CASE 4:
TIE-DOWN RESTRAINT WITH WEBBING STRAPS

Load:

- Bundles of timberboard plastic wrapped, pyramid stacked (3 bundles) – *Figure 493*.
- Each bundle weighs 500 kg. The total mass of the load is 1,500 kg.

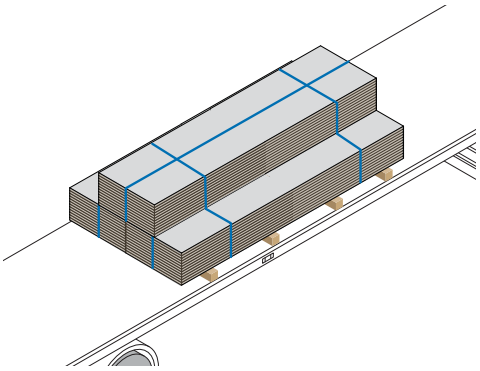
Vehicle:

- A prime mover and flat-tray semitrailer combination.

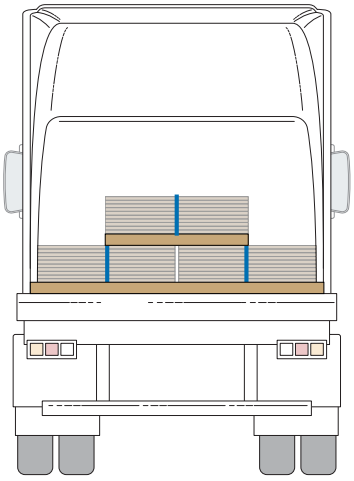
Equipment:

- Lashing: 50 mm webbing straps.
- Tensioner: standard ratchet tensioner (average pre-tension 300 kgf).

Figure 493 Pyramid stacked timberboard with plastic wrapping



IDENTIFY THE LOAD, VEHICLE AND EQUIPMENT:



Step 1:
Which part of the load do I want to restrain?

I want to restrain the 3 bundles of timber in the middle 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 ratchet tensioner (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 timber – 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 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 forwards forces (equivalent to 80% of the weight).

WORK OUT THE NUMBERS:

Step 6:
What is the mass of the load?

The mass of the top portion of the load is **500 kg**. The total mass of the timber bundles is **1,500 kg**.

⚠ Simply restraining for the entire load mass in this situation could lead to the top layer potentially being under restrained.

⚠ 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?

There are **2 different friction levels** in this load.
You should:

- Calculate the number of lashings required to **restrain the portion of the load with the lowest friction**.
- Check that the number of lashings is enough to restrain the **entire mass of the load**.

In this example, the **top portion** of the load is plastic on plastic (one plastic wrapped bundle sitting on top of the other plastic wrapped bundles). Plastic on plastic is very slippery and therefore has a **VERY LOW** friction level.

For the **bottom portion,** the load is timber dunnage on a steel flat-tray truck. The friction level is **MEDIUM**.

For a list of typical friction levels see Table 1: Typical friction levels.

Tips:

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

See Interlayer packaging for more information.

Step 8:
How many lashings do I need?
EASY OPTION – USE THE TABLES

Top portion:

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)**	**500 kg (top bundle only)**
Friction level **(Step 7)**	**VERY LOW**

We assume you can only get a **lashing angle of 45°** when restraining the top portion; however, you can get a **lashing angle greater than 75°** when strapping the entire load.

The table below outlines the number of lashings needed to restrain the **load weight** when using 50 mm webbing straps with a lashing pretention of **300 kgf** if the load is **UNBLOCKED** and it has a **VERY LOW** 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
VERY LOW FRICTION	**Static friction:** 0.2		**Example:** Smooth steel on timber			
	1	190 kg	170 kg	140 kg	100 kg	51 kg
	2	380 kg	340 kg	280 kg	200 kg	100 kg
	3	570 kg	510 kg	420 kg	300 kg	150 kg
	4	770 kg	690 kg	560 kg	400 kg	200 kg
	5	960 kg	860 kg	700 kg	500 kg	250 kg
	6	1,100 kg	1,000 kg	840 kg	600 kg	310 kg
	7	1,300 kg	1,200 kg	980 kg	700 kg	360 kg
	8	1500 kg	1,300 kg	1,100 kg	800 kg	410 kg
	9	1,700 kg	1,500 kg	1,200 kg	900 kg	460 kg
	10	1,900 kg	1,700 kg	1,400 kg	1,000 kg	510 kg

The load mass is **500 kg** (for the top bundle). Based on a **lashing angle of 45°**, when a load is **UNBLOCKED** and the friction level is **VERY LOW,** 4x 50 mm webbing straps can restrain **560 kg.** Therefore, **4 straps** are needed to restrain this portion of the load.

Entire load:

The table below outlines the number of lashings needed to restrain the **load weight** when using 50 mm webbing straps with a 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

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

The load weight is **1,500 kg** (entire mass of the load). Based on a **lashing angle greater than 75°**, when a load is **UNBLOCKED** and the friction level is **MEDIUM**, 3x 50 mm webbing straps can restrain 1,700 kg. Therefore, at least **3 straps** are needed to restrain the entire load.

✔ Choose the highest number of lashings.

The highest number of straps should be used to ensure the load is adequately restrained. Therefore **4 straps** are needed to restrain the entire load.

⚠ 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.