row of pallets needs 3 straps, not just the front row. All rows have the forward force.

⚠ 3 straps per row seems a lot, but this is what is required if the front of the load is not blocked forwards.

Tips:



To reduce the number of straps required you can block with:

- crossover straps – [Figure 489](#), or
- stacked pallets – [Figure 490](#), or
- a pallet on end tied back a 'de facto' headboard – [Figure 491](#).

To calculate the restraint requirements for different equipment and friction levels see the tie-down lashing tables.

Figure 489 Crossover straps

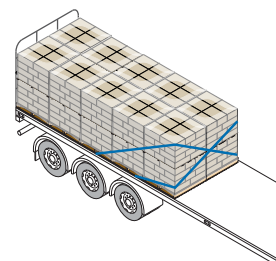


Figure 490 Stacked pallets

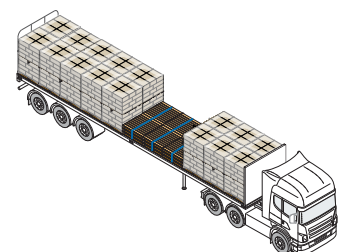


Figure 491 Pallet on end tied back

