# CASE 1:
## TIE-DOWN RESTRAINT WITH WEBBING STRAPS

**Load:**

- 3 rows of pallets blocked against a rated headboard (the front portion indicated in – *Figure 487*).
- Each pallet weighs 700 kg. A row of pallets weights 1,400 kg (2 pallets per row).

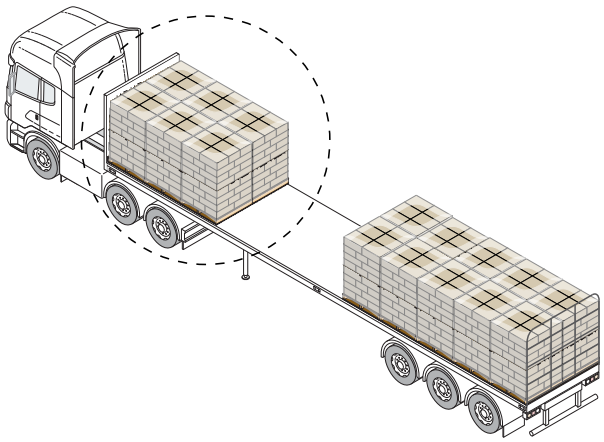
**Vehicle:**

- A prime mover and flat-tray semitrailer combination.

**Equipment:**

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

*Figure 487 Pallets blocked against a rated headboard – front 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 3 rows of pallets at the front of the truck. These pallets are positioned at the front of the truck, against the headboard.

### Step 2:
### What vehicle will I use?

A prime mover and flat-tray semitrailer combination.

### Step 3:
### What restraint equipment will I use?

Webbing straps (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?

**Yes** – this part of the load can be **BLOCKED** against the rated headboard (capable of withstanding 0.3 of the total load weight).

✔ Position the load against the headboard, or with a small gap (no more than 200 mm from the headboard).

✔ Block the load tightly so the sum of any gaps along the trailer (front to rear of the load) is less than 200 mm.

⚠ A load is not regarded as blocked if it is greater than 200 mm away from the headboard or the cumulative amount of gaps along the trailer (front to rear) is greater than 200 mm.

# WORK OUT THE NUMBERS:

## Step 6:
### What is the mass of the load?

The mass of a **row** of pallets in **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.

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)** | **BLOCKED** |
| Load weight **(Step 6)** | **1,400 kg** |
| Friction level **(Step 7)** | **MEDIUM** |

For this example, assume 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 **BLOCKED** and has a **MEDIUM** level of friction.

| **Lashings:** | **Tensioner:** | **Pre-tension:** |
|---|---|---|
| 50 mm webbing straps | Push-up hand ratchet or truck winch | 300 kgf |

**BLOCKED**
**(RESTRAINED TO 0.5G)**

| | **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** | 2,300 kg | 2,000 kg | 1,600 kg | 1,200 kg | 620 kg |
| | **2** | 4,600 kg | 4,100 kg | 3,300 kg | 2,400 kg | 1,200 kg |
| | **3** | 6,900 kg | 6,200 kg | 5,000 kg | 3,600 kg | 1,800 kg |
| | **4** | 9,200 kg | 8,300 kg | 6,700 kg | 4,800 kg | 2,400 kg |
| | **5** | 11,000 kg | 10,000 kg | 8,400 kg | 6,000 kg | 3,100 kg |
| | **6** | 13,000 kg | 12,000 kg | 10,000 kg | 7,200 kg | 3,700 kg |
| | **7** | 16,000 kg | 14,000 kg | 11,000 kg | 8,400 kg | 4,300 kg |
| | **8** | 18,000 kg | 16,000 kg | 13,000 kg | 9,600 kg | 4,900 kg |
| | **9** | 20,000 kg | 18,000 kg | 15,000 kg | 10,000 kg | 5,500 kg |
| | **10** | 23,000 kg | 20,000 kg | 16,000 kg | 12,000 kg | 6,200 kg |

***Table note:*** *Blocked load tables are based on a headboard capable of withstanding forces from 0.3 g. If the headboard used provides less than 0.3 g forward restraint, use the unblocked table to calculate the number of lashings required.*

**Based on a lashing angle greater than 60°**, when a load is **BLOCKED** and the friction level is **MEDIUM**, one 50 mm webbing strap can restrain **2,000 kg**.

The **load weight 1,400 kg** (per row of pallets) is under **2,000 kg**. Therefore, **one strap for a row of pallets** is needed.

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

### Tips:

- **Block loads if possible**. 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).
- **Increasing friction levels** can reduce the number of lashings needed. Friction can be increased using interlayer packaging or dunnage.
- **Keep lashing angles greater than 60°** wherever possible. The lower the lashing angle the less effective the tie-down lashing will be. Lashing angles can be increased by using dunnage.