3 Principles of packing

3.1 Load distribution

3.1.1 Freight containers, flatracks and platforms are designed according to ISO standards, amongst others, in such a way that the permissible payload P, if homogeneously distributed over the entire loading floor, can safely be transferred to the four corner posts under all conditions of carriage. This includes a safety margin for temporary weight increase due to vertical accelerations during a sea passage. When the payload is not homogeneously distributed over the loading floor, the limitations for concentrated loads should be considered. It may be necessary to transfer the weight to the corner posts by supporting the cargo on strong timber or steel beams as appropriate (see figure 7.21).

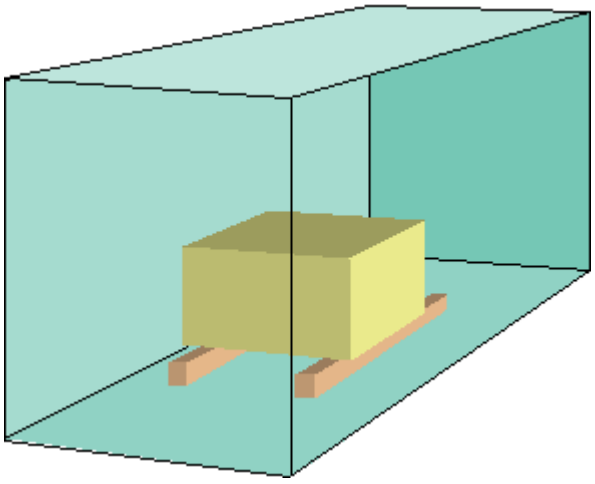

Figure 7.21 Load transfer beams

3.1.2 The bending strength of the beams should be sufficient for the purpose of load transfer of concentrated loads. The arrangement, the required number and the strength of timber beams or steel beams should be designed in consultation with the CTU operator.

3.1.3 Concentrated loads on platforms or flatracks should be similarly expanded by bedding on longitudinal beams or the load should be reduced against the maximum payload. The permissible load should be designed in consultation with the CTU operator.

3.1.4 Where freight containers, including flatracks or platforms, will be lifted and handled in a level state during transport, the cargo should be so arranged and secured in the freight container that its joint centre of gravity is close to the mid-length and mid-width of the freight container. The eccentricity of the centre of gravity of the cargo should not exceed ±5% in general. As a rule of thumb this can be taken as 60% of the cargo's total mass in 50% of the freight container's length. Under particular circumstances an eccentricity of up to ±10% could be accepted, as advanced spreaders for handling freight containers are capable of adjusting for such eccentricity. The precise longitudinal position of the centre of gravity of the cargo may be determined by calculation (see appendix 4 to this annex).

3.1.5 Roll trailers have structural properties similar to platforms, but are less sensitive to concentrated loads due to the usual wheel support at about 3 /4 of their length from the gooseneck tunnel end. As they are generally handled without lifting, the longitudinal position of the cargo centre of gravity is also not as critical.

3.1.6 Swap bodies have structural properties similar to freight containers, but in most cases less tare weight and less overall strength. They are normally not stackable. The loading instructions given under subsection 3.1.2 and 3.1.5 should be applied to swap bodies as appropriate.

3.1.7 Road trucks and road trailers are in particular sensitive regarding the position of the centre of gravity of the cargo packed in them, due to specified axle loads for maintaining steering and braking ability. Such vehicles may be equipped with specific diagrams, which show the permissible cargo mass as a function of the longitudinal position of its centre of gravity. Generally, the maximum cargo mass may be used only when the centre of gravity (CoG) is positioned within narrow boundaries about half the length of the loading space (see figures 7.22 and 7.23).

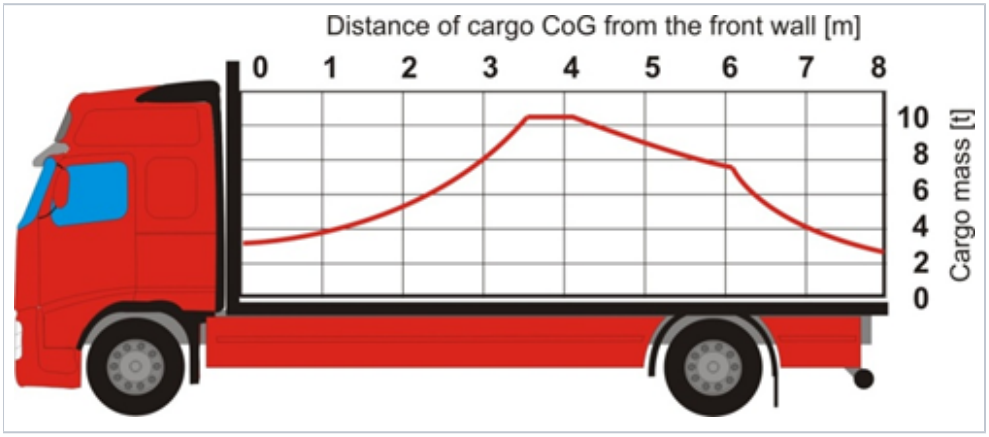

Figure 7.22 An example of a load distribution diagram for a rigid truck

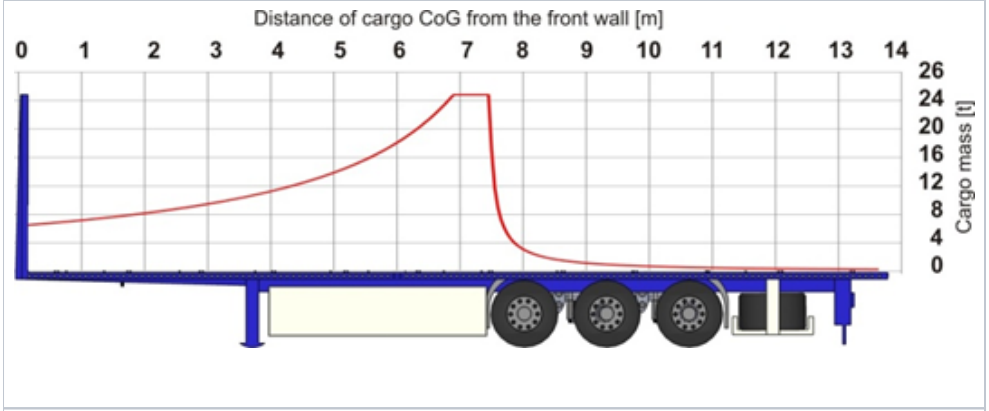

Figure 7.23 An example of a load distribution diagram for a semi-trailer

3.1.8 Railway routes are generally classified into line categories, by which permissible axle loads and loads per metre length of cargo space are allocated to each railway wagon. The applicable figures should be observed in view of the intended route of the wagon. Tolerable concentrated loads are graded depending on their bedding length. The appropriate load figures are marked on the wagons. The transverse and longitudinal deviation of cargo centre of gravity from wagon centre-lines is limited by defined relations of transverse wheel loads and longitudinal axle/bogie loads. The proper loading of railway wagons should be supervised by specifically trained persons.

3.2 General stowage/packing techniques

3.2.1 Stowage and packing techniques should be suitable to the nature of the cargo with regard to weight, shape, structural strength and climatic conditions. This includes the proper use of dunnage material (see section 2.1 of this annex), the selection of the appropriate method of mechanical handling and the proper stowage of vented packages. The concept of stowage should incorporate the feasibility of smooth unloading.

3.2.2 Any marking on parcels should be strictly observed. Cargoes marked "this way up" should not only be stowed upright but also kept upright during entire handling. Goods which may be subject to inspection by the carrier or by authorities, like dangerous goods or goods liable to Customs duty, should, if possible, be stowed at the door end of the CTU.

3.2.3 When packing mixed cargoes, their compatibility should be considered. Irrespective of the regulations for the stowage of dangerous goods (see chapter 10 of this Code) the following general rules are applicable:

- Heavier cargoes should not be stowed on top of lighter cargoes. This will also provide for the centre of gravity of the CTU in a level not exceeding half the height of the CTU;
- Heavy units should not be stowed on top of fragile parcels;
- Sharp-edged pieces should not be stowed on top of units with weak surfaces;
- Liquid cargoes should not be stowed on solid cargoes;
- Dusty or dirty cargoes should not be placed near to clean and easily soiled cargoes like foodstuff in porous packaging;
- Cargoes emitting moisture should not be stowed on or near to cargoes sensitive to moisture;
- Odorous cargoes should not be stowed in the vicinity of cargoes easily absorbing odour;
- Incompatible cargoes should be packed into the same CTU only if their stow is appropriately separated and/or the goods are effectively protected by suitable sheathing material.

3.2.4 Stacking of sensitive cartons of uniform size and shape should be precise in a way that the mass from above is transferred to the vertical boards of the cartons below. If necessary, e.g. due to lateral leeway of the stack in the CTU, intermediate sheets of fibreboard, plywood or pallets should be placed between layers of the stack (see figures 7.24 and 7.25). Cartons of irregular shape and/or size should be stacked only with due consideration of their structural hardiness. Gaps and irregularities of level should be stuffed or equalized by means of dunnage.

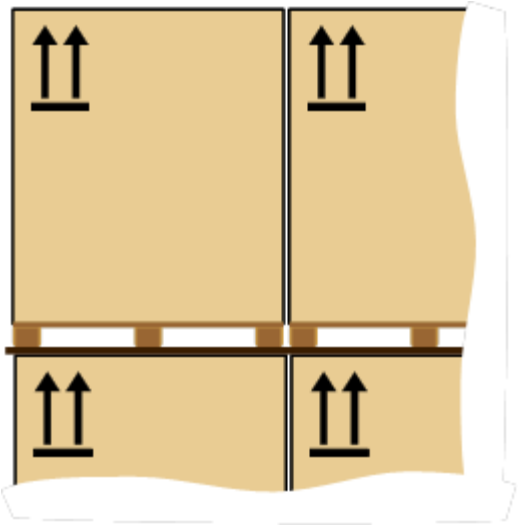

Figure 7.24 With intermediate board

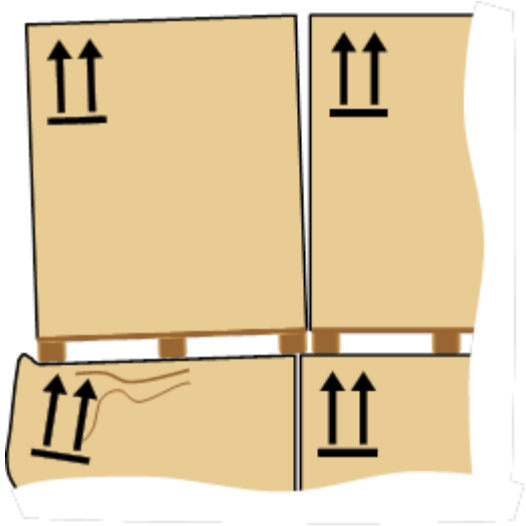

Figure 7.25 Without intermediate board

3.2.5 Packages with a less defined shape like bags or bales may be stacked in an interlocking pattern, also called cross-tie, thereby creating a solid pile that may be secured by blocking or fencing (see figure 7.26). Round longish units like pipes may be stacked into the grooves of the layer below. However, care should be taken of the lateral forces produced by top layers in the grooves of the bottom layers, which may locally overload the side walls of the CTU if the friction between the pipes is low.

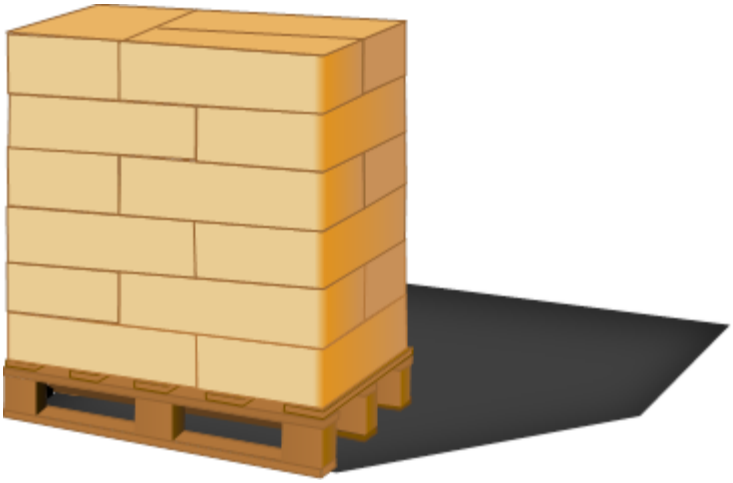

Figure 7.26 Cross-tie stowage

3.2.6 Uniform parcels like drums or standardized pallets should be packed in a way that minimizes lost space and provides a tight stow at the same time. Drums may be stowed either in regular lines, also called "soldier stowage", or into the vertical grooves, also called "offset stowage" (see figures 7.27 and 7.28). With small drums the offset packing is more effective, while with greater drum diameters the advantage may be with the soldier stow. Pallet dimensions are widely standardized and adapted to the inner width and length of cargo spaces in road trucks, road trailers and swap bodies, but not throughout to the inner dimensions of freight containers.

Figure 7.27 Mixed stow, dry over wet goods

Figure 7.28 Mixed stow, use of pallets

3.2.7 Near to completion of packing a CTU, care should be taken to build a firm face of the cargo so as to prevent a "fall out" when the CTU is opened. If there is any doubt about the stability of the face, further steps should be taken such as strapping top layers of cargo back to securing points or building a timber fence between the rear posts in a CTU (see subsection 2.3.4 of this annex). It should be borne in mind, that a freight container on a trailer usually inclines towards the doors aft and that cargo may move against the doors due to vibration induced shift or by jolts during transport.

3.3 Cargo handling

3.3.1 Relevant regulations on the use of personnel protection equipment (helmet, shoes, gloves and clothing) should be adhered to. Personnel should have been instructed on ergonomic aspects of manual lifting of weighty parcels. Weight limitations of parcels to be lifted and carried by persons should be observed.

3.3.2 Forklift trucks, used for driving inside roofed CTUs, should have a short lifting mast and a low driver's overhead guard. If the lift truck operates inside a CTU care should be taken of the exhaust gases and equipment with electric power supply or similar should be used. The truck should be equipped with adequate lighting so that the operator can place packages accurately. Forklift trucks s operated by a combustion engine should comply with national combustion emission standards. Forklift trucks s with engines burning LPG fuel should not be used in enclosed space, in order to prevent the accumulation of explosive gas mixtures from unexpected leaks.

3.3.3 Where there is a risk of explosion due to the vapours, fumes or dust given off by the cargo, all electrical equipment mounted on the forklift trucks should be evaluated to ensure that they are safe for flammable and explosive atmospheres.

3.3.4 Driving forklift trucks into swap bodies, semi-trailers or other supported CTUs should be done slowly, in particular with careful starting and braking, in order to avoid dangerous horizontal forces to the supports of the CTU.

3.3.5 If CTUs are to be packed with forklift trucks from the side, significant lateral impact forces to the CTU should be avoided. Such lateral forces may occur when packages or overpacks are pushed across the loading area. If, during such operations, there is a risk of turning the CTU over packers may consider packing either from both sides to the centre line of the CTU or by using forklift trucks with higher capacity and long forks, which would permit accurate placement without pushing.

3.3.6 If persons need to access the roof of a CTU, e.g. for filling the CTU with a free-flowing bulk cargo, the load-bearing capability of the roof should be considered. Roofs of freight containers are designed for and tested with a load of 300 kg (660 lbs), which acts uniformly on an area of 600 x 300 mm (24 x 12 inches) in the weakest region of the roof (reference: CSC, Annex II). Practically, no more than two persons should work on a freight container roof simultaneously.

3.3.7 When loading or unloading heavy parcels with C-hooks through doors or from the sides of a CTU, care should be taken, that the transverse or longitudinal girders of the roof or side walls are struck neither by the hook nor the cargo. The movement of the unit should be controlled by appropriate means, e.g. guide ropes. Relevant regulations for the prevention of accidents should be observed.