Informal meeting on Code of Practice for Packing of Cargo Transport Units

at the request of the United Nations Economic Commission for Europe Working Party on Intermodal Transport and Logistics

Geneva and virtual, 12-13 July 2022

Bedding arrangements

Submitted by IUMI and Mariterm AB

This document proposes guidance on bedding arrangements to be included in clause 3.1.2 of Annex 7. The text proposed below should replace the existing text under that clause. This current document builds on the document discussed at the previous session and proposes some further text adjustments to clause 3.1.2 based on comments received. It also suggests adding a new section 3.2 on Bedding arrangements on flatracks and platform containers and in road vehicles. This new section 3.2 incorporates the existing clause 3.1.3 which has been further adjusted. Moreover, with the inclusion of the new section 3.2, a further adjustment to clause 3.1.1 is proposed. As a result, the text presented below proposes changes to section 3 (Principles of packing), clauses 3.1.1 to 3.1.3. Changes to para 3.1.1 and to the text as presented in CTU-Code/2022/first-informal-meeting/9 with regard to clause 3.1.2 are marked in red. Also, the new clause 3.2 is marked in red.

Background:

The weight of dense, heavy cargoes should be spread over a greater area of the container floor by suitable bedding arrangements. By putting longitudinal beams underneath the cargo, its weight can be spread over more crossbeams of the container floor.

The bedding beams are to be used in pairs or two groups of beams, that are spaced as far apart as possible in a saddle arrangement. Multiple, separate beams that are spaced evenly underneath the full width of the cargo should be avoided as the purpose is the spread the weight towards the sides of the containers as well as in the longitudinal direction.

Proposed text to replace exiting clauses 3.1.1 to 3.1.3.:

3.1 Bedding arrangements in freight containers (box type)

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).

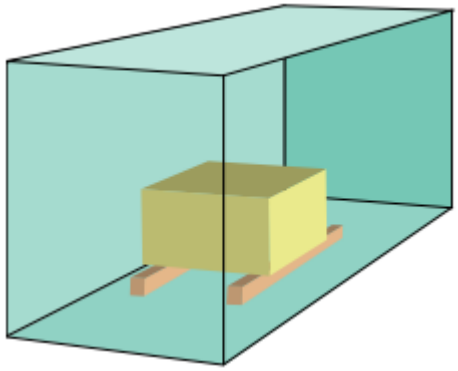


Figure 7.21 Load transfer beams

3.1.2. The necessary length (L_R) of these beams depends on the cargo ~~weight~~ mass and their mutual distance (B). It is important to make the distance B of the longitudinal beams as large as possible in order to minimise the stress onto the cross-members of the container floor.

The beams must have sufficient strength for effectively spreading the load. Their necessary dimensions should be determined by the cargo ~~weight~~ mass and the intended spreading effect, expressed by their "free length".

This simple arrangement complies with the principles of structural engineering. There is no benefit of flooring the area under the cargo item with beams of lesser strength.

The ~~following~~ steps given in 3.1.2.1 and 3.1.2.2 should be followed for dimensioning bedding beams in freight containers:

3.1.2.1 - Step 1 - Minimum length

The bedding beams must be long enough to cover the distance of the container's floor so that load from the cargo will not overstress the floor.

The minimum length depends on the following factors:

- The cargo mass (in tonnes)
- The spacing of the beams, B (in meters)

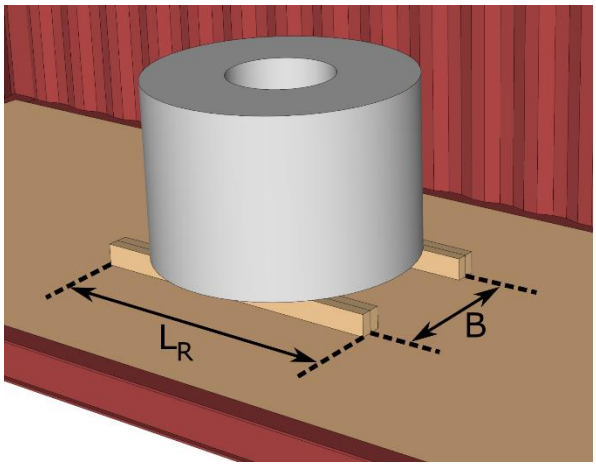


Table X.1 below gives the minimum required length, L_R, of longitudinal bedding beams based on these two factors.

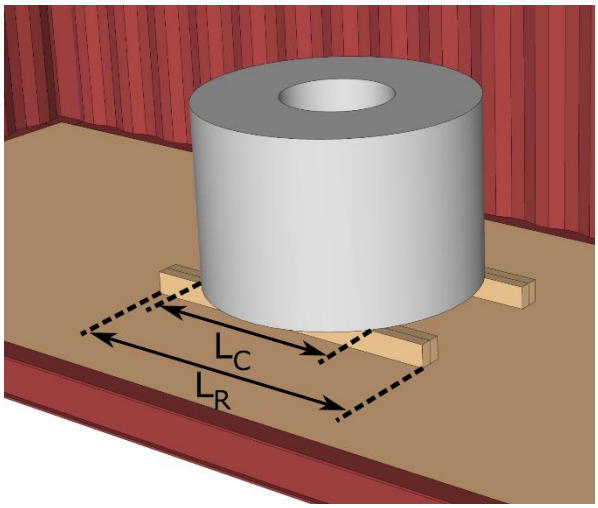
Minimum required length of longitudinal bedding beams, L_R, [m]							
Spacing between beams, B [m]	**Cargo mass [ton]**						
	4	**8**	**12**	**16**	**20**	**24**	**28**
0.50	1.2	2.4	3.6	4.8	6.0	-	-
0.75	1.0	2.1	3.1	4.1	5.1	6.2	-
1.00	0.9	1.7	2.6	3.4	4.3	5.2	6.0
1.25	0.7	1.4	2.1	2.8	3.5	4.2	4.9
1.50	-	1.1	1.6	2.1	2.6	3.2	3.7
1.75	-	0.7	1.1	1.5	1.8	2.2	3.0
2.00	-	-	0.6	0.8	1.3	2.1	3.0

Table X.1

3.1.2.2 Step 2 - Minimum dimensions

The proper size of the bedding beams depends on the bending resistance (section modulus) that is required of the beams for them to successfully transfer the load from the cargo over the required floor length. The required section modulus depends on the following factors:

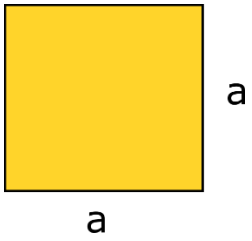
- The cargo mass (in tonnes)
- The minimum length of the beams, L_R (in meters), as given by Table X.1
- The length of the footprint of the cargo on the beams, L_C (in meters)
- The strength of the material of the bending beams



~~The difference between the length of the beams, L_R, and the length of the cargo footprint, L_C, is denominated as the free length.~~

~~When wooden beams are used, the section modulus is given by their cross section dimensions, where the height of the beam is more influential than its width. In table X.2 below, the minimum height and width, a x a, of square wooden beams to use are given in mm based on the cargo mass and the free length of the beams.~~

When wooden beams are used, the section modulus is calculated by the cross section. It is recommended that square sections are used to ensure the beams stability with a height and width of "a" measured in mm.



Definition of height and width, "a" ~~x a~~, for wooden beams with a square cross section

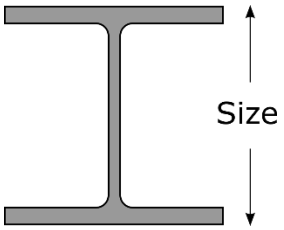
Table X.2 shows the minimum value of a based on the cargo mass and the free length of the beams.
Free length is defined as:

$$\frac{L_R - L_C}{2}$$

Minimum height and width, "a" ~~a x a~~, of a pair of square wooden beams with σ_p = 1.5 kN/cm² [mm]							
Free length (L_R - L_C) / 2 [m]	**Cargo mass [tonnes]**						
	4	**8**	**12**	**16**	**20**	**24**	**28**
~~0.5~~ 0.25	79	99	114	125	135	143	151
~~1.0~~ 0.50	99	125	143	158	170	181	190
~~1.5~~ 0.75	114	143	164	181	194	207	218
~~2.0~~ 1.00	125	158	181	199	214	227	239
~~2.5~~ 1.25	135	170	194	214	231	245	258
~~3.0~~ 1.50	143	181	207	227	245	260	274
~~3.5~~ 1.75	151	190	218	239	258	274	289
~~4.0~~ 2.00	158	199	227	250	270	287	302

Table X.2

When steel beams are used, the section modulus depends on which type of profile that is used. In table X.3 below, the minimum size (in mm) to use for standard HEB profiles is given based on the cargo mass and the free length of the beams.



Definition of size for HEB steel profiles

Minimum size of a pair of HEB steel beams with σ_p = 15 kN/cm^2 [mm]							
Free length (L_R - L_C) / 2 [m]	**Cargo mass [tonnes]**						
	4	**8**	**12**	**16**	**20**	**24**	**28**
~~0.5~~ **0.25**	100	100	100	100	100	100	100
~~1.0~~ **0.50**	100	100	100	100	100	120	120
~~1.5~~ **0.75**	100	100	100	120	120	140	140
~~2.0~~ **1.00**	100	100	120	120	140	140	160
~~2.5~~ **1.25**	100	100	120	140	140	160	160
~~3.0~~ **1.50**	100	120	140	140	160	160	180
~~3.5~~ **1.75**	100	120	140	160	160	180	180
~~4.0~~ **2.00**	100	120	140	160	180	180	200

Table X.3

If multiple pairs of beams or beams with a different cross section are used, they shall have the same combined section modulus as the beams represented in the tables above. Furthermore, the required section modulus is proportional to the bending strengths, σ_p, given in each of the tables X.2 and X.3 above.

3.2 Bedding arrangements on flatracks and platform containers and in road vehicles

3.2.1 CTUs with longitudinal structural beams do not require the bedding arrangements described in 3.1 but still do require beams to be placed under heavy cargo items to ensure that there are no areas where forces are concentrated and to ensure that the forces are transmitted to the longitudinal structural beams.

3.2.2 The bedding arrangement for these types of CTU should be placed transversally so that they land on the longitudinal structural beams.

3.2.3 The bedding arrangement should also support the cargo item so that no part of the cargo items is landed on the cargo deck. This is particularly true when transporting coiled materials and the bedding arrangement can incorporate wedge beams to prevent the coil (eye to the side) from rolling.

3.2.4 If bedding beams cannot be used for concentrated loads on flatracks or platform containers and road trailers, the load may have to be reduced against the maximum payload. The permissible load should be designed in consultation with the CTU operator.

3.3 Load distribution

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(see document 10 for proposed text on Load distribution)