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**Construction of wooden boxes for
packing**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Packing Association (Jpa)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS Z 1402:2014**), which has been technically revised.

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Construction of wooden boxes for packing

1 Scope

This Japanese Industrial Standard specifies the construction of wooden boxes intended for the transport packaging of contents of not more than 1 500 kg in mass, having the external dimensions of not more than 6.0 m in length, not more than 1.5 m in width and not more than 2.25 m in height.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS A 5508 *Nails*

JIS B 1180 *Hexagon head bolts and hexagon head screws*

JIS B 1181 *Hexagon nuts and hexagon thin nuts*

JIS G 3141 *Cold-reduced carbon steel sheet and strip*

JIS Z 0107 *Glossary of terms used in wooden box for packing*

JIS Z 0108 *Packaging—Vocabulary*

JIS Z 1514 *Polyethylene coated paper*

Japanese Agricultural Standard (JAS) *Plywood*

Japanese Agricultural Standard (JAS) *Laminated veneer lumber*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS Z 0107** and **JIS Z 0108** apply.

4 Classification and design elements

4.1 Classification

The wooden boxes are classified as shown in Table 1 according to the mass of contents, construction and usage method of outer boards. Construction examples are shown in Figure 1 and Figure 2. Also, the constructions of end faces and end battens of normal wooden box are shown in Figure 4 to Figure 8.

Table 1 Classification

Type	Classification							Application
	Construction of wooden box		Construction of outer boards		Construction of end faces and end battens		Mass of contents	
Type I•A-1	Type I	Normal wooden box ^{a)} (see Figure 1 and Figure 4 to Figure 8)	Type A	Sealed boarding	Type 1	No batten	20 kg max.	Case where the protection of contents from water, moisture, etc., or the prevention of contents drop is required.
Type I•A-2					Type 2	Vertical end batten	150 kg max.	
Type I•A-3					Type 3	Horizontal end batten		
Type I•A-4					Type 4	Interior cleat		
Type I•A-5					Type 5	Butt-joint full cleat	200 kg max.	
Type I•B-1			Type B	Open-crate boarding	Type 1	No batten	20 kg max.	Case where the waterproofing for contents is unnecessary but local protection is required.
Type I•B-2					Type 2	Vertical end batten	150 kg max.	
Type I•B-3					Type 3	Horizontal end batten		
Type I•B-4					Type 4	Interior cleat		
Type I•B-5					Type 5	Butt-joint full cleat	200 kg max.	
Type I•C-5			Type C	Sealed plywood	Type 5	Butt-joint full cleat	150 kg max.	Same as Type A.
Type II•A	Type II	Skidded wooden box (see Figure 2)	Type A	Sealed boarding	—	—	1 500 kg max.	Same as Type I•A.
Type II•B			Type B	Open-crate boarding				Same as Type I•B.
Type II•C			Type C	Sealed plywood				Same as Type I•A.
Note ^{a)} The volume of normal wooden boxes shall be not more than 1 m ³ .								

4.2 Design classification

In designing, Type I normal wooden boxes are classified by the load condition according to the contents, and Type II skidded wooden boxes are classified by the distribution condition, respectively, as follows.

- Normal wooden box** In designing of normal wooden boxes, usually, they are divided into the case of uniform load and the case of concentrated load according to the load condition to be applied. However, this division may be altered based on the nature of contents, distribution condition and packaging method (individual packaging, inner packaging, fixation, cushioning, etc.).
- Skidded wooden box**

- 1) **Class 1** Applicable to the cases where the wooden boxes are subjected to many transmissions/transshipments and likely to be exposed to massive external loads, and where they are mainly intended for exports in conventional vessels, and also for exports in containers from which the wooden boxes are vanned at ports or unloaded at the destination then further distributed.
- 2) **Class 2** Applicable to the cases where the wooden boxes are subjected to few transmissions/transshipments and not likely to be exposed to massive external loads (about 2/3 of that of Class 1), and where they are mainly intended for domestic transportations, and sometimes for through-transit exports by unit loads.

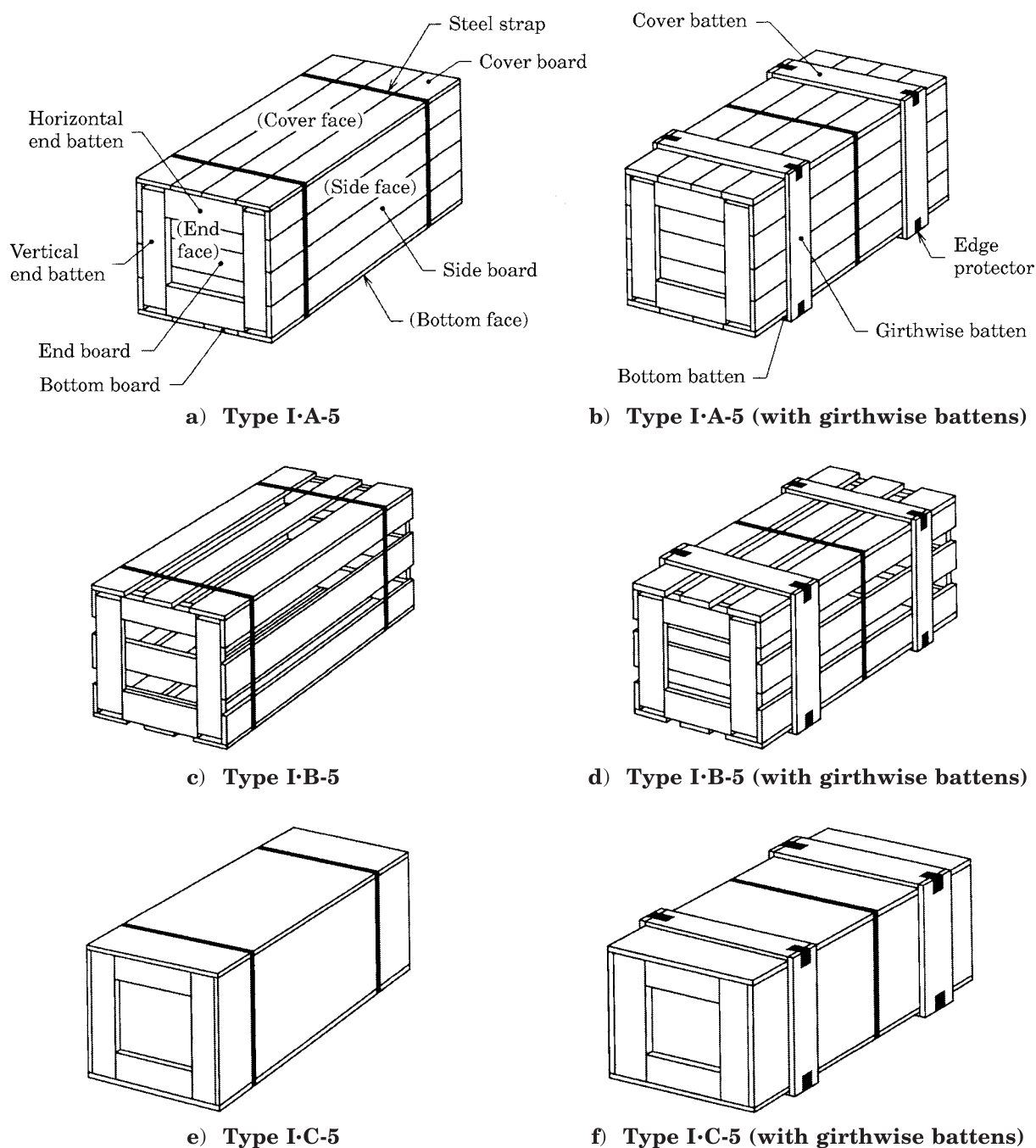
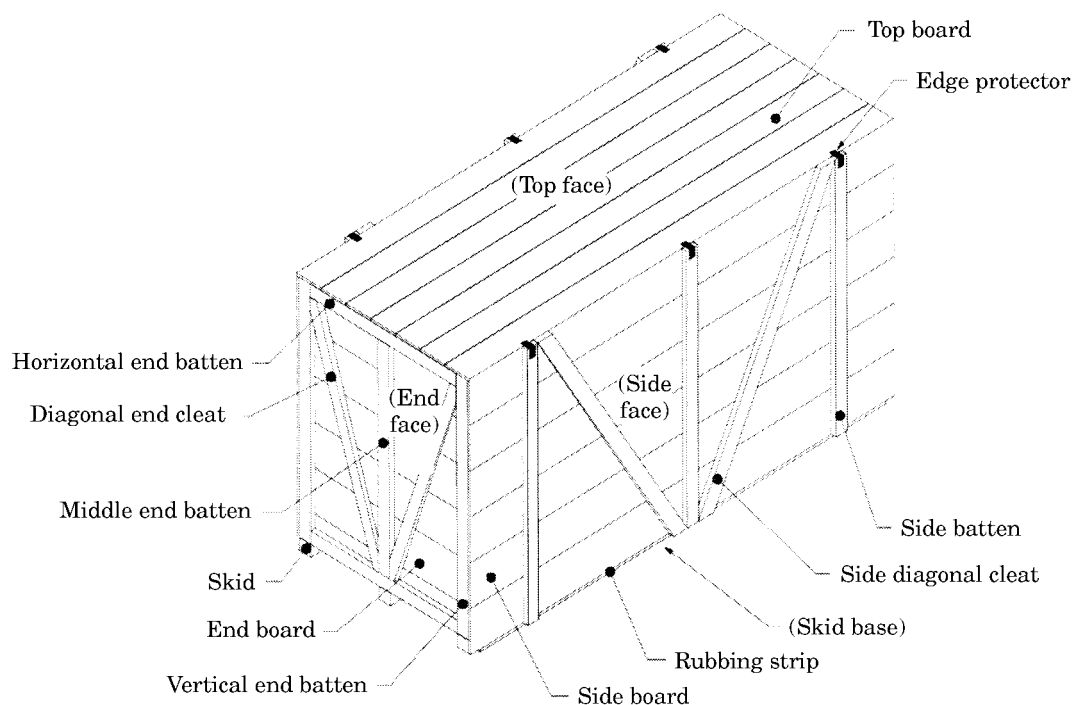
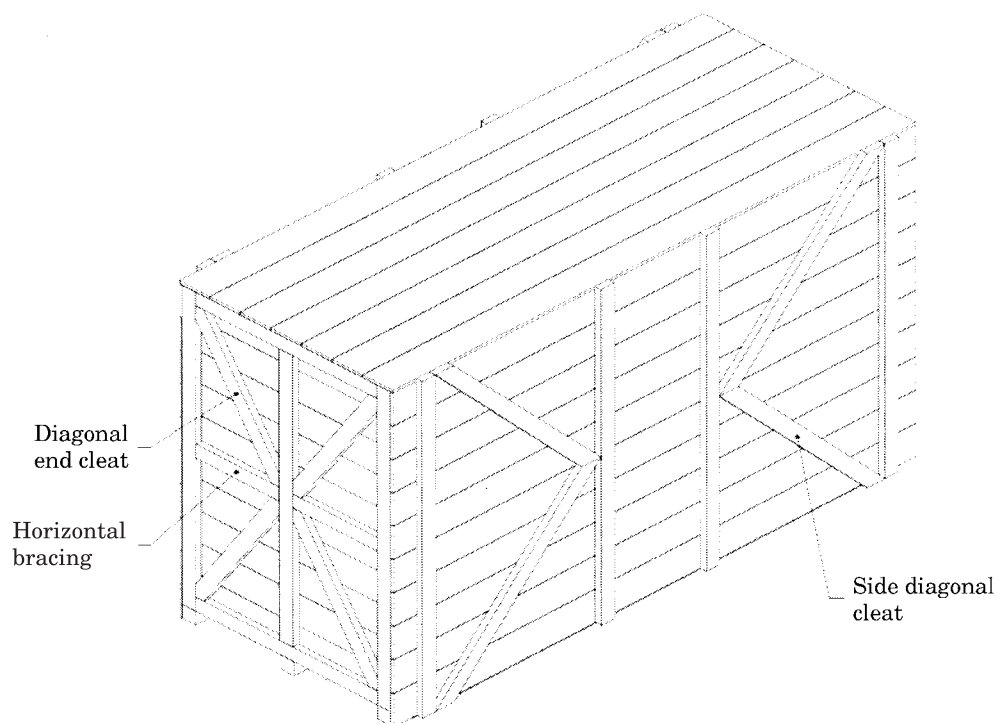


Figure 1 Example of normal wooden boxes

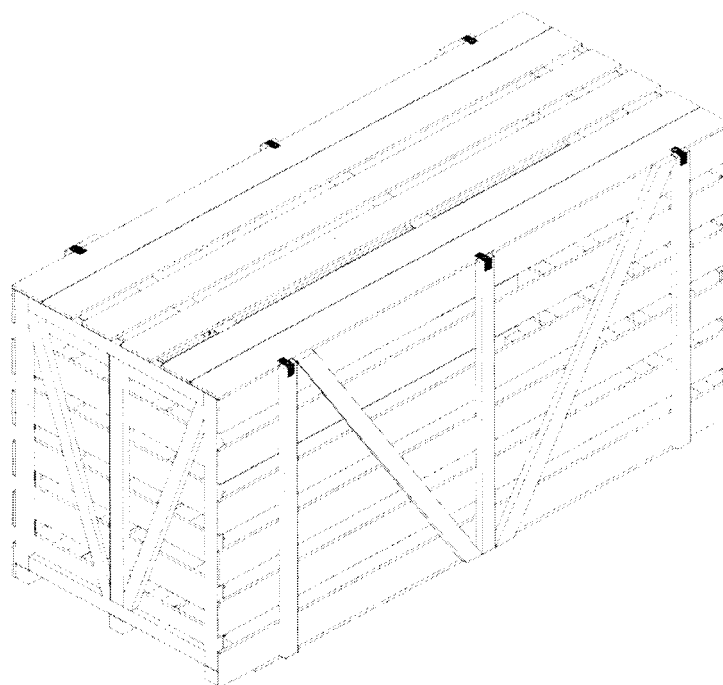


a) Type II-A (sealed), when length of side batten is not more than 150 cm

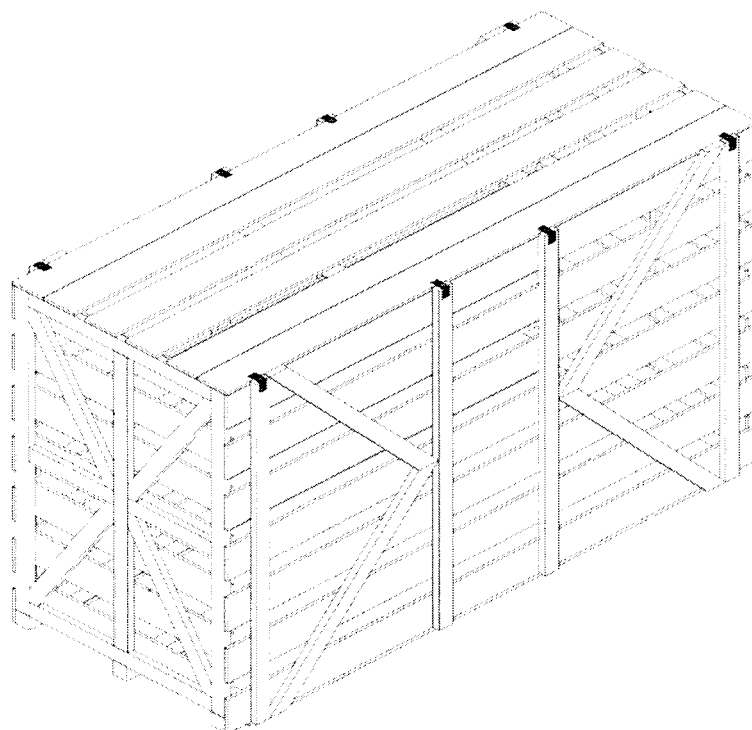


b) Type II-A (sealed), when length of side batten is over 150 cm

Figure 2 Example of skidded wooden boxes

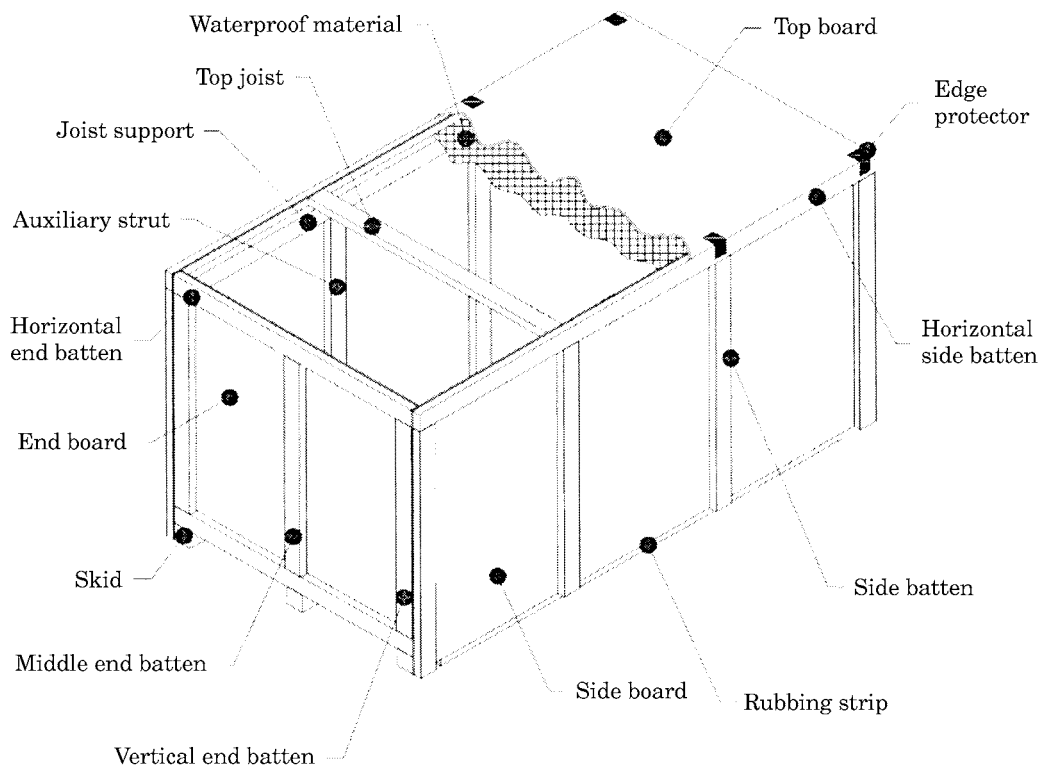


c) Type II·B (open-crate), when length of side batten is not more than 150 cm

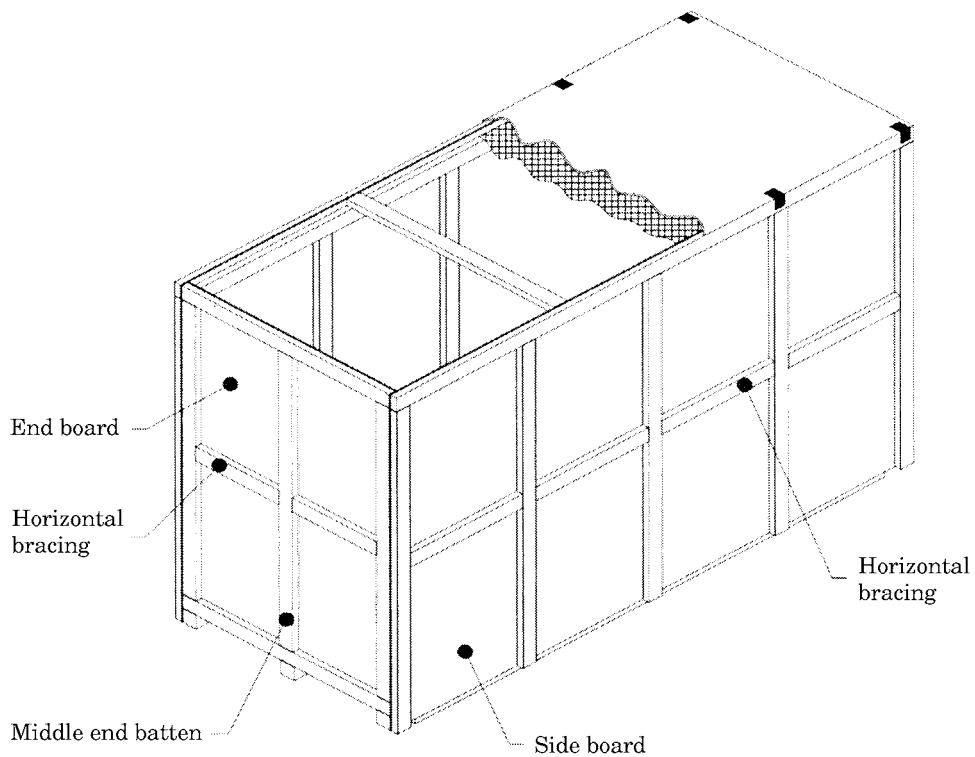


d) Type II·B (open-crate), when length of side batten is over 150 cm

Figure 2 (continued)



e) Type II-C (sealed plywood), when length of side batten is not more than 150 cm



f) Type II-C (sealed plywood), when length of side batten is over 150 cm

Figure 2 (concluded)

5 Constructions and dimensions

5.1 General conditions

The wooden boxes shall consist of side faces, end faces, a bottom face (a skid base for Type II) and a cover face (a top face for Type II), and shall be designed to be minimum in volume as far as possible.

a) Basic conditions

- 1) **Allowable strength of lumbers** The allowable strength of lumbers used for wooden boxes shall be as shown in Table 2.

Table 2 Allowable strength of lumbers

Unit: MPa

Bending strength perpendicular to length direction of member		Compressive strength in length direction of member	Tensile strength in length direction of member
Flat direction 	Lumber edge direction 		
10.5(15.7)	8.1(12.1)	6.0(9.0)	15.0(22.4)
The parenthesized values shall apply to Class 2.			

The values in this table are based on the allowable strengths of radiata pine among the lumbers shown in Table 13, which is the lumber commonly used.

According to the lumber type to be used, the quantity used and/or the dimensions of lumber may be altered based on the ratio of the allowable strength to that shown in Table 2. The allowable strengths depending on the lumber type and the calculation methods shall be in accordance with Annex B.

- 2) **Upper portion load** The normally anticipated upper portion load of skidded wooden box shall consist of the following.
 - 2.1) **Top load**¹⁾ The top load exerted on the top joists shall be 4.0 kPa.
 - 2.2) **Superimposed load**¹⁾ The superimposed load subjected to the side faces shall be 10.0 kPa irrespective of the mass of contents.

Note ¹⁾ For the purpose of this Standard, the top load means the upper portion load supported mainly by the top joists, and the superimposed load means the upper portion load supported mainly by the side faces. When a freight smaller in width than that of top face is directly placed on the wooden box, the wooden box will be subjected to both the top load and the superimposed load. When freights of the same width, or those of any width are stacked on the wooden box using a suitable wooden base blocks having the length not smaller than the width of top face, the wooden box will be mainly subjected to the superimposed load.

- b) **Clearance** In the case where the contents may be damaged by the contact with the inner surface of wooden box, a clearance shall be provided between the contents and the wooden box, as appropriate.

c) **Expression method of dimensions** The size of wooden boxes shall be expressed by either of the following internal or external dimensions.

1) **Internal dimensions** Internal dimensions shall be as follows.

- Internal length: distance between inner surfaces of both end boards
- Internal width: distance between inner surfaces of both side boards
- Internal height (Type I) distance between inner surfaces of cover board and bottom board
(Type II) distance between inner surfaces of top board and non-load bearing floor member

2) **External dimensions** External dimensions shall be as follows.

- External length Internal length + (thickness of end board + thickness of end batten) × 2
- External width Internal width + (thickness of side board + thickness of side batten) × 2
- External height (Type I) Internal height + thickness of cover board + thickness of cover batten + thickness of bottom board + thickness of bottom batten
(Type II) Internal height + thickness of top board + thickness of non-load bearing floor member + thickness of skid + thickness of rubbing strip

d) **Dimensions of lumber** The dimensions of lumber shall be expressed by the nominal dimensions, and the dimension ranges corresponding to thickness and width to the nominal dimensions shall be as shown in Table 3.

Table 3 Dimension range of thickness and width of lumber

Unit: cm

Nominal dimension	Dimension range	Nominal dimension	Dimension range
1.2	1.00 or over up to and incl. 1.20	6.0	5.55 or over up to and incl. 6.00
1.5	1.25 or over up to and incl. 1.50	7.5	7.00 or over up to and incl. 7.50
1.8	1.55 or over up to and incl. 1.80	9.0	8.45 or over up to and incl. 9.00
2.1	1.85 or over up to and incl. 2.10	10.0	9.45 or over up to and incl. 10.00
2.4	2.15 or over up to and incl. 2.40	12.0	11.40 or over up to and incl. 12.00
3.0	2.70 or over up to and incl. 3.00	15.0	14.35 or over up to and incl. 15.00
4.0	3.65 or over up to and incl. 4.00	18.0	17.30 or over up to and incl. 18.00
4.5	4.15 or over up to and incl. 4.50	21.0	20.20 or over up to and incl. 21.00
5.0	4.60 or over up to and incl. 5.00	Over 21.0	[(Nominal dimension value) – 0.80] or over up to and incl. (nominal dimension)

e) **Joint method of outer boards** The outer boards shall be normally butt-jointed, and also rabbet-jointed as required (see Figure 3).

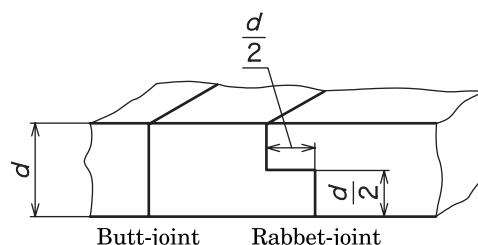


Figure 3 Joint of outer boards

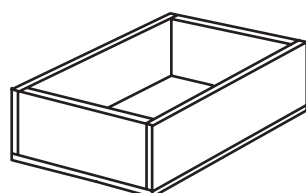
5.2 Constructions and dimensions of normal wooden box (Type I)

5.2.1 Constructions (constructions of end faces and end battens)

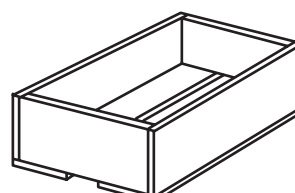
A normal wooden box shall consist of side faces, end faces, a bottom face and a cover face. They shall be assembled in such a way that the side faces are mounted to the end faces and then the bottom face and the cover face are mounted to the end faces and the side faces, as follows.

a) Constructions of end faces and end battens

- 1) **Wooden box without batten (Type 1)** This type shall consist of the single-board end faces and shall be used when the mass of contents is not more than 20 kg and the load condition of contents is the uniform load. The sum of the internal dimensions (length + width + height) shall not exceed 130 cm, and the height shall not exceed 25 cm (see Figure 4).



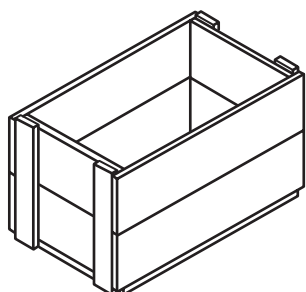
a) Type I-A-1



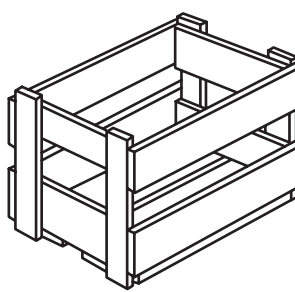
b) Type I-B-1

Figure 4 Example of Type 1

- 2) **Wooden box with vertical end battens (Type 2)** This type shall consist of the end faces reinforced by vertical battens, and shall be used when the mass of contents is not more than 150 kg (see Figure 5).



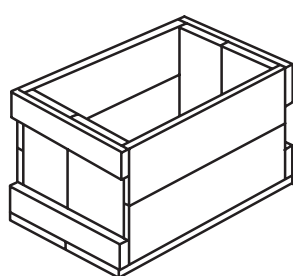
a) Type I-A-2



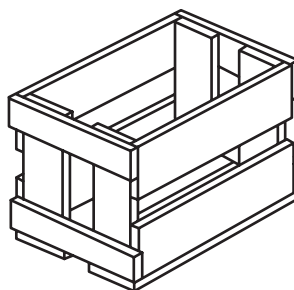
b) Type I-B-2

Figure 5 Example of Type 2

- 3) **Wooden box with horizontal end battens (Type 3)** This type shall consist of the end faces reinforced by horizontal battens, and shall be used when the mass of contents is not more than 150 kg (see Figure 6).



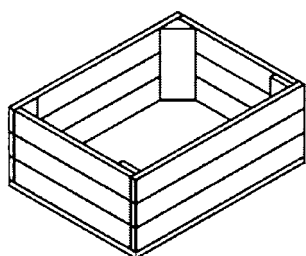
a) Type I-A-3



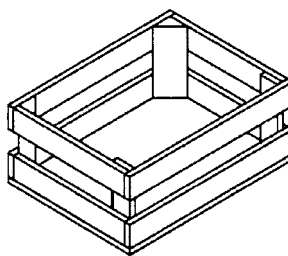
b) Type I-B-3

Figure 6 Example of Type 3

- 4) **Wooden box with interior cleats (Type 4)** This type shall consist of the end faces reinforced by interior vertical cleats, and shall be used when the mass of contents is not more than 150 kg. The cross-section of vertical cleat may be triangular (see Figure 7).



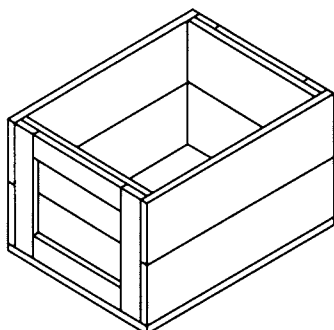
a) Type I-A-4



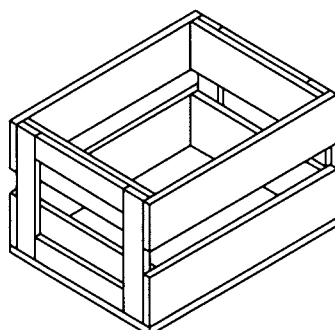
b) Type I-B-4

Figure 7 Example of Type 4

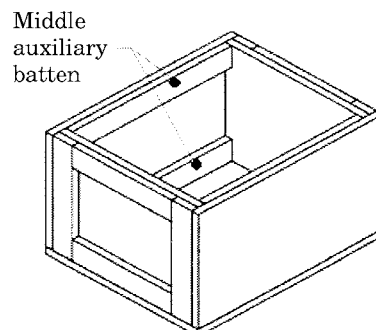
- 5) **Wooden box with butt-joint full cleats (Type 5)** This type shall consist of the end faces reinforced by horizontal and vertical battens, and shall be used when the mass of contents is not more than 200 kg. Type C shall be used when the mass of contents is not more than 150 kg, and the middle auxiliary battens shall be mounted as required (see Figure 8).



a) Type I-A-5



b) Type I-B-5



c) Type I-C-5

Figure 8 Example of Type 5

5.2.2 Dimensions of members

The width and thickness of members shall be as follows depending on the construction of outer boards.

a) Thickness of outer boards

- 1) **Type I•A and Type I•C** The thickness of outer boards for Type I•A and Type I•C shall be as shown in Table 4.
- 2) **Type I•B** The thickness of outer boards for Type I•B shall be either of the following.
 - 2.1) The thicknesses shown in Table 5 shall apply to the thicknesses of Type I•A shown in Table 4 according to the space ratio of outer boards.

The space ratio means the ratio of the space width against the total width, which is obtained according to Formula (1). For example, the space ratio of sealed boarding is 0 %.

$$R = \frac{L_2}{L_1} \times 100 \dots\dots\dots (1)$$

where, R : space ratio against total width (%)

L_1 : total width (cm)

L_2 : space width (cm)

- 2.2) The thicknesses of Type I•A shown in Table 4 shall apply. In this case, the unsupported distance shall be obtained according to Formula (2), in which the unsupported distance for the sealed boarding shown in Table 6 is multiplied by the sealing ratio according to the space ratio.

The unsupported distance means the internal length or the internal distance between reinforcing battens for side faces, and the internal distance between vertical end battens for end faces.

$$F_2 = F_1 \times (1 - R) \dots\dots\dots (2)$$

where, F_1 : unsupported distance for sealed boarding (cm)

F_2 : unsupported distance in Type I•B (cm)

The obtaining methods of thickness and unsupported distance of outer boards for Type I•B are exemplified in Annex D.

b) Width of outer boards

- 1) **Type I•A and Type I•B** The board width shall be not less than 6 cm. If three or more boards are used, the mean board width²⁾ shall be not less than 10.5 cm.
- 2) **Type I•C** The width of plywood shall be not less than 15 cm and the mean board width²⁾ shall be not less than 25 cm.

Note ²⁾ The mean board width means the value obtained by dividing the total width of boards on each surface of outer board by the number of boards.

- c) **Width and thickness of battens** The width and thickness of battens shall be as shown in Table 4.

Table 4 Dimensions of members for Type I•A and Type I•C

Unit: cm

Mass of contents (kg)	Constructions of end faces and end battens	Uniform load			Concentrated load		
		Thickness of side/cover/ bottom face	Thick- ness of end face	Width × thickness of batten	Thickness of side/cover/ bottom face	Thick- ness of end face	Width × thickness of batten
20 or under	Type 1/Type 2/ Type 3/Type 4	1.2	1.5	4.5×1.5	Not applicable to Type 1. Same dimensions for Type 2/Type 3/ Type 4 when the load condition is uniform load.		
40 or under	Type 2/Type 3/ Type 4	1.2	1.8	6.0×1.8	1.2	1.8	7.5×1.8
	Type 5	1.2 (0.9)	1.5 (0.9)		1.2 (0.9)	1.5 (0.9)	
100 or under	Type 2/Type 3/ Type 4	1.5 (0.9)	1.8 (0.9)	7.5×1.8	1.5 (0.9)	1.8 (0.9)	9.0×1.8
	Type 5		1.5 (0.9)	7.5×1.5			7.5×1.8
150 or under	Type 2/Type 3/ Type 4	1.8 (0.9)	1.8 (0.9)	7.5×1.8	—		
	Type 5				1.8 (0.9)	1.8 (0.9)	9.0×2.1
200 or under	Type 5	1.8	1.8	9.0×1.8	1.8	2.1	9.0×2.4
The parenthesized values show the dimensions for Type I•C.							
In the case of the cargo handling by forklift, the thickness of bottom batten may be increased for convenience.							

Table 5 Thickness of outer boards used for Type I•B

Unit: cm

Thickness of outer boards for Type I•A	Space ratio of each surface (%)	Thickness of outer boards for Type I•B
1.2	35 or under	1.5
	Over 35 up to and incl. 56	1.8
1.5	30 or under	1.8
	Over 30 up to and incl. 49	2.1
1.8	26 or under	2.1
	Over 26 up to and incl. 43	2.4
2.1	24 or under	2.4
	Over 24 up to and incl. 39	2.7
If the thickness of outer boards of Type I•B exceeds the thickness of battens shown in Table 4, the battens having the same thickness as the outer board shall be used.		

5.2.3 Reinforcement

The reinforcement shall be as follows.

- a) **Reinforcing batten** When the unsupported distance shown in Figure 9 exceeds the value specified in Table 6, reinforcing battens (girthwise battens, middle battens or diagonal cleats) shall be used for reinforcement. When the load condition is the uniform load and the thickness of outer boards is not more than 1.5 cm, steel strapping may be used in place of girthwise battens. The dimensions of reinforcing battens shall be as shown in Table 4. Examples of battens used for the reinforcement of unsupported distance are shown in Figure 9 and Figure 10. When reinforcing battens are used for end faces, the middle battens shall be used for reinforcement of rectangular end face, and the diagonal cleat shall be used for reinforcement for the almost square (the diagonal of end is $45^\circ \pm 10^\circ$ against the bottom face) end face.

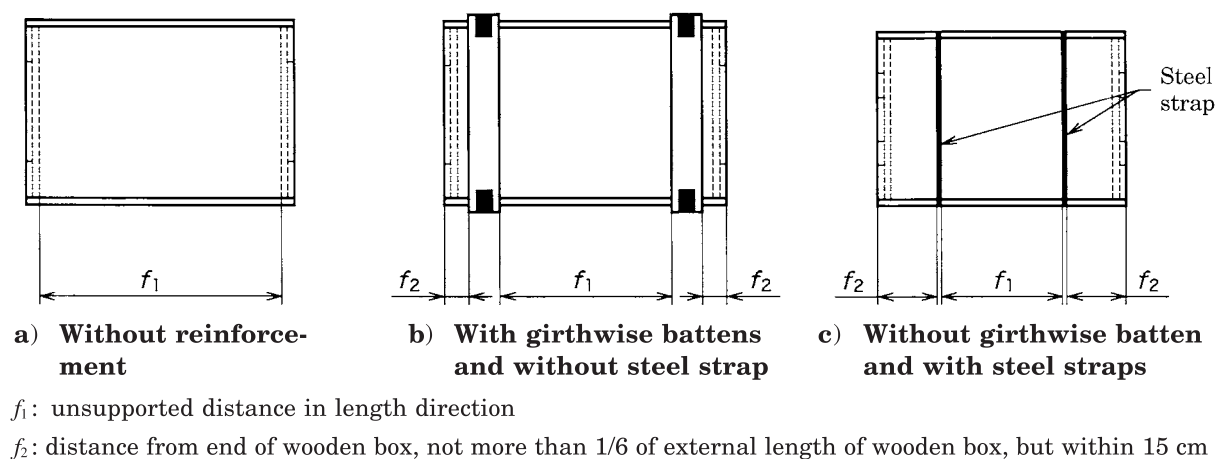


Figure 9 Example of reinforcement using reinforcing battens or steel straps for side faces, bottom face and cover face

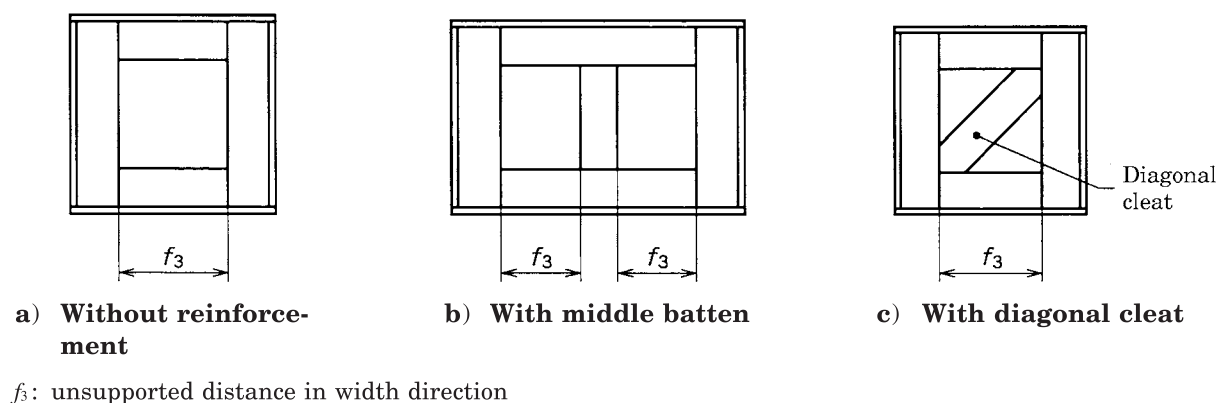


Figure 10 Example of reinforcement for end face

Table 6 Unsupported distance for sealed boarding

Unit: cm

Thickness of member		Uniform load		Concentrated load	
		Length direction f_1	Width direction f_3	Length direction f_1	Width direction f_3
Board	1.2	80	—	64	—
	1.5	96	64	80	64
	1.8	112	80	96	80
	2.1	—	—	—	100
Plywood	0.9	60	60	50	50
When the board thickness of each surface of Type I·B is the same as that specified in Table 4, the distance specified in this table shall be reduced according to the ratio of space against the total width of each surface.					

- b) **Steel strap** The steel straps shall be machine tightened until they dig firmly into the wooden box at the respective ridges, and shall be sealed.

Materials other than steel having the strength at least equal thereto may be used.

- 1) **Dimensions of steel strap** The dimensions of steel strap shall be as shown in Table 7 according to the mass of contents. The steel strap of other dimensions may be used, if the cross-sectional area is not less than the required value.

Table 7 Dimensions of steel strap

Mass of contents kg	Thickness mm	Width mm	Cross-sectional area mm ²
50 or under	0.4	16	6.4
Over 50 up to and incl. 200	0.5	19	9.5

- 2) **Number and positions of steel straps** The necessary number and positions of steel straps shall be as follows.

- The distance between steel straps shall be not more than 60 cm. The distance from the end of wooden box shall be not more than 1/6 of the external length but within 15 cm.
- In the case where the steel straps are used instead of the girthwise battens when the load condition is the uniform load, the distance between steel straps shall be within 45 cm when the board thickness is not more than 1.5 cm or when plywood is used. The distance from the end of wooden box shall be not more than 1/6 of the external length but within 15 cm.
- In the case where the load condition is the uniform load and the mass of contents is not more than 25 kg and the length of contents is not more than 30 cm, one steel strap should be used at the centre of wooden box.

- In the case where the girthwise battens are used, a steel strap shall be used at the centre between girthwise battens. If the distance between girthwise battens is not more than 70 % of the required value for reinforcing battens specified in **5.2.3 a)**, the steel strap is unnecessary.

5.3 Constructions and dimensions of skidded wooden box (Type II)

5.3.1 General

A skidded wooden box shall consist of a skid base, side faces, end faces and a top face. They shall be assembled in such a way that the side faces and the end faces are mounted to the skid base and then the top face is mounted to the side faces and the end faces (see Figure 11). As an exception for the form of skid base, Annex C is applicable.

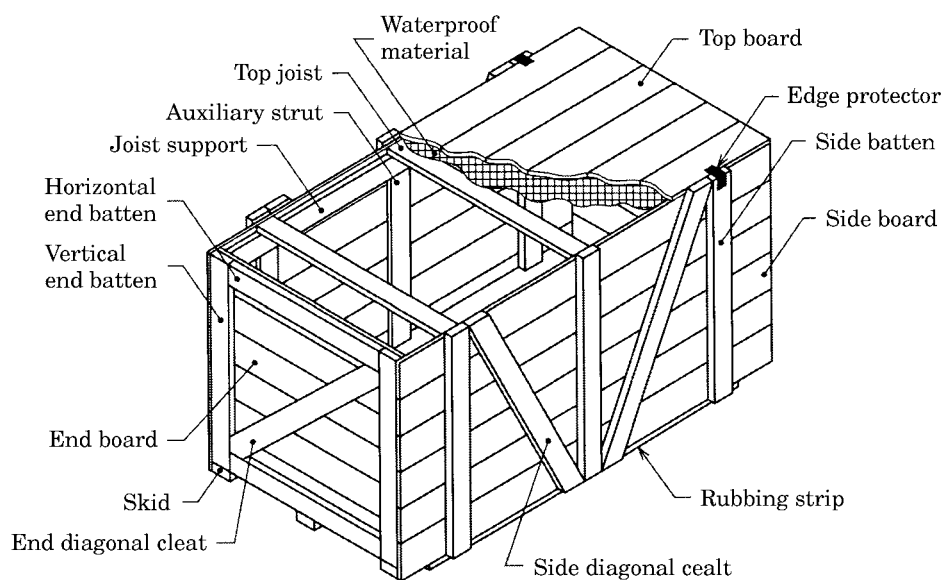
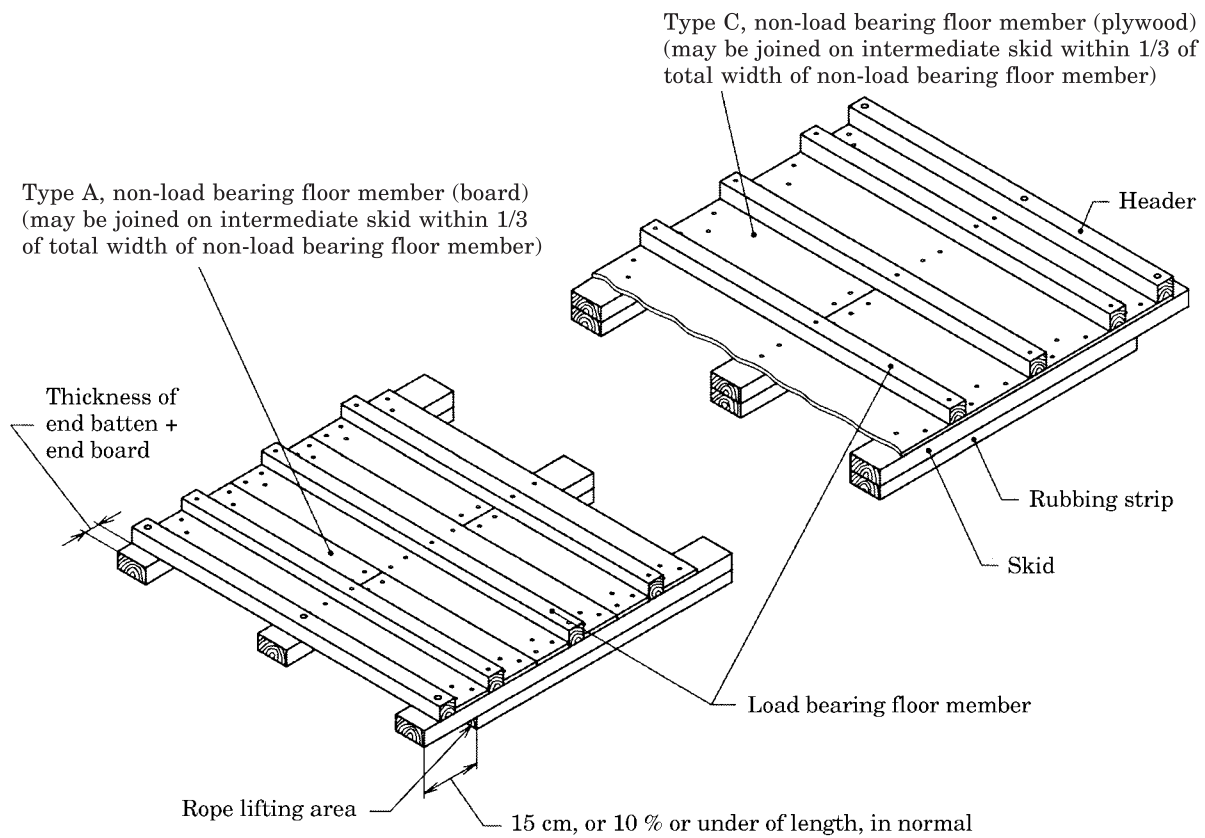


Figure 11 Example of construction of Type II-A (skidded wooden boxes)

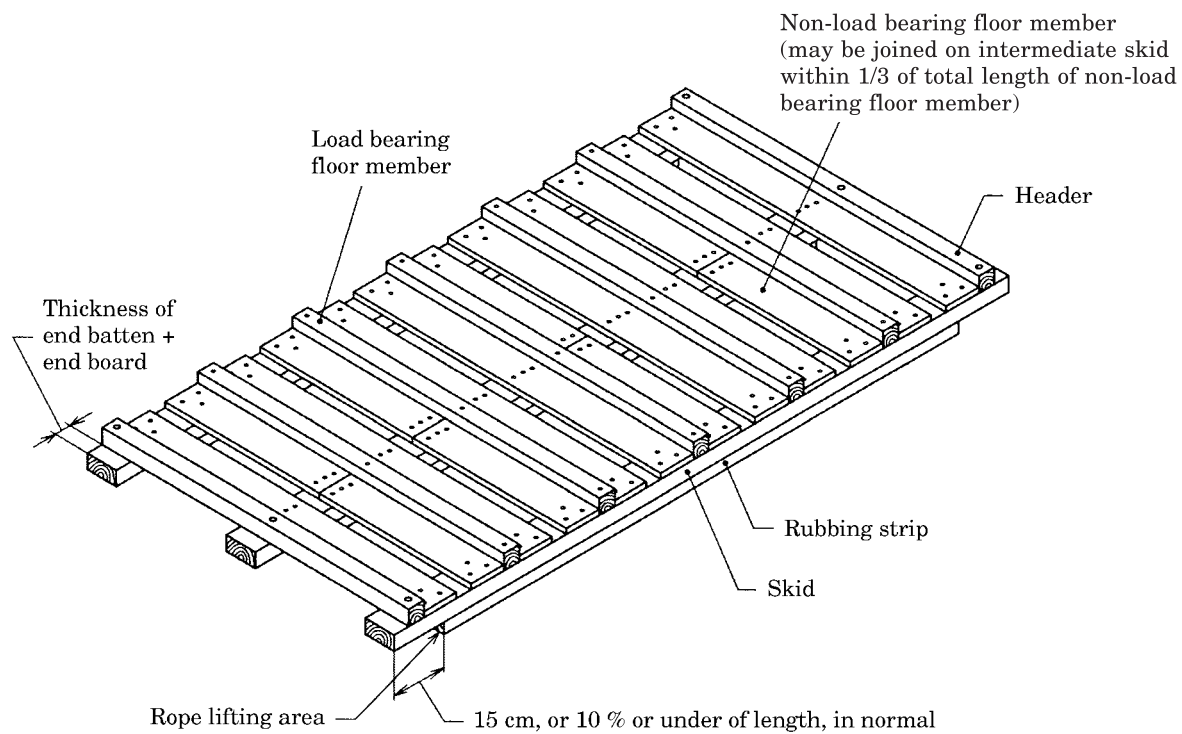
5.3.2 Skid base

The skid base shall be the bottom surface of skidded wooden box, and shall support the contents by mounting to the side faces and the end faces (see Figure 12 and Figure 13). The construction shall be as follows.

NOTE This Standard does not cover such a handling that a wooden box without side faces, end faces and a top face is lifted only by the skid base.



a) Type A and Type C



b) Type B

Figure 12 Example of skid base

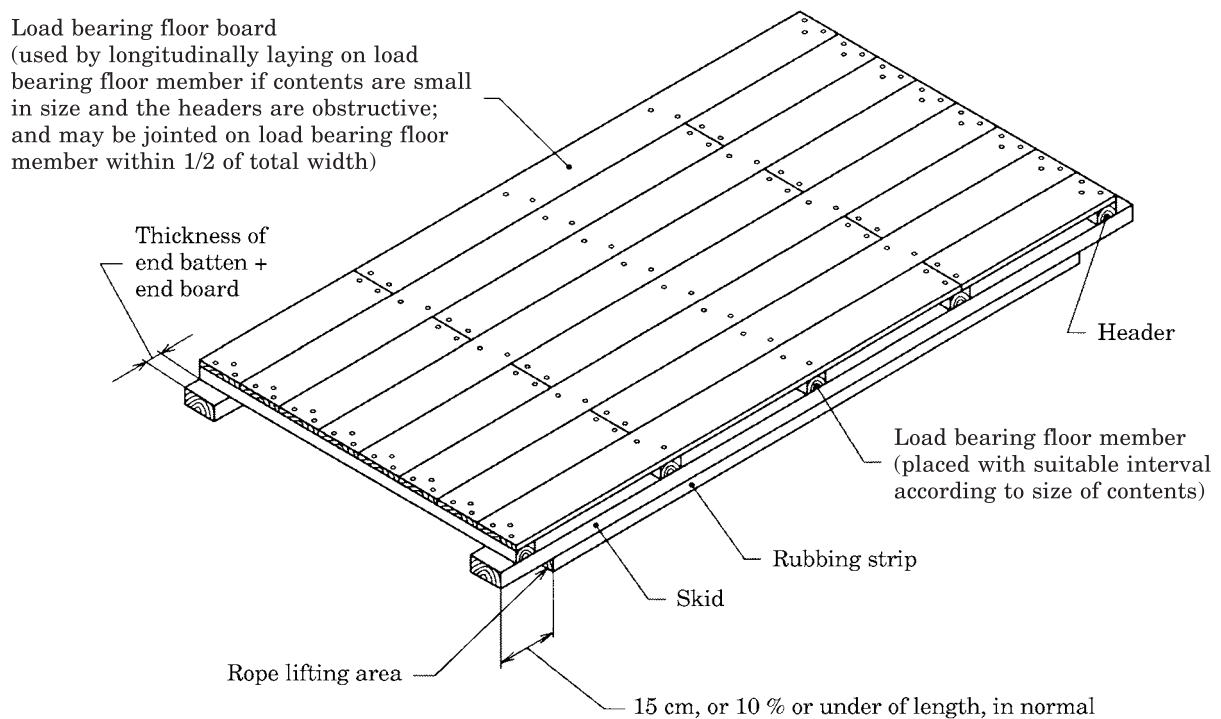


Figure 13 Example of skid base

- a) **Skid** The skid shall be the member of the skid base in the length direction, and shall support the load of contents along with the load bearing floor members and the side faces, as follows.
- 1) **Dimensions of skid** The dimensions of skid shall be as shown in Table 8 according to the mass of contents and the internal length (or the distance between the support points of rope lifting) of skidded wooden box.
 - 2) **Number of skids** When the width of skid base (internal width) exceeds 100 cm, a skid of the same dimensions shall be used at the intermediate position.
 - 3) **Jointing of skids** It is preferable to use a single consecutive member as the skid; however, if a long member of at least 7.5 cm × 7.5 cm is not available, members may be jointed as shown in Figure 14. The joint positions shall be within the range of rubbing strip but shall avoid the position of the centre of gravity. The skids on both outsides shall be alternated from side to side. When the skids are jointed through the butt joint, the length of reinforcing member shall be not less than 80 cm, and at least two bolts shall be used on the left and right of the joint position.