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(Reaffirmed 1998)

भारतीय मानक

कॉंक्रीट शटरिंग कार्य के लिये प्लाईवुड — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

PLYWOOD FOR CONCRETE SHUTTERING WORK — SPECIFICATION

(Second Revision)

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wood Products Sectional Committee had been approved by the Civil Engineering Division Council.

Concrete shuttering plywood is a BWP grade plywood, preservative treated and specially suited for use in concrete shuttering and form work. Concrete shuttering plywood is very economic in view of its re-use value as it can be put to repeated use, depending upon the care taken during erection and dismantling. The main requirements of such plywood for shuttering work are that it should be durable under alternate wetting and drying conditions, its surface should be hard, it should possess adequate strength to withstand the load of concrete and the forces caused by pouring of concrete and vibrations. This standard specifies the requirements of such plywood for use in concrete shuttering and form work and provides guidance in the manufacture and use of concrete shuttering plywood.

This standard was first published in 1969 and then revised in 1981. Following are the major changes brought out in this second revision:

a) All species of timber have been permitted subject to the fulfilment of other requirements of the standard. However, a list of species of timber has been included for guidance.

b) Three types of concrete shuttering plywood, namely, Type 1 (Plain); Type 2 (Coated); and Type 3 (Film Faced) plywood have now been specified.

c) The minimum thickness of face veneer has been specified as 1·2 mm.

d) The amount of phenol formaldehyde or creosol formaldehyde to be used for making concrete shuttering plywood with plastic coating or with suitable overlay has been specified as not less than 100 g/m² as against not less than 250 g/m² specified in earlier version.

e) Requirements for modulus of elasticity and corresponding test have been included.

This standard also includes in Annex C, a recommended method for handling, storing and use of plywood for concrete shuttering and form work.

In the formulation of this standard, due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

The Composition of the technical committee responsible for the formulation of this standard is given at Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PLYWOOD FOR CONCRETE SHUTTERING WORK — SPECIFICATION

(*Second Revision*)

1 SCOPE

This standard covers the requirements of plywood for concrete shuttering and form work.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 707 : 1976 shall apply.

4 TYPES

Plywood for concrete shuttering work shall be preservative treated, of BWP grade and shall be of three types as given below:

Type	*Description*	*Designation*
1	Plywood for concrete shuttering work (plain)	CS
2	Plywood for concrete shuttering work with plastic coating (coated)	CSC
3	Plywood for concrete shuttering work with suitable overlay (film faced)	CSFF

5 MATERIALS

5.1 Timber

Any species of timber may be used for manufacture of concrete shuttering plywood. However a list of species given in Annex B may be used for selection of species.

5.2 Adhesives for Bonding of Veneers

The adhesive used for bonding shall be of the hot press synthetic resin (phenol formaldehyde) type and shall conform to BWP type specified in IS 848 : 1974. Extenders shall not be added to the adhesive. Addition of a dye to the adhesive to check that all the parts of the veneer are completely covered by adhesive shall be permissible. Addition of a filler not exceeding 5 percent shall be permissible provided the filler does not detract from the water resistance of the adhesive.

6 MANUFACTURE

6.1 Veneers for the manufacture of plywood for concrete shuttering work shall be either rotary cut or sliced, but preferably rotary cut. The veneers shall be reasonably smooth to permit an even spread of glue. The veneers shall be dried to a moisture content not exceed 6 percent before bonding. The glue shall be evenly spread. The veneers shall then be assembled with alternate layers at right angles to each other (except in the case of even number of veneers when the two central veneers are in the same direction) and hot pressed under controlled conditions of temperature, pressure and pressing time. The core veneers shall not have open joints or splits beyond the limits prescribed in **8.2**. No unglued areas shall be found on separation of the veneers. The two face veneers shall run in the same direction and the assembly shall be balanced around the central plane of plywood.

6.1.1 The veneers may have sound knots of diameter not exceeding 50 mm. Tight fitted patches, with distance from one patch to the other not less than 0·6 m, shall be permitted, but maximum diameter of any patch shall not exceed 40 mm. Pin-holes on face veneers shall not be more than 10 in any square metre of the surface. Harmless discolouration may be permitted, but loose knots and dry-rot shall not be permitted (*see* **8.1**).

6.2 The thickness of all individual veneers shall be uniform with a variation of ± 5 percent. The veneer shall be straight grained within a permitted slope of $\pm 10°$. Veneers with same distance from the central plane shall be of same thickness.

6.3 Thickness of face veneer shall not be less than 1·2 mm.

6.4 Plywood for concrete shuttering work shall be preservative treated and bounded with BWP adhesive. When ruquired, concrete shuttering plywood may be supplied with or without any plastic coating or suitable overlay (*see* **6.7** and **10.1.4**).

6.5 When boards of a size larger than the available press size are required, these may be made by scarf jointing the finished board, the scarf being through the thickness of the board.

6.5.1 All scarf joints shall be bonded with adhesives conforming to IS 848 : 1974, having similar properties to those used in the bond of veneers. Scarf joints shall be made with 1 : 8 slope.

6.6 The plywood after manufacture shall be given a preservative treatment as covered by IS 5539 : 1969, and conditioned to a moisture content not exceeding 15 percent. Generally, the preservative used shall have a copper-chrome-arsenic (CCA) composition or copper-chrome-boron (CCB) composition with a retention of not less than 12 kg/m^3.

6.7 Plywood for concrete shuttering work with plastic coating, or with suitable overlay shall be made with a surface film of phenol formaldehyde or creosol formaldehyde resin, either carried by tissue paper or evenly spread by a mechanical spreader with resin content not less than 100 g/m^2 (Paper weight : total weight shall be at least 1 : 1·5, which is subsequently cured under heat and pressure to give a smooth and waterproof surface. The film shall be applied on the surface of preservative treated plywood after manufacture. The pressing shall be such that the film uniformly melts and finishes into a smooth and hard surface on the plywood.

7 DIMENSIONS AND TOLERANCES

7.1 The dimensions of plywood boards shall be as given in **7.1.1**.

7.1.1 The first dimension shall represent the length, that is, the dimension parallel to the grain of the faces; the second, the width as given in **7.2**, and the third the thickness, as given in **7.3**.

7.2 Size

Unless otherwise specified, plywood boards for concrete shuttering work shall be of length and width as specified below:

mm	mm	mm	mm
2 400	× 1 200	1 500	× 1 200
2 400	× 900	1 500	× 900
2 100	× 1 200	1 200	× 1 200
2 100	× 900	1 200	× 900
1 800	× 1 200	1 200	× 600
1 800	× 900	900	× 900

NOTE — Plywood boards for concrete shuttering may also be manufactured under the following alternative sizes if specified by the purchaser:

mm	mm	mm	mm
2 440	× 1 220	1 540	× 1 220
2 440	× 920	1 540	× 920
2 140	× 1 220	1 220	× 1 220
2 140	× 920	1 220	× 920
1 840	× 1 220	1 220	× 610
1 840	× 920	920	× 920

7.3 Thickness

Unless otherwise specified, thickness of plywood board shall be as specified below for the respective number of plies:

Board	*Thickness*
3-ply	4 mm
	5 mm
	6 mm
5-ply	6 mm
	8 mm
	9 mm
7-ply	12 mm
	16 mm
9-ply	16 mm
	19 mm
More than 9-ply	22 mm
	25 mm
	30 mm
	35 mm
	40 mm

7.4 Tolerances

The tolerances on the nominal sizes of finished boards shall be as specified in IS 12049 : 1987.

8 WORKMANSHIP AND FINISH

8.1 The plywood for concrete shuttering work shall be smooth and the faces and back shall be free from harmful discolouration, pleats, overlaps and loose knots. The edges shall be of smooth uniform finish.

8.2 Gaps and open joints shall be permitted as follows:

a) *In Face* — The gap or opening shall not exceed a width of 0·4 mm. If it exceeds 0·4 mm, this may be rectified by well-fitted veneer inserts of suitable width provided the grain of the veneer insert does not deviate by more than 10 percent from the grain direction of the surrounding veneer.

b) *In Core* (*Cross-Band*) — The width of the opening shall not exceed 0·8 mm in the case of 3-ply or 3·2 mm in the case of multi-ply, provided such openings are not less than 300 mm apart in any veneer and staggered not less than 150 mm between any veneer and the next one with the same grain direction.

8.3 The faces of plywood for concrete shuttering work with plastic coating, or with suitable overlay, shall be dense, smooth and without blisters and patch marks. It shall be of uniform colour.

9 SAMPLING

The method of drawing representative samples and the criteria for conformity shall be as prescribed in IS 7638 : 1986.

10 TESTS

10.1 The test pieces, cut from each of the boards selected as specified in **9**, shall be subjected to the tests specified under **10.1.1** to **10.1.7**.

10.1.1 *Moisture Content*

The average moisture content of three test pieces cut out from each board selected as in **9**, when tested in accordance with IS 1734 (Part 1) : 1983, shall be not less than 5 percent and not more than 15 percent.

10.1.2 *Glue Adhesion in Dry State*

10.1.2.1 *Glue shear strength*

Six test specimens when tested for glue adhesion by the method described in IS 1734 (Part 4) : 1983, the average failing load shall be not less than 1 350 N (135 kgf) and no individual value shall be less than 1 100 N (110 kgf).

10.1.2.2 *Adhesion of plies*

Adhesion shall be tested by knife test method described in IS 1734 (Part 5) : 1983. The adhesion of plies may also be tested by forcibly separating the layers. The veneers shall offer appreciable resistance to separation and the fractured samples shall show some adherent fibres distributed more or less uniformly.

NOTE — If a definite result is not obtained by the method described in IS 1734 (Part 4) : 1983, the result of knife test described in IS 1734 (Part 5) : 1983 shall be considered as decisive. In case of even number of plies where the grains of central plies follow the same direction, the result as obtained from knife test shall be considered final.

10.1.3 *Water Resistance Test*

Six test pieces each approximately 250 mm × 100 mm shall be cut for adhesion of Plies Test from any position in the board such that the grains of the face veneer are parallel to the length of the piece. Six more test specimens shall be prepared as given in IS 1734 (Part 4) : 1983. These specimens shall be kept submerged horizontally in a pan on boiling water for a period of 72 hours. These test pieces shall then be romoved from the boiling water and cooled down to room temperature by plunging them in cold water. While still in wet condition, they shall be subjected to tests described under **10.1.3.1** and **10.1.3.2**.

10.1.3.1 *Glue shear strength*

When tested for glue shear strength by the method described in IS 1734 (Part 4) : 1983, the average failing load shall be not less than 1 000 N (100 kgf) and no individual value shall be less than 800 N (80 kgf).

10.1.3.2 *Adhesion of plies*

Adhesion shall be tested by knife test method described in IS 1734 (Part 5) : 1983. The adhesion of plies may also be tested by forcibly separating the layers; the veneers shall offer appreciable resistance to separation and the fractured sample shall show some adherent fibres distributed more or less uniformly.

NOTE — If a definite result is not obtained by the method described in IS 1734 (Part 4) : 1983, the result of knife test described in IS 1734 (Part 5) : 1983 shall be considered as decisive. In case of even number of plies where the grains of central plies follow the same direction, the result as obtained from knife test shall be considered final.

10.1.4 Plywood for concrete shuttering work with plastic coating or with suitable overlay (*see* **6.4**), after being subjected to 72 hours boiling, shall not show any softening, checking, cracking or deterioration of the surface layer.

10.1.5 When tested plywood shall have a retention of preservative chemical not less than 12 kg/m^3.

10.1.6 *Tensile Strength*

The tensile strength, when determined by the method described in IS 1734 (Part 9) : 1983, shall comply with the following requirements:

a) Tensile strength shall be not less than 32·5 N/mm^2 (325 kgf/cm^2) in the direction parallel to the grain direction of the face veneers,

b) Tensile strength shall be not less than 22·5 N/mm^2 (225 kgf/cm^2) in the direction at right angles to the grain direction of the face veneers, and

c) The sum of the tensile strengths in both directions shall be not less than 60·0 N/mm^2 (600 kgf/cm^2).

10.1.7 *Mycological Test*

The test for resistance to micro-organisms shall be carried out by the method described in IS 1734 (Part 7) : 1983. The test piece shall:

a) show no appreciable signs of separation at the edges of the veneers, and

b) comply with the requirements specified in **10.1.3.1** and **10.1.3.2**.

10.1.8 *Modulus of Elasticity*

The modulus of elasticity as determined by the method described in IS 1734 (Part 11) : 1983 shall be not less than 8 000 N/mm^2 along the direction parallel to the grain direction of the

face veneer and not less than 4 000 N/mm² perpendicular to the grain direction of the face veneers, when tested in dry condition.

10.2 Re-test

If any specimen fails to fulfil the test requirements specified under **10.1.1** to **10.1.8**, a further two sets of samples on the basis prescribed in **9** shall be selected by the purchaser from the same batch and tested in the same manner. Test specimens prepared from these two further samples shall comply with the requirements specified in **10**, otherwise the batch shall be rejected.

11 MARKING

11.1 Each plywood board shall be legibly and indelibly marked or stamped with the following particulars:

a) Manufacturer's mark of identification,

b) Year of manufacture, and

c) Type of plywood (*see* **4**).

11.1.1 Each board may also be marked with the Standard Mark.

12 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

The manufacturer shall supply on demand to the purchaser full technical data and recommended method of use and loading. This information shall cover in particular the following:

a) The type of adhesives used;

b) The type of preservative used;

c) Radii to which the plywood of given dimensions is recommended as bendable for architectural concrete work;

d) Loading and deflection tables for the purpose of calculating the supports, that is, the sizes of bearers and distances of bearers;

e) Density or mass per square metre of the plywood; and

f) Species of timber.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
707 : 1974	Glossary of terms applicable to timber technology and utilization (*second revision*)
848 : 1974	Specification for synthetic resin adhesives for plywood (phenolic and aminoplastic) (*first revision*)
1734 (Part 1) : 1983	Methods of test for plywood: Part 1 Determination of density and moisture content (*second revision*)
1734 (Part 4) : 1983	Methods of test for plywood: Part 4 Determination of glue shear strength (*second revision*)
1734 (Part 5) : 1983	Methods of test for plywood: Part 5 Test for adhesion of plies (*second revision*)
1734 (Part 7) : 1983	Methods of test for plywood: Part 7 Mycological test (*second revision*)
1734 (Part 9) : 1983	Methods of test for plywood: Part 9 Determination of tensile strength (*second revision*)
1734 (Part 11) : 1983	Methods of test for plywood: Part 11 Determination of static bending strength (*second revision*)
5539 : 1969	Specification for preservative treated plywood (*second revision*)
7638 : 1986	Methods of sampling for plywood, fibre hardboards, insulation boards and particle boards (*first revision*)
12049 : 1987	Dimensions and tolerances relating to wood based panel materials

ANNEX B

(*Clause* 5.1)

TIMBER SPECIES

Sl No.	Trade Name	Botanical Name	Abbreviation
1.	Aini	*Artocarpus hirsutus*	AIN
2.	Alder	*Alnus nitida*	ALD
3.	Alder	*Alnus* spp.	ALD
4.	Amari	*Amoora* spp.	AMA
5.	Amra	*Spondias* spp.	AMR
6.	Arjun	*Terminalia arjuna*	ARJ
7.	Bahera	*Terminalia bellerica*	BAH
8.	Banati	*Lophopetalum wightianum*	BAN
9.	Birch	*Betula* spp.	BIR
10.	Bonsum	*Phoebe* spp.	BON
11.	Carallia	*Carallia brachiata* (Syn. *Carallia integerrima*)	CAR
12.	Champ	*Michelia* spp.	CHM
13.	Chaplash	*Artocarpus Chaplasha*	CHP
14.	Chatian	*Alstonia scholaris*	CHT
15.	Chikrassy	*Chukrasia tabularis*	CHI
16.	Chilauni	*Schima wallichii*	CHL
17.	Cinnamon	*Cinnamomum cecicodaphne*	CIN
18.	Debdaru	*Polyalthia* spp.	DEB
19.	Dhup	*Canarium* spp.	DHU
20.	Didu	*Salmalia insignis*	DID
21.	Dillenia	*Dillenia* spp.	DIL
22.	Ebony	*Diospyros* spp.	EBO
23.	Elm	*Ulmus wallichiana*	ELM
24.	Gamari	*Gmelina arborea*	GAM
25.	Garuga	*Garuga pinnata*	GAU
26.	Gokul	*Ailanthus grandis*	GOK
27.	Gurjan	*Dipterocarpus* spp.	GUR
28.	Gutel	*Trewia nudiflora*	GUT
29.	Haldu	*Adina cordifolia*	HAL
30.	Hathipaila	*Pterospermum acerifolium*	HAT
31.	Hollock	*Terminalia myriocarpa*	HOL
32.	Hollong	*Dipterocarpus macrocarpus*	HON
33.	Indian Oak	*Quercus semecarpifolia*	IOA
34.	Indian Oak	*Quercus dilatata*	IOA
35.	Indian Oak	*Quercus serrata*	IOA
36.	Jaman	*Syzygium* spp.	JAM
37.	Jhingan	*Lannea coromandelica* (Syn: *Lannea grandis*)	JHI
38.	Jutili	*Altingia excelsa*	JUT
39.	Kadam	*Anthocephalus cadampa*	KAD
40.	Kanju	*Holoptelea integrifolia*	KAN
41.	Karani	*Cullenia rosayroana* (Syn. *cullenia excelsa*)	KAR
42.	Kathal	*Artocarpus heterophyllus*	KAT
43.	Kindal	*Terminalia paniculata*	KIN
44.	Kokko	*Albizia lebbeck*	KOK
45.	Lampati	*Duabanga grandiflora*	LAP
46.	Laurel	*Terminalia tomentosa*	LAU
47.	Litsa	*Liteasa polyantha*	LIT
48.	Machilus	*Machilus* spp.	MAC
49.	Mahogany	*Swietenia* spp.	MAG
50.	Maina	*Teterameles nudiflora*	MAI
51.	Makai	*Shorea assamica*	MAK
52.	Mango	*Mangifera indica*	MAN
53.	Maple	*Acer* spp.	MAP
54.	Menudito	*Enterolobium* spp. (Exotic)	MEN (ENT)
55.	Mullilam	*Fagara budrunga* (Syn. *Zanthoxylum rhetsa*)	MUI
56.	Mundani	*Acrocarpus fraxinifolius*	MUN
57.	Narikel	*Pterygota alata*	NAR
58.	Neem	*Azadirachta indica*	NEE
59.	Nodunari	*Mansonia* spp.	NED
60.	Pali	*Palaquium ellipticum*	PAL
61.	Persian Lilach	*Melia azadarach*	PLI
62.	Piney	*Kingiodendron pinnatum* (Syn. *Hardwickia pinnata*)	PIN
63.	Pitraj	*Aphanamixis polystachya*	PIT
64.	Poon	*Colopyllum* spp.	POO
65.	Poplar	*Populus ciliata*	POP
66.	Poplar	*Populus deltoides*	POP
67.	Pula	*Kydia calycina*	PUL

Sl No.	Trade Name	Botanical Name	Abbreviation
68.	Pussur	*Xylocarpus molluccensis*	PUS
69.	Pyinma	*Lagerstroemia hypoleuca*	PYI
70.	Red Bombwe	*Planchonia valida* (Syn. *Planchonia andamanica*)	RBO
71.	Red Dhup	*Parishia insignis*	RDH
72.	Rosewood	*Dalbergia latifolia*	ROS
73.	Salai	*Boswellia serrata*	SAA
74.	Satinwood	*Chloroxylon swietenia*	SAT
75.	Seleng	*Sapium baccatum*	SEL
76.	Semul	*Salmolia malabrica*	SEM
77.	Silver Oak	*Grevillea robusta*	SOA
78.	Sissoo	*Dalbergia sissoo*	SIS
79.	Teak	*Tectona grandis*	TEA
80.	Toon	*Cedrela* spp.	TOO
81.	Udal	*Firmiana villosa* (Syn. *Sterculia villosa*)	UDA
82.	Uriam	*Bischofia javanica*	URI
83.	Vellapine	*Vateria indica*	VEL
84.	Walnut	*Juglans* spp.	WAL
85.	White Bombwe (badam)	*Terminalia procera*	WBO
86.	White Cedar	*Dysoxylum malabricum*	WCE
87.	White Chuglam	*Terminalia bialata* (Sapwood)	WCH

ANNEX C
(*Foreword*)

RECOMMENDED METHOD OF HANDLING, STORING AND USE OF PLYWOOD FOR CONCRETE SHUTTERING AND FORM WORK

C-1 GENERAL

C-1.1 Concrete shuttering plywood is a preservative treated, BWP-bonded plywood and has its economy in use for concrete shuttering because of its great re-use value. It is claimed that concrete shuttering plywood is capable of being re-used many times. However, the re-use value of concrete shuttering plywood depends on the care taken in handling the boards and following the manufacturer's instructions.

C-1.1.1 Another important advantage claimed for concrete shuttering plywood is that it gives to the concrete work smooth surface, requiring very little additional plastering. The retention of this quality by shuttering plywood again depends on the care taken during use. Cleaning the surface and occasional oiling go a long way in increasing the life of shuttering plywood. The large size panels in which shuttering plywood is available increases the economy, but only if nails and screws are fixed carefully and not allowed to damage the plywood unduly. Plywood for shuttering has an advantage over steel sheeting in very hot or very cold climatic conditions as the external heat or cold does not penetrate through plywood as it does in case of metal sheeting.

C-2 RECEIVING AND STORING

C-2.1 At the time of despatch from the factory, the plywood sheets shall be carefully loaded to prevent any damage. Extra care should be taken in the case of coated and film faced plywood to avoid any scratches. Preferably a sheet of thick water proof paper/polythene sheet may be inserted between the two surfaces to prevent scratches. The plywood should be properly secured and covered with tarpaulin to ensure delivery to destination in clean and serviceable condition.

C-2.2 The plywood boards shall be unloaded carefully from the carrier truck or wagon. These shall be lifted, carried and stacked in a careful manner to avoid damage to the corners of surfaces. These shall be stored in packs on a level, flat and raised surface in a clean, dry and covered place with free circulation of air. The boards and stacks shall be protected from rain and dampness. The edges of a board in a pack shall be in a straight vertical line. The top of the stack shall be covered with a cover board and weighed down suitably.

C-2.2.1 The plywood boards shall not be dragged particularly those supplied with plastic coating or with suitable overlay, over one another as this would scratch the surface if the edges are dragged on faces or any extraneous matter like sand or small stone particles lie in between the surfaces.

C-3 OILING THE SURFACE

Concrete shuttering plywood gives much longer service life if the surfaces are coated with suitable mould-oil which acts both as a parting agent and also gives surface protection.

The mould oil for use in coating of shuttering plywood should have the following basic

characteristics:

a) It shall be a solution of preservative in a heavy mineral oil with a viscosity of 70-80 centipoise.

b) It shall be free from dark and other suspended particles and shall be of light grey colour.

Some manufacturers supply the boards already shop-coated with mould-oil. After 3-4 uses and also in cases when plywood has been stored for a long time, it should be re-coated with mould-oil before the next use.

Cut edges of the plywood at the time of making concrete former should also be coated with suitable sealants like chlorinated rubber paint, for longer life of the board.

C-4 DRYING OF PANELS

The plywood for concrete shuttering work may be used repeatedly. However, if it has to be stored for a long time after one use, the panels should be dried by stacking in free circulation of air and on suitable spacers before storage.

C-5 DESIGN DATA

C-5.1 The following data are generally applicable to plywood for concrete shuttering work. However, as the species of timber used vary from manufacturer to manufacturer and with that the density and strength, the instructions of the manufacturers would be helpful for individual cases.

C-5.1.1 *Mass*

Generally, density of shuttering plywood may be taken as 650 kgf/m³. The mass per m² in various thickness is given below:

Thickness	*Mass*
mm	kg/m²
6	3·90
9	5·85
12	7·80
19	12·35
25	16·25

NOTE — When in wet condition, the mass may increase by 30 percent or more. The accuracy of the above mass can be taken only within a tolerance of ± 10 percent because of varying species and also variation in the moisture content.

C-5.2 Loading and Deflection

Taking the maximum permitted deflection as 1 : 270 (that is 1/270th of the span between the bearers), the following loads in kg/m² are arrived at; the maximum load permitted is given provided that the face grain of the plywood is perpendicualr to the length of bearers:

Centre Distance of Bearers (Span)	*9-mm Thickness*	*12-mm Thickness*
mm	kg/m²	kg/m²
300	1 270	1 950
400	540	850
450	320	640
600	170	360

C-5.2.1 When the face grain of plywood is parallel to the bearers, the permissible load may be as follows:

Centre Distance of Bearers (Span)	*9-mm Thickness*	*12-mm Thickness*
mm	kg/m²	kg/m²
300	760	1 220
400	320	540
450	195	390
600	110	170

NOTES

1 The above loads apply when the concrete is laid on concrete shuttering plywood as in slabs and beams. The same thickness of concrete in a wall can be held without excess deflection by thinner boards.

2 The maximum loads should be reduced to 75 percent if wet boards are used.

C-5.3 Bending Radii

The following are approximately the minimum bending radii for concrete shuttering plywood when dry:

Thickness	*Across the Grain of the Outer Plies*	*Parallel with the Grain of the Outer Plies*
mm	m	m
6	0·90	1·25
9	1·65	2·15
12	2·55	3·30

C-5.3.1 Plywood without any plastic coating or suitable overlay may be bent to still smaller radii by soaking in cold or hot water (temperature up to 70°C) before fixing.

C-5.4 Fixing

It is advised that, wherever possible, screws or nuts and bolts are used for fixing. When handling, scratching by screws, nuts and bolts or other metal fixtures should be avoided. This is particularly so in case of plywood with plastic coating or with suitable overlay.

C-6 CONSTRUCTION

C-6.1 Concrete shuttering formers for columns, piers, walls and other vertical surfaces are usually made from concrete shuttering plywood by fixing the same on to a backing framework of timber or iron. The timber frame members can be joined end to end by butt joint or lap joint or mitred joint. The shuttering plywood should be screwed or nailed to the framework. When designing the formers, these shall be made in the form of shooks to be joined side to side by suitable nuts and bolts spaced at suitable distances. This would permit easy assembly and dismantling of the former and reassembling for second use. Steel frameworks may be of angled iron or channel section suitably fabricated and braced to which shuttering plywood can be fixed either by nuts and bolts or by screws, the latter driven from the steel frame side. As an illustration, a concrete former box for a column is made in the form of four shooks or frames one for each side. The plywood is so fixed on to the timber or steel framework that it gives a flush surface on the inside. The four-side frames are assembled into box form by use of nuts and bolts at appropriate distances, where holes have been drilled earlier. After the concrete is poured and kept for the prescribed time, the former can be disassembled by opening the nuts and bolts fixed on the sides and reassembled or refixed for the second use with the same nuts and bolts.

C-6.2 Concrete formers for concrete walls or other broad vertical surface works may be similarly made in the form of wood or iron frames fixed with shuttering plywood panels. The two wide side surfaces on the two sides of a wall can be further secured to avoid a sag at intermediate places by use of nuts and bolts through the concrete. This would keep the former frames from spreading out. Such intermediate nuts and bolts may be removed after 48 hours of concrete pouring and the hole in the wall later on plugged with concrete. The bolts may also be left in and later on cut out at the protruding portions. An alternative method would be the provision of well-designed additional supports and props outside. Formers if required on one side only of a wall as in underground tanks and sewers, should be similarly made and suitably supported.

C-6.3 In case of concrete slabs, the concrete shuttering plywood may be laid without any framework on suitable bearers and assembled side by side with suitable fixing cleats to avoid any ridge formation in the concrete work at the joint. Dismantling may be done by carefully removing the props and beams from one side. Some users prefer use of backing frame work even for horizontal slabs and beams. Backing framework may be made of wood or steel.

C-6.4 For concrete beams, box formers are made as in **C-6.1** and then suitably supported by props.

C-6.5 Some users use steel framework into which plywood may be slid just in the same way as pressed steel shuttering sheets. The plywood for use as shuttering in such cases should be cut to the size of the recess or to the required shape and rested into the position like shuttering steel sheets.

C-6.6 The supporting structure for the plywood shuttering should be adequately strong. The design data given under **C-5.2** provides some guidance to design these supports.

C-6.7 Many users use thin sheets of concrete shuttering plywood as linings over conventional timber shuttering. The advantage gained by this is, primarily, a uniform, smooth surface on the concrete work. Care should be taken in such cases that the level of timber battens is reasonably correct to take the maximum advantage of getting a uniform and smooth surface finish of concrete work.

C-6.8 When used for architectural concrete and curved forms, the data given in **C-5.3** should be used to design the curved surfaces of the formers.

C-6.9 When removing concrete formers or sheets, care should be taken to carry out the parting, sliding and lowering carefully to avoid damage.

C-6.10 Plywood supplied with suitable overlay requires handling with special care to avoid scratching of the surface as scratches on the surface take away the advantage of surface overlay. The sheets after each use shall be cleaned of any sticking sand or aggregate.

C-7 PRECAUTIONS

C-7.1 After work at one site is over, the plywood used should be dried and sent to stores, or taken for re-use elsewhere. If a builder has finished his work and does not want to store shuttering plywood for long, the same could be disposed off to another builder for shuttering work or may be used as commercial plywood of non-decorative type for general purpose.

C-7.2 There is a tendency in builders to cut plywood to shorter sizes for convenient handling. This should be discouraged as the greatest advantage of plywood for concrete shuttering is in its availability in large sizes leading to smooth ridge-free concrete work, thus saving in the expenses of elaborate plastering.

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Wood Products Sectional Committee, CED 20

Chairman	*Representing*
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DR A. N. NAYER	In Personal Capacity (*C-59 Inderpuri, New Delhi 110 012*)
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(*Continued on page* 10)

(*Continued from page* 9)

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Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards: Monthly Additions'.

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AMENDMENT NO. 1 APRIL 2000
TO
IS 4990 : 1993 PLYWOOD FOR CONCRETE SHUTTERING WORK — SPECIFICATION

(Second Revision)

(*Second cover page, Foreword*) — Insert the following after fifth para as a separate para:

'A scheme of labelling environment friendly products to be known as ECO Mark has been introduced at the instance of the Ministry of Environment and Forests (MEF), Government of India. The ECO Mark shall be administered by the *Bureau of Indian Standards (BIS)* under the *BIS Act*, 1986 as per the Resolution No. 71 dated 21 February 1991 and Resolution No. 425 dated 28 October 1992 published in the Gazette of the Government of India. For a product to be eligible for ECO Mark, it shall also carry the Standard Mark of the BIS besides meeting additional environment friendly requirements. For this purpose, the Standard Mark of BIS would be a single mark being a combination of the ISI Mark and the Eco logo. Requirements to be satisfied for a product to qualify for the BIS Standard Mark for Eco friendliness, will be included in the relevant published Indian Standards through an amendment. These requirements will be optional; manufacturing units will be free to opt for ISI Mark alone also.

The amendment pertaining to Eco criteria is based on the Gazette Notification No. 170 dated 18 May 1996 for Wood Substitutes as Environment Friendly Products published in the Gazette of the Government of India.'

(*Page* 1, *clause* **5.1**) — Insert the following at the end of the clause:

'For ECO Mark only species of wood from sources other than natural forests such as wood from rubber, coconut, cashew, industrial and social forestry plantations, etc and shade trees from tea and coffee estates shall be used for the manufacture of plywood.'

(*Page* 4, *clause* **10.2**) — Insert the following new clause after **10.2** and renumber the subsequent clasues:

'**11 OPTIONAL REQUIREMENTS FOR ECO MARK**

11.1 General Requirements

11.1.1 The plywood shall conform to the requirements of quality and performance as specified in this standard.

11.1.2 The manufacturer shall produce to BIS environmental consent clearance from the concerned State Pollution Control Board as per the provisions of the *Water (Prevention and Control of Pollution) Act*, 1974 and *Air (Prevention and Control of Pollution) Act*, 1981 and *Water (Prevention and Control of Pollution) Cess Act*, 1977 alongwith the authorization, if required under the *Environment (Protection) Act*, 1986, while applying for ECO Mark appropriate with enforced rules and regulations of Forest Department.

11.2 Specific Requirements

The plywood shall conform to the specific requirements given for ECO Mark under relevant clauses of the standard.

NOTE — The manufacturer shall provide documentary evidence by way of certificate or declaration to Bureau of Indian Standards while applying for ECO Mark.'

(*Page* 4, *renumbered clause* **12.1**) — Insert the following matter under the clause:

'd) The criteria for which the plywood has been labelled as ECO Mark.'

(*Page* 4, *Annex* A) — Substitute 'IS 707 : 1976' *for* 'IS 707 : 1974' and 'IS 7638 : 1999 Wood/Lignocellulosic based panel products — Methods of sampling (*second revision*)' *for* 'IS 7638 : 1986 Methods of sampling for plywood, fibre hardboards, insulation boards and particle boards (*first revision*)'.

(CED 20)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 JULY 2002
TO
IS 4990 : 1993 PLYWOOD FOR CONCRETE SHUTTERING WORK — SPECIFICATION

(Second Revision)

[*Page* 2, *clause* **8.2**(b)] — Substitute the following for the existing clause:

'b) *In Core (Cross-Band)* — The width of the opening shall not exceed 1 mm in the case of 3-ply and 5-ply, and 2 mm in case of plywood of more than 5-ply, provided that such openings are not less than 300 mm apart in any veneer and staggered not less than 150 mm between any veneer and the next one with the same direction.'

(CED 20)

Reprography Unit, BIS, New Delhi, India