

INVITATION FOR QUOTATIONS FOR CONSTRUCTION OF CIVIL WORKS UNDER SHOPPING PROCEDURES.

No : CRO/TSD/KERS/NHP/ESTC QTN /2017-18/ 1770-79 Date: 01-02-2018

To:

Dear Sirs,

Sub:- INVITATION FOR QUOTATIONS UPGRADATION OF DATA CENTRE
AT KERS UNDER NHP.

1. You are invited to submit your most competitive quotation for the following works;

Sl. No.	Brief Description of the works	Approximate Value of Works (Rs. in lakhs)	Period of Completion
1	Providing wall paneling ,Acoustic works & Electrification to class rooms at ESTC ,KERS ,K R Sagara.	38.00 /-	60 Days (including monsoon & mobilisation Periods)

2. The Government of India has received Loan from the International Bank for Reconstruction and Development (IBRD) in various currencies equivalent to US Dollars 175.0 million towards the cost of the National Hydrology Project and intends to apply part of the proceeds of this Loan to eligible payments under the Contract(s) for which this Invitation for quotations is issued.
3. To assist you in the preparation of your quotation, the following details will be supplied to the intending bidder;
- Layout Drawings of the works;
 - Bill of Quantities;
 - Technical Specifications;
 - Instructions to Bidders;
 - Draft Contract Agreement format which will be used for finalizing the agreement for this Contract.
4. You are requested to provide your offer latest by **16.00 hrs on Dated: 03-03-2018**
5. Quotations will be opened in the presence of Bidders or their representatives who choose to attend at **17.00 hrs on Dated: 03-03-2018** in the **Office of the Chief Research officer T.S Division KERS ,KR Sagara.**
6. We look forward to receiving your quotations and thank you for your interest in this project.

Sd/-
Chief Research Officer,
Technical Services Division,
K.E.R.S., K.R.Sagara- 571 607.

1. Copy submitted to the Director, KERS, K.R.Sagara for kind information.
2. Copy submitted to the Chief Engineer and Project director NHP WRDO, Bangalore for kind information.
3. Copy to Principal, Engineering Staff College, for information with a request to display the Notification on the Notice Board.
4. Copy submitted to Director Geomatics, WRDO Bangalore, for kind information and requested to publish the quotation in WRDO website.
5. Copy to Chief Research Officer, S.M. & F.E. Division, KERS for information with a request to display the Notification on the Notice Board.
6. Copy to Chief Research Officer, Hydraulics Division, KERS for information with a request to display the Notification on the Notice Board.
7. Copy to Chief Research Officer, Coastal Engineering Division, KERS for information with a request to display the Notification on the Notice Board.
8. Copy to District Information and Public Relations Officer, Department of Information and Public Relations Office, Mandya for information with a request to publish the quotation notification in one State level Kannada news paper.
9. Copy to Research Officer, Works Branch, Technical Services Division KERS for information.
10. Copy to Accounts Superident, Technical Services Division.
11. Office Copy.

Chief Research Officer,
Technical Services Division,
K.E.R.S., K.R.Sagara- 571 607.

W-5

**PROCUREMENT OF CIVIL WORKS
UNDER
NATIONAL SHOPPING PROCEDURES**

**UNDER
NATIONAL HYDROLOGY PROJECT**

**UPGRADATION OF DATA CENTRE AT
KERS UNDER NHP.**

*(For Works valued less than equivalent of
US \$ 100,000 each)*

**INVITATION FOR QUOTATIONS FOR CONSTRUCTION OF
CIVIL WORKS UNDER SHOPPING PROCEDURES**

No: CRO/TSD/KERS/QTN/NHP/ESTC/CR /2017-18/ 1770-79

Date: 01-02-2018

To

Dear Sirs,

Sub: INVITATION FOR QUOTATIONS UPGRADATION OF DATA CENTRE
AT KERS UNDER NHP.

1. You are invited to submit your most competitive quotation for the following works:-

Sl. No	Brief Description of the works	Approximate Value of Works (Rs. in lakhs)	Period of Completion
1	Providing wall paneling, Acoustic works & Electrification to class rooms at ESTC, KERS, K R Sagara.	38.00 /-	60 days (including monsoon season)

2. The Government of India has received Loan from the International Bank for Reconstruction and Development (IBRD) in various currencies equivalent to US Dollars 175.0 million towards the cost of the National Hydrology Project and intends to apply part of the proceeds of this Loan to eligible payments under the Contract(s) for which this Invitation for quotations is issued.
3. To assist you in the preparation of your quotation, we are enclosing the following:
- Layout Drawings of the works;
 - Bill of Quantities
 - Technical Specifications;
 - Instructions to Bidders (in two sections).
 - Draft Contract Agreement format which will be used for finalizing the agreement for this Contract.
4. You are requested to provide your offer latest by **14.00 Hrs. on 03-03-2018**
5. Quotations will be opened in the presence of Bidders or their representatives who choose to attend at **17.00 hrs on 03-03-2018** in the " **Office of the Chief Research officer T.S.Division KERS ,KR Sagara.**"
6. We look forward to receiving your quotations and thank you for your interest in this project.

Name:

Address:

Instructions to Bidders

SECTION - A

1. Scope of Works

The invites quotations for the construction of works as detailed in the table given below

Brief Description of the Works	Approximate value of Works (Rs.)in lakhs	Period of Completion
Providing wall paneling ,Acoustic works &Electrification to class rooms at ESTC ,kers,K R Sagara.	38.00	60 days (including monsoon season)

The successful bidder will be expected to complete the works by the intended completion date specified above.

2. Qualification of the bidder: The bidder shall provide qualification information with supporting documents which shall include :

- Average annual turnover on construction works shall be at least 100 % of the estimated cost during last three years.
- Report on his financial standing, Solvency of the amount equal to or greater than 40 % of the estimated cost as certified from a bank.
- Details of any litigation, current or during the last 3 years in which the bidder is involved, the parties concerned and disputed amount in each case.

3. To qualify for award of the contract the bidder :-

- should have satisfactorily completed Similar works as a prime contractor atleast one work with value equal to or more than 80% of the estimated cost or two works each of at least 60 % value of the estimated cost or three works each of at least 40 % of the estimated cost in the last seven years.**
- should possess valid electrical license for executing building electrification works (in the event of the works being sub - contracted, the sub-contractor should have the necessary license);**
- should possess required valid license for executing the water supply/sanitary works (in the event of the works being sub-contracted, the sub-contractor should have the necessary license);
- The tenderer should be a KPWD registered Class-I & above Contractor.
- Work done certificate should be issued by competent authority not below the rank of Executive Engineer.

4. Bid Price

- a) All duties, taxes and other levies payable by the contractor under the contract shall be included in the **total price**.
- b) The rates quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.
- c) The rates should be quoted in Indian Rupees only.

5. Submission of Quotations

5.1 The bidder is advised to visit the site of works at his own expense and obtain all information that may be necessary for preparing the quotation.

5.2 Each bidder shall submit only one quotation.

5.3 The quotation submitted by the bidder shall comprise the following:-

- (a) Quotation in the format given in Section B.
- (b) Signed Bill of Quantities; and
- (c) Qualification information form given in Section B duly completed.

5.4 The bidder shall seal the quotation in an envelope addressed to the **Chief Research officer T.S Division KERS ,K.R.Sagara**. The envelope will also bear the following identification:-

- Quotation for. **Providing wall paneling ,Acoustic works &Electrification to class rooms at ESTC ,kers,K R Sagara.**
- Do not open before **17.00 Hrs on 03-03-2018**

5.5 Quotations must be received in the **office of the Chief Research officer TS Division KERS ,K.R.Sagara**. not later than the time and date given in the letter of invitation. If the specified date is declared a holiday, quotations shall be received upto the appointed time on the next working day.

5.6 Any quotation received in the **office of the Chief Research officer TS Division KERS ,K.R.Sagara** after the deadline for submission of quotations will be rejected and returned unopened to the bidder.

6. Validity of Quotation

Quotation shall remain valid for a period not less than **45 days** after the deadline date specified for submission.

7. Opening of Quotations

Quotations will be opened in the presence of bidders or their representatives who choose to attend on the date and time and at the place specified in the letter of invitation.

8. Information relating to evaluation of quotations and recommendations for the award of contract shall not be disclosed to bidders or any other persons not officially concerned with the process until the award to the successful bidder is announced.

9. Evaluation of Quotations

The Employer will evaluate and compare the quotations determined to be substantially responsive i.e. which

- (a) meet the qualification criteria specified in clause 3 above;
- (b) are properly signed ; and
- (c) conform to the terms and conditions, specifications and drawings without material deviations.

10. Award of contract

The Employer will award the contract to the bidder whose quotation has been determined to be substantially responsive and who has offered the lowest evaluated quotation price and who meets the specified qualification criteria.

- 10.1 Notwithstanding the above, the Employer reserves the right to accept or reject any quotations and to cancel the bidding process and reject all quotations at any time prior to the award of contract.
- 10.2 The bidder whose bid is accepted will be notified of the award of contract by the Employer prior to expiration of the quotation validity period.

11. Performance Security

Within 15 days of receiving letter of acceptance, the successful bidder shall deliver to **The Chief Research officer TS Division KERS ,K.R.Sagara** the the performance security (DD or FDR drawn in favour of **Chief Research officer, TS Division, KERS ,K.R.Sagara**) for an **amount equivalent of 7.5 % of the contract price**. The Performance Security shall be valid till the expiry of the period of maintenance of the work, specified in clause 12.

12. Period of Maintenance:

The “**Period of Maintenance**” for the **work is One year** from the date of completion of work. During the period of maintenance, the contractor will be responsible for rectifying any defects in construction free of cost to the Employer.

13. Purchase of all construction materials including cement and steel as per the specifications (ISI certification marked goods wherever available) shall be the responsibility of the contractor.

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SECTION - B

1. Format for Qualification Information.
2. Format for Submission of Quotation.
3. Format of Letter of Acceptance.

QUALIFICATION INFORMATION

1. For Individual Bidders

1.1 Principal place of business:

Power of attorney of signatory of Quotation.

[Attach copy]

1.2 Total value of Civil Engineering 20_____

(Construction work performed in the last 20_____

three years (in Rs. Lakhs) 20_____

1.3 Work performed as **prime contractor** (in the same name) on works of a similar nature over the last three years.

Project Name	Name of Employer	Description of work	Contract No.	Value of contract (Rs.Lakhs)	Date of issue of work order	Stipulated period of completion	Actual date of completion	Remarks explaining reasons for delay and work completed
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Existing commitments and on-going works:

Description of Work	Place & State	Contract No. & Date	Value of Contract (Rs. Lakh)	Stipulated period of completion	Value of works* remaining to be completed (Rs. Lakhs)	Anticipated date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)

* Enclose a certificate from Engineer concerned.

1.4 Proposed subcontracts and firms involved.

Sections of the works	Value of Sub-contract	Sub-contractor (name & address)	Experience in similar work
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- 1.5** Evidence of access to financial resources to meet the requirements of working capital: cash in hand, lines of credit, etc. List them below and attach copies of support documents.
- 1.6** Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.
- 1.7** Information on litigation history in which the Bidder is involved.

Other party(ies)	Employer	Cause of dispute	Amount involved	Remarks showing present status

QUOTATION

Description of the Works: **Providing wall paneling ,Acoustic works & Electrification to class rooms at ESTC ,KERS ,K R Sagara.**

To:

Subject : UPGRADATION OF DATA CENTRE AT KERS UNDER NHP.

Reference: dated.....2018...

Sir,

We offer to execute the Works described in your letter referred to above in accordance with the Conditions of Contract enclosed for a total Contract Price of -

Rs. ** _____ [in figures]

Rs. _____ [in words]

This quotation and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any quotation you receive.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

We hereby confirm that this quotation is valid for 45 days as required in Clause 6 of the Instructions to Bidders.

Yours faithfully,

Authorized Signature : _____ Date: _____

Name & Title of Signatory : _____

Name of Bidder : _____

Address :

* To be filled in by the Employer before issue of the Letter of Invitation.

** To be filled in by the Bidder, together with his particulars and date of submission at the bottom of this Form.

**LETTER OF ACCEPTANCE
CUM NOTICE TO PROCEED WITH THE WORK**

(LETTERHEAD OF THE EMPLOYER)

Dated : _____

To : _____

[Name and address of the Contractor]

Dear Sirs,

This is to notify you that your Quotation dated _____ for execution of the _____ for the contract price of Rupees _____ [amount in words and figures], is hereby accepted by us.

You are hereby requested to furnish performance security for an amount of Rs. _____ **(equivalent to 7.5% of the contract price) within 15 days** of the receipt of the letter. The Performance Security in the form of DD or Pay order in favour of **Chief Research officer, T.S Division, KERS ,K.R.Sagara** shall be valid till the expiry of the period of maintenance i.e. upto _____. Failure to furnish the Performance Security will entail cancellation of the award of contract.

You are also requested to sign the agreement form and proceed with the work not later than _____ under the instructions of the Engineer, _____ and ensure its completion within the contract period.

With the issuance of this acceptance letter and your furnishing the Performance Security, contract for the above said work stands concluded.

Yours faithfully,

Draft Agreement form for Construction through National Shopping

ARTICLES OF AGREEMENT

This deed of agreement is made in the form of agreement on _____ day _____ month _____ 2018, between the _____ (Employer) or his authorized representative (hereinafter referred to as the first party) and _____ (Name of the Contractor), S/O _____ resident of _____ (hereinafter referred to as the second party), to execute the work of construction of _____ (hereinafter referred to as works) on the following terms and conditions.

2. Cost of the Contract

The total cost of the works (hereinafter referred to as the "total cost") is Rs. _____ as reflected in Annexure - 1.

3.1 Payments under its contract:

Payments to the second party for the construction work will be released by the first party in the following manner:-

After Successful completion of whole work - 100% of the total cost acceptable by the first party

3.2 Payments will be made by the first party:

- (a) on the second party submitting an invoice for an equivalent amount ;
- (b) on certification of the invoice by the engineer nominated by the first party with respect to quality of works in the format in Annexure - 2;

4. Notice by Contractor to Engineer

The second party, on the works reaching each stage of construction, issue a notice to the first party or the Engineer nominated by the first party (who is responsible for supervising the contractor, administering the contract, certifying the payments due to the contractor, issuing and valuing variations to the contract, awarding extensions of time etc.), to visit the site for certification of stage completion. Within 15 days of the receipt of such notice, the first party or the engineer nominated by it, will ensure issue of stage completion certificate after due verification.

5. Completion time

The works **should be completed in 60 days (months/weeks/days)** from the date of this Agreement. In exceptional circumstances, the time period stated in this clause may be extended in writing by mutual consent of both the parties.

6. If any of the compensation events mentioned below would prevent the work being completed by the intended completion date, the first party will decide on the intended completion date being extended by a suitable period:
- a) The first party does not give access to the site or a part thereof by the agreed period.
 - b) The first party orders a delay or does not issue completed drawings, specifications or instructions for execution of the work on time.
 - c) Ground conditions are substantially more adverse than could reasonably have been assumed before issue of letter of acceptance and from information provided to second party or from visual inspection of the site.
 - d) Payments due to the second party are delayed without reason.
 - e) Certification for stage completion of the work is delayed unreasonably.
7. Any willful delay on the part of the second party in completing the construction within the stipulated period will render him liable to **pay liquidated damages. @ Rs. 1900 / per day** which will be deducted from payments due to him. The first party may cancel the contract and take recourse to such other action as deemed appropriate once the total amount **of liquidated damages exceeds 2 % of the contract amount.**

(* Note : The amount of liquidated damages per day is determined at 0.05 % of the contract value of the works and indicated there).

8. Duties and responsibilities of the first party

- 8.1 The first party shall be responsible for providing regular and frequent supervision and guidance to the second party for carrying out the works as per specifications. This will include written guidelines and regular site visit of the authorized personnel of the first party, for checking quality of material and construction to ensure that it is as per the norms.
- 8.2 The first party **shall supply 3 sets of drawings**, specifications and guidelines to the second party for the proposed works.
- 8.3 Possession of the site will be handed over to the second party within 10 days of signing of the agreement.
- 8.4 The Engineer or such other person as may be authorized by the first party shall hold meeting once in a month where the second party or his representative at site will submit the latest information including progress report and difficulties if any, in the execution of the work. The whole team may jointly inspect the site on a particular day to take stock of activities.

- 8.5 The Engineer shall record his observations/instructions at the time of his site visit in a site register maintained by the second party. The second party will carry out the instructions and promptly rectify any deviations pointed out by the engineer. If the deviations are not rectified, within the time specified in the Engineer's notice, the first party as well as the engineer nominated by it, may instruct stoppage or suspension of the construction. It shall thereupon be open to the first party or the engineer to have the deviations rectified at the cost of the second party.

9. Duties and responsibilities of the second party

9.1 The second party shall:

- a) take up the works and arrange for its completion within the time period **stipulated in clause 5;**
- b) employ suitable skilled persons to carry out the works ;
- c) regularly supervise and monitor the progress of work ;
- d) abide by the technical suggestions / direction of supervisory personnel including engineers etc. regarding building construction ;
- e) be responsible for bringing any discrepancy to the notice of the representative of the first party and seek necessary clarification :
- f) ensure that the work is carried out in accordance with specifications, drawings and within the total of the contract amount without any cost escalation ;
- g) keep the first party informed about the progress of work ;
- h) be responsible for all security and watch and ward arrangements at site till handing over of the building to the first party ; and
- i) maintain necessary insurance against loss of materials/cash, etc. or workman disability compensation claims of the personnel deployed on the works as well as third party claims.
- j) Pay all duties, taxes and other levies payable by construction agencies as per law under the contract (First party will effect deduction from running bills in respect of such taxes as may be imposed under the law).

10. Variations / Extra Items

The works shall be carried out by the second party in accordance with the approved drawings and specifications. However, if, on account of site conditions or any other factors, variations are considered necessary, the following procedure shall be followed:-

- a) The second party shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven days of the request before the Variation is ordered.

- b) If the quotation given by the second party is unreasonable, the Engineer may order the Variation and make a change to the Contract Price which shall be based on Engineer's own forecast of the effects of the **Variation on the Contractor's costs.**
- c) **The second party shall not be entitled to additional payment for costs which could have been avoided by giving early warning.**

11. Securities

The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance As mentioned in Section A clause 11.

12. Termination

12.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

12.2 Fundamental breaches of Contract include, but shall not be limited to the following:

- a) The contractor stops work **for 28 days** and the stoppage has not been authorized by the Engineer;
- b) The Contractor has become bankrupt or goes into liquidation other than for a reconstruction or amalgamation;
- c) The Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;
- d) The Contractor does not maintain a security which is required;

12.3 Notwithstanding the above, the Employer may terminate the Contract for convenience.

12.4 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

13. Payment upon Termination

13.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law.

13.2 If the Contract is terminated at the Employer's convenience, **the *Chief Research Officer* shall issue a certificate for the value of the work done,** the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to be deducted at source as per applicable law.

14. Dispute settlement

If over the works, any dispute arises between the two parties, relating to any aspects of this Agreement, the parties shall first attempt to settle the dispute through mutual and amicable consultation.

In the event of agreement not being reached, the matter will be referred for arbitration by a Sole Arbitrator not below the level of retired Superintending Engineer, PWD to be appointed by the first party. The Arbitration will be conducted in accordance with the Arbitration and Conciliation Act, 1996. The decision of the Arbitrator shall be final and binding on both the parties.

BILL OF QUANTITIES

Sl.No.	Description of Work	Qty.	Unit	Quoted Rate		Amount In Rs.
				In figure (Rs.)	In Words	
<div>ENCLOSED</div>						

Gross Total Cost: Rs.....

We agree to execute the works in accordance with the approved drawings and technical specifications i.e., for a total contract price of Rs. (amount in figures) (Rs. amount in words).

Signature of Contractor

Format of certificate

Certified that the works upto ----- level in respect of construction of ----- at ----- have been executed in accordance with the approved drawing and technical specifications.

Signature

Name & Designation
(Official address)

Place :

Date :

Office seal

Name of work:- UPGRADATION OF DATA CENTRE AT KERS UNDER NHP.

(Providing wall panelling, Acoustic Works and Electrification to class rooms at ESTC, KERS K.R.Sagara)

SI No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
Part -A Civil Work						
1	Providing and fixing acoustic Veneer paneling, over the 50mm x 35mm sal wood frame work at spacing not exceeding 600mm c/c fixed to the wall and top covered out of 4mm thick approved quality Veneer, fixed over 19mm thick ply strips of 100mm to 200mm with a gap of 6 to10mm in between strips of approved brand termite and water resistance, finished with melamine polish, complete including cost and conveyance of all materials, labour for all items of work, HOM of equipment including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	302.89			
2	Providing and fixing 100mm wide venitian blinds of window fashion fabric of Taiwan make, with 50mm thick powder coated channel with balance, imported, acrylic self alignable mechanism and equally placed spacers, imported tilting mechanism for easy tilting operation,with nylon imported thread and beadings, 100mm wide imported washable reusable fabric placed with top hanger and bottom with 100mm long bottom plate connected to nylon imported bottom link chain. The rate is inclusive of drilling holes for fixing channels to the wall, fixing threads and beadings and link chains, hard ware fixtures complete as per drawing, Specification including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	40.44			
3	Mineral Fiber false ceiling : Providing and laying of world class mineral acoustic ceiling panels of as per the following specification:- Tile of approved make Mineral Acoustic ceiling panels of size 595x595mm-12mm thick suitable for use in arrears up to 40 C and RH 70UR as per manufacturer. Tile have 15 min fire retardant and does not contain asbestos/urea formaldehyde, Technical details of New Modena are- Thermal conductivity Non-disposable, Light Reflection 80% fire resistance Non-resistance Non-disposable. Mineral fiber ceiling panels are placed inside the grid work. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	143.12			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
4	Providing and laying of teak wooden polished flooring of 12mm thick, high density timber of approved colour and design with end trims, transition, profiles, beading, 15mm thick felt, and 20 micron polyester film with 4mm thick foam underlay etc including cost of materials, mortar, labour, curing, etc Complete as per Specification including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	76.84			
5	dismantling of existing wall at class room Dismantling burnt brick masonry in clay mortar/lime mortar/cement mortar and stacking the bricks within a radius of 50m and removing the debris to a distance upto 200m. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Cum	1.33			
6	Providing &fixing Honne wood door frame KSRB 9.4-2 : Providing Honne wood frames of doors, windows, clerestory windows, ventilators and other frames, wrought, framed or assembled including making plaster grooves (excluding cost of cement concrete and side clamps), but including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work. . Specification No. KBS 9.33.	Cum	0.19			
7	Providing &fixing HONNE wood door shutters KSRB 9.5-1 : Providing and fixing in position fully panelled Honne wood shutters for doors, styles and rails of 40mm. thick with bottom and lock rails 180mm wide top rail and styles 100mm wide as per drawing and panels of 25mm thick including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work. (excluding cost of fixtures) Specification No. KBS 9.34.	Sqm	4.28			
8	KSRB 6-5.4 : Providing and constructing burnt brick masonry with approved quality of modular bricks of standard size of class designation 5.0 Newton per sqmm (table moulded) with cement mortar 1:4 for basement and superstructure including cost of materials, labour charges, scaffolding, curing including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work. Specification No. KBS 6.2	Cum	0.41			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
9	KSRB15-3.5 : Providing 15mm thick cement plaster in single coat with cement mortar 1:4, to brick masonry including rounding off corners wherever required smooth rendering, : Providing and removing scaffolding, including cost of materials, labour, curing complete as per specifications. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	7.70			
10	Dismantling the tile work in floor and roof laid in cement or surki mortar including stacking the materials with in 50 m lead of tiles thickness 10mm to 25mm. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	6.00			
11	Providing and Fixing vitrified tiles of approved make, quality and colour of size 600x600x10mm thick fixed on bed of 12mm thick cement mortar for flooring, skirting and jointed with neat cement slurry mixed with pigment to match shade of tile, including proving spaces at required interval and removing stains, including cost of all materials , mortar, labour, etc complete as per specification including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	6.00			
12	KSRB 15-14.1 : Providing and applying two coats with oil bound washable distemper of approved brand and shade on wall surface including priming coat with distemper primer after thoroughly brooming the surface free from mortar drops and other foreign matter including preparing the surface even and sand paper smooth, cost of materials, labour complete as per specification, including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	40.69			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
13	Providing and fixing door frame with or without ventilator made out of cold rolled steel section of thickness 1.25mm formed into section of 60mm x 105mm welded to form a rectangular door conforming to IS 513-1973 and phosphated and painted and with one coat of red oxide primer, two coat of approved enamel paints the frame work with 4nos. of hold fast of size 200 x 25 x 4mm fixed in cement concrete 1:3 :6 of 20mm down size jelly and 4nos. of ISI marked hinges 125mm long welded to the frame and fixed with shutter made out of Honne wood styles and rails of 30mm thick with panels of 12mm thick 'Ecoboard' Plain Particle Board of exterior grade conforming to IS- 3087 excluding the cost of fixtures but including labour charges for fixing of fixtures.. The hollow portion of the frame to be filled with c.c1:2:4 of 20mm down size jelly.including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Sqm	4.62			
Part - B Electrical Works						
1	Open Conduit System Supplying heavy gauge PVC conduit pipe 25mm dia 2mm thick confirming to IS 2509 with suitable size bends, junction boxes, adhesive paste etc., and fixing using inverted wood plugs in case of RCC ceiling and RCC wall stone structure or rawl plugs in case of brick walls and cement plastering damaged portion using heavy gauge saddles at an interval of 700mm using NF screws. as specification including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	150.00			
2	Open Conduit System Supplying heavy gauge PVC conduit pipe 32mm dia 2.5mm thick confirming to IS 2509 with suitable size bends, junction boxes, adhesive paste etc., and fixing using inverted wood plugs in case of RCC ceiling and RCC wall stone structure or rawl plugs in case of brick walls and cement plastering damaged portion using heavy gauge saddles at an interval of 700mm using NF screws. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	10.00			
3	Supplying And Fixing M.S. Rafter ClampSet made out of M.S. Flat & 14mm M.S. rod. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	8.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
4	Supplying and surface/flush mounting unbreakable PVC modular box suitable for mounting modular switch plates. The box should be firmly surface/flush mounted after due groove cutting in Brick/C.C wall, fixing including necessary rawl plugs, Machine/NF screws etc., complete.1-3Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	10.00			
5	Supplying and surface/flush mounting unbreakable PVC modular box suitable for mounting modular switch plates. The box should be firmly surface/flush mounted after due groove cutting in Brick/C.C wall, fixing including necessary rawl plugs, Machine/NF screws etc., complete. 6-8Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			
6	Supplying and surface/flush mounting unbreakable PVC modular box suitable for mounting modular switch plates. The box should be firmly surface/flush mounted after due groove cutting in Brick/C.C wall, fixing including necessary rawl plugs, Machine/NF screws etc., complete. 10-12Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	10.00			
7	Supplying and flush mounting powder coated metal box suitable for mounting modular switch plates. The box should be firmly flush mounted after due groove cutting in Brick/Stone/C.C wall 1-3Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	10.00			
8	Supplying and flush mounting powder coated metal box suitable for mounting modular switch plates. The box should be firmly flush mounted after due groove cutting in Brick/Stone/C.C wall 8Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			
9	Supplying and flush mounting powder coated metal box suitable for mounting modular switch plates. The box should be firmly flush mounted after due groove cutting in Brick/Stone/C.C wall 10-12Way including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	10.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
10	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 sing Group "A" materials 6Amps one way. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	30.00			
11	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 Using Group "A" materials 6Amps 3way socket. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	12.00			
12	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 Using Group "A" materials Stepped Fan Regulator. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
13	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 Using Group "A" materials 32Amps DP switch including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
14	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 Using Group "A" materials 6/16Amps universal socket including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
15	Supplying and fixing of modular switch/ Socket/stepped electronic fan regulator/ dimmer/telephone socket etc on existing modular switch plate as per IS 3854 and IS 1293 using Group "A" materials RJ45/ I.O. outlet including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	10.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
16	Point wiring using Copper wire without switch. Supplying and wiring adopting loop system in existing PVC Conduit /casing capping using 1100V grade, COPPER conductor flexible multicore FRPVC insulated, extruded FR PVC outer sheathed 2C X1.5Sq.mm Cable confirming to the GTP without switch, the other end of the wires shall be terminated with sufficient loose length in a wood/PVC round block. complete for each outlet. Short point up to 3Mtr from tapping point to out let via switch box including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Pts	6.00			
17	Point wiring using Copper wire without switch. Supplying and wiring adopting loop system in existing PVC Conduit /casing capping using 1100V grade, COPPER conductor flexible multicore FRPVC insulated, extruded FR PVC outer sheathed 2C X1.5Sq.mm Cable confirming to the GTP without switch, the other end of the wires shall be terminated with sufficient loose length in a wood/PVC round block. complete for each outlet. Medium point above 3Mtr up to 6Mtr from tapping point to out let via switch box including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Pts	6.00			
18	Point wiring using Copper wire without switch. Supplying and wiring adopting loop system in existing PVC Conduit /casing capping using 1100V grade, COPPER conductor flexible multicore FRPVC insulated, extruded FR PVC outer sheathed 2C X1.5Sq.mm Cable confirming to the GTP without switch, the other end of the wires shall be terminated with sufficient loose length in a wood/PVC round block. complete for each outlet. Long point above 6Mtr up to 10Mtr from tapping point to out let via switch box including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Pts	6.00			
19	Supplying and fixing a drop light using one PBBC/bakelite pendent holder, PVC insulated twin twisted copper wire of 10/0.3mm length upto 1000mm, one of 60/100 watts lamp of 230 volts grade and one of 5 amps bakelite ceiling rose fixed on the existing wooden block of the outlet Group A. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	18.00			
20	Wiring for lighting/power circuit using one of FRPVC insulated 1100V grade, multistrand Copper conductor single core cable in open or concealed system of wiring as per IS-694:1990 & confirming to the attached GTP of GROUP -B. 1.5sqmm. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	150.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
21	Wiring for lighting/power circuit using one of FR PVC insulated 1100V grade, multistrand Copper conductor single core cable in open or concealed system of wiring as per IS-694:1990 & confirming to the attached GTP of GROUP -B. 2.5 sqmm including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	150.00			
22	Wiring for lighting/power circuit using one of FR PVC insulated 1100V grade, multistrand Copper conductor single core cable in open or concealed system of wiring as per IS-694:1990 & confirming to the attached GTP of GROUP -B. 4 sqmm including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	200.00			
23	Supplying and fixing miniature circuit breakers on existing MCB distribution boards using necessary fixing materials and 'C' Type curve , indicator ON/OFF, energy cross-3 with Short circuit breaking capacity of 10K and complete wiring as required confirming to IEC 60898. Group A 5-32 Amps DP including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
24	Supplying and fixing miniature circuit breakers on existing MCB distribution boards using necessary fixing materials and 'C' Type curve , indicator ON/OFF, energy cross-3 with Short circuit breaking capacity of 10K and complete wiring as required confirming to IEC 60898. Group A 40-63Amps DP including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
25	Supplying and fixing miniature circuit breakers on existing MCB distribution boards using necessary fixing materials and 'C' Type curve , indicator ON/OFF, energy cross-3 with Short circuit breaking capacity of 10K and complete wiring as required confirming to IEC 60898. Group A 40-63Amps TPN including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	1.00			
26	Supplying, fixing and wiring Earth Leakage Miniature Circuit Breaker [ELMCB] 240/450V up to 300mA sensitivity on existing wood/panel board. 32-40 Amps 4 pole including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	1.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
27	Supplying and fixing regular MCB distribution boards on wall / wood board / flush mounting using required clamps, bolts, nuts etc., with provision for fixing suitable type capacity MCB's single phase / 3 phase / single door with powder coated painting. Made out of 14 SWG MS enclosure. II - Double Door 8Way SP &N Group A including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
28	Supplying wall mounting fan suitable to operate at single-phase 230v A.C. supply. 300mm Sweep Group A including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
29	Supply of 2'x2' LED recessed luminaire with 36 Watts system wattage. Housing shall be with pressure die cast aluminium alloy with corrosion proof resistant polyester power coated. Driver operates with voltage range from 100V to 270V 50/60 Hz with short circuit, overload & mis-wiring protection. Lumen Maintenance of 70% at 50000 Hrs. Injection moulded poly carbonate diffuser for better mechanical stability, light transmission & avoid pot hole effect. Junction temperature shall be < 70 degree Celsius. Driver is on constant current driver @ 0.06A with PF > 0.92 with line voltage @ 220-240V @ 50/60Hz, driver efficiency > 85% & THD<15%. LED Efficiency > 130 lm/W at 1W & Fixture Efficiency >75lm/w with CRI > 75 with injection moulded Polycarbonate lens with < 8mm depth. 5 years Warranty against any manufacturing defect working under standard electrical condition LED modular downlight 2'x2' 36 watts Group A including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	12.00			
30	Supply of LED Square Recessed Downlighter with 18W System Wattage. Housing shall be with powder coated pressure die cast aluminium alloy with corrosion resistant polyester powder coat & with extended heat sink. Diffuser/cover made of Lexan plastic material. Rated life shall be L70 @ 50000 Hrs which shall has inbuilt electrical protection like over/under voltage, short circuit, overload, open circuit & miswiring. Driver is on constant current driver @ 0.06A with PF > 0.9 with line voltage @ 220-240V @ 50/60Hz, driver efficiency > 85% & THD<15%. LED Efficiency > 130 lm/W & Fixture Efficiency >75lm/w with CRI > 75 with injection moulded Polycarbonate lens. 5 years Warranty against any manufacturing defect working under standard electrical condition LED Recessed Downlighter with 18W including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	16.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
31	LED Light fixture withW System Power consumption. LED Efficiency>130lm/w at 1W & Fixture Efficiency >80lm/w with nominal CRI >75. Luminaire manufacturer should have in-house facility accredited by NABL/CPRI & any Government certified agency & Design & Development facility certified by ISO 9001:2008 . Housing with supplier word mark /name shall be Engraved / Embossing on the die cast housing/ Body part. Warranty of 5 Years against any manufacturing defect working under standard electrical conditions as mentioned above should be given by LED manufacturer & Cree/Nichia/Lumileds/Osram make LED Source. Suitable for B1/B2 Roads as per IS 1944 Part I & Part II. LED Streetlight 65watts including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	4.00			
32	Supplying fixing and wiring earth electrode for grounding of lifts, transformers, DG sets etc using 40mm dia 2.9mm thick 2.5 mtr long GI pipe with GI funnel with mesh and suitable size reducer fixed on the top of the earth electrode. The funnel should be enclosed in a CC chamber of 400x400x400mm with a cast iron cover. The earth electrode shall have staggered holes of 12mm dia and the electrode should be covered 150mm around with alternate layers of salt and charcoal from the bottom of the CC chamber. The connection from the electrode is to be established through GI strip using GI bolts and nuts. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	2.00			
33	Supplying and running GI/Copper conductor for grounding and (along with other wires in conduit system of wiring) using necessary suitable size clamps, nails, guttas/spacers etc. GI Wire c) 8 SWG including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	20.00			
34	Supplying and Fixing 32mm dia class A GI pipe bracket up to 2.7 meters long terminated with a reducing collar of 40x25mm to which extra pipe of 175mm length is fixed for fixing MV/SV/MH/FTL street light fitting of all capacities on rail/RCC/wall/tubular pole, using suitable clamps, bolts ,nuts and wiring using suitable capacity wires. Using 32mm dia G.I.pipe including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
35	Fixing all types and all capacities of fluorescent / false ceiling / spot light / CFL / LED fittings indoor on the wall / ceiling / rafters / girders using 23/0.0076" twin twisted PVC insulated wires, required Nos of round blocks and clamps. On wall / ceiling / Rafter / Girders including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	28.00			
36	Fixing a ceiling / wall mounting fan of all capacities and all types, with necessary clamps and 'S' hook made out of 15mm dia MS rod, with 5 amps. ceiling rose of approved quality with necessary length of 23 / 0.0076 inch PVC insulated twin twisted wire of approved quality, mounted on a suitable size wooden board and wired. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
37	Supply , installation, testing and commisioning of Table top model chairman unit with gooseneck mic with ring LED and interconnection cable and out sockets for linking next unit with talk and priority switch aluminium/PVC housing and headphone socket including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	2.00			
38	Supply , installation, testing and commisioning of Table top model Delegate unit with gooseneck mic with ring LED and interconnection cable in and out sockets for linking next unit with talk switch aluminium/PVC housing and headphone socket. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	2.00			
39	Supply,installation, testing and commissioning of 2 core shielded multistrand high gain low loss cable with required end connectors 10meter to connect between the delegate units including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	50.00			
40	Supply,installation, testing and commissioning of compact Wall mount speaker with power handling up to 40Watt RMS 0/100volt@ 1456 ohms single channel. selectable taping Specs: Power handling : 15 to 30 watt Frequency response : 80 Hz to 18khz Spl :including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	8.00			
41	Supply, installation, testing and commisioning of Controller unit with 1 mic input 1 aux PA out, Rec out, rack mountable. can handle up to 60 delegate units.with expansion options.including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	2.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
42	Supply, installation, testing and commissioning of booster amplifier with power handling of 250 to 300 watt RMS 4ohms Dual and 100/70 volt output on bridge mode single channel Rack mountable Specs: frequency response : 20 hz to 20khtz including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	2.00			
43	Supply, installation, testing and commissioning of cardioids handheld/collar VHF/UHF wireless microphone Transmitter and receiver with selectable carrier Frequency from VHF/UHF 179-279 MHz. 575 Mhz to 875 Mhz including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	4.00			
44	Supply, installation, testing and commissioning professional grade 2.5 sq mm TIN coated low loss 2 core multi strand Oxidation Free speaker cable including, lead and lifts, loading and unloading, cost of conveyance for all the materials with the acces including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	240.00			
45	Supplying and drawing UTP-CAT 6E LAN cable. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	100.00			
46	Supplying fixing of Network Switches. 5 port 10/100 Switch including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
47	Supplying fixing of Network Switches. 16 port 10/100 Switch including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
48	Supplying & Fixing of switch mounting rack with power manager & Cable manager 6U with 450mm depth including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
49	Supplying & Fixing of Power strip including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
50	Supplying of shelf including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
51	Supplying & Fixing of Fan including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			

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				In Figure (Rs.)	In Words	
52	Supplying & Fixing of 1.0 mtrs Cat6 Patch Cable 1mtr including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	20.00			
53	Supplying of 2.0 TR split Air conditioners suitable for operation on A/C supply single phase 50 Hz 230 Volts with hermetically sealed compressor with air cooled condenser, motor capacitor and start run capacitors, relay and over load protector internal unit, with one indoor and one outdoor unit. The condenser unit will be placed outside the room on the terrace to avoid noise including standard length of suitable size copper tubing covered with insulation tube.(High wall chorded/chordless) suitable capacity 3 core sheathed/ PVC copper cable and a battery operated wireless remote unit. 3star 2 ton capacity including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			
54	Installation charges for split type air conditioner with allied works for one indoor and one outdoor unit is to be mounted on suitable Angle Iron support up to 3.0 ton split/cassette type A/C. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			
55	Supplying and installation of insulated refrigerent copper tubing of 5/8`` and 3/8`` with polythene foam insulation 3 core 80 stand copper wiring between indoor and outdoor unit. Leak testing oil and gas charging for additional piping length of tube. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	40.00			
56	Supplying & filling refrigerent (F-22/F/12) for air conditioning equipments. Which includes the labour & Nitrogen gas for pressure and leak testing. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Kg	10.00			
57	Extra for Fabrication supply and fixing of Stand fabricated using slotted angle/L.angle of size 6mm x 50mm for mounting out door/indoor A.C. unit./ Batteries. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			
58	Supplying, errection, testing and commissioning of voltage stabilizer suitable for 170 to 270 v in put and load variation from no load to full load, with over load protection, spike suppression, operating at 0 C.To 40 C. Range etc., complete. 4KVA Capacity including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	4.00			

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				In Figure (Rs.)	In Words	
59	supplying erecting testing and comissining of offline UPS System suitable for operation on 230V-50HZ AC supply with all accessories complete and excluding battaries and wiring complete with 2KVA offline UPS 2 hour back up excluding 3 x 120 AH battaries including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
60	supplying erecting testing and comissining of 12 V DC 180 AH capacity maintance free battaries in poly propylene container for UPS low maintainance tubular battaries of 180 AH capacity for 2 hours backup online UPS System suitable for operation on 230V-50HZ AC supply with all accessories complete and excluding battaries and wiring for 5KVA onlin UPS 2 hour back up excluding 6 x 150 AH battaries including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	6.00			
61	Supply, Erection, testing and commissioning of AMF panel suitable for 30.0 KVA DG set. The panel is of cubical type base/floor mounting control panel with hinged doors, undrilled bottom gland plate, aluminum Bus Bar with the accommodation foramps 4 pole contactor for alternator with thermal O/L relay,..... Amps 4 pole contactor for mains, HRC fuse for short circuit protection, Microprocessor based AMF module with supply failure timer, Restoration timer, 3 impulse automatic engine start/stop logic, Mains/generator voltage,capacity bypass switch and frequency sensing, PCC 1301 controller with water temperature/Lube oil pressure/ engine speed, Voltage/ampere/Frequency/ KVA, Running-hour count, No of starts, Fault indication, over /under speed, Fails to start, Low oil pleasure, High engine temperature, Under/over voltage, over current, Earth fault relay, with indications for Mains on, Load on Mains, Battery charger on Push buttons AMf module by pass Mode, Battery charger unit with inbuilt Auto/Manual and Flat/Boost facility. - Up to 62.5kva dg set including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Each	2.00			
62	Supplying fixing and wiring earth electrode for grounding of lifts, transformers, DG sets etc. using 40mm dia 2.9mm thick 2.5 mtr long GI pipe with GI funnel with mesh and suitable size reducer fixed on the top of the earth electrode. The funnel should be enclosed in a CC chamber of 400x400x400mm with a cast iron cover. The earth electrode shall have staggered holes of 12mm dia and the electrode should be covered 150mm all-round with alternate layers of salt and charcoal from the bottom of the CC chamber. The connection from the electrode is to be established through GI strip using GI bolts and nuts. including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	No's	4.00			

Sl No.	Description of Item	Unit	Quantity	Rate Quoted by Agency		Total Amount in Rs.
				In Figure (Rs.)	In Words	
63	Supplying of 1.1 KV LT UG cable having aluminum conductor PVC insulated, extruded inner sheathed, galvanized, steel strip (except 2CX10Sq.mm wire armoured) confirming to IS-3975:1990 (No. of Strip indicated in GTP) & extruded PVC outer sheathed armoured cable with specified IS-1554 Part-1:1988 & confirming to GTP of GROUP-A. 3.5 core 50 sqmm including cost of materials, labour, HOM of machineries, lead and lift, Transportation, loading and unloading, all taxes etc complete as per specifications and as Directed by the Engineer in charge of work.	Mtr	20.00			

Grand Total Cost : Rs.

We agree to execute the works in accordance with the approved drawings and technical specifications at total contract price of Rs.
..... (amount in figures)

(Rs.)(amount in words).

Signature of Contractor

SECTION 6 BRICKWORK

6. SPECIFICATIONS FOR BRICKS / BRICK TILES / BRICK BATS

6.1. **Bricks / Brick tiles / Brick bats** - Bricks used in the masonry may be of the following type:

a) **Common burnt clay bricks** - Shall be hand moulded or machine moulded. They shall be free from nodules of free lime; visible cracks, flaws warpage and organic matter have a frog 100mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be marked with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials.

b) **Fly ash lime brick** - Shall be sound, compact and uniform in shape free from visible cracks, war pages flaws and organic matter, have a frog 100 mm in length, 40mm width and 10 to 20 mm deep on one of its flat side. The shape and size of the frog shall conform to IS: 12894.

Fly Ash: Fly ash shall conform to grade I or Grade 2 of IS: 3812.

Bottom ash used as replacement of sand shall not have more than 12% loss on ignition when tested.

Sand: Deleterious materials, such as clay and silt in the sand shall preferably be less than 5%.

Lime: Lime shall conform to Class 'C'hydrated lime of IS: 712.

Additives: Any Suitable additive considered not detrimental to the durability of bricks may be used.

c) **Clay fly ash bricks** - The clay fly ash brick shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter. The bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides.

d) **Fly ash shall conform to grade I of II of IS: 3812**

Calcium silicate bricks - Calcium silicate bricks shall be sound, compact and uniform in shape – bricks shall be free from visible cracks, warpage organic matter, large pebbles and nodules of free lime. Bricks shall be solid and with or without frog. The bricks shall be made of finely grounded sand siliceous rock and lime. In addition limited quantity of fly ash conforming to IS: 3812 may be used in the mix.

e) **Tile brick** - The bricks of 4 cm height shall be moulded without frogs. Where modular tiles are not freely available in the market, the tile bricks of F.P.S. thickness 44mm (1-3/4") shall be used unless otherwise specified.

f) **Brick bats** - Brick bats shall be obtained from well burnt bricks.

6.1.1. **Dimensions** - The brick may be modular or non-modular. Size for both types of bricks/ tiles shall be as per Table 1. While use of modular brick tiles is recommended, non-modular (FPS) bricks/tiles can also be used where so specified. Non-modular bricks / tiles of sizes other than the sizes mentioned in Table 1 may also be used where specified.

Table 1

Type of Bricks / tiles	Nominal size mm	Actual size mm
Modular Bricks	200x100x100mm	190x90x90mm
Modular Tile Bricks	200x100x40mm	190x90x40mm
Non-Modular Tile Bricks	229x114x44mm	225x111x44mm
Non-Modular Bricks	229x114x70mm	225x111x70mm 225x112.5x65mm

6.1.2. **Classification** - Bricks / Brick tiles shall be classified on the basis of their minimum compressive strength as given below.

Table 2

Class Designation	Average compressive strength			
	Not less than		Less than	
	N/mm ²	(kgf/cm ²)	N/mm ²	(kgf/cm ²)
10(100)	10	(100)	12.5	125
7.5(75)	7.5	(75)	10	100
5(50)	5	(50)	7.5	75
3.5(35)	3.5	(35)	5.0	50

The bricks shall have smooth rectangular faces with sharp corner and shall be uniform in colour and emit clear ringing sound when struck.

(Note: Upper limits specified in Table 2 are for calculating the average compressive strength in accordance with Annexure 6-A.2.)

6.1.3. **Sampling and tests** - Sampling of bricks shall be subjected to the following tests

(a) Dimensional tolerance (b) Water absorption (c) Efflorescence (d) Compressive strength

6.1.3.1. **Sampling** - For carrying out compressive strength, water absorption, efflorescence and dimensional tests, the samples of bricks shall be taken at random according to the size of lot as given in table 3 below. The sample thus taken shall be stored in a dry place until tests are made. For the purpose of sampling the following definition shall apply.

a) **Lot** - A collection of same class and size, manufactured under relatively similar conditions of production. For the purpose of sampling a lot shall contain a maximum of 50,000 bricks

In case a consignment has bricks more than 50,000 of the same classification and size and manufactured under relatively similar conditions of production, it shall be divided into lots of 50,000 bricks or part thereof.

(b) **Sample** - A collection of bricks selected for inspection and/ or testing from a lot to reach the decision regarding the acceptance or rejection of the lot.

(c) **Defective** - A brick failing to meet one or more of the specified requirements.

6.1.3.2. **The samples shall be taken as below:**

(i) **Sampling from a stack** - When it is necessary to take a sample from a stack, the stack shall be divided into a number of real or imaginary sections and the required number of bricks drawn from each section. For this purpose bricks in the upper layers of the stack shall be removed to enable units to be sampled from places within the stack.

Note: For other methods of sampling i.e. sampling in motion and sampling from lorries or trucks, IS: 5454 may be referred. Scale of sampling and criteria for conformity for visual and dimensional characteristics: -

Visual characteristics - The bricks shall be selected and inspected for ascertaining their conformity to the requirements of the relevant specification.

The number of bricks to be selected from a lot shall depend on the size of lot and shall in accordance of col. 1 and 2 of Table 3 for visual characteristics in all case and dimensional characteristics if specified for individual bricks.

(ii) **Visual characteristics** - All the bricks selected above in accordance with col. 1 and 2 of Table 3 shall be examined for visual characteristics. If the number of defective bricks found in the sample is less than or equal to the corresponding number as specified in col.3 of table 3 the lot shall be considered as satisfying the requirements of visual characteristics, otherwise the lot shall be deemed as not having met the visual requirements.

(iii) **Dimensional characteristics** - The number of bricks to be selected for inspecting the dimensions and tolerance shall be in accordance with col.1. and 4 of Table 3. These bricks will be divided into groups of 20 bricks at random and each of 20 bricks thus formed will be tested for all the dimensions

and tolerances. A lot shall be considered having found meeting the requirements of dimensions and tolerance, if none of the groups of bricks inspected fails to meet the specified requirements.

Table 3 Scale of sampling and permissible number of defectives for visual and dimensional characteristics

No. of bricks in the lot	For characteristics specified for individual bricks		For dimensional characteristics for group of 20 bricks- No. of bricks to be selected
	No. of bricks to be selected	Permissible no of defectives in the sample	
2001-10000	20	1	40
10001-35000	32	2	60
35001-50000	50	3	80

Note: In case the lot contains 2000 or less bricks the sampling shall be as per decision of the engineer.

iv) **Scale of sampling and criteria for physical characteristics** - The lot which has been found satisfactory in respect of visual and dimensional requirements shall be next tested for physical characteristics like compressive strength water absorption, efflorescence as specified in relevant material specification. The bricks for this purpose shall be taken at random from those already selected above. The number of bricks to be selected for each of these characteristics shall be in accordance with relevant columns of Table 4.

Table 4

Lot Size	Sample size for compressive strength, water absorption and efflorescence	Permissible No. of defectives for efflorescence
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of engineer.

v) A lot shall be considered having satisfied the requirements of physical characteristics if the condition stipulated here in are all satisfied.

(a) From the test results for compressive strength the average shall be calculated and shall satisfy the requirements specified in relevant material specification.

Note: In case any of the test results for compressive strength exceeds the upper limit for the class of bricks, the same shall be limited to the upper limit of the class for the purpose of average

(b) Where specified in the material specification, the compressive strength of any individual bricks tested in the sample shall not fall below the minimum average compressive strength specified for the corresponding class of brick by more than 20 per cent. (c) From the test results for water absorption, the average for the bricks in the sample shall be calculated and shall satisfy the relevant requirements shall satisfy the relevant requirements specification in material specification. (d) The number of bricks failing to satisfy the requirements of the efflorescence specified in the relevant specification should not be more than the permissible no. of defectives given in col. 3 of Table 4.

6.1.3.3. **Dimensional tolerances** - The dimensions of modular bricks when tested as described above as per procedure described in Annexure 6-A.1 shall be within the following limits per 20 bricks.

Length 372 to 388 cm (380 ± 8 cm)

Width 176 to 184 cm (180 ± 4 cm)

Height 176 to 184 cm (180 ± 4 cm) for 90 cm high bricks

Brick tiles

76 to 84 cm (80 ± 4) for 40 mm high brick tiles. In case of non-modular bricks, %age tolerance will be $\pm 2\%$ for group of 20 numbers of classes, 10 bricks and $\pm 4\%$ for other class of bricks.

6.1.3.4. **Compressive strength** - The bricks when tested in accordance with the procedure laid down in Annexure 6-A.2 shall have a minimum average compressive strength for various classes as given in Table 2 the compressive strength of any individual brick tested shall not fall below the min average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified in Table 2 for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table 2 for the purpose of calculating the average compressive strength.

6.1.3.5. **Water absorption** - The average water absorption of bricks when tested in accordance with the procedure laid down in Annexure 6-A.3 shall be not more than 20% by weight.

6.1.3.6. **Efflorescence** - The rating of efflorescence of bricks when tested in accordance with the procedure laid in Annexure 6-A.4 shall be not more than moderate.

6.2. SPECIFICATIONS FOR BRICK WORK

6.2.1. **Classification** - The brick work shall be classified according to the class designation of bricks used.

6.2.2. **Mortar** - The mortar for the brick work shall be as specified, and conform to accepted standards. Lime shall not be used where reinforcement is provided in brickwork.

6.2.3. **Soaking of bricks** - Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. The bricks required for masonry work using mud mortar shall not be soaked. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Note: 1. The period of soaking be easily found at site by a field test in which the bricks are soaked in water for extent of water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in construction work.

Note: 2. If the bricks are soaked for the required time in water that is frequently changed the soluble salt in the bricks will be leached out, and subsequently efflorescence will be reduced.

6.2.4. Laying

6.2.4.1. Bricks shall be laid in English bond (fig.2.3.) unless otherwise specified. For brick work in half brick wall, bricks shall be laid in stretcher bond. Half or cut bricks shall not be used except as closer where necessary to complete the bond. Closers in such cases shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

Note: Header bond shall also be used in foundation footings unless thickness of walls (width of footing) makes the use of headers impracticable, where thickness of footing is uniform for a number of courses the top course of footing shall be headers.

6.2.4.2. All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar when laying each brick shall, be properly bedded and set in position by gently pressing with the handle of a trowel. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow spaces are left inside the joints.

6.2.4.3. The walls shall be taken up truly in plumb or true to the required batter where specified. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in the alternate course shall come directly one over the other. Quoin, jambs and other angles shall be properly plumbed as the work proceeds. Care shall be taken to keep the propounds properly aligned within following maximum permissible tolerances:

- (a) Deviation from vertical within a storey shall not exceed 6 mm per 3m height.
- (b) Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5. mm
- (c) Deviation from position shown on plan of any brickwork shall not exceed 12.5. mm
- (d) Relative displacement between load bearing wall in adjacent storey intended to be vertical alignments all not exceed 6 mm.
- (e) A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 meter rule line and plumb shall be kept on the site of work for every 3 masons for every 3 masons for proper check during the progress of work.

6.2.4.4. All quoins shall be accurately contracted and the height of brick courses shall be kept uniform. This will be checked using graduated wooden straight edge or storey rod indicating height of each course including thickness of joints. The position of damp proof course, windowsills, bottom of lintels top of the wall etc, along the height of the wall shall be marked on the graduated straight edge or storey rod. Acute and obtuse quoins shall be bonded, where practicable in the same way as square quoins. Obtuse quoins shall be formed with squint showing three quarters brick on one face and quarter brick on the other.

6.2.4.5. The brickwork shall be built in uniform layers. **No part of the wall during its construction shall rise more than one meter above the general construction level.** Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal. Toothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

6.2.4.6. All pipe fittings and specials, spouts hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified in their correct position as the work proceeds unless otherwise directed by the engineer.

6.2.4.7. Top courses of all plinths, parapets, steps and top of walls below floor and roof slabs shall be laid with brick on edge, unless specified otherwise. Brick on edge laid in the top courses at corner of walls shall be properly radiated and keyed into position to form cut corners as shown in Fig. 4. Where bricks cannot be cut to the required shape to form cut corners, cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) equal to thickness of course shall be provided in lieu of cut bricks.

6.2.4.8. Bricks shall be laid with frog (where provided) up. However, when top course is exposed bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.

6.2.4.9. In case of walls one brick thick and under one face shall be kept even and in proper plane, which the other face may be slightly rough. In case of walls more than one brick thick, both the faces shall be kept even and in proper plane.

6.2.4.10. To facilitate taking service lines later without excessive cutting of completed work, sleeves (to be paid separately) shall be provided, where specified, while raising the brick work. Such sleeves in external walls shall be sloped down outward so as to avoid passage of water inside.

6.2.4.11. Top of the brickwork in coping and sills in external walls shall be slightly tilted. Where brick coping and sills are projecting beyond the face of the wall drip course/ throating (to be paid separately) shall be provided where indicated.

6.2.4.12. Care shall be taken during construction that edges of jambs sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpaulin so as to prevent the mortar from being washed away. Damage if any, shall be made good to the satisfaction of the engineer.

6.2.4.13. Vertical reinforcement in the form of bars (MS or high strength deformed bars) considered necessary at the corners and junction of walls and jamb opening doors, windows etc., shall be encased with cement mortar not leaner than 1:4 (1 Cement 4 coarse sand) or cement concrete mix as specified. The reinforcement shall be suitably tied, properly embedded in the foundation and at roof level. The Dia of bars shall not be less than 8 mm and concrete grade shall be minimum 1:3:6 (1 cement 3 coarse sand: 6 graded stone aggregate 20 mm nominal size).

6.2.4.14. In retaining walls and the like where water is likely to accumulate weep holes, 50 to 75 mm square shall be provided at 2 m vertically and horizontally unless otherwise specified. The lowest weep hole shall be at about 30 cm above the ground level. All weep holes shall be surrounded by loose stones and shall have sufficient fall to drain of the water quickly.

(Note: Work of providing loose stone will be payable extra).

6.2.4.15. Work of cutting chases, where required to be made in the walls for housing G.I pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below:

(a) Cutting of chases in one brick thick and above load bearing walls

(i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided. (ii) The depths of vertical chases and horizontal chases shall not exceed one third and one sixth of the thickness of the masonry respectively. (iii) When narrow stretches of masonry (or short length of walls) such as between doors and windows, cannot be avoided they should not be pierced with openings for soil or waste pipes or possibility of load concentration such narrow lengths of walls shall be checked for stresses and high strength bricks in mortar or concrete walls provided if required. (iv) Horizontal chases when unavoidable should be located in the upper or lower one third or height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one meter in length. Where unavoidable stresses in the affected area should be checked and kept within the permissible limits. (v) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable stresses in the affected area should be checked and kept within permissible limits, (vi) Masonry directly above a recess, if wider than 30 cm horizontal dimension should be supported on lintel. Holes in masonry may be provided up to 10 cm width and 30 cm height without any lintel. In the case of circular holes in the masonry, no lintel need be provided for holes up to 40 cm in diameter.

(b) Cutting of chases in half brick load bearing walls -

No chase shall be permitted in half brick load bearing walls and as such no recessed conduits and concealed pipes shall be provided with half thick load bearing walls.

(c) Cutting of chases in half brick non-load bearing wall - Services should be planned with the help of vertical chases. Horizontal chase should be provided only when unavoidable.

6.2.5. **Joints** - The thickness of all types of joints including brick wall joints shall be such that four course and three joints taken consecutively shall measure as follows:

(i) In case of modular bricks conforming to IS: 1077 specification for common burnt clay building bricks, equal to 39 cm. (ii) In case of non-modular bricks, it shall be equal to 31 cm.

Note: Specified thickness of joints shall be of 1 cm. Deviation from the specified thickness of all joints shall not exceed one – fifth of specified thickness.

6.2.5.1. **Finishing of joints** - The face of brickwork be finished flush or by pointing. In flush finishing either the face joints of mortar shall be worked out while still green to give a finished surface flush with the face of the brick work or the joints shall be squarely raked out to a depth of 1 cm while the mortar is still green for subsequently plastering. The faces of brickwork shall be cleaned with wire brush so as to remove any splashes of mortar during the course of raising the brickwork. In pointing the joints shall be squarely raked out to a depth of 1.5 cm while the mortar is still green and raked joints shall be brushed to remove dust and loose particles and well wetted and shall be later refilled with mortar to give ruled finish some such finishes are "flush" "weathered" "ruled" etc.,

6.2.6. **Curing** - The brickwork shall be constantly kept moist on all faces for a minimum period of seven days. Brickwork done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

6.2.7. **Scaffolding** - Scaffolding shall be strong to withstand all dead, live and impact loads, which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work.

6.2.7.1. Single scaffolding - Where plastering pointing or any finishing has been indicated for brickwork single scaffolding may be provided unless otherwise specified. In single scaffolding one end of the put –logs / pole shall rest in the hole provided in the header course of brick masonry. Not more than one header for each put – log / pole rest in the hole provided in the header course of brick masonry. Not more than one header for each put log / pole shall be left out. Such holes shall not be allowed in the case of pillars, brick work less than one metre in length between the openings or near the skewbacks of arches or immediately under or near the structural member supported by the walls. The holes for putlogs / poles shall be made good with brickwork and wall finishing as specified.

6.2.7.2. Double Scaffolding - Where the brick work or tile work is to be exposed and not to be finished with plastering etc., double scaffolding having two independent supports clear of the work, shall be provided.

6.2.8. Measurements

6.2.8.1. Brickwork shall be measured in cubic meters unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01-m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq.mtrs and the cubic contents shall be worked out to the nearest 0.01 cubic meters.

6.2.8.2. Brickwork shall be measured separately in the following stages

- (a) From foundation to floor one level (Plinth level)
- (b) Plinth (floor one) level to floor two level
- (c) Between two specified floor levels above floor two level

Note: (1) Brick work in parapet walls, mummy, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

6.2.8.3. No deductions or additions shall be done and no extra payment made for the following:

Note: Where minimum area is defined for deduction of an opening or void or both such areas shall refer only to opening or void the space measured.

- a) Ends of dissimilar materials (that is, joints beams, lintels, posts, girders, rafters, purlins trusses, corbels, steps etc.,) up to 0.1 m² in section.
- b) Opening up to 0.1.m² in area (see Note)
- c) Wall plates, bed plates and bearing of slabs chejjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall:
- d) Cement concrete blocks as for holdfasts and holding down bolts:
- e) Iron fixtures such as wall ties pipes upto 300 mm diameter and hold fasts for doors and windows;
- and f) Chases of section not exceeding 50 cm in girth g) Bearing portion drip course bearing of moulding and cornice.

Note: In calculating area of an opening any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded. Extra width of rebated reveals, if any shall also be excluded.

6.2.8.4. Walls half brick and less shall each be measured separately in square meters stating thickness.

6.2.8.5. Walls beyond half brick thickness shall be measured in multiples of half brick, which shall be deemed to be inclusive of mortar joints for the sizes of bricks specified in 6.1.1. half brick thickness shall mean 100 mm for modular and 115 mm for non – modular bricks.

Where fractions of half brick occur due to architectural or other reasons, measurement shall be as follows: a) upto 1/4th brick – actual measurements and b) exceeding ¼ brick- full half bricks.

6.2.8.6. String courses, projecting pilasters, aprons sills and other projections shall be fully described and measure separately in running meters stating dimensions of each projection.

6.2.8.7. Square or rectangular pillars shall be measured separately in cubic meters in multiple of half brick.

6.2.8.8. Circular pillars shall be measured separately in cubic meters as per actual dimensions.

6.2.8.9. Brick work curved on plan shall be measured like the brick in straight walls and shall include all cutting and wastage of bricks tapered, vertical joints and use of extra mortar, if any. Brick work curved on plan to a mean radius not exceeding six meters shall be measured separately and extra shall be payable over the rates for brick work in straight walls. Nothing extra shall be payable if the mean radius of the brickwork curved in plan exceeds six meters.

6.2.8.10. Tapered walls shall be measured net as walls and extra payment shall be allowed for making tapered surface for brickwork in walls.

6.2.8.11. Brick work with brick tiles shall be measured and paid for separately.

6.2.9. **Rate** - The rate shall include the cost of materials and labour required for all the operations described above except the vertical reinforcement and its encasement in cement mortar or cement concrete the rate shall also include the following:

- a) Raking out joints or finishing joints flush as the work proceeds;
- b) Preparing tops of existing walls and the like for raising further new brick work.
- c) Rough cutting and waste for forming gables splays at eaves and the like.
- d) Leaving holes for pipes upto 150 mm dia and encasing hold fasts etc.
- e) Rough cutting and waste for brick work curved in plan and for backing to stone or other types of facing.
- f) Embedding in ends of beams, joints slabs, lintels, sills, trusses etc.
- g) Bedding wall plates lintels, sills, roof tiles corrugated sheets etc in or on walls if not covered in respective items and
- h) Leaving chases of section not exceeding 50 cm in girth or 350 sq in cross-section.
- i) Brick on edge courses, cut brick corners, splays reveal, cavity walls, brick works, curved on plan to a mean radius exceeding six meters.

6.3. SPECIFICATIONS FOR BRICK WORK IN ARCHES (Fig 5)

6.3.0. The detailed specifications for brick work mentioned in 6.2 shall apply, in so far as these are applicable. Arch work shall include masonry for both gauged as well as plain arches. In gauged arches, cut or moulded bricks shall be used. In plain arches uncut bricks shall be used.

Brick forming skew – backs shall be dressed or cut so as give proper radials to the end voussiors. Defects in dressing of bricks shall not be permitted by extravagant use of mortar, nor shall the use of chips or bats etc., be permitted.

The bricks of the spandrel wall at their junction with the extrudes of the arch shall be cut fit the curvature of the arch.

6.3.1. **Circular arches** - These shall be either (a) plain arches, and shall be built in half brick concentric rings with break joints, or (b) gauged arches built with bricks cut or moulded to proper shape. The arch work shall be carried up from both ends extraneously and keyed in the centre. The bricks shall be flush with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be full of mortar and thickness of joints shall not be less than 5 mm nor more than 15 mm. After the arch is completed, the haunches shall be loaded by filling up the spandrels upto the crown level of the arch. Care shall be taken to load the haunches on two sides of the spandrels.

When the arch face is to be pointed (and not plastered), the face bricks shall be cut to proper shape or moulded so as to have the joints not more than 5 mm thick These shall be laid with radial joints to the full depth of the arch. The voussiors shall break joints to the full depth of the arch.

6.3.2. **Flat arches** - These shall be gauged arches of brick cut or moulded to proper shape. The extrudes shall be kept horizontal and the intrudes shall be given slight camber of 1 in 100 of the span. The center of the arch from which joints shall radiate shall be determined by the point of the

inter – section of the two lines drawn from the ends of the arch at the springing level and at 60 to horizontal. In flat arches bricks shall be laid with radial joints to the full depth of arch and voussiors breaking joints with each other. The arch work shall be carried up from both ends simultaneously and keyed in the center. The thickness of the joints shall not exceed 5 mm. Flat arches may be used for the sake of appearance but for purpose of carrying loads of the wall above these shall be used in conjunction with relieving arches, lintels placed below.

6.3.3. Centering and shuttering - The centering and shuttering for the arch shall be got approved by the engineer before the arch work is started. It shall be strong enough to bear the dead load of the arch and the live loads that are likely to come upon it during construction, without any appreciable deflections.

The shuttering shall be tightened with hard wood wedged or sandboxes, so that the same could be eased without jerks being transmitted to the arch. The sequence of easing the shuttering shall be got approved from the engineer. The shuttering shall be struck within 48 hours. This shall be done after the spandrel has been filled in and the arch loaded.

6.3.4. Measurements - The length of the arch shall be measured as the mean of the extrudes and intrudes of the arch correct to a cm. The thickness of the arch shall be measured in multiples of the half brick. The breadth in the direction of the thickness of wall shall be measured as specified.

The cubical contents shall be calculated in cubic meter correct to two places of decimal.

For arches exceeding 6 m in spans extra payment shall be made on the actual area of the soffit for additional cost of centering including all strutting, bolting, wedging, easing, striking and its removal.

6.3.5. Rate - The rate is inclusive of the cost of the materials and labour for all the operations described above.

6.4. Half brickwork - Brick work in half brick walls shall be done in the same manner as described above in 6.2.4 except that the bricks shall be laid in stretcher bond. When the half brick work is to be reinforced 2Nos. M.S. bars of 6mm dia, shall be embedded in every third course as given in the item (the dia of bars shall not exceed 8 mm). These shall be securely anchored at their end where the partitions end. The free ends of the reinforcement shall be keyed into the mortar of the main brickwork to which the half brickwork is joined. The mortar used for reinforced brickwork shall be rich dense cement mortar of mix 1:4. Lime mortar shall not be used. Over laps in reinforcement if any shall not be less than 30 cm.

The mortar interposed between the reinforcement bars and the brick shall not be less than 5mm. The mortar covering in the direction of joints shall not be less than 15 mm.

6.4.1. Measurements - The length and height of the wall shall be measured correct to a cm. The area shall be calculated in sqm where half brick wall is joined to the main walls of one brick or greater thickness and measurements for half brick wall shall be taken for its clear length from the face of the thicker wall.

6.4.2. Rate - The rate includes the cost of the materials and labour involved in all the operations described above except reinforcement which is to be paid for separately.

6.5. SPECIFICATIONS FOR BRICK TILE WORK

The work shall be done in the same manner as described in 6.2.4 except that brick tile shall be used instead of bricks. The measurements and rate shall be same as specified under 6.2.

6.6. SPECIFICATIONS FOR HONEYCOMB BRICKWORK

The brick honeycomb work shall be done with specified class of brick, laid in specified mortar. All joints and edges shall be struck flush to given an even surface.

The thickness of the brick honeycomb works shall be half-brick only, unless otherwise specified. Openings shall be equal and alternate with half brick laid with a bearing of 2cm on either side.

6.6.1. **Measurements** - The length and height shall be measure correct to a cm. Area shall be calculated in square meters correct to two places of decimal. Honeycomb openings shall not be deducted.

6.6.2. **Rate** - The rate includes the cost of materials and labour involved in all the operations described above.

6.7. SPECIFICATIONS FOR JOINING OLD BRICK WORK WITH NEW BRICK WORK.

6.7.1. In case the height of the bricks of old as well as new work is same, the old work shall be toothed to the full width of the new wall and to the depth of a quarter of brick in alternate courses. In case the height of the bricks is unequal, the height of each course of new work shall be made equal to the height of the old work by adjusting thickness of horizontal mortar joints in the new wall. Where necessary adjustment shall be made equal to thickness of old wall by adjusting the thickness of vertical joints.

6.7.2. For joining new cross wall to old main walls a number of rectangular recesses of width equal to the thickness of cross wall, there courses in height and half a brick in depth shall be cut in the main walls. A space of the three courses shall be left between two consecutive recesses. The new cross wall shall be bonded into the recesses to avoid settlement.

6.7.3. Joining of old brickwork with the new brickwork shall be done in such a way that there shall not be any hump r projection at the joint.

6.7.4. **Measurement** - The height and thickness of vertical face in contact with new work shall be measured to the nearest 0.01 m and the area shall be calculated to the nearest 0.01 sqm.

6.7.5. **Rate** - The rate includes the cost of labour and material involved in all the operations described above.

6.8. SPECIFICATIONS FOR MOULDING AND CORNICES.

The specifications described under 6.2 shall apply in so far these are applicable. Moulding and cornices shall be made with bricks as specified for brickwork. The bricks shall be cut and dressed to the required shape as shown in the architectural drawings.

6.8.1. Cornices shall not ordinarily project by more than 15 cm to 20 cm and this projection shall be obtained by projecting each brick course by not more than one fourth of the brick length. For cornices projecting more than 20cm projection metal cramps shall be used and paid for separately.

6.8.2. Corbelling shall be brought roughly to shape by plastering with the specified mortar. When the mortar is still green, the moldings shall be finished straight and true with the help of metal templates.

6.8.3. **Curing and protection** - The moulding and cornices shall be cured for at least seven days. These shall be protected from the effects of sun and rain by suitable covering and also from damage during the execution of the work.

6.8.4. **Measurements** - For the purpose of measurements the sectional periphery of moulding and cornices (excluding the portion in contact with wall shall be measured in centimeters and length in meters (fig below). The girth and length shall be measured correct to cm. No deduction shall be made from the masonry of wall for the bearing of the moulding and cornices.

6.8.5. **Rate** - The rate includes the cost of materials and labour involved in all the operations described above

6.9. SPECIFICATIONS FOR BRICK WORK UNDER WATER OF FOUL POSITIONS.

Brick work under following conditions:

(1) Work in or under water / or liquid mud (2) Work in or under foul positions shall be measured separately for payment of extra rate over and above the quantity measured and paid under para 6.2.8.

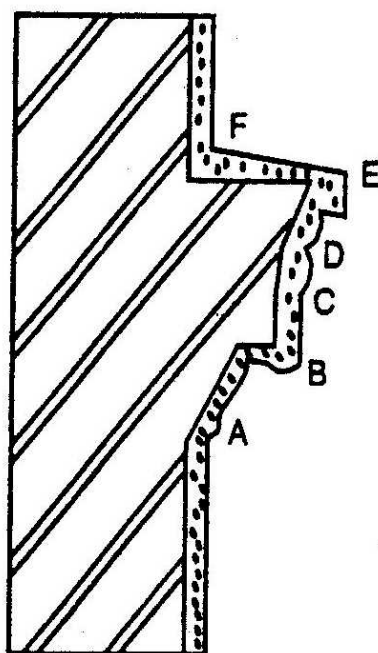
6.10. SPECIFICATIONS FOR EXPOSED BRICK WORK

6.10.1. Facing bricks - The facing bricks made from suitable soils shall be free from cracks, flaws, and nodules of free lime warpage and organic matter. These shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angled edges. Facing bricks shall have uniform colour and even texture. Unless otherwise specified, facing bricks shall be machine moulded. Selected hand moulded bricks may also be used as facing bricks where specified. As far as possible, total requirements of facing bricks for a work shall be arranged from the same kiln. Bricks with chipped edges and broken corners shall not be used.

6.10.2. Dimensions and tolerances - The standard sizes of machine moulded facing bricks shall be as specified in 6.1.1.

The permissible tolerances shall be as under:

	Dimension mm	Tolerance (for Machine moulded bricks) mm
Length	190 or 225	± 3
Width	90 or 111	± 1.5
Thickness	40 or 44	± 1.5



Notes: (1) The sectional periphery curve ABCDEF (2) Length FA shall not be measured

Note: Tolerance and dimensions for selected had moulded bricks ± 4 mm in length and ± 3 mm in width and thickness

6.10.3. Sampling: As per para 6.1.3 and 6.1.3.2.

6.10.4. Physical requirements - Facing bricks shall be of class designation 75 unless otherwise specified. Average compressive strength shall not be less than 7.5.N/mn². Water absorption shall not exceed 20 per cent by weight and efflorescence rating shall be nil when tested in accordance with procedure laid down and tolerance in dimensions shall be checked as per the procedure laid down.

Mortar, soaking of bricks and laying shall be as specified in para 6.2.2., 6.2.3. and 6.2.4 respectively.

6.10.5. Joints in the exposed brickwork shall be truly horizontal and vertical and kept uniform with the help of wooden or steel strips. The thickness of joints shall be as per 6.2.5.0.

6.10.6. Curing and scaffolding shall be as specified in 6.2.6 and 6.2.7 to 6.2.7.2 respectively.

6.10.7. **Measurements** - Exposed brick work in face using machine moulded bricks and selected hand moulded bricks shall be measured separately and the measurement shall be as specified in 6.2.8.

6.10.8. **Rate** - The rates shall be as specified in 6.2.9 and shall also include the following;

a) Labour for selecting bricks and wastage of bricks where use of selected hand moulded brick is specified (b) Leaving uniform horizontal and vertical grooves of specified depth and providing joints of required thickness using wooden or steel strips as the proceeds.

6.11. SPECIFICATIONS FOR CAVITY WALL.

It is a wall comprising of two leaves, each leaf being built of masonry units and separated by a cavity so as to provide an air space within the wall and tied together with metal ties or bonding units to ensure that two leaves act as one structural unit. The width of the cavity shall not be less than 50 mm and not more than 115mm. Each leaf of the cavity wall shall not be less than 75mm. The space between the leaves being either left as cavity or filled with non-load bearing insulating and water proofing materials.

6.11.1. **Metal ties** - These may be of galvanized iron wrought iron, gun metal brass, copper, stainless steel or any such corrosion resistant metal made of flats 20x5 mm cranked or twisted at their mid point with ends split and fish tailed. They shall be built into horizontal bed joints during erection, placed sloping towards the exterior side to prevent water from flowing along it from outer to inner leaf side. (Refer fig 6)

6.11.2. **Bonding units** - These shall be preferably precast R.C.C. units having cross – section as per Fig. No 6.

Length of the bonding units will be sum of thickness of both leaves plus width of cavity if the leaves are 75 mm or 115 mm. If the leaves are more than 115 mm thick, then length of a unit will be $2 \times 115 + \text{width of cavity}$ as shown in fig.6. Precast RCC units shall be provided with 2 no. 8mm Torsteel reinforcement bars tied with 2 no. 3mm dia M.S hard drawn wire cross bars (as shown in Fig. 6) placed in the center of units.

Cement concrete used in the bonding units shall not be leaner than 1:3:6 (1 Cement: 3 coarse sand: 6 graded stone aggregate 20mm nominal size).

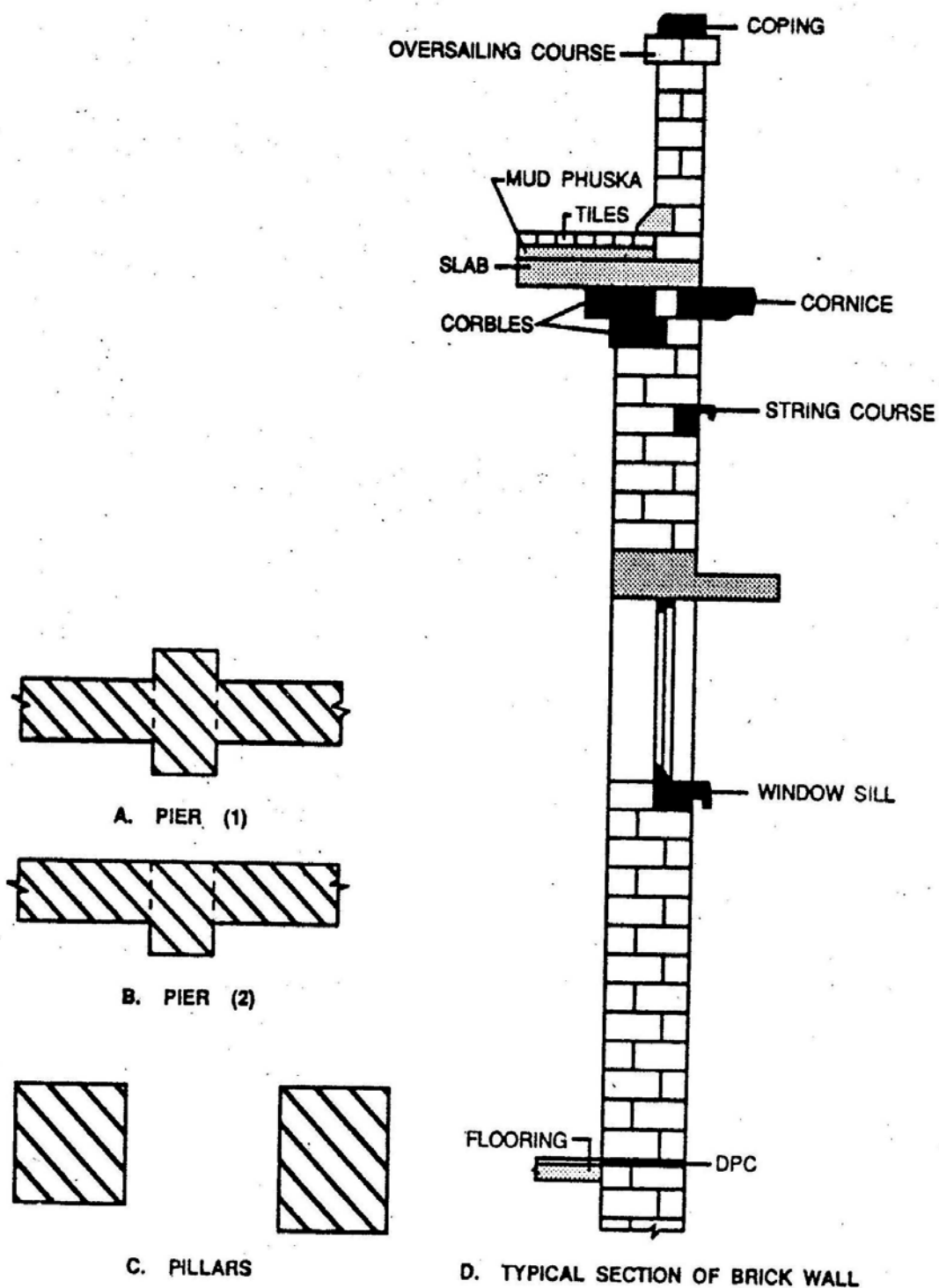
6.11.3. **Spacing** - Metal ties/bonding units shall be spaced not more than 90 cm apart horizontally and 45 cm vertically and staggered in each course. Additional ties shall be used near openings.

6.11.4. **Restrictions** - Cavity walls shall not normally be built more than 7.5 meters in height and 9 meters in length. Where large lengths and heights are desired, the wall shall be divided into panels with strengthening measures such as pillars etc., cavity shall be covered at the top with at least two courses of masonry unit and/ or coping over it.

Adoption of cavity walls is not recommended when heavy concentrated load from beam etc are to be supported by walls:

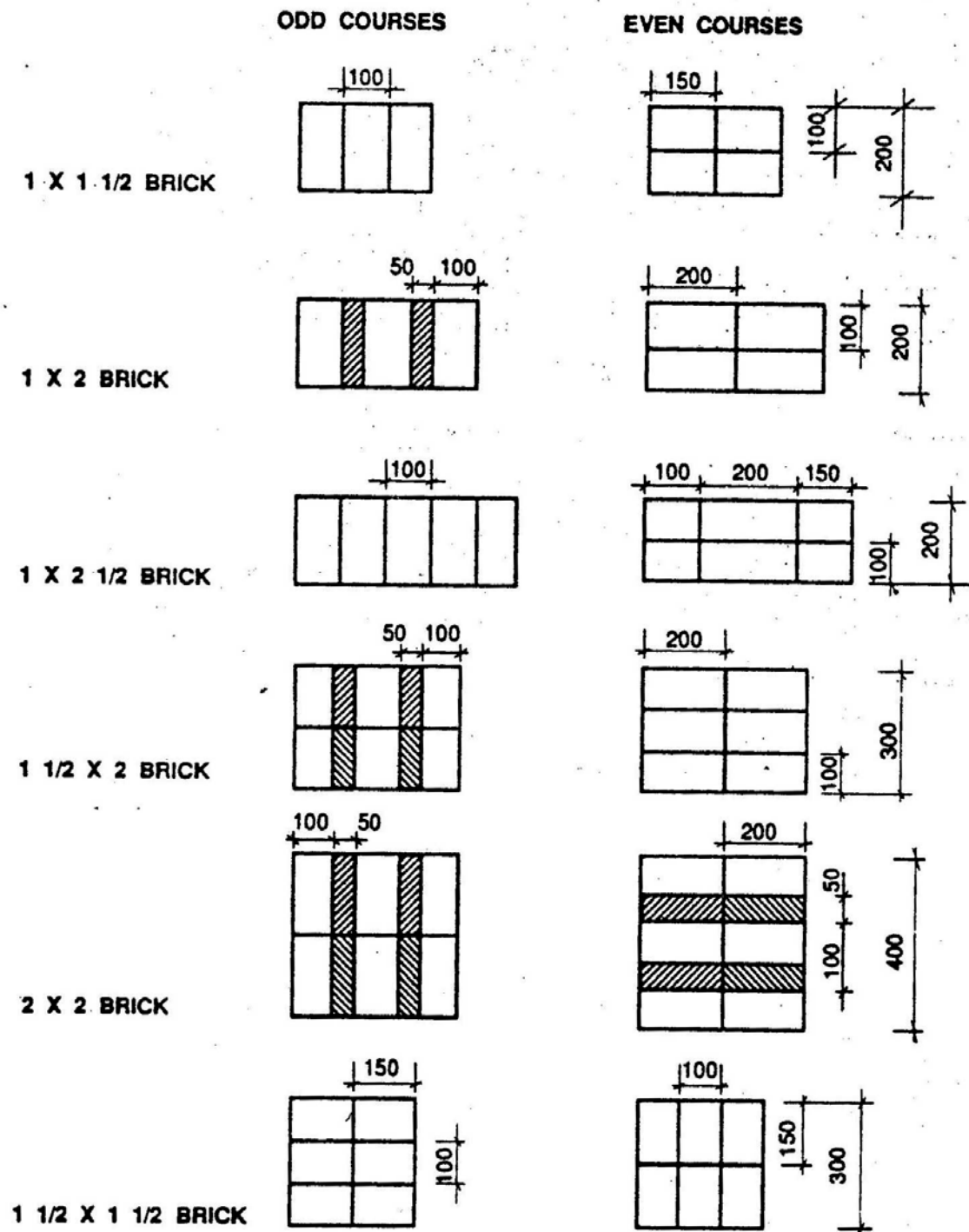
6.11.5. Measurements and rate

(a) Brickwork in walls shall be included and measured with general brickwork. The width of the cavity shall not be measured skin of cavity wall, half brick thickness shall be measured as and paid as described in para 6.2.8 and 6.4.(b) The forming of the cavity shall be given in square meters stating the width of the cavity and shall include the metal ties / bonding unit specifying the numbers per square metre.(c) Labour and material for closing cavities at the jambs, sills and heads of opening shall be as described and measured separately in running meters.(d) The item shall include use of device for keeping cavity clear and forming the requisite weep and vent holes and nothing extra on this account shall be payable.



THE BREADTH SHALL NOT EXCEED
THREE TIMES THE THICKNESS AND
THICKNESS ITSELF SHALL NOT
EXCEED MORE THAN THREE BRICKS

Fig. 1



ENGLISH BOND

Fig. 2

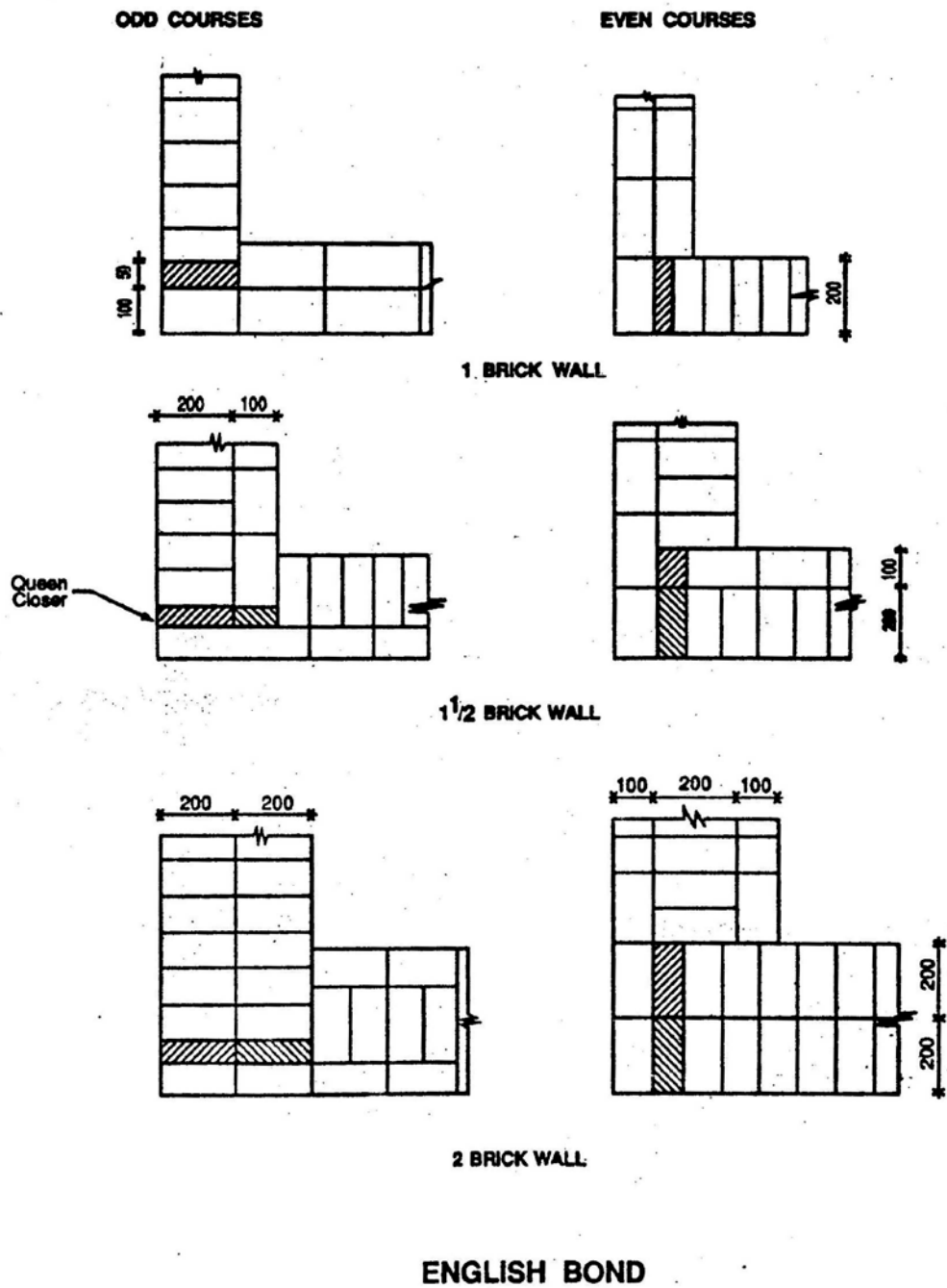


Fig. 3

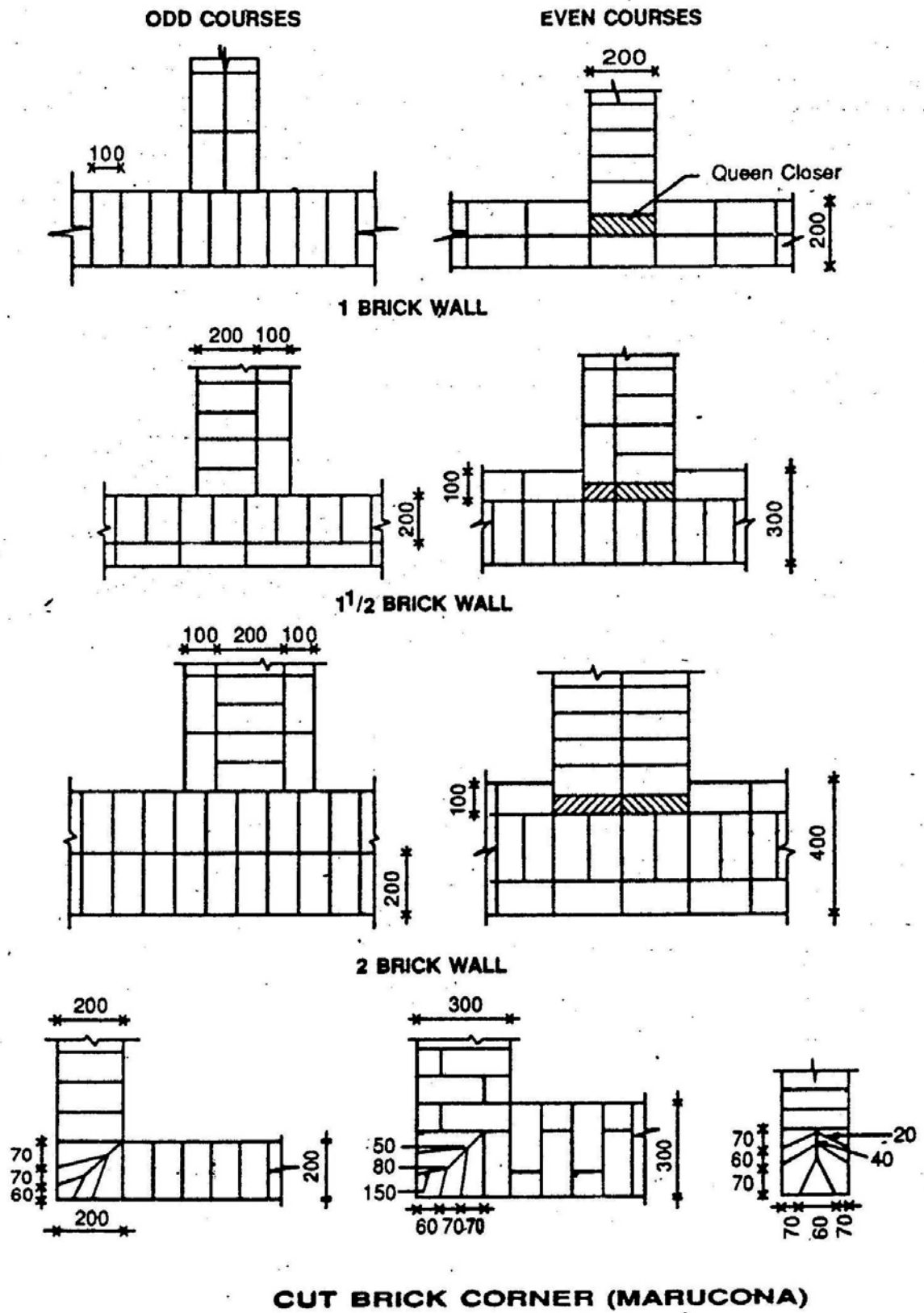
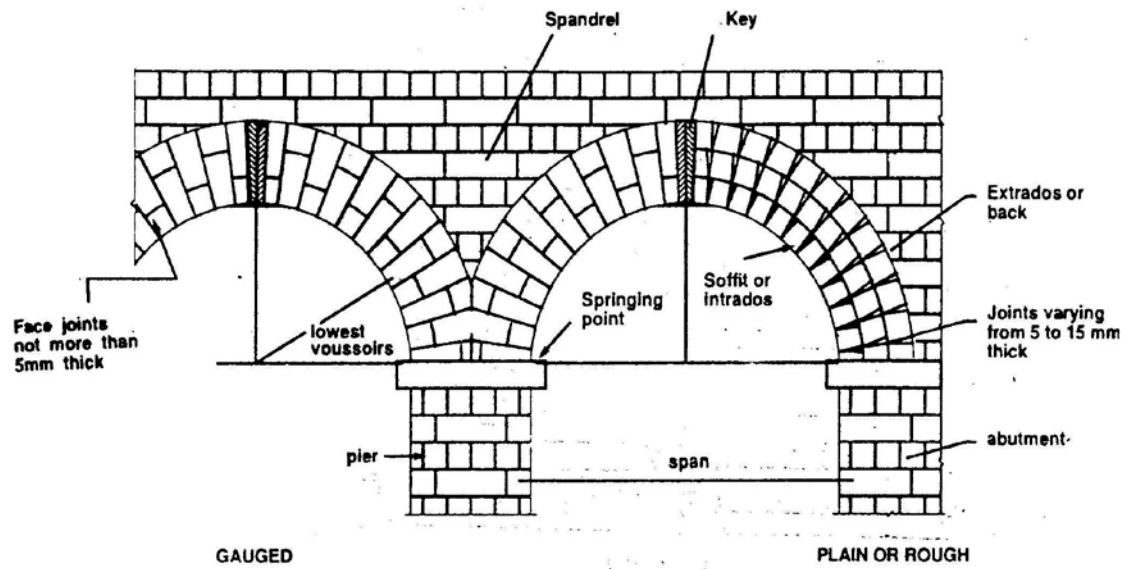
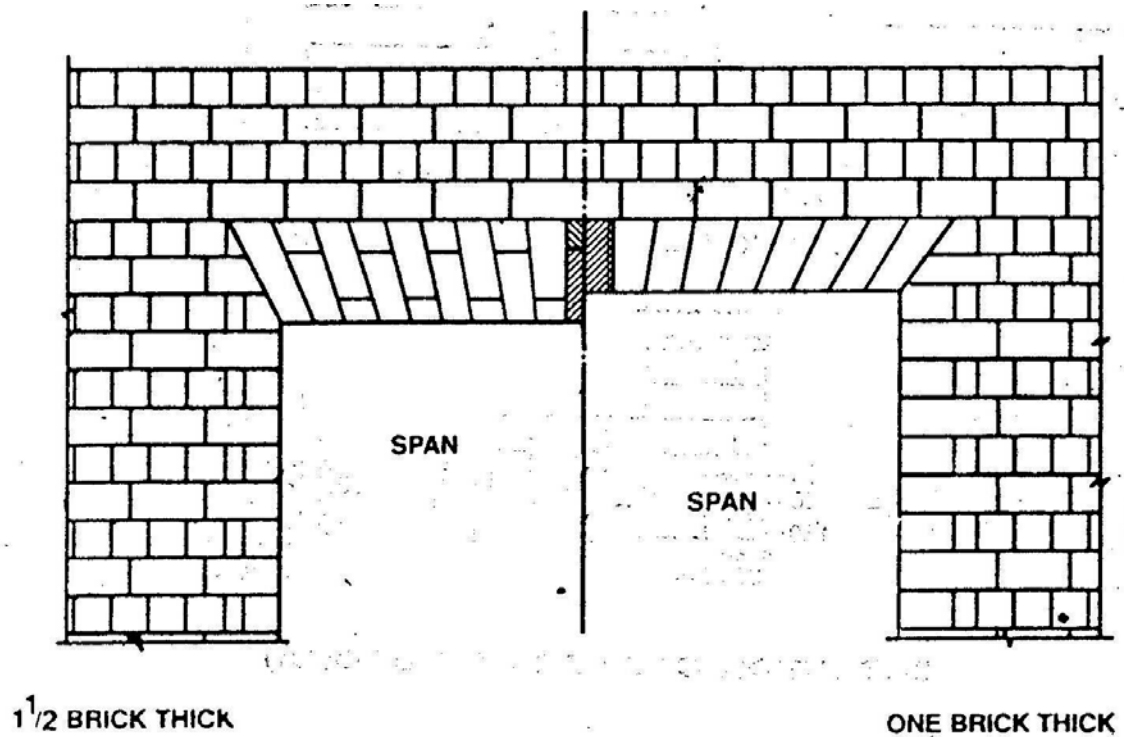


Fig. 4

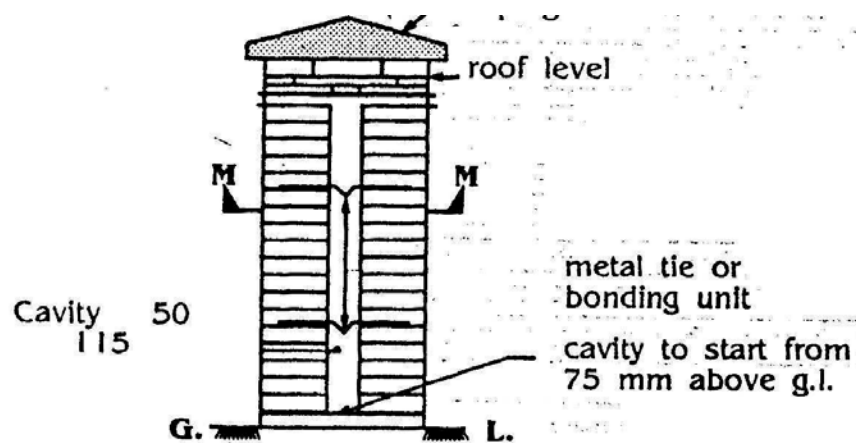


CIRCULAR ARCH

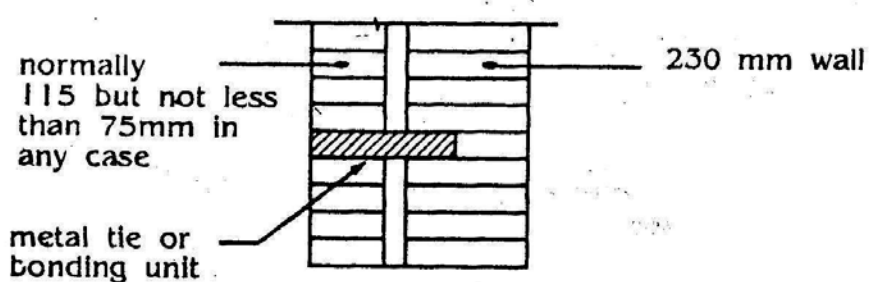


FLAT GAUGED ARCH

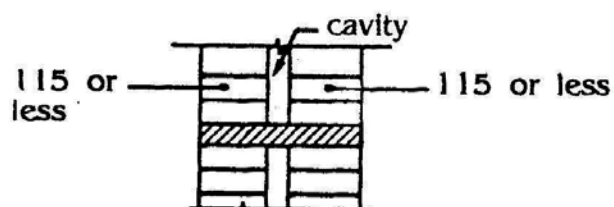
Fig. 5



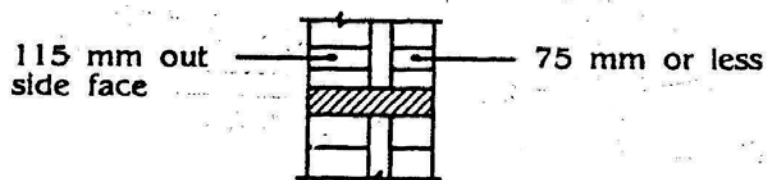
(a) SECTION OF CAVITY WALL



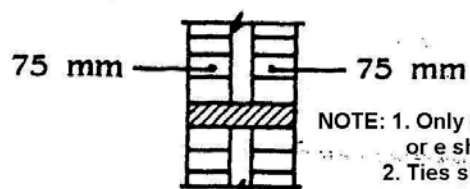
(b) SECTIONAL PLAN - MM



(c) PLAN AT MM



(d) PLAN AT MM



(e) PLAN AT MM

NOTE: 1. Only one of the alternative a,b,c,d or e shall be applicable in each case
2. Ties shall be placed sloping towards exterior side.

Fig. 6

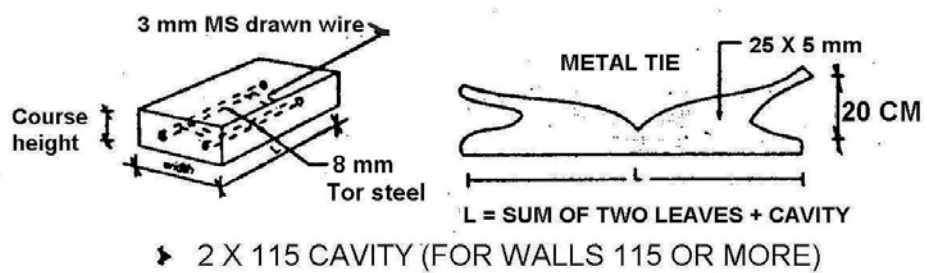
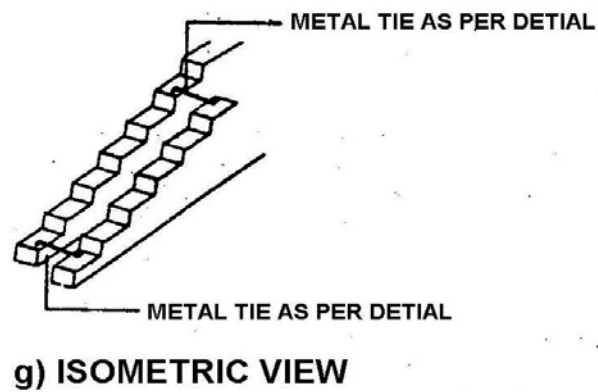
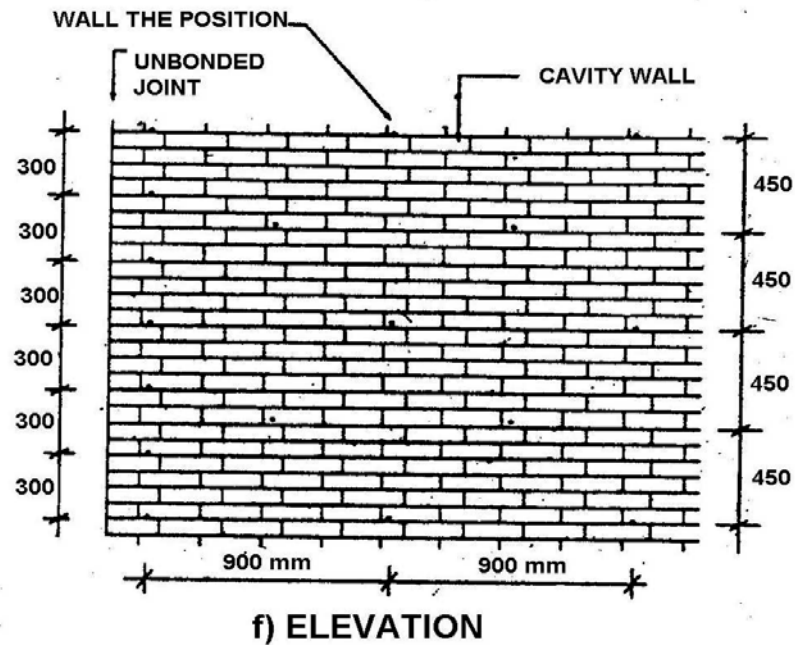


Fig. 6

TEST FOR DIMENSIONAL TOLERANCE (Para 6.1.3.3.)

1. **Sampling** - As per para 6.1.3.1 and 6.1.3.2.
2. **Procedure** - All the blisters loose particles of clay and small projections shall be removed from the surface of bricks. Each specimen of 20 bricks shall them be arranged upon a level surface successively as indicated in fig. A contact with each other and in straight line. The overall length of the assembled bricks (20 Nos.) shall be measured with a steel tape sufficiently long to measure the whole row at one stretch.
3. **Tolerance** - The actual dimensions of bricks when tested as described in A-2 shall be with in the following limits per 20 bricks.

Modular bricks

Length 372 to 388 cm (380 ± 8 cm)

Width 176 to 184 cm (180 ± 4 cm)

Heights 176 to 184cm (180 ± 4 cm) for 90 mm high brick.

"A " Measurement of Length

"B " Measurement of Width

"C " Measurement of Height

76 to 84 cm(80 ± 4) for 40 mm high brick.

Non - Modular bricks

For class 10

Length 441 to 459cm

Width 218 to 226 cm

Height 138 to 142 cm (for 70 mm high bricks)

86 to 90 cm (for high bricks)

For other classes

Length 432 to 468

Width 213 to 231

Height 134 to 146 cm (for 70 mm high bricks)

84 to 92 cm (for 44 mm high bricks)

A.4. **Criteria for conformity** - A lot shall be considered conforming to the requirements of dimensions and tolerances if all the groups of bricks are tested to meet the specified requirements.

Annexure 6-A.2.

TEST FOR COMPRESSIVE STRENGTH (Para 6.1.3.4.)

1. **Specimen** - Five whole bricks shall be taken from the samples as specimens for this test. Length and width of each specimen shall be measured correct to 1 mm.
2. **Apparatus** - The apparatus consists of compression testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the center of which shall co-incide with the center of the plate.
3. **Procedure**
 - (a) **Pre-conditioning** - The specimen shall be immersed in the water for 24 hours at 25°to 29°C. Any surplus moisture shall be allowed to drain at room temperature. The frog of the bricks should be filled flush with mortar 1:3 (1 cement: 3 clean coarse sand of grade 3mm and down) and shall be kept under damp jute bags for 24 hours after that these shall be immersed in clean water for three days. After removal from water, the bricks shall be wiped lean without of any traces of moisture.
 - (b) **Actual testing** - Specimen shall be placed with flat faces horizontal and mortar filled face upward between three 3-ply plywood sheets each of thickness 3 mm and carefully centered between plates of the testing machine. Plaster of Paris can also be used in place of plywood sheets to ensure a uniform

surface. Load shall be applied carefully axially at uniform rate of 14 N. mm² per minute till the failure of the specimen occurs.

4. Reporting the test results - The compressive strength of each specimen shall be calculated in N/mm² as under:

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (in N)}}{\text{Area of specimen (in sq. mm)}}$$

In case the compressive strength of any individual brick tested exceeds the upper limit of the average compressive strength the same shall be limited to the upper limit of the class specified in 6.1.1. for the purpose of calculating the average compressive strength. Compressive strength of all the individual bricks comprising the sample shall be averaged and reported.

5. Criteria for conformity - A lot shall be considered having satisfied the requirements of average compressive strength if the average compressive strength specified in 6.1.2. for the corresponding class of brick tested is not below the minimum average compressive strength specified for the corresponding class of bricks by more than 20 percent.

Annexure 6-A.3

TEST FOR WATER ABSORPTION (Para 6.1.3.5.)

1. No. of specimen - Five whole bricks shall be taken from samples as specimen for this test.

2. Apparatus - A balance required for this test shall be sensitive to weigh 0.1 per cent of the weight of the specimen

3. Procedure:

(a) **Pre-conditioning** - The specimen shall be allowed to dry in a ventilated oven at a 110°C to 115°C till it attains a substantially constant weight. If the specimen is known to be relatively dry this would be accomplished in 48 hours, if the specimen is wet several additional hours may be required to attain a constant weight. It shall be allowed to cool at room temperature. In a ventilated room, properly separated bricks will require four hours for cooling unless electric fan passes air over them continuously in which case two hours may suffice. The cooled specimen shall be weighed (W1) a warm specimen shall not be used for this purpose. (b) **Actual testing** - Specimen shall be completely dried before immersion in the water. It shall be kept in clean water at a temperature of 27°C±2°C for 24 hours. Specimen shall be wiped out of the traces of water with a damp cloth after removing from the water and then shall be weighed within three minutes after removing from water (W2).

4. Reporting the test results - The water absorption of each specimen shall be calculated as follows and the average of five tests shall be reported.

$$\text{Water Absorption} = \frac{W2 - W1}{W1} \times 100$$

5. Criteria for conformity - A lot shall be considered having satisfied the requirements of water absorption if the average water absorption is not more than 20% by weight.

Annexure 6-A.4.

TEST FOR EFFLORESCENCE (Para 6.1.3.6.)

1. No. of Specimen - Five whole bricks shall be taken as specimen for this test.

2. Apparatus - Apparatus required for this test shall be a shallow flat bottom dish containing distilled water.

3. Procedure (actual testing) - The brick shall be placed vertically in the dish with 2.5. cm immersed in the water. The room shall be warm (18°C to 30°C) and well ventilated. The bricks should not be removed until it absorbs whole water. When the whole water is absorbed and the brick appears to be

dry places a similar quantity of water in that dish and allow it to evaporate as before. The brick shall be examined after the second evaporation.

D.4. Reporting the test results - The rating to efflorescence in ascending order shall be reported as 'NIL', 'SLIGHT', 'MODERATE', 'HEAVY' OR 'SERIOUS' in accordance with the following:

- (a) **Nil** - when there is no perceptible deposit of efflorescence,
- (b) **Slight** - When not more than 10percent of the area of the brick is covered with a thin deposit of salts.
- (c) **Moderate** - When there is heavier deposit and covering upto 50% of the area of the brick surface but unaccompanied by powdering or flaking of the surface.
- (d) **Heavy** - When there is a heavy deposit of salts covering 50% or more of the brick surface be unaccompanied by powdering or faking of the surface.
- (e) **Serious** - When there is heavy deposit of salts accompanied powdering and/ or flaking of the surface and tending to increase in the repeated wetting of the specimen.

5. Criteria for conformity - A lot be considered having satisfied the requirements of efflorescence if for 4 out of the specimen of 5 bricks, the rating of efflorescence is not beyond "moderate".

SECTION – 9 WOODWORK

9.1. GENERAL SPECIFICATIONS FOR TIMBER USED IN BUILDINGS

9.1.1 Timbers generally used in buildings are either of solid timber or panel products like plywood, particle board, etc. The major use is in door and window frames and their shutters, furniture and the like. It is also used in structures especially in hilly regions where timber is abundantly available and other common building materials like brick are not easy to come by.

9.1.2. India has around two hundred species of commercial timber grown in different parts of the country. For quite sometime timber was transported over long distances for some specific services even when species suitable for the purpose would be secured from nearby sources. The reason apparently appears to be the misconception that in timber there are primary species (teak) and secondary species. No such classification exists and it is a misnomer. All species can be used, only each species has different end use. Some species are even stronger in cumulative properties than teak. IS: 399-1963 classifies commercial timber and their distribution in India along with different end uses. Therefore it is necessary to check locally available timber for building purposes before specifying the species for woodwork.

9.1.3. Moisture content is an important requirement for use of timber in woodwork. Moisture content affects its workability, size, etc. the moisture content of timber changes from season to season depending on atmospheric humidity. The application of a finish (paint or varnish) reduces the change in moisture content with changes in humidity in the atmosphere. IS: 287-1993 governs the recommendations for maximum permissible moisture content for timber used for different purposes.

9.1.4. For actual end use seasoning and treatment of timber are necessary. Seasoning will help in the control of moisture and it should be done as per IS: 1141-1993; and preservation as per IS: 401-1982.

9.1.5. A number of Annexures are enclosed to this section, which are informative and at the same time offer valuable guidance to the engineers in charge of the design and execution of works. They are by no means exhaustive but illustrative of the wealth of information available in the BI standards. The engineers are strongly advised to be not only aware of the various applicable standards but also keep track of the latest amendments, as it is mandatory to execute the works in accordance with the specifications and the latest applicable BI standards.

9.2. Classification of timber

9.2.1. Zonal distribution

IS: 399-1963 details the zonal distribution of common commercial and timber of India, classified according to their various end uses and gives information on availability and on some of the other properties of these timbers. The uses, include

- (a) Constructional purpose, including building construction, piles, bridges, poles, railways sleepers, etc; and
- (b) Furniture and cabinet making.

India is divided into five zones for convenience in tabulating the information on timber. The zones are

Zone 1: Jammu & Kashmir, Punjab, Himachal Pradesh, Haryana and Rajasthan.

Zone 2: Assam, Manipur, Tripura, West Bengal, Bihar, Orissa, Mizoram, Arunachal Pradesh, Nagaland, Sikkim, Haryana, Bhutan, Andamans.

Zone 3: Madhya Pradesh, Vidharba areas of Maharashtra and north east part of Andhra Pradesh (Godavari Delta area).

Zone 4: Maharashtra (except Vidharbha area), Gujarat, and North West part of Karnataka.

Zone 5: Tamil Nadu, Pondichery, Andhra Pradesh (except Godhavari Delta area), Kerala and Karnataka (except North West part).

9.2.2. Information on timber

Tables in IS: 399- 1963 give information on the following aspects of timbers available in these zones.

- (1). **Availability** - Availability of commercial timber is categorized under three classes as given below

X - Most common, 1400 cu.m and more per year

Y - Common, 350 – 1400 cu.m per year

Z - Less common. Below 350 cu.m per year.

(2). **Mass per cubic metre**– The average mass per cubic metre at 12 percent moisture content for all timbers.

(3). **Durability** - The figures of durability are based on grave yard tests carried out on 60 cm X 5 cm X 5 cm specimens and are categorized as below

High – Timber having, an average life of 120 months and over

Moderate – Timber having an average life between 60 to 120 months.

Low – Timber having an average life less than 120 months.

(4). **Treatability** – Treatability, reflecting the resistance offered by the heartwood to the penetration of preservation fluid under pressure of 10.5 kg/cm² is classified as below

(a) Heartwood easily treatable (b) Heartwood treatable, but complete penetration of preservative not always obtained (c) Heartwood only partially treatable (d) Heartwood refractory to treatment

(e) Heartwood very refractory to treatment, penetration being practically nil from side or end

(5) **Compressive strength coefficient** – The compressive strength coefficient is arrived at by grouping the various important mechanical properties of timber that may come into play for any particular use and giving due weightage to the relative important of these properties.

(6). **The Handbook SP 33 (S & T) 1986** covers the engineering aspects of use timber.

Timber species is identified by using IS: 4970-1973 [keys for identification of commercial timbers] around 50 cards are available for identifying species.

Timber may be graded on the basis of defects as per IS: 6534-1971 which gives guidelines of grading and inspection of timber.

Since publication of IS: 399-1963 further work has been done in identifying species of timber suitable for doors and window shutters and frames; and for furniture and cabinets. These are covered in IS: 12896 -1990 for shutters and frames and IS: 13622-1993 for furniture and cabinets. These additional species have been brought in for these end uses.

9.3. Quality of different varieties of timber available in Karnataka state

9.3.1. **Teak** – It is a moderately hard. The sapwood is white. The heartwood is pale brown or dark golden yellow, darkening with age. On seasoning, the wood turns brown to dark brown or nearly black with long age. When once it is seasoned it does not split, crack, shrinks, or warp or alter its shape. It floats in water. It possesses fragrant oil with a strong scent which prevents the white ants from attacking the heartwood and preserves the same from the effects of weather. In buildings, it will for ever and as sleepers for atleast 20 years. It does not corrode iron.

9.3.2. **Honne** – It grows to great dimensions from 3 to 4.5 meters in girth with bole of 9 to 12 meters and a height of 25 meters. The sapwood is small. Heartwood is yellow to grey brown with dark streaks running the whole length of the tree. It is very hard and close grained, durable, seasons well and is not affected by damp and changes of temperature. It can easily be worked to a good surface and it takes a fine polish.

9.3.3. **Nandi or Benteak** – This tree grows to a great size attaining a height of 30 meters and over with a girth of 2.5 to 3 meters and a clean bole of 12 to 15 meters and yields one of the best timbers of the reserved trees of Karnataka. It is of dull red or reddish brown colour, straight grained, moderately hard, very elastic and tough, durable especially in salt water. It has to be carefully seasoned.

9.3.4. **Rosewood** – This grows to large dimensions with a bole of 15 to 25 meters and a girth of 3 to 4 meters or even 5 meters. The sapwood is yellow and small. It is very hard, durable, strong, heavy and cross grained. It is stronger than teak. It takes a fine polish which gives it an extremely handsome appearance.

9.3.5. **White Cedar** – This is close grained yellowish, hard wood with elastic fibres. The bark is grey hard and covered with white warts. It is strong and durable but sometimes warps even after long seasoning. It has a strong cedar-like smell and a fine satin luster. Takes fine polish.

9.3.6. **Karachi or Kamara or Anjan tree** – This is fine grained wood, dark red or brown in colour, streaked with black bands often with purplish tinge and does not warp. It splits easily when struck tangentially but very difficult in a radial section. It seasons with difficulty and is subjected to fine cup and heart shakes.

9.3.7. **Shivani** – The bark of this tree is very pale, smooth and covered with lenticles. The wood is yellowish or reddish white with a glossy lusture, smooth close and even grained. It is strong and durable but light and insects do not attack. It seasons well and evenly and does not warp or shrink. It presents a good appearance like ivory and takes readily paint or varnish.

9.3.8. **Jali Mara or Babul** – This wood is hard pinkish white turning red or dark reddish brown on exposure to the air, mottles with dark streaks. It is hard, tough, close grained, very durable if seasoned. It is fairly heavy, short fibered and somewhat brittle to work but takes a smooth surface and good polish.

9.3.9. **Yettiga Heddi** – This wood is moderately hard and even grained. It is lemon yellow in colour when cut, turning yellow grey on exposure. It works very easily and takes a good polish. It seasons well and is durable, but somewhat liable to warp and crack.

9.3.10. **Burgaw, Yelagada Mara, Silk Cotton tree** – This tree grows 25 to 35 meters in height and to a girth of 4 to 5 meters. The wood is greyish white turning to dark brown and gets discoloured when seasoned. The wood is soft, coarse-grained and porous. It decays rapidly on exposures, but lasts well under water. It seasons quickly and is easily worked. It is easily attacked by white ants.

9.3.11. **Karimathi** – This grows to height of 25 to 30 meters with a girth of 3 to 4 meters and a bole of 12 to 15 meters. The sapwood is reddish white. The heartwood is freshly cut, turning grey on exposure. This timber is strong, difficult to saw and plane. It splits unless thoroughly seasoned, but somewhat difficult to season. It is durable especially under water.

9.3.12. **Hunal** – The wood is grey or pale brown, even and close-grained, cutting to a smooth surface, prettily mottled, very hard and fairly durable. The wood is good, but somewhat liable to split and not very difficult to work. It is improved by being kept under water. It is liable to the attack of white ants when burried in the ground.

9.3.13. **Thadsal or Dadsal** – The wood is red, brown in colour. It is very elastic, moderately hard and straight grained with long fibre. It is smooth, takes a fine polish and can be easily worked. It is durable and seasons fairly well.

9.3.14. **Holematti, Bilimatti** – The wood is dark brown with darker coloured streaks and very hard. It is apt to split in seasoning and is not easy to work.

9.3.15. **Bagemara or Thiruchal or Bellali** – The wood is dark brown with paler or dark reddish brown streaks, mottled and shining. The wood is hard, close grained. It is tough and fairly durable. It seasons well and easy to work.

9.3.16. **Jack or Halasu** – The wood is bright yellow in colour and mottled when freshly cut, darkening on exposure to orange-brown. It is moderately hard and close grained. It seasons readily and does not warp or split. It works easily and is fairly durable. It takes a good polish. It stands well under water.

9.3.17. **Haiga** – The wood is brown, hard, close-grained and smooth. It is a valuable timber and is considered as one of the best timbers in Tinnevely.

9.3.18. **Tamarind or Hunse Mara** – The tree grows to large dimensions. The stem is seldom straight being mostly short, knotty and thick while the crown is unbraceous. The heartwood forms only a very small portion of the stem. It is dark, purplish brown, hard, close-grained and very durable.

9.3.19. **Sadhupa or Dhupada** – The tree grows to great height with a clear bole of 20 to 25 meters. The wood is grey to light grey in colour, moderately hard, working freely to a smooth surface and presenting a easy appearance if well planed.

9.3.20. **Gandhagarige or Red Cedar Wood** – Bright reddish to red, shining, close and even grained, soft and sweet scented with prominent lines on the longitudinal cut, representing the pores. It is lighter and works to a smooth surface. It takes fine polish but requires a considerable filling before polishing and absorbs much of the polish. The timber seasons quickly and is durable under cover. It does not

warp or split but shrinks and expands with variations of temperature and moisture. It is not attacked by white ants.

9.3.21. **Kadavala or Kadaga** – The wood is yellowish or pinkish brown. It is close-grained, moderately hard and durable if not exposed to wet. It is easy to cut and works to a smooth surface. In seasoning, it is liable to fine longitudinal cracks which, however, do not penetrate deep into the log.

9.3.22. **Poonspar or Surahonne Tree** – The tree attains a height of about 40 meters and more with a girth of 4 to 5 meters. The bark is furrowed with long longitudinal cracks. The wood is of reddish-brown colour and of a streaky and wavy appearance. It is very elastic and seasons fairly well under water. The wood is moderately hard, coarse-grained, strong and fairly durable.

9.3.23. **Channangi** – The wood is grey-brown in colour very hard, cutting to a smooth shining surface, durable and not readily attacked by white ants, it is moderately heavy, difficult to work and rather liable to split. It is close-grained, straight and elastic.

9.3.24. **Ippe** – It attains a height of 30 meters with a girth of 3 to 5 meters. The wood is moderately hard and close-grained. It is heavy, close and straight grained, very flexible and durable.

9.3.25. **Jamba (Inga Xylocarpa or Xylia Xylocarpa)** – This is also known as the iron wood of Arracan, found through S.India. Very superior quality wood, heavy, hard, close-grained and durable and of a very dark red colour. Not easily worked and resists nails. Extensively used for bridgework, posts, piles, etc. good for sleepers and paving blocks. Plentiful in Mangalore, Udupi & Karwar districts.

9.3.26. **Jambe mara** – It grows to a height of 25 meters with a bole 9 meters and a girth of 2.0 to 2.5 meters. The wood is dark brown or reddish brown in colour, annual rings darker but not distinct. It is tough and strong, very hard and difficult to saw especially the seasoned timber. It is cross and coarse-grained and somewhat twisted, cutting to a smooth shining surface which takes paints or varnish readily and well. It is liable to crack and warp very badly while seasoning.

9.3.27. **Nerale** - The tree attains a girth of 3 to 4 meters with a clear bole of about 12 meters. The wood is reddish brown in colour, coarse, moderately hard, darker near the centre, but there is no distinct heartwood. It is tough and fairly durable, not attacked by white ants. It is sometimes liable to warp in seasoning.

9.3.28. **Surahonne or Kal-Honne** – It grows to a girth of 2 meters with a clean bole of 6 to 8 meters. Bark is light brown. Sapwood is small and gray. The wood is grey to greyish brown, mottled handsome, close-grained, very elastic, tough and hard. It takes a good polish. It seasons well and not liable to warp, nor is subject to the attacks of white ants.

9.3.29. **Mavu or Mango** – The wood in older trees is greyish brown to dark brown in colour, streaks with dark coloured tissues, hard, durable and lasts well in water. It is coarse-grained and twisted in fibre and soft in younger trees, readily eaten by insects. It seasons well and does not warp or shrink when joined.

9.3.30. **Mashwal of Satin Wood (Huragalu)** – The wood is very hard, lemon yellow or cream coloured. The inner wood is darker than the outer, but no distinct heartwood. It is fragrant and has a fine satiny luster. A planed surface presents a very smooth shining appearance, often handsomely figured. It is durable and hard but is somewhat liable to split. It takes a fine polish. It seasons moderately well and stands immersion in water. It loses its beauty with age unless it is protected by a coat of fine varnish.

9.3.31. **Nagasampige** – Cultivated in gardens and near temples for the sake of its sweet scent and large flowers. Bark reddish brown, peeling off in thin flat flakes, having a slightly roughened surface. The wood somewhat resembles calophyllum; but much harder and heavier. It is dark red in colour. It is very difficult to work. It should be used well seasoned as it is liable to warp and split.

9.3.32. **Bakul, Ranja or Pagademara** – The wood is very hard even grained. Sapwood reddish brown and heartwood dark-red. It is strong, durable of good colour and quality, but heavy. It works to a smooth surface, seasons well and takes very fine polish, but is difficult to saw and work.

9.3.33. **Malbar Mahoghani, Yennemara** – Bark is dark-brown and green, rather rough. The wood is dark or reddish brown to red, straight and even grained, moderately hard and takes a fine polish. From the wood exudes a red sticky resin.

9.3.34. **Nirvan Teak or Hole Dasaval** – It is called the “pride of India” on account of its beautiful pink flowers. The tree yields an excellent timber but is not known outside its local limits more on account of its very little supply. The wood is light red being brighter when freshly cut, hard, durable and smooth. It lasts well under water and is able to stand rough wear and tear. It works easily and takes a fine polish.

9.3.35. **White Siris, Bellatte or Bilewate** – The sapwood is large, yellow white, not durable. Heartwood brown shining with alternate belts of darker and lighter colour, often indistinguishable from that of Bagemara or Thirchal. The wood is straight and even grained, seasons well and the heartwood is durable.

9.3.36. **Kendal, Sagade** – It is a useful tree as it gets new leaves before the hot season and on this account it is known as forester's friend. It attains a height of 12 to 15 meters and girth of 2 to 3 meters. The wood is extremely hard light pinkish-brown or red and cross-grained. It is tough, strong and durable, season well, though little liable to crack. It is a very heavy timber and possesses considerable power to withstand the attacks of marine bores. It takes a good polish.

9.3.37. **Mukarhi** – A small tree, preferring clayey soils generally. It is found not to grow more than 1.5 meters in girth. The wood is moderately hard, even and close grained and light brown, often with a red tinge. The outer wood is white. It takes a good polish. It seasons well and is durable, but thin planks are somewhat liable to warp.

The root is said to be a specific against snake bites and the bark used in native medicine is said to be a virulent poison.

9.3.38. **Kadaga, Kadamba or Nirabale** – The wood is white with a yellowish tinge, soft and even grained. It has a slight unpleasant smell.

9.3.39. **Havalige** – It attains a height of 30 to 45 meters with a bole of 30 meters. The wood is light-red and straight-grained. It is moderately hard. Some trees split splendidly into shingles but others are found to be totally unfit for the purpose.

9.3.40. **Naihalasu** – The tree attains a girth of 3 to 4 meters with a clean bole of 10 to 15 meters. The wood is hard red and very handsome. The medullar rays are regular, very broad and prominent forming a handsome silver grain. The wood seasons well, and takes a very fine polish.

9.3.41. **Bilvapatre, Bilpatre** – The wood is yellowish greyish white in colour with a strong aromatic scent when freshly cut. It is hard but not very durable.

9.3.42. **Ebony, Karimara, Balemara** – It grows on attaining a girth up 4.5 meters on well drained soils and found chiefly in company with other species “Diospyros” but the heartwood is more than 1.5 meters in girth. One of the reserved trees of Mysore. The wood is very hard and durable, jet black, close and even grained. The wood produces the true ebony of commerce being the only tree of this order that has absolutely black heartwood.

9.3.43. **Kadjuka, Jiraka** – The wood is dark greyish-brown very hard and close-grained.

9.3.44. **Bilvara** – This is known as the raiyats' tree and the wood is useful for nearly every purpose in his domestic economy. The pods are smaller, thinner and darker. The wood is dark in color than those of Bage brown, shining with paler streaks, straight grained, even smooth and long fibred. It is harder than Siris and seasons and works well and takes fine polish and is fairly durable. It is liable to split if not carefully and slowly seasoned.

9.3.45. **Padri, Kaladri** – The tree attains a height of 10 to 15 meters and a girth 1.5 to 2 meters and more. The wood is greyish brown with patches of brighter brown coarse and hard. It has no heartwood. It is scented and moderately durable, strong and elastic. It stands well under water.

9.3.46. **Sampige Mara** – This is a fragrant flower tree. The wood is olive-brown in colour beautifully mottled. It is light, soft, close and grained, very durable especially underground and contains a bitter ingredient which prevents rot. It seasons well and takes a fine polish.

9.3.47. **Dindiga** – It grows 1 to 1.5 meters in girth with a clean bole of 9 meters and more. The bark is pale-brown or white-grey and smooth with shallow depressions of account of its peeling off in small flakes. The wood in older trees is yellowish-grey, hard, shining, and coarse with a very hard dark, purple centre of small size and irregular shape. It is strong, tough, and elastic and difficult to saw in green state. It is fairly durable under cover, though somewhat liable to split in seasoning.

9.3.48. **Kanagalu Mara** – The wood is reddish-grey in colour. It is rough and moderately hard, heavy strong and durable, even when buried underground. It is apt to split, warp, and crack.

9.3.49. **Massimara** – The wood is greyish brown or olivered grey, moderately hard, shining, close and even grained, seasons well, durable and is not attacked by while ants,

9.3.50. **Godda** – The tree generally attains a girth of 2 meters and even a little more and is capable of yielding good sized logs. The wood is like that of Boswellia (Maddi) when grown into a big tree. It gives handsome reddish brown heartwood of good quality, even grained and smooth. It seasons well.

9.3.51. **Hadaga** – The tree does not attain much grith. The wood is light brown in colour beautifully mottled with darker veins, even grained and very hard. It is durable and stronger than teak.

9.3.52. **Tare Mara** – The wood is yellowish grey, straight grained, rather coarse and hard with no heartwood. It is not durable as it is readily attacked by insects.

9.3.53. **Myrabolam Tree or Alale** – The wood is brownish grey with a greenish or yellowish tinge, close grained and fairly durable. The timber is cross grained and difficult to work, but takes a good polish.

9.3.54. **Genasu** – The tree is generally crooked and is not capable of attaining more than 1.5 meters in girth. However lengths of 3 to 4 meters can be secured. The wood is very hard, reddish brown and resembles teak. It is smooth, straight grained and even. The wood is tough, elastic and takes a good polish.

9.3.55. **Camboge Tree Guragi, Arsina-Guragi Kankutaka** – The wood is yellow, hard, mottled with numerous wavy concentric bends of soft texture.

9.3.56. **Jagalaganti** – The stem of this tree is generally fluted or furrowed. The wood is grey, dirty white when cut, turning yellow or brown on exposure and streaked with patches of darker colour, especially towards the centre, but there is no regular ebony heartwood. It is fine grained and durable. It is moderately hard and difficult to cut with the axe.

9.3.57. **Noviladi or Bharanige** – Bark is yellowish grey or greyish brown and rough. The wood is grey with a tinge of olive brown, hard, smooth and close grained and polishes well; but it is liable to split and warp. It is durable under water. Much esteemed in Ceylon.

9.3.58. **Chittagong wood or Kalgarige** – The wood is reddish-brown and hard with a fine silver grain and beautiful satiny lusture, seasons and works well. It is most elegantly veined and at the same time very close in the grain. Sapwood is pale and of lighter colour. The fibre run in somewhat different directions and is consequently difficult to plane.

The bark is a powerful astringent and the flowers give a red or yellow dye.

9.3.59. **Vate Mara** – The heart wood is yellow in colour and changes to dull brown on exposure. It is smooth, even grained, fairly hard and durable. It works easily and presents a fair appearance when polished. It gives out an unpleasant odour while being sawn, probably due to the resinous nature of the wood. It resists the attack of white ants.

9.3.60. **Jalari Mara** – The wood is yellow or yellowish brown or grey, hard, smooth and even grained with small dark coloured irregularly shaped heartwood. The wood seasons well and is not attacked by white ants on account of its resinous nature.

9.3.61. **Kavalu or Gavalada Mara** – The wood is dark reddish brown, even grained and durable. It is fairly hard and strong but not very heavy. It is a fine wood, cuts to a smooth surface and takes a good polish. It is difficult to season. It stands well under water.

9.3.62. **Rampatre or Ramanadike** – It is light reddish brown, moderately hard with prominent regular concentric lines.

9.3.63. **Aine tree or Hebbahalasu** – The wood is yellowish-brown in colour. It is moderately hard and straight grained durable, seasons and polishes well. It does not warp or crack nor is eaten by white ants. It stands contact with water well. This is one of the reserved trees of Karnataka.

9.3.64. **Bende Mara** – The wood is white grey and soft. The bark yields a fibre for rope making, for temporary raft tying. It becomes brittle and rots if allowed to dry.

9.3.65. **Hale or Beppale** – The tree is much fluted and grows badly. It is capable of yielding pieces suitable for turning and carving work. The wood is white, moderately hard and even grained. Pores very scanty and very small.

9.3.66. **Kaidhupa or Koidhupa** – The wood is pinkish white when freshly cut, turning grey on exposure. It is straight grained and moderately hard and not durable. The tree yields a large quantity of black resin which is an important article of trade in Mangalore and Udupi districts.

9.3.67. **Kasarike or Casuarina** – The wood is yellowish-pink to reddish brown in colour with a long fibre. It is very hard and not easy to work. Sometimes the fibre becomes twisted. It cracks and splits if the timber is not seasoned slowly. It is not durable when exposed but fairly so under cover. It bears great strain and is well adapted for posts.

9.3.68. **Dodda Thoppe or Doddi** – The tree attains a girth of 2 to 2.5 meters with a bole of 8 to 10 meters. The wood is white when cut up fresh and brownish grey if cut up dry. It is soft, but of good quality for purposes for which soft wood is useful.

9.3.69. **Bili Halasu or Sattale** – The tree attains a good size with a clean bole of 15 to 20 meters and even more. The wood is reddish grey, moderately hard and close grained. It seasons well and works to a smooth surface. It is durable if smoked.

9.3.70. **Incence Tree, Maddi, Guggala Dhupa, or Sambrani Dhupa** – Trees growing up to 1.5 to 2 meters in girth are common. The bark is yellow or greenish yellow, exfoliating in small, hard and irregular flakes or thin plates. The heartwood is very small and when present it is handsome, streaked in darker and lighter bands. The wood is moderately hard, smooth and brown in colour. It is not durable, and to some extent free from attacks of white ants.

9.3.71 **Maddale or Madhalle** – The tree attains gigantic girth sometimes and also a height of 30 meters and even more. The wood is white soft and even grained, but seasons badly and soon gets mouldy and discoloured, if allowed to season in logs. The wood is not durable, but is easily workable.

9.3.72 **Ramanadike** – The trees does not grow more than 2 meters in girth, but a height of 15 to 20 meters is common. The wood is light reddish brown, streaked, soft. With many prominent brown concentric lines. The wood is handsome.

9.3.73 **Nirangi** – The wood is red or barks brown in colour, soft, porous and even grained. The tree does not attain more than 1.5 meters in girth even in favourable places.

9.3.74 **Gulmavu** – The wood is orange brown and moderately hard. The timber seasons well, and does not split and cracks.

9.3.75 **Bevu or Margosa Tree** – The wood is dull red in colour. It is fairly hard, close grained and slightly scented. It is durable, mottled and heavy and takes good polish. It is so bitter that no insects attack it. The wood is very much like Mahogany beautifully mottled and heavy.

9.4. **General woodwork – wrought & put up**

9.4.1 **“Carpenter’s work”** includes all timber in roofs, floors, verandahs, staircases, door and window frames, bridges, centerings, cofferdams, curbs of well, shores, struts, large gates, and generally all wood-work except in the case of battens used in roofing trellis-works, etc., which is not specially moulded or carved.

9.4.2 When the thickness of carpenter’s work does not exceed 50 mm and at the same time the width exceeds twice the thickness, it is called **“planking”**.

9.4.3 **“Joiner’s work”** includes furniture, doors and windows, and turned, carved, or moulded work of all kinds.

9.4.4. **Carpenter's work is rated per cubic meter, except planking**, which is rated by the square metre of a specified thickness, or per Rmtr with specified breadth and thickness and batten work which is rated by the square meter. Doors, windows and similar work, and paneled work generally, are rated per square meter; other joiner's work at special rates, according to the nature of each case.

9.4.5. **The timber is to be of the best quality, well seasoned, felled not less than two years before use for carpentry and four years for joinery and free from large or loose knots and from shakes or defects of any kind.** Sapwood will be rejected unless it is thoroughly impregnated with creosote or some other approved preservative. Any timber so rejected shall be removed at once from the site of the works, and not again brought thereon unless with the express written permission of the engineer.

9.4.6. **The engineer may inspect all logs previous to use, and reject any which he considers defective. The engineer shall however have power of rejecting at any stage, any work which may be found defective in quality or workmanship and shall not be debarred from rejecting wrought timber by reason of his having previously passed the same in the log or in un-worked stage.**

9.4.7. **Carpenter's work is ordinarily specified as "wrought" or "wrought and put up," or "wrought, framed and fixed".**

9.4.8. The rate for wrought timber includes carriage to, and delivery at, the site of the works, the fair rendering of all surfaces, chamfering of angles, etc.

9.4.9. The rate of timber "wrought and put up" includes all that is specified in the preceding paragraph, and in addition, all work required for fixing the timber in its proper position in a building, bridge centering, or other construction. The rate includes all special scaffolding, labour, materials, and apparatus for lifting and fixing in position according to the drawing or other instructions furnished by the engineer.

9.4.10. The rate for framed wood-work to include all sawing, jointing framing, labour and materials for raising and fixing, and also, the fitting, fixing and supply, of all straps, bolts, nails, treenails, spikes, screws, etc., necessary for the framing and fixing.

9.4.11. All workmanship is to be of the best description and all joints must fit accurately without wedging or filling. After the wood-work has been erected, any undue shrinkage or bad workmanship is discovered, the contractor shall forthwith amend the same, without any extra charge.

9.4.12. Planking is to be specified with straight square edges, or rebated, ploughed, tongued, or dowelled as may be directed.

9.4.13. All carpenter's work shall be paid by net measurement, no allowance being made for wastage or for dimensions supplied beyond those specified, but the length of each piece shall be taken over all, so as to include projections for tenons or scarfs.

9.4.14. The contractor shall give due notice to the engineer when any timber is to be covered up in the ground, or in the walls of a building, or otherwise; failing which it shall be optional with the engineer to order it to be uncovered at the contractor's expense, or to measure and pay for only so much as is uncovered.

9.4.15. No timber work shall be painted, tarred, or oiled without the previous written permission of the engineer.

9.4.16. The engineer may order any truss or other framed work to be put together on the ground, and submitted to suitable tests before being placed in position.

9.4.17. When unwrought timber is supplied by a contractor, the rate paid will in all cases include carriage to, and delivery at, the place where it is required for use.

9.4.18. Timber in the log, or wholly or partially wrought, may be supplied to the contractor from government stores or from a dismantled building. In such case the value of the timber so supplied, at the rate payable to the contractor for similar material, will be deducted from the price of the finished work. Where the contract schedule contains no rate for similar material, the value to be deducted will form the subject of special agreement.

9.4.19. A separate rate will be required when material thus supplied has to be framed, re-fitted or reworked in any manner.

9.4.20. When material is supplied to be contractor under either of the two preceding paragraphs, he shall be charged for its full dimensions, no allowance being made for wastage in working or altering it and all of such material not used and charged for as finished work shall be the contractor's property, but the contractor shall be entitled if required and permitted to utilise such material, as is in his opinion, unsuited to the purpose intended, in consequence of excessive wastage or other cause.

9.4.21. The conditions detailed above will apply to joiners as well as to carpenter's work, except where they are plainly inapplicable.

9.4.22. All timber resting on or bedded in masonry must be well coated with boiling coal tar.

9.4.23. The ends of all timbers set in masonry shall have as air space left on end and sides to allow of free circulation of air round it.

9.4.24. Glue shall not be used in joints which are exposed to the weather, and in such exposed work any hard stopping shall be done with tight driven plugs.

9.4.25. No wood-work of any sort shall be set within 0.5 metres of a fireplace or flue.

9.4.26. The contractor will be responsible for the easing or otherwise of all doors, etc., and the closing of all joints which may occur within six months of the completion of the work and which, in the opinion of the engineer, should be attended to.

9.5. Defects in timber for structural and carpenter's work

9.5.1. **Prohibited defects** - Timber for structural shall not have loose grains, splits, compression wood in coniferous structural timber, heartwood rot, sap rot, and warp, wormhole made by powder pest beetles and pitch pockets. Knots, shakes and checks shall not be permitted in regions of maximum stress intensities nor shall they be permitted at locations where joints are to be provided.

9.5.2. Permissible defects

The following defects are permissible

a) Wanes provided they are not combined with knots and reduction in strength on account of the wanes is not more than the reduction with the maximum allowable knots. (b) Worm holes, other than those due to powder pest beetles, located and grouped that reduce the strength of timber shall be evaluated in the same way as knots. (c) Sap wood not more than 15 per cent of the area of the section may be allowed provided it is properly treated with preservative as specified in IS: 401-1982, Code of practice for preservation of timber. (e) All other defects which do not affect any of the mechanical properties. (f) Location and permissible limit of the size of knots, depth of checks and shakes and slope of grain shall be as applicable for Grade I structural timber as per IS: 3629-1986. Details furnished in Annexure 9-A.1.

9.5.3. Defects in timber for joiner's work

9.5.3.1. **Prohibited defects** - Timber for joiner's work shall be free from decay, fungal growth, boxed heart, pitch pocket or streaks on the exposed edges, boxer holes, splits, cracks, pin holes and worm holes.

9.5.3.2. Permissible defects

(a) Cross grain shall not be steeper than 1 in 15. (b) The diameter of individual sound knot and live knot shall not exceed 25 mm and the aggregate area of the knots shall not exceed one percent of the area of the piece. (c) Timber shall be generally free from sapwood, but traces of sapwood up to 15 percent may be allowed provided it is properly treated with preservative as specified in IS: 401-1982, Code of Practice for preservation of timber.

9.6. **Seasoning of timber** - The process of drying timber under controlled conditions is called seasoning of timber. Timber shall be either air seasoned or kiln-seasoned and in both cases moisture content of a seasoned timber shall be as specified in Table given below. Unless otherwise specified, air seasoned timber shall be used. Kiln seasoning of timber, where specified, shall be done as per IS: 1141-1993 in a plant approved by engineer.

9.7. **Tolerances** - Seasoned timber (whether air or kiln dried) shall be deemed to conform to the moisture content requirements if the average moisture content of all samples from a given lot is within + 3 per cent and the moisture content of individual sample is within + 5 per cent of the maximum permissible moisture content for the particular end use and locality as indicated above.

9.8. **Moisture content** - Moisture meters obviate the necessity of cutting test samples and yield immediate results and are particularly suited for checking of moisture of timber in the field. This method is however not as precise and fool-proof as oven drying method. The accuracy of determination under field conditions of use after observing necessary precautions and applying the appropriate corrections to take account of timber species is not better than ± 2 per cent of the results obtained by oven drying method. Any dispute concerning the moisture content of timber shall be decided by recourse to the oven drying method as described in IS: 287-1973. (See Annexure 9-A.2)

Maximum permissible moisture content of timber

Sl.No.	Use	Max moisture content percent			
		Zone I	Zone II	Zone III	Zone IV
1.	Beams, Rafters and Posts	12	14	17	20
2.	Doors and Windows				
	a) 50 mm and above thickness	10	12	14	16
	b) Thinner than 50 mm	8	10	12	14
3.	Flooring strips	8	10	10	12
4.	Furniture and Cabinet making	10	12	14	15

9.9. **Preservation of timber** - Preservative treatment does not improve basic properties of timber but gives varying degree of protection against deterioration due to attacks by fungi, termites, borers, and marine organisms. Preservative treatment, where specified, shall be done using oil type, organic solvent type or water –soluble type preservative. Oil type preservatives shall be used if the timber is not required to be polished or painted. Before preservative treatment, the timber shall be sawn and seasoned. All surfaces exposed after treatment, except due to planning, shall be thoroughly brushed with the preservative before jointing. Preservative treatment of timber shall be done as per IS: 401 - 1987 in a plant approved by the engineer.

9.10. **General guidelines for good workmanship** - All wood work and carpenter's work shall be carried out as detailed in drawings or as directed by the engineer.

9.10.1. **Species of timber** - Only the specified species of timber shall be used. For any one structural unit, only one species of timber shall be used.

9.10.2. **Sawing and planing** - Sawing shall be truly straight and square and in the direction of grains except for the members which are curved. Where indicated, the members shall be planed smooth to the full dimensions are rebated, rounded, chamfered or moulded as detailed in the drawings or directed, before they are fixed or framed and fixed. A tolerance of - 2 mm and + 3 mm shall be allowed in the finished cross sectional dimensions.

9.10.3. **Nails** - Steel wire nails shall conform to IS: 723-1972, Specification for steel countersunk head wire nails. The nails shall be machine made. The head should be properly formed, chequered and concentric with the shank. The ends shall be sharp and pointed. Nails shall be plain finished.

9.10.4. **Wood screws** - Steel wood screws shall conform to IS: 451-1972. Technical supply condition for wood screws and of the type, finish and size as required or as directed. Screws shall be cleanly finished and the heads shall be true and concentric with the shank. Slots in the head shall be clear, straight and free from burrs and central with regard to the head. Threads shall be clear and well defined. Wood screws shall be in 'self colour' condition.

9.10.5. **Glue** - Adhesives and glues for putting together in wood work and joinery shall conform to (a) Synthetic adhesives WRB or MR grade conforming to IS: 851-1978, Synthetic resin adhesives for construction work in wood; or (b) synthetic adhesives conforming to IS: 4835-1979, polyvinyl acetate dispersion based adhesives for wood;

9.10.6. **Jointing** - The contractor shall observe the following principles in forming joints

(a) To form joints and arrange the fastenings in such a way so as to weaken as little as possible the pieces of timber they connect. b) To place each abutting surface in a joint, as nearly as possible, perpendicular to the pressure it has to transmit ; (c) To form and fit accurately every pair of surfaces that come in contact.

9.10.7. **Joints** - Joints in timber frames shall be made carefully and securely. Notches shall in no case remove more than the quarter of the section. All mortice and tenon mitred, scarf and other joints shall fit fully and truly without wedging or bamboo pins of about 10 mm dia.

9.10.8. **Fabrication** - Fabrication shall be done in the best possible manner and all necessary mild steel ties, straps, bolts, etc., shall be fitted as indicated. Members shall be fabricated accurately so that these can be assembled without being unduly packed, strained or forced into position and when build up shall be true to shape and free from twist, kinks, buckle or open joints. Patching or plugging of any kind shall not be allowed.

9.11. SPECIFICATIONS FOR WOODEN BALLIES

9.11.1. Unless otherwise ordered, the ballies shall conform to the dimensions given below

Type of ballies	Diameter at the top in cm	Diameter at the butt end in cm
1	Over 8.5 up to 12.5	Over 15 up to 20
2	Over 6.5 up to 8.5	Over 11.5 up to 15
3	Over 5 up to 6.5	Over 7.5 up to 11.5

Note: The top and butt end diameters shall be measured at the extreme ends of the ballies.

9.11.2. Ballies shall be reasonably straight that when laid horizontally in any position the centre line joining the apex and base shall not deviate from the actual axis of the ballies by more than 7.5 cm. Ballies shall be air-dried to a moisture content not exceeding 20 per cent within a depth of 12 mm from the surface, when measured at 30 cm from the butt end of the ballies.

9.11.3. Ballies shall be free from cuts across the grain, live insect attack, any kind of decay (rot), pronounced spiral or twisted grain, hollow heart and dead knots exceeding 5 cm in diameter. The number, size and distribution of knots shall be such as not to weaken a ballies to such an extent as to make it unsuitable for use.

9.11.4. Surface cracks shall not exceed 19 mm in depth and 3 mm in width for type 1 ballies, and 12 mm in depth and 3 mm in width for type 2 and type 3 ballies provided they are not so numerous or so located as to impair the usefulness of the ballies. Spiral or twisted grain shall not be more than one complete twist of grain or spiral in any 6 m of length. Short crooks shall not exceed two in number per balli. Pin hole (dead infestation) shall be scattered and not concentrated; provided they are not due to powder pest beetles.

9.11.5. SPECIFICATIONS FOR SAL BALLI WORK

Ballies shall be free from large and dead knots, cracks and wooden borer infection. These shall be as far as possible straight and of uniform section. The diameter specified shall be the mean diameter. This mean diameter shall be the average of two diameters at ends.

The tolerance shall permit as under.

Length	Mean diameter or diameter at the centre	Tolerance in diameter at the thinner end
Ballies not exceeding 3 metre length	Not less than the specified diameter	The diameter at the thinner end shall not be less than specified diameter by more than 10 mm
Ballies exceeding 3 metre length	Not less than the specified diameter	The diameter at the thinner end shall not be less than specified diameter by more than 10 mm

9.11.5.1. **Surface treatment** - It shall be as specified in 9.27.6.

9.11.5.2. **Fixing** - The fixing of the ballies for posts, purlins and rafters shall be done by clamps, bolts and nuts and spikes (country nails) as specified or as directed by the engineer. In case of the last alternative the large nail with a cap shall be driven through about 40 mm beyond the ballies to be fixed together and the end of the nail turned back so as to ensure proper fastening. Where so required, holes of slightly smaller size may be drilled before hammering in spike.

9.11.5.3. **Trusses** - The ballies in truss work shall be as far as possible of full lengths. Where making up is considered necessary it may be done by half lap joints secured together with 50 x 6 mm M. S. clamps of suitable length and shape fixed with bolts and nuts.

9.11.5.4. **Measurements** - The Sal ballies shall be measured in running metres correct to a cm. Each piece shall be measured overall so as to include half lap joints etc.

9.11.5.5. **Rate** - The rate includes the cost of materials and labour required for all the operations described above. The cost of bolts, nuts, flat iron clamps and other iron work except nails and spikes shall be paid for separately under relevant item of steel work.

9.12. SPECIFICATIONS FOR SHORING AND STRUTTING

Walls, floors, roofs, partitions etc., where indicated or directed to be supported, shall be adequately shored to the satisfaction of the engineer. The contractor shall be responsible for the soundness and strength of the timber used for shoring and strutting and for properly bracing and securing them to sustain the pressure to which the shoring is likely to be subjected. Shoring shall be removed only after its removal has been approved by the engineer.

Shoring shall consist of all requisite dogs, hoop iron, hooks, rakers, sole-pieces, wall pieces, braces, struts, needles, cleats, wedges and posts. Shoring shall be of suitable structural timber, clean sawn. Racking shore may be at an angle of 60 degree to 75 degree Celsius with a building but 40 degree is the best angle, if obtained. Sole piece should be quite at right angle to the shore. The top needle should be at least 0.6 metre down from the top of the wall.

9.13. SPECIFICATIONS FOR FORMWORK

9.13.1. **Materials** - Formwork shall be of timber. Alternatively the contractor may provide form work of plywood, timber with steel sheet lining or steel plate stiffened by steel angles without any price adjustment.

9.13.2. **Classification of form work** - Form work shall be classified depending upon the type of finish required for the concrete as under -

(a) **Form work for rough finish** - Form work required for the concrete surface which is either hidden from view or is specified to be separately finished with plastering or rendering

(b) **Form work for fair finish** - Form work required for the concrete surface which may show some joint – marks which may not be objectionable (on account of forming a pattern by itself or otherwise not objectionable), and is presentable without any further treatment.

9.13.3. **General requirement** - The form work shall be rigid and so constructed as to retain the shape and dimensions of the member being cast. It shall have sufficient strength and rigidity to withstand the load of concrete, vibrations, movement or men, materials and plants and any other incidental loads without excessive deflection beyond permissible limits. Before concreting is started, the props and wedges shall be thoroughly checked to see that these are intact, and are not loose. While concreting is in progress, a constant watch shall be kept on the props and immediate remedial measures taken as soon as any of these gets loosened. Care shall be taken that props and wedges do not get loose for the minimum period specified for the removal of form work.

9.13.4. **Propping and centering** - The props shall consist of ballies, steel sections or of brick pillars laid dry or mud mortar. Ballies shall be placed at a spacing of 1 to 1.2 metres and shall rest squarely on wooden sole plates. Double wedges shall be provided between the sole plate and the wooden prop, so as to facilitate tightening and easing of shuttering without jarring the concrete. In case brick

masonry pillars are used as props, the wooden sole plate shall be provided at the top of pillar and double wedges inserted between the sole plate and the bottom of shutting.

In case of multi-storeyed structures, the weight of concrete and form work of any upper floor shall be suitably supported on at least two floors below the same. In case the height of centring exceeds 3.50 metres, the props may be provided in multi-stages.

9.13.5. Shuttering - Shuttering for 'rough finish' surface of concrete may have clean sawn or wrought surfaces which come in contact with concrete surface and planed on the sides. The shuttering of 'fair finish' surface shall have wrought and smooth surfaces which come in contact with concrete surface and planed on sides. Joints shall not permit leakages of cement grout.

Form lining shall be such as would not discolour the concrete. Where steel sheet lining is provided to timber forms, it shall have, on mounting, minimum amount of kinks and other imperfections. Where metal forms are used, all bolts and nuts shall be countersunk and well ground to provide a smooth plain surface.

Where concrete is required to have a rounded edge, bevelled edge or moulded edge; provision shall be made in the form itself. Opening for fan clamps and other fitting connected with services shall be provided in the shuttering as directed by the engineer.

As far as possible, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nails shall be used and these shall be left projecting so that they can be easily withdrawn.

9.13.6. Surface treatment to shuttering - Forms shall be thoroughly cleaned of all dust, dirt, wood shavings and other matter by washing with water. The surface shall then be coated with soap solution before concreting is done. Soap solution shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil / refined pale paraffin mineral oil of approved manufacture may be applied. Care shall be taken that the coating does not get on construction joint surface and reinforcement bars. It shall also not cause softening or permanent straining of concrete surface nor shall impede the wetting of surfaces to be water-cured. Special care shall be taken in case of small grooves. The form strips shall be oiled coated thoroughly so as to prevent swelling of the forms and damages to the concrete on removal of forms.

9.13.7. Camber - The shuttering for beams and slabs shall have a camber of 1 in 250 and for cantilevers at the free end of 1/50 of the projected or as directed by the engineer.

9.13.8. Erection of assembly of forms - Form work shall be erected true to line, vertical or battered to proper slope as required and free twist. It shall be so assembled as to facilitate easing, and removal of the various parts in proper sequence without jarring the concrete. For column etc., where concreting is done in stages, one side of the form work shall be made in suitable parts and shall be capable of being fixed securely and quickly in position. The complete form work shall be inspected and approved by the engineer before placing reinforcement and laying concrete.

9.13.9. The form work shall conform to the shapes, lines and dimensions as shown on the drawings or as indicated within the tolerance given below -

Deviation from specified dimensions of cross section of column and beam	-6 mm +12 mm
Deviations from dimension of footing Dimension in plan	(See Note) -12 mm + 30 mm
Eccentricity	0.02 times the width of footing in the direction of deviation but not more than 50 mm.

Note: Tolerance apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowel.

9.13.10. Striking / removal of forms - Forms shall be removed gently. They shall be eased carefully in order to prevent the load being suddenly transferred to concrete. The minimum periods that shall

elapse after the concrete has been laid and before form work is eased and removed are given in Section 4 – Concrete.

Reuse - Before reuse, the forms shall be thoroughly scraped, cleaned and joints gone over and repaired where necessary. Inside surface shall be retreated to prevent adhesion of concrete.

9.14. SPECIFICATIONS FOR CENTERING FOR ARCHES

Centering for arches shall be of timber and so constructed and stayed as to remain rigid and unyielding during the construction of the work for which it acts as support. Other materials such as bricks, etc., may be used as supports only for centering if they will serve effectively the purpose desired, subject to the approval of the engineer. In preparing centering, allowance shall be made for easing by means of wedges before striking the centres. Centering shall be set truly level, unless

9.15. SPECIFICATIONS FOR SCANTLINGS

Unless otherwise indicated, the contractor shall supply scantlings in one piece in lengths up to 3 m. For lengths over 3 m the contractor shall be allowed to use more than one piece. One for every extra 3 m or part thereof; and shall connect the same with proper scarf or other lengthening joints, as directed by the engineer.

9.16. SPECIFICATIONS FOR NAIL JOINTED TIMBER CONSTRUCTION

9.16.1. Nails with blunt, tapered and diamond point are preferable for structural work. Diameter of nails shall be within the limits of $1/11$ to $1/6$ of the least thickness of the members to be connected. It should be such that while driving, the nails should not cause splits or cracks in the timber. The length shall be such that the nails fully penetrate through all the members to be jointed. A minimum of two nails for model joints for lengthening joints shall be used.

9.16.2. **Spacing of nails** - Unless otherwise indicated or directed, minimum distance of nails, prebore end, between the nail distance from the edge shall be as per IS: 2366-1983.

9.16.3. **Driving of nails** - Nails shall be driven through and through. Adjacent nails shall be driven alternately from either faces. Protruding nails shall be cut down or clenched. Where required prebore shall be drilled before driving the nails to avoid the splitting of timber. Prebore for various size of nails shall be as specified in IS: 2366-1983.

9.16.4. **Camber** - The initial camber recommended in nail jointed construction is $L/200$ where L is the span of the truss.

9.17. SPECIFICATIONS FOR BOLT JOINTED TIMBER CONSTRUCTION

9.17.1. **Spacing of bolts** - Unless otherwise indicated or directed, spacing of bolts shall be as per IS: 11096-1984.

9.17.2. **Bolting** - Staggering of bolts shall be avoided as far as possible in case of members loaded parallel to grain of wood. For loads acting perpendicular to grain of wood, staggering is preferable to avoid splitting due to weather effects. The bolt holes shall be bored or drilled perpendicular to the surface involved. Bolts shall not be forcibly driven. A bolt hole of 1 mm oversize may be used as a guide for pre-boring. Washer shall be used between the wood and the bolt head and between wood and the nut.

9.18. SPECIFICATIONS FOR BATTENS FOR MANGALORE TILE ROOFING

9.18.1. The spacing of rafters shall not normally exceed 60 cm. The battens shall be fixed over the rafters or the boarding at the spacing indicated and nailed to the rafters/boarding with plain headed nails. The nails shall penetrate at least 2 cm in to the rafters/boarding. The length of battens shall be extended with butt joints and shall be located only over the rafters. The joints of no two adjacent rows of battens shall come over the same rafter. At the eaves tilting fillet shall be fixed, unless otherwise indicated.

9.18.2. Nailing and screwing of fillets, battens and boards - Fillets, battens, trellis work ; etc. shall be nailed, or screwed, if indicated, at every support. Boarding shall be nailed, or screwed if indicated; using two nails or screws for every board per support. Where the support is continuous, the nailing or screwing shall be done at intervals not exceeding 30 cm. As a guide, the minimum length of nails and screws shall be as under -

For 15 mm to 20 mm thick timber	30 to 40 mm long.
For 25 mm to 30 mm thick timber	50 to 60 mm long.
For 35 mm to 45 mm thick timber	60 to 80 mm long
For 50 mm thick timber	100 mm long.

9.19. SPECIFICATIONS FOR ROOF BOARDING

Heading joints shall come over centre of rafters or purlins in all cases. For tiled roofs, etc., the boarding shall be laid horizontally over rafters butt jointed, well cramped up and securely nailed to rafters. When fixed direct to purlins, the boarding shall be laid diagonally with butt joints, well cramped up and securely nailed to purlins. When fixed under felt etc. the boarding shall be tongued and grooved, traversed and cleaned off after fixing, to an even surface. All nail heads shall be driven in and all exposed arises rounded off.

9.20. SPECIFICATIONS FOR WEATHER BOARDING

Weather Boarding shall be 12 to 18 cm in width plain or feather edged, rebated and chamfered, hollow or V jointed, with edges shot or chamfered and of thickness as indicated fixed with 60 mm long nails and neatly cut and fitted around doors, windows, etc.

The types of weather boarding shall be as specified.

9.21. SPECIFICATIONS FOR TIMBER CEILING

9.21.1. Timber ceilings shall be provided as detailed in drawings. Unless otherwise indicated, timber boards/planks shall be 15 to 20 mm thick as indicated and width 100 to 150 mm as indicated. The longitudinal edges of the planks shall be jointed to each other in one of the following ways, as indicated -

a) **Butt and beading type** - The planks shall be butted together with a small gap and a beading provided.

(b) **Overlap Type** - Each plank shall overlap the adjoining plank by at least 15 mm on both sides such that any two adjoining planks are in two levels.

(c) **Half lap Type** - The adjoining planks shall be half lapped by 15 mm.

(d) **Tongued and Grooved Type** - The adjoining planks shall be jointed together through tongued and grooved joint with tongue 10 mm long.

9.21.2. **Fixing** - The plank joints shall be parallel and in perfect line. The first plank next to the wall shall be fixed carefully and accurately very close to the wall. Subsequent planks shall be jointed up as indicated with utmost care. The longitudinal joints of the plank shall be as indicated. Heading joints shall be square butt type and shall occur under centre line of the supplying joint. The countersunk screw holes and the joints between the planks (except butt joints) shall be filled with putty or stopping. The beading where indicated shall be fixed to boarding with screws of length 50 mm or equal to the overall thickness of the planks and beading whichever is larger. The overlap of the beading shall be equal on either side of the two adjoining planks. The beading shall be mitred at junctions. The spacing of the screws shall be staggered along the length so that each one is driven completely through the planks. Screws shall be countersunk and screw holes filled up with putty or stopping.

9.22. SPECIFICATIONS FOR TIMBER FLOORS

9.22.1. Timber floors shall be provided as detailed in the drawings. Timber floor boards shall be of the species and class as indicated. Only selected quality of boards of uniform width shall be used.

Floor boards shall be 25 mm to 40 mm in thickness as indicated and shall not be less than 10 cm nor more than 15 cm in width. The same width of boarding shall be maintained throughout the floor except where the width of the room is not an exact multiple of the boards; in which case the difference shall be equally adjusted between the two end boards adjacent to walls. The maximum length of the boards shall be restricted to 3 metres. The minimum length of board shall be such that the boards rest at least on three supports but in no case it shall be less than 2 metres.

9.22.2. **Finish and joining** - The boards shall be planed true on the top surface only with edges shot, tongued and grooved rebated or rebated and filleted (with loose fillet) and heading joints shall be close butt, tongued and grooved, cross tongued or secret nailed, as indicated. Heading joints shall occur over the centre line of the supporting joists/rough ground and that heading joints in adjacent boards shall not be placed over the same joist. The length of the nails and screws shall be not less than twice the thickness of the board. Where use of screw is indicated they shall not be thinner than designation 8.

9.22.3. **Fixing** - The joists or the rough grounds on which planks are fixed shall be checked and corrected to levels. The end boards shall be accurately fixed with sides and close to the walls. A margin on minimum 5 mm all round shall be left to allow the floor to expand. Unless otherwise indicated, each adjoining board shall be properly jointed and tightened into position and nailed, or screwed where indicated. Two nails/screws shall be used for fixing each board to the joist/rough ground at each end and one nail/screw at the intermediate joists in a zigzag manner. The screws shall be countersunk and screw holes filled with approved stopping. The junction between timber flooring and adjacent flooring shall be formed by inserting an aluminium strip at the junction. The metal strip shall be fixed to the end of the planks by screws. The flooring shall be truly level and plane. The flooring shall be planed in both directions and made perfectly even, true and smooth.

9.22.4. **Finishing** - The surface of the floor shall be waxed or otherwise finished as indicated. The lower face shall be treated as indicated.

9.23. SPECIFICATIONS FOR TIMBER FENCING POSTS

9.23.1. Fencing posts shall be provided as detailed in the drawing. The bottom ends shall be sawn square and tops shall be either tapered or sawn square as indicated or as directed.

9.23.2. Knots in the timber fencing posts shall not be more than half the cross sectional dimensions of fence posts. The number condition and distribution shall be as not to weaken a post to an extent to make it unsuitable for use. Surface cracks shall be permitted only up to 5 mm in depth, 1 mm in width and up to 10 cm in length. Their number and location shall not impair the usefulness of posts.

Pin holes shall be well scattered and not concentrated in any area. No pin hole shall be permitted if they contain live infestation of powder pest beetles. All fence posts shall be seasoned to moisture content not more than 18 per cent.

9.23.3. A tolerance of ± 5 mm in dimension of fence posts shall be permitted.

9.23.4. **Erection** - Unless otherwise indicated, fence posts shall be erected so that at least 40 cm of the butt is firmly gripped in the ground. The holes in the ground shall be as small as practicable to allow for refilling with earth which shall be well rammed. When posts are set in concrete, concrete shall be set with posts completely gripped in it and earth well rammed on all sides of concrete. The top of the concrete may be sloped away from the post in all directions.

9.24. SPECIFICATIONS FOR TIMBER PILES

9.24.1. Species of timber for piles shall be as indicated. Ballies used for piling shall be specially selected any straight. The ratio of heartwood diameter to the pile butt diameter shall be not less than 0.8. Circumference less by 5 cm than that specified in 10 per cent piles may be acceptable. Defects like short crooks twists, knots, etc. shall not exceed those specified for structural timber ballies.

9.24.2. **Setting out** - The piles shall be set out to proper alignments, correctly centered and driven vertically or battered as indicated. In loose sand and stiff clay pile driving shall proceed outward from the centre. In the case of very soft soils driving may have to proceed from outside to inside, unless otherwise directed.

9.24.3. **Driving** - The pile shall be pointed in the form of a truncated cone or a pyramid having the end 25 cm 2 to 40 cm 2 in area and the length shall be of 1-1/2 to 2 times the diameter. If the driving is to be done; through hard material such stiff clay and gravels etc., metal shoes of approved design shall be attached to the tip. To prevent splitting and reduce brooming the head of the pile shall be hooped. The heads of piles shall be further protected by provision of cushion blocks.

9.24.4. **Control of alignment** - The pile shall be driven as accurately as possible to the vertical or to the specified batter. Any pile deviating from its proper alignment to such an extent that the resulting eccentricity cannot be taken care of, shall at the discretion of the engineer, be replaced or supplemented by an additional pile at no extra cost to the Govt. As a general guide, permissible positional deviation for piles shall be not greater than 75 mm from their designed position at the working level of the pile rig. In case of single pile in the column position, the tolerance shall not be more than 50 mm and shall not exceed two per cent (one degree) from the specified inclination.

9.24.5. **Amount of driving** - Care shall be taken not to damage the piles by over driving. Any sudden change in the rate of penetration, which cannot be ascribed to the nature of the ground, shall be noted and its cause ascertained if possible, before driving is continued.

9.24.6. **Recording of data** - The recorded data shall include the following -

(a) the diameter of the pile ;(b) the depth driven ;(c) the sequence of driving –in pile groups ;(d) the final set for the last ten blows, or as may be directed ;(e) the type and size of hammer and its stroke, or with double-acting hammers the number of blows per minute ; and(f) the type and condition of the packing on the pile head and the dolly in the helmet.

9.24.7. **Cut offs and capping** - After driving pile tops shall be cut off to a true plane and shall show a solid head at the plane of cut off. Capping shall be done when the piles are in correct position.

9.25. SPECIFICATIONS FOR WOODEN PLUGS

Wooden plugs shall be made of hardwood and shall be wedge shaped. Unless otherwise indicated or directed, the size of plugs shall be 20 mm square at one end, 25 mm square at the other end and 50 mm long. Wooden plugs shall be driven into the martices, embedded in the hole with grout around them, if necessary, at the time of construction, generally, if plugs are fixed later, a near hole of a size slightly longer than the size shall be made and plug fixed in the hole and the surrounding space grouted with neat cement mortar. The side with the larger cross section shall be inserted inside the wall.

9.26. SPECIFICATIONS FOR PANELLING MATERIAL - TIMBER

9.26.1. **Timber** - Timber panels shall be preferably made of timber of larger width. The minimum width and thickness of a panel shall be 150 mm and 15 mm respectively. When made from more than one piece, the pieces shall be joined with a continuous tongue and groove joint, glued together and reinforced with metal dowels. The grains of timber panels shall run along the longer dimensions of the panels. The panels shall be designed such that no single panel exceeds 0.5 square metre in area.

9.26.2. SPECIFICATIONS FOR PANELLING MATERIAL – PLYWOOD BOARDS

9.26.2.1. **Plywood boards** – 9.6.2.1. Plywood boards are formed by gluing and pressing three or more layer of veneers with the grains of adjacent veneers running at right angles to each other. The veneers shall be either rotary cut or sliced and shall be sufficiently smooth to permit an even spread of glue. Face veneers may be either commercial or decorative on both sides or one side commercial and the other decorative. Plywood shall be of BWP grade or BWR grade as per IS: 303.

9.26.2.2. **Adhesive** - Adhesive used for bonding BWP grade of plywood boards shall be BWP type synthetic resins conforming to IS: 848 respectively.

9.26.2.3. The thickness of all veneers shall be uniform, within a tolerance of ± 5 per cent. Corresponding veneers on either side of the centre one shall be of the same thickness and species. The requirements of thickness and core veneers shall be as follows -

(a) In 3 ply boards up to 5 mm thick. The combined thickness of the face veneers shall not exceed twice the thickness of centre ply (b) In a multiply boards, the thickness of any veneer shall not be more than thrice the thickness of any other veneer. (c) The sum of the thickness of the veneers in one direction shall approximate to the sum of the thickness of the veneers at right angle to them and shall not be greater than 1.5 times this sum except for 3 ply as specified in (a).

9.26.2.4. **Thickness** - Plywood boards are available in thickness ranging from 3 to 35 mm. Tolerance in thickness shall be $\pm 10\%$ for boards up to and including 5 mm; $\pm 7\%$ for boards from 6 to 9 mm and $\pm 5\%$ for boards above 9 mm thickness. The boards shall be of uniform thickness and the surface of the boards shall be sanded to a smooth finish. Number of plies in plywood boards shall be as under.

Thickness in mm	No. of ply	Thickness in mm	No. of ply
3,4,5,6	3	12,15,16,19	9
5,6,8,9	5	19,22,25	11
9,12,15,16	7		

9.26.2.5. Moisture content of the plywood boards when tested in accordance with IS: 1783 -1993 (Part 1) shall not be less than 5 per cent and not more than 15 per cent.

9.26.2.6. **Testing** - One sample for every 100 sqm or part thereof shall be taken and testing done as per IS 303. However, testing may not be done if the total requirement of plywood boards is less than 30 sqm.. All the samples tested shall meet the requirements of physical and mechanical properties of plywood boards specified in Annexure 9-A.3.

9.26.2.7. **Thickness** - Type of face veneer and grade of plywood boards shall be as specified. Unless otherwise stated, only BWP grade plywood boards shall be used.

9.26.3. SPECIFICATIONS FOR PANELLING MATERIAL – PARTICLE BOARDS

9.26.3.1. **Particle boards** - Particle boards shall be of medium density and manufacture of from particles of agro waste, wood or lignocelluloses i.e. material blended with adhesive and formed into solid panels under the influence of heat, moisture, pressure etc. The particle boards shall be flat pressed with single three or multi layers and graded and of Type 1 as per Table 1 of IS: 3087 - 1985. Both surfaces of the boards shall be sanded to obtain a smooth finish.

9.26.3.2. **Adhesives** - Adhesives used for bonding shall be BWP type synthetic resin conforming to IS: 848 - 1974.

9.26.3.3. **Thickness and tolerance** - Particle boards are available in thickness ranging from 6 mm to 40 mm. Tolerance in thickness shall be $\pm 5\%$ for boards up to and including 25 mm thick and ± 2.5 per cent for boards above 25 mm thickness. Each board shall be of uniform thickness.

9.26.3.4. **Testing** - One sample for every 100 sqm or part thereof shall be taken and testing done as per IS 3087. However, testing may not be done if the total requirement of particle boards in a work is less than 30 sqm. All the samples tested shall meet the requirement of physical and mechanical properties of particle boards as specified.

9.26.3.5. Thickness of particle and adhesive used for bonding shall be as specified. Unless otherwise stated, only type 1 particle boards bonded with BWP type synthetic resin adhesive shall be used.

9.26.4. SPECIFICATIONS FOR PANELLING MATERIAL - VENEERED PARTICLE BOARDS

9.26.4.1. Veneered Particle Boards have a solid core of medium density Type 1 particle board which is covered with commercial or decorative veneers on one face and commercial veneers on the other. Face veneers are bonded using adhesives under the influence of heat and pressure. Veneered

particle board shall be of exterior grade (Grade I) as per IS 3097. Both surfaces of the boards shall be sanded to a smooth finish.

9.26.4.2. **Adhesives** - The adhesive used for bonding shall be BWP synthetic resin conformity it IS 848 - 1974.

9.26.4.3. **Thickness & tolerance** - Veneered particle boards are available in thickness ranging from 6 to 50 mm.

Tolerance in thickness shall $\pm 5\%$ for boards up to and including 25 mm thick and $\pm 2.5\%$ for boards above 25 mm thickness. Each board shall be of uniform thickness.

9.26.4.4. **Testing** - One sample for every 100 sqm or part thereof shall be taken and testing done as per IS 3097. However, testing may not be done if the total requirement of veneered particle boards in a work is less than 30 sqm. All the samples tested shall meet the requirements of physical and mechanical properties of veneered particle boards as specified.

9.26.4.5. Type of face veneers thickness of veneered particle boards and adhesive used for bonding shall be as specified. Unless otherwise stated, exterior grade veneered particle boards with BWP type synthetic resin adhesive shall be used.

9.26.5. SPECIFICATIONS FOR PANELLING MATERIAL – HARD BOARD

9.26.5.1. **Hard Board** - Hard boards are generally classified in to the following three types according to their method of manufacture, density and other related mechanical and physical properties.

a) **Medium hard boards** A homogeneous fibre building board having a density exceeding 480 kg/m³ but not exceeding 800 kg/m³.

(b). **Normal hard board.** A homogeneous fibre building board having a density exceeding 800 kg/m³ but not exceeding 1200 kg/m³.

(c) **Tempered hard board.** Hard board which has been further treated in the course of manufacture to increase its density strength and water resistance.

9.26.5.2. The hard board used for paneling of door shutters shall be tempered quality. The thickness of hard board paneling used shall not be less than 12 mm in case of single panels shutter and 10 mm in case of two or more panels shutter. The hard board shall be regular and unless otherwise specified shall have square edges. The lengths of the two diagonals of the board shall not differ by more than ± 3 mm per metre length of the diagonal. The tolerance on length and width shall be ± 3 mm and on thickness ± 0.3 mm.

9.26.5.3. **Workability** - The hard board shall not crack split or chip when drilled sewed or nailed perpendicular to the surface.

9.26.5.4. **Finish** - The boards shall be of uniform thickness subject to tolerance stated above. They shall be free from warp. The surfaces shall be flat, free from cracks and lumps and of natural colour. At least one face shall be smooth.

9.26.6. SPECIFICATIONS FOR PANELLING MATERIAL – BLOCK BOARD

9.26.6.1. **Block board** - Block Boards have a solid core made up of uniform strip of wood each not exceeding 25 mm in width, laid separately, or spot glued, or otherwise joined to form a slab which is glued. Between two or more outer veneers, with the direction of the grain of the core block running at right angles to that of adjacent veneers. In any one block board, the core strips shall be of one species of timber only. Face veneers may be decorative or commercial on both faces or decorative on one face and commercial on the other. Block boards shall be Grade (Exterior Grade) as per IS: 1659-1990. Both surfaces of the boards shall be sanded to a smooth finish.

9.26.6.2. **Adhesives** - The adhesives used for bonding shall be BWP type synthetic resin conforming to IS 848 for Grade I block boards.

9.26.6.3. **Thickness and tolerance** - Block boards are available in thickness ranging from 12 to 50 mm. Tolerance in thickness shall be $\pm 5\%$ for boards up to and including 25 mm thick and $\pm 2.5\%$ for boards above 25 mm thickness. Each board shall be of uniform thickness.

9.26.6.4. **Testing** - One sample for every 100 sqm or part thereof shall be taken and testing done as per IS: 1659. However, testing may not be done if the total requirement of block boards in a work is less than 30 sqm. All the samples tested shall meet the requirements of physical and mechanical properties of block boards specified in the relevant I.S. code.

9.26.6.5. Type of face veneers, thickness and grade of block boards shall be as specified. Unless otherwise stated, grade I (exterior grade) block board, bonded with BWP grade be used.

9.26.7. SPECIFICATIONS FOR PANELLING MATERIAL – ASBESTOS CEMENT BOARD

9.26.7.1. **Asbestos cement board** - This should conform to IS: 2096-1992. The material used in the manufacture of asbestos cement building boards shall be composed of an inert aggregate consisting of clean asbestos fibre cemented together by ordinary Portland cement, rapid hardening and low heat Portland cement, or blast furnace slag cement. No organic or inorganic materials shall be added to the composition. Pigments which are embodied in the asbestos cement for colouring purpose shall be of permanent colours and shall conform to the requirements. The thickness of the asbestos cement board used for paneling shall not generally be less than 6.5 mm in case of single panels shutters and 5 mm in case of two or more panel shutter. Asbestos cement building boards shall be of two classes, namely class 'A' and class B. The thickness of class A shall be 6.5 mm and for class 'B' 5 mm. The tolerance on thickness shall be +/- 0.5 mm.

9.26.8. SPECIFICATIONS FOR PANELLING MATERIAL-FIBRE BOARD

9.26.8.1. **Fibre Board** - Fibre boards shall be of medium density and manufactured from wood fibre, produced by fiberising steamed wood under pressure, blended with adhesive and wax and formed into solid panels under controlled conditions of heat and pressure.

Fibre boards are flat pressed single layer and shall be Exterior Grade as per IS: 12406-1988. Both surfaces of the boards shall be sanded to a smooth finish.

9.26.8.2. **Adhesives** - The adhesive used for bonding shall be BWP type synthetic resin conforming to IS: 848.

9.26.8.3. **Thickness** - Fibre boards are available in thickness ranging from 6 to 40 mm. The tolerance in thickness shall be + / - 0.3 mm up to and including 9 mm thickness and + / - 0.6mm for thickness above 9 mm.

9.26.8.4. **Testing** - One sample for every 100 sqm or part thereof shall be taken and testing done as per IS: 12406 -1988. However, testing may not be done if the total requirement of fibre boards in a work is less than 30 sqm. All the samples tested shall meet the requirements of physical and mechanical properties of fibre boards specified in the relevant BIS codes.

9.26.8.5. Thickness of fibre boards and adhesive used for bonding shall be as specified. Unless otherwise stated, exterior grade fibre boards bonded with BWP type synthetic resin adhesive shall be used.

9.26.9. SPECIFICATIONS FOR PANELLING MATERIAL-SHEET GLASS, FROSTED SHEET GLASS

9.26.9.1. **Sheet glass, frosted sheet glass** - Sheet Glass shall be flat, transparent and clear as judged by the unaided eye. It may, however, possess a slight tint when viewed edgewise. Sheet Glass shall be of Selected Quality (SQ) or Ordinary Quality (OQ) as per IS-2835. Glass shall be free from cracks. Unless otherwise specified, ordinary quality sheet glass shall be used.

9.26.9.2. **Dimensions** - Nominal thickness and range of thickness of sheet glass shall be as per Table given below. Tolerance on cut sizes (length and width) shall be + / - 2.0 mm.

Thickness and weight of Sheet Glass

Nominal thickness Mm	Range of thickness mm	Weight (Kg/sqm)
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3.0	2.8 to 3.2	7.5
4.0	3.8 to 4.2	10.0
4.8	4.6 to 5.1	11.9
5.5	5.2 to 5.8	13.5
6.3	6.0 to 6.6	15.5

9.26.9.3. Sheet Glass of 4 mm nominal thickness weighing not less than 10 Kg/sqm shall be used for glass panel of area up to 0.5 sqm.

For panel exceeding 0.5 sqm in area, the nominal thickness of the glass to be used shall be as specified.

9.26.10. SPECIFICATIONS FOR PANELLING MATERIAL- WIRE CLOTH

9.26.10.1. **Wire cloth (Wire gauze)** - Wire Cloth which shall generally conform to IS: 1568 -1970 shall be regularly woven with equally spaced galvanised mild steel wires in both warp and weft directions. The wire cloth shall be properly selvaged by one or more wires in each edge.

9.26.10.2. **Mesh** - Average width of aperture and the nominal diameter of the wire shall be as under -

Average width of Aperture mm	Nominal dia. of wire mm
1.40	0.63
1.18	0.556
1.0	0.50

9.26.10.3. Width of the aperture and dia of wire of wire cloth shall be as specified. Unless otherwise stated, wire cloth of 1.40 mm average aperture width woven with 0.63 mm nominal dia galvanised mild steel wire shall be used.

9.26.10.4. Fly – proof wire cloth (aperture 1.40 mm) is generally provided in Kitchen and dining areas while wire cloth of smaller aperture is used in mosquito proof shutters.

9.26.11. SPECIFICATIONS FOR PANELLING MATERIAL- GYPSUM BOARD

9.26.11.1 Gypsum Board is formed by enclosing and bonding together a core gypsum plaster (a calcium sulphate mineral) with or without fibre between two sheets of highly durable paper. The gypsum boards shall be non-resonant, dimensionally stable and possess flame retardant qualities. The boards shall conform to IS: 2095 and gypsum plaster shall conform to IS: 2547. The surfaces of the board shall be true and free from imperfection that would render the board unfit for use with or without decoration.

9.26.11.2. **Types** - Gypsum plaster boards are classified according to their use.

9.26.11.3. **Gypsum wall board with reduced water absorption rate** - These boards have additives in the core and/or the paper liners to reduce the water absorption rate. They may be suitable for special applications in buildings where reduced absorption properties are required to improve the performance of the board. Unless stated otherwise, decoration may be applied to the face.

9.26.11.4. **Gypsum wall board with improved core cohesion at high temperatures** - These boards have mineral fibres and /or other additives in the gypsum core to improve core cohesion at high temperatures. They have a face suitable for direct decoration.

9.26.11.5. **Gypsum plaster base board** - These boards have a face suitable to receive gypsum plaster and may be perforated during primary manufacture.

9.26.11.6. **Gypsum plaster base board with improved core cohesion at high temperatures** - These boards have mineral fibres and / or other additives in the gypsum core to improve core cohesion at high temperatures. They have a face suitable to receive gypsum plaster and may be perforated during primary manufacture.

Physical requirements

9.26.11.7. **Dimensions** - The width, length and thickness of the boards shall be as given in Table below. The lengths of the two longitudinals of the boards shall not differ more than +/- 3 mm per metre length of the diagonal.

9.26.11.8. **Tolerance** - The tolerance on dimension shall be as given below –

Type	Tolerance in mm on		
	Width	Length	Thickness
Gypsum wall board	0 to -5	0 to -6	+/- 0.6
Gypsum base board			
a) Non-perforated	0 to 8	0 to -6	+/- 0.6
b) Perforated	0 to -8	0 to -10	+/- 0.6

9.26.11.9. **Transverse strength** - Breaking load for gypsum plaster boards, shall be in accordance with Table given below -

Breaking load of gypsum plaster boards

Type of Board	Thickness Mm	Breaking load, Transverse Direction N	Min. Longitudinal Direction N
Plaster Board	9.5	140	360
	12.5	180	500
	15.0	220	650
Base Board	9.5	123	180
	12.5	165	235

Dimensions of gypsum plaster boards

Type of Board	Width in mm	Length in mm	Thickness in mm
Wall board	600, 900 and 1200	1800 to 3600 in steps of 100 mm	9.5, 12.5 and 15
Base Board	400 and 900	1200, 1500 and 1800	9.5 and 12.5

9.27. SPECIFICATIONS FOR TRUSSES

9.27.1. **Trusses** - The work shall be carried out as per detailed drawings and as directed by the engineer specified timber shall be used. Sawing shall be truly straight and square, and in the direction of the grains. The scantlings shall be accurately planned smooth to the full dimensions and rebate roundings and mouldings shown on the drawings, before the same are framed. Patching or plugging of any kind shall not be permitted. A tolerance of $\pm 2\text{mm}$ or $\pm 3\text{mm}$ shall be allowed in the finished cross sectional dimension.

9.27.2. **Joints** - Joins shall be simple, neat and strong. All mortise and tenon joints, mitred joints, scarfs etc. shall fit in fully and accurately without wedging or fillings. The joints shall be as per detailed drawings. Holes of correct sizes shall be drilled before inserting screws bolts. Holes for bolts shall be of uniform diameter. The screws, bolts and nails shall be dipped in oil before using. The heads of nails and screws shall be sunk and puttied or dealt with as instructed by engineer. The gauge and Length of nails, screws and bolts shall be approved by the engineer before using on works.

9.27.3. **Shaping form and cutting** - The wood sections, as specified or required, shall be straightened, cut square and to correct lengths. A fine accuracy shall be ensured in the fabrication of various member so that these can be assembled without being unduly packed, strained or forced into position and when build, shall be true to shape and free from twist, kinks, buckles or open joints.

9.27.4. **Fabrication** - As per drawing, a full size truss diagram shall first be drawn on a levelled platform. From this full size diagram, templates of all joints as for tenons, mortises, scarves etc. shall be made for use in the fabrication. The template shall be made to correspond to each member and plate holes for screws and bolts shall be marked accurately on them and drilled. The templates shall be laid on wooden members and the holes for screwing and bolting marked on them. The ends of the wooden members shall also be marked for cutting. The base of columns and the position of anchor bolts shall be carefully set out. Before fabrication of the truss individual members shall be assembled together to ensure close abutting or lapping of the surfaces of the different members and fitted close together as per drawing.

9.27.5. **Hoisting and placing in position** - The trusses shall be hoisted and placed in position carefully, without any damage to itself and other building work and injury to workman. The trusses shall be secured to walls by means of holding down bolts or as directed by the engineer. The necessary mechanical appliances such as lifting tackle, winch, etc. for hoisting the truss shall be used. The trusses shall be stayed temporarily till they are permanently secured in position and connected with each other by means of purlins. Holding down bolts cleats used for purlins and bottom plates used for tie and rafter member shall be paid for separately.

9.27.6. **Surface treatment** - Wood work shall not be painted, oiled or otherwise treated before it has been approved by the engineer. All portions of timber built into or against or close to masonry or concrete or buried in ground shall be given two coats of boiling coal tar. All junctions of rafters, purlins, beams and wall plates shall be painted with approved wood primer.

9.27.7. **Measurements** - Wood work shall be measured for finished dimensions. No allowance shall be made for dimensions supplied beyond those specified. Length of each piece shall be measured over all nearest to a cm, so as to include projections for tenons, scarves or miters. Width and thickness shall be measured to the nearest mm. Cubical contents can be worked out in units of 10 cubic decimetre in whole number.

9.27.8. **Rate** - The rate includes the cost of materials and labour involved in all the operations described above. Unless otherwise specified, iron fixtures such as bolts and nuts, M. S. steel plates, holding down bolts and staining, priming, painting or polishing of the work shall be paid for separately.

9.28. SPECIFICATIONS FOR WALL LINING

9.28.1 Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made, before assembly. Patching or plugging of, any kind shall not be permitted except as provided.

9.28.2. **Grounds** - Grounds shall be provided where so specified. These shall consist of first class hard wood plugs or the class of wood used for fabricating the frames, of trapezoidal shape having base of 50 x 50 mm and top 35 x 35 mm width of 5.0 cm and embedded in the wall with cement mortar 1:3 and batten of first class hard wood or as specified of size 50 x 25 mm or as specified, fixed over the plugs with 50 mm long wood screws. The plugs shall be spaced at 45 to 60 mm centres, depending upon the nature of work. The battens shall be painted with priming coat, of approved wood primer before fixing.

9.28.3. SPECIFICATIONS FOR PANELING – TEAKWOOD PANELING

9.28.3.1. **Teak wood paneling** - The thickness of panel shall be 16 mm up to a width 40 cm and 19 mm for a greater width. Solid wood panels shall be made out of one or more pieces of timber of not less than 12.5 cm in width. In order to avoid warping, splitting and cracking, normally pieces not exceeding 20 cm in width should be used. When made from more than one piece, the pieces shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels. The grains of the solid panel shall run along the longer dimensions of the panel. The finished work with a tolerance of ± 1 mm in thickness may be accepted.

9.28.3.2. **Block board paneling** - This paneling shall be decorative or non-decorative (Paintable) type as per design and thickness specified by the engineer. These shall be specified in details of the type and construction of core. The specification in general shall conform to Indian Standard Specifications IS: 2202 (Part I) and 2202 (Part II).

9.28.3.3. **Ornamental work** - The ornamental wood work shall be painted on the back with priming coat of approved wood primer before fixing the same to the grounds with screws, which shall be sunk into the wood work and their tops covered with putty. The ornamental work shall be made true and accurate to the dimensions shown in the working drawings. The fixing shall be done true to lines and levels. The planks for wall lining shall be tongued and grooved, unless otherwise specified.

9.28.3.4. **Measurements** - Length and breadth shall be measured correct to a cm. Wall paneling such as teakwood paneling and block paneling, plain lining, the plain skirting each shall be measured separately in square metre nearest to two places of decimal. The moulded work shall be measured in cm running metre i.e. in running metres stating the girth in cm. The sectional periphery (girth) of moulding excluding the portion in contact with wall shall be measured in cm correct to 5 mm and length in metre correct to a cm. The measurements for ground shall be taken on the basis of cubical contents of battens and paid for separately, unless otherwise specified. Where only plugs are required to be fixed for the ornamental work, the costs for the same shall be deemed to be included in the rate of ornamental work and no separate payment shall be made for plugs.

9.28.3.5. **Rates for paneling and ornamental work** - The rate include the cost of materials and labour required for all the operation described above.

Note Use of wood for wall paneling has been prohibited by Government of India, (cabinet secretariat office order no. 6/4/90/cab. date 29.6.1990).

9.29. SPECIFICATIONS FOR SHELVES

9.29.1. Shelves and vertical partitions of cupboards shall be of timber planks fibre board, particle board, block board or veneered particle board as specified. Thickness and type of planks or boards shall be as specified. Each shelf shall be a single piece and vertical partitions between two consecutive shelves shall be without any joint. Exposed edges of boards having particle board core shall be sealed with 3 mm thick single piece teak wood strips of width equal to the thickness of board with headless pins. The arrangement of shelves and vertical partitions shall be as per drawings or as directed by the engineer.

9.29.2. **Fixing** - Planks for shelves shall be planed on all faces and edges. In case of boards they shall be sawn to the required size truly straight and square. Timber battens 25 x 40 mm unless otherwise specified shall be planed smooth and fixed inside the cupboard with wooden plugs and screws. Shelves shall be fixed to the battens and vertical portions shall be held in position by fixing them to the battens and shelves using screws. Teakwood strips for edge sealing of the boards shall be planed smooth and fixed with headless nails. Tolerance in width shall be ± 5 mm and in thickness 1 mm.

9.29.3. **Measurements** - Length and width of shelves and vertical partitions shall be measured correct to a cm. separately for each type of board stating its thickness. Area shall be calculated correct to 0.01 sqm.

9.29.4. **Rate** - In includes the cost of materials and labour required for all the operations described above.

9.30. SPECIFICATIONS FOR TRELLIS WORK

9.30.1. Specified timber shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings, and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

9.30.2. **Plain trellis** - This shall consist of wooden strips or laths 35 x 10 mm section unless otherwise specified planed and nailed together at every alternate crossing. The strips shall cross each other at right angle and shall be spaced 35 mm apart, so as to form 35 x 35 mm square opening or as shown in the drawing. These shall be fixed with nails to the frame. To cover the ends of strips, 50 x 12 mm beading shall be fixed to the frame with screws. The finished work with a tolerance of +/- 1 mm may be accepted.

9.30.3. **Trellis doors and windows shutters** - Shutter frame of specified timber shall consist of two stiles and top, lock and bottom rails, each of section 75 x 35 mm unless otherwise specified. The stiles and rails shall be properly mortised and tenoned. The tenons shall pass through the stiles for at least 3/4th of the width of the stile. Shutter frame shall be assembled and passed by the engineer before jointing. The joints shall be pressed and secured by bamboo pins of about 6 mm diameter. To this frame, plain trellis work as described shall be fixed as shown in the drawings or as directed by the engineer. Fixing, fittings, wooden cleats and blocks shall be provided as specified.

9.30.4. **Measurements** - Width and height of plain trellis work and trellis shutters shall be measured overall correct to a cm. The area shall be calculated in square metres nearest to two places of decimal. In case of shutters, the measurement shall be as specified.

9.30.5. **Rate** - It includes the cost of materials and labour required in all the operations described above.

9.31. SPECIFICATIONS FOR PELMETS

9.31.1. Planks and curtain rods of specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings, and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted.

9.31.2. Sides, front and top of the pelmets shall be of 12 mm planks or boards of specified quality and width unless otherwise stated. These shall project from the wall face by 15 mm or as specified, and shall be securely fixed to walls with wood screws by means of wooden plugs and 10 cm long 25 x 3 mm M. S. flat bent in the form of angle or by any other device approved by the engineer. The pelmets shall be provided with curtain rods and brackets or curtain rails with rollers, stop ends and brackets wooden, brass or chromium plated brass as specified. Intermediate wooden brackets shall be provided, if the front length of pelmet exceeds 1.5 metres.

9.31.3. **Measurements** - The pelmets box shall be measured along the sides and front planking correct to a centimetre.

9.31.4. **Rate** - The rate includes the cost of sides, front and top planking curtain rods with brackets or curtain rails with rollers labour and materials required for all the operations described above.

9.32. SPECIFICATIONS FOR HOLD FASTS IN WOODEN FRAMES

9.32.1. Hold fasts

9.32.1.1. These shall be made from mild steel flat 40 x 5 mm size conforming to IS: 7196 without any burns or dents. 5 cm length of M. S. flat at one end shall be bent at right angle and one hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged with wooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bent at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 136 (1 cement 3 coarse sand 6 graded stone aggregate, 20 mm nominal size) or as specified

9.32.1.2. **Measurements** - Measurements for the hold fasts shall be in number.

9.32.1.3. **Rate** - It includes the cost of labour and material involved in all the operations described above including fixing bolt and cement concrete blocks.

9.32.2. SPECIFICATIONS FOR EXPANDED METAL, HARD DRAWN STEEL WIRE FABRIC AND WIRE GAUZE IN WOODEN FRAMES

Expanded metal, hard drawn steel wire fabric or wire gauge or weld mesh as described in the item of work shall be fixed to the window frames on the outside or inside as per detailed drawings or as directed by the engineer. These shall be free from rust and other defects.

9.32.2.1. **Expanded metal** - This shall be in the form of rhombus with its opening diagonals 20 x 60 mm and strands 3.25 mm wide and 1.6 mm thick weighing 3.633 kg/m² unless otherwise specified.

9.32.2.2. **Welded steel drawn wire fabric** - This shall conform to IS 4948 and shall have rectangular mesh of 75 x 25 mm size with wires of diameter not less than 5 mm longitudinally and 3.15 mm transversely. Its weight shall be not less than 7.75 kg/m² unless otherwise specified.

9.32.2.3. **Wire-gauze** - This shall conform to 9.26.10.

9.32.2.4. **Fixing** - Expanded metal, hard drawn steel wire fabric and wire gauze shall cut in one piece to the size of the frame (out to out). Expanded metal and hard drawn steel wire fabric shall be fixed on to the frame with staples, over which wooden beading 60 x 20 mm shall be fixed with wood screws.

9.32.2.5. **Measurements** - The length and breadth shall be measured correct to a cm, the area from outside to outside of beading shall be calculated in square metre nearest to two places of decimal.

9.32.2.6. **Rate** - It includes the cost of labour and materials required for all the operations described above.

9.33. SPECIFICATIONS FOR DOOR, WINDOW AND VENTILATOR FRAMES

9.33.1. Timber for door, window and ventilators frames shall be as specified. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without warp or blow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates, rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of +/- 3 mm and 2 mm shall be permitted in the specified finished dimensions of timber sections in frames.

9.33.2. **Joints** - The frames shall have dovetail joints Fig. 1. The Jamb posts shall be through tenoned in to the mortise of the transoms to the full thickness of the transoms and the thickness of the tenon shall be not less than 2.5 cm. The tenons shall closely fit into the mortise without any wedging or filling. The contact surface of tenon and mortise before putting together shall be glued with polyvinyl acetate dispersion based adhesive conforming to IS: 4835 or adhesive conforming the WBP or MR grade of IS: 851 and pinned with 10 mm dia hard wood dowels, or bamboo pins or star shaped metal pins. The joints shall be at right angles when checked from the inside surfaces of the respective members. The joints shall be pressed in position. Each assembled door frame shall be fitted with a temporary stretcher and a temporary diagonal brace on the rebated faces.

9.33.3. **Fixing of frames** - The frames shall be got inspected approved by the engineer before being pinned, oiled or otherwise treated and before fixing in position. The surface of the frames abutting masonry or concrete and the portions of the frames embedded in floors shall be given a coating of coal tar. Frames shall be fixed to the abutting masonry or concrete with hold fasts or metallic fasteners as specified. After fixing, the jamb posts of the frames shall be plugged suitably and finished neat. Vertical members of the door frames shall be embedded in the floor for the full thickness of the floor finish and shall be warping during construction. A minimum of three hold fasts shall be fixed on each side of door and window frames one at centre point and other two at 30 cm from the top and bottom of the frames. In case of window and ventilator frames of less than 1 m in height two hold fasts shall be fixed on each side at quarter point of the frames. Hold fasts and metallic fasteners shall be measured and paid for separately.

9.33.4. **Measurements** - Wood work wrought, framed and fixed shall be measured for finished dimension without any allowance for the wastage or for dimensions beyond specified dimension without any allowance for the wastage or for dimension beyond specified dimensions. However, in case of members having mouldings, roundings or rebates and members of circular or varying sections, finished dimensions shall be taken as the sides of the smallest square or rectangle from which such a section can be cut. Length of each member shall be measured over all to the nearest cm so as to include projection for tenons. Width and thickness shall be measured to the nearest mm and the quantity shall be worked out in unit of 10 cubic decimetre in whole numbers.

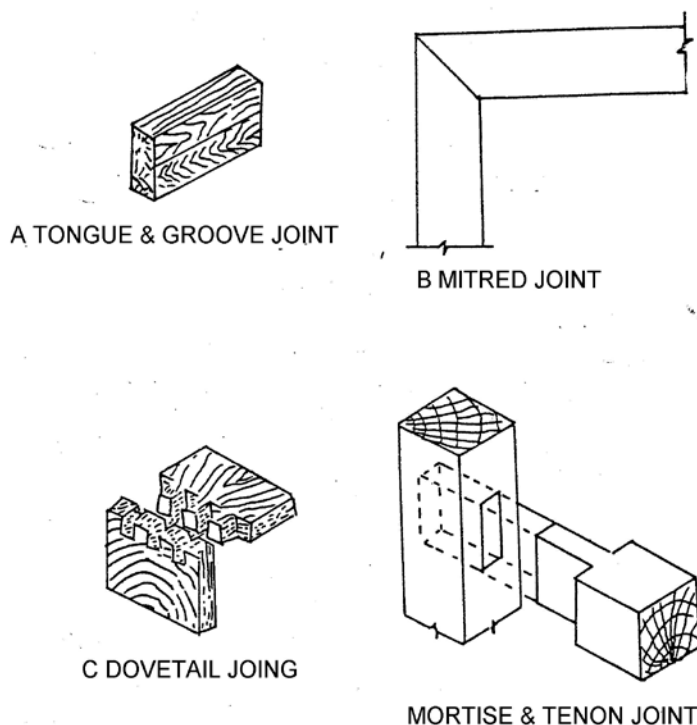


Fig. 1 Joints in timber

9.33.5. **Rate** - The rate shall include the cost of material and labour involved in all the operational described above except the hold fasts or metallic fasteners which will be paid for separately.

9.34. SPECIFICATIONS FOR PANELLED GLAZED OR PANELLED AND GLAZED SHUTTERS

9.34.1. Paneled or glazed shutters for doors, windows, ventilators and cupboards shall be constructed in the form of timber frame work of stiles and rails with panel inserts of timber, plywood, block board, veneered particle board, fibre board wire gauze or sheet glass. The shutters, single or multi-paneled, as shown in the drawings or as directed by the engineer. Timber for frame work, material for panel inserts and thickness of shutters shall be as specified. All members of the shutters shall be straight without any warp or bow and shall have smooth well planed face at right angles to each other. Any warp or bow shall not exceed 1.5 mm. The right angle for the shutter shall be checked by measuring the diagonals and the difference between the two diagonals should not be more than ± 3 mm.

9.34.2. **Frame work** - Timber for stiles and rails shall be of the same species and shall be sawn in the directions of grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions. The stiles and rails shall be joined to each other by plain or haunched mortise and tenon joints and the rails shall be inserted 25 mm short of the width of the stiles. The bottom rails shall have double tenon joints and for other rails single tenon joints shall be provided. The lock rails of door shutter shall have its centre line at a height of 800 mm from the bottom of the shutters unless otherwise specified. The thickness of each tenon shall be

approximately one-third the finished thickness of the members and the width of each tenon shall not exceed three times its thickness.

9.34.3. Gluing of joints - The contact surfaces of tenon and mortise shall be treated, before putting together, with bulk type synthetic resin adhesive conforming to IS: 851 suitable for construction in wood or synthetic resin adhesive (Phenolic and aminoplastic) conforming to IS: 848 or polyvinyl acetate dispersion based adhesive conforming to IS: 4835 and pinned with 10 mm dia hardwood dowels or bamboo pins or star shaped metal pins ; after the frames are put together and pressed in position by means of press.

Stiles and bottom rail shall be made out of one piece of timber only. Intermediate rail exceeding 200 mm in width may be out of one or more pieces of timber. The width of each piece shall be not less than 75 mm. Where more than one piece of timber is used for rails, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200 mm.

Dimensions of components of frame work

Sl.No.	Description	Width mm	Thickness mm	
A. Door shutters				
a.	Stile, top and free rail	100	35 or	40
b.	Lock rail	150	35 or	40
c.	Bottom rail	200	35 or	40
d.	Muntin	100	35 or	40
e.	Glazing bar	40	35 or	40
B. Window, ventilator & cupboard shutters				
a.	Stile, top and freeze rail	80	20, 25 or	30
b.	Bottom rail	80	20, 25 or	30
c.	Muntin	60	20, 25 or	30
d.	Glazing bar	40	20, 25 or	30

Muntin and glazing bars where required shall be sub-tenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm whichever is less. Unless otherwise specified the finished dimensions of the components of frame works of shutters shall be as given in Table 7. Tolerance on widths of stiles and rails shall be ± 3 mm. The thickness of all components of frame work shall be the same as the thickness of the shutter. Tolerance on over all dimensions of the shutter shall be ± 3 mm.

9.34.4. Rebating - The shutters shall be single-leaf or double leaved as shown in the drawings or as directed by the engineer. In case of double leaved shutters, the meeting of the stiles shall be rebated by one-third the thickness of the shutter. The rebating shall be either sprayed or square type as shown in Fig. 2.

9.34.5. Paneling - The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, hard board and particle board panels shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving on space of 1.5 mm. Width and depth of the rebate shall be equal to half of the thickness of stiles and rails. Glass panels, asbestos panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

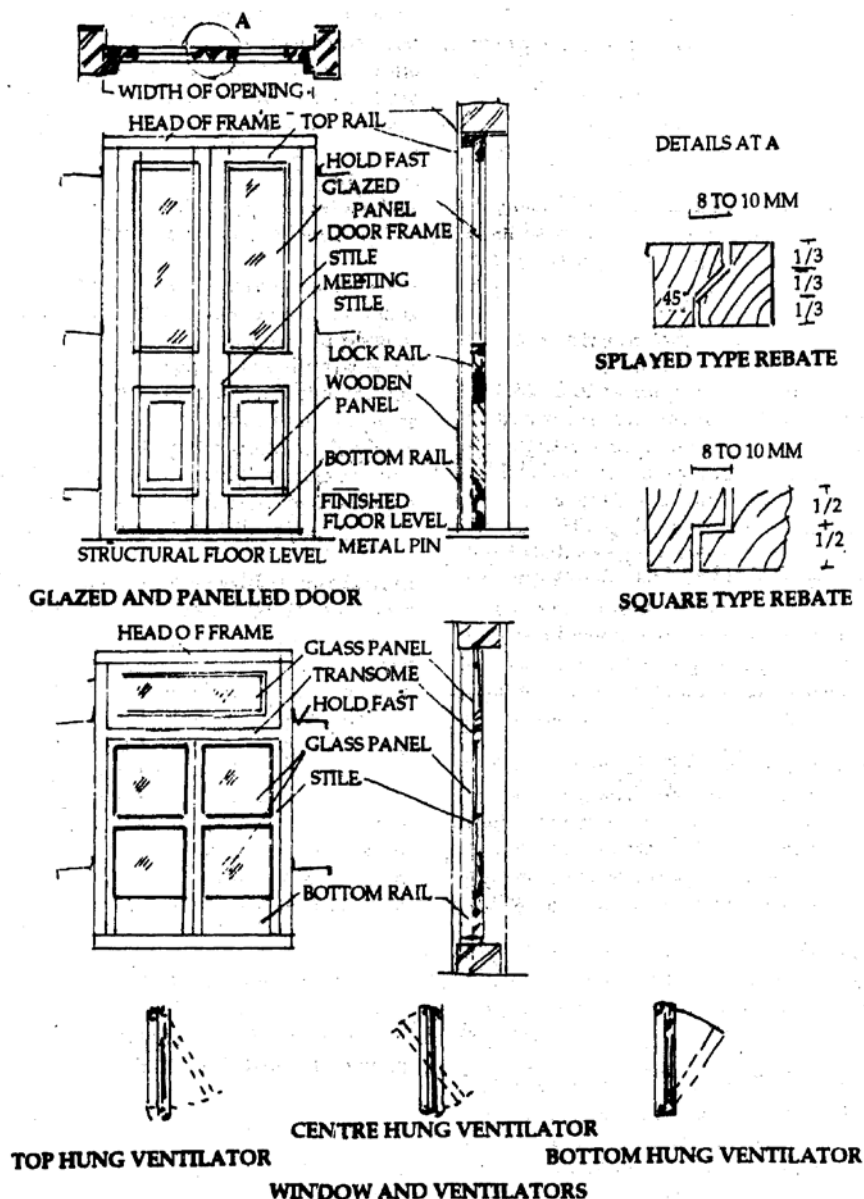


Fig. 2 Terminology timber door, window & ventilator components

9.34.6. **Timber panels** - Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be 150 mm, and 15 mm respectively. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooved joint glued together and reinforced with headless nails at regular intervals not exceeding 100 mm. Depth and thickness of such joint shall be equal to one-third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 square metres in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

9.34.7. **Plywood panels** - Plywood panels used for paneling of shutters shall be BWP type or grade as specified in 9.2.8. Each panel shall be a single piece of thickness, 9 mm for two or more panel construction and 12 mm for single panel construction unless otherwise specified.

9.34.8. **Block board panels** - Block Board used for paneling of shutters shall be Grade 1 (Exterior Grade) bonded with BWP Type Synthetic resin adhesives as specified. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

9.34.9. **Veneered particle board panels** - Veneered Particle board used for paneling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

9.34.10. **Fibre board panels** - Fibre board used for paneling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified. Each fibre board panel shall be a single piece of thickness 10 mm unless otherwise specified.

9.34.11. **Wire gauze panels** - Wire Gauze used for paneling of shutters shall be woven with 0.63 mm dia galvanised mild steel wire to form average aperture size of 1.40 mm as specified. Wire gauze

shall be securely housed into the rebates of stiles and rails by giving right angles bend turned back and fixed by means of suitable staples at intervals of 75 mm and over this wooden beading shall be fixed. The space between the rebate and the beading shall be fixed with putty to give a neat finish. Each wire gauze panel shall be as single piece, and the panels shall be so designed that no single panels exceeds 0.5 sqm in area. However, care shall be taken to prevent sagging of wire gauge, of panel by providing and fixing 20 x 20 mm square or equivalent beading on the external face in the required patterns as decided by the engineer.

9.35. SPECIFICATIONS FOR FLUSH DOOR SHUTTERS (FIG. 3)

9.35.1 Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS: 2202-1991 (Part I). Nominal thickness of shutters may be 25, 30, or 35 mm. Thickness and type of shutters shall be as specified.

Width and height of the shutters shall be as shown in the drawings or as indicated by the engineer. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS: 1708-1986.

9.35.2. **Core** - The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails shall not be less than 75 mm and not more than 100 mm. The width of each wooden strip shall not exceed 25 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be one species only but it may or may not be same species as that of the stiles and rails.

9.35.3. **Face panel** - The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall between 0.5 mm and 1.5 mm for commercial veneers and between 0.5 mm and 1.0 mm for decorative veneers. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture.

9.35.4. **Lipping** - Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

9.35.5. **Rebating** - Rebating shall be as specified.

9.35.6. **Opening for glazing** - Where specified the opening for glazing shall be 25 cm in height and 20 cm in width unless directed otherwise. The bottom of the opening shall be at a height of 140 cm from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified or shown in the drawing.

9.35.7. **Venetian opening** - Where specified the height of the Venetian opening shall be 30 cm from the top of the bottom rail unless directed otherwise. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and Venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

9.35.8. **Tolerance** - Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be +/- 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

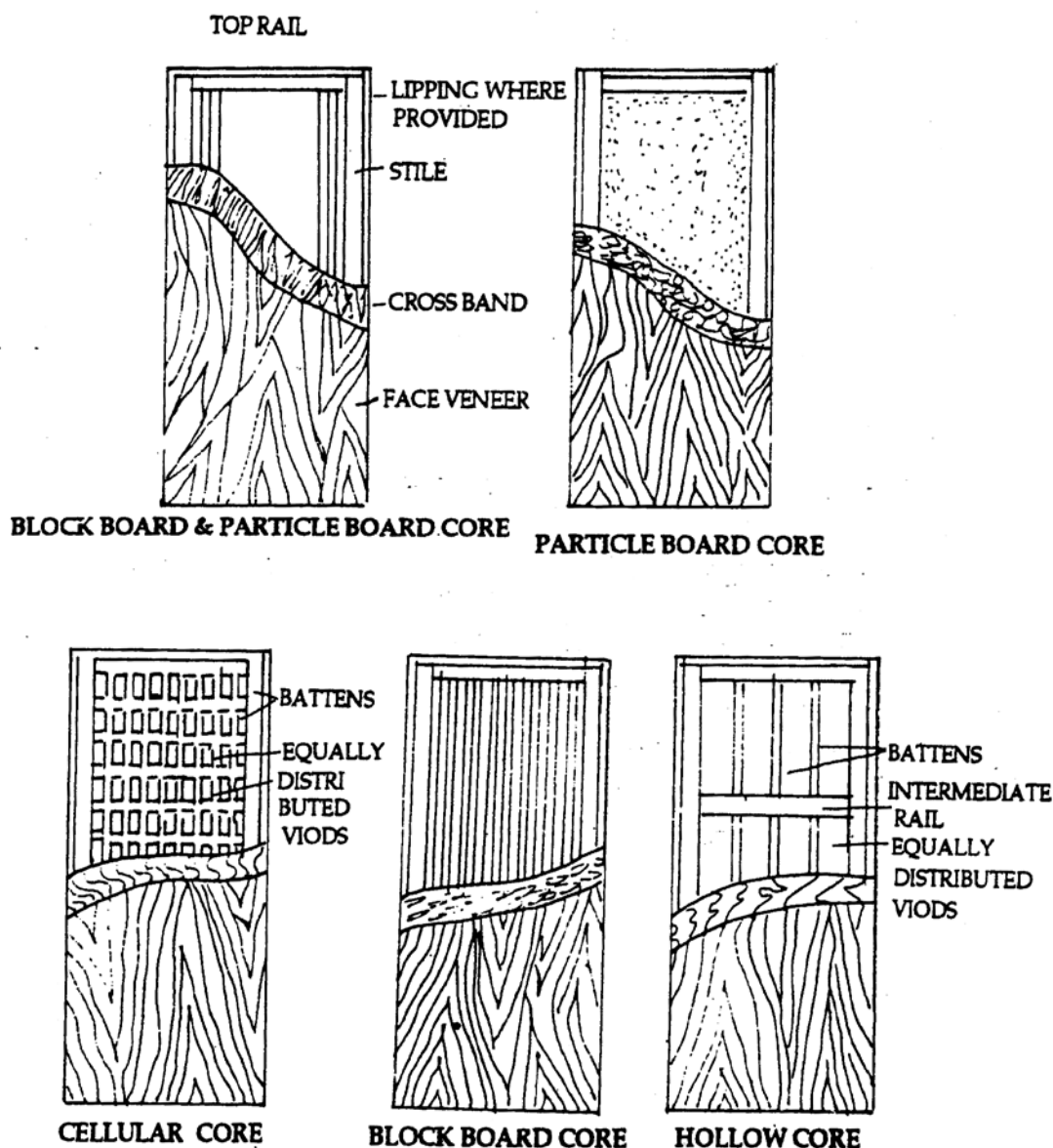


Fig. 3 Wooden flush doors shutters

9.35.9. **Adhesive** - Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

9.35.10. **Tests** - Samples of flush door shutters shall be subjected to the following tests -

(a) **End Immersion Test** (b) **Knife Test** (c) **Glue Adhesion Test**

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out **Glue Adhesion Test**. Knife Test shall be done on the remaining portion of each sample shutter. Test shall be done as laid down in IS standards.

9.35.11. **Sample size** - Shutters of decorative and non-decorative type from each manufacturer, irrespective of their thickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shall be as specified in Table given below. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the direction of the engineer and in such cases extra payment shall be made for the sample shutter provided the sample does not fail in any of the test specified.

Lot Size	Sample Size
Upto 50	1
50 – 150	2
151 – 300	3
301 – 500	4
501 and above	5

9.35.12. **Criteria for conformity** - All the samples shutters when tested shall satisfy the requirements of the tests laid down in Annexure 9-A.5. If the number of sample shutters found unsatisfactory for a test is one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

9.35.13. **Fixing of shutters** - For side hung shutters of height upto 1.2 m, each leaf shall be hung on two hinges at quarter points and for shutter of height more than 1.2 m, each leaf shall be hung on three hinges one at the centre and the other two at 200 mm from the top and bottom of the shutters. Top hung and bottom hung shutters shall be hung on two hinges fixed at quarter points of top rail or bottom rail. Centre hung shutter shall be suspended on a suitable pivot in the centre of the frame. Size and type of hinges and pivots be as specified. Flap of hinges shall be neatly counter sunk into the recesses cut to the exact dimensions of flap. Screws for fixing the hinges shall be screwed in with screwdriver and not hammered in. Unless otherwise specified, shutters of height more than 1.2 mm shall be hung on butt hinges of size 100 mm and for all other shutters of lesser height butt hinges of size 75 mm shall be used. For shutter of more than 40 mm thickness butt hinges of size 125 x 90 x 4 mm shall be used. Continuous (piano) hinges shall be used for fixing cup-board shutters where specified.

9.35.14. **Measurements** - Length and width of the shutters shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame. Overlap of two shutters shall not be measured.

All work shall be measured net as fixed and area calculated in square metres to nearest two places of decimal. No deduction shall be made for providing Venetian opening and opening for glazing.

9.35.15. **Rates** - The rate includes the cost of material and labour involved in all the operations described above. Extra rate shall be payable for providing rebates in double leaved shutters.

9.36. SPECIFICATIONS FOR BATTENED AND FRAMED DOOR AND WINDOW SHUTTERS

9.36.1. Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made before assembly. Patching or plugging of any kind shall not be permitted except as provided.

Planks for battens shall be 20 mm thick unless otherwise specified and of the uniform width of 75 to 100 mm. These shall be planed and made smooth, and provided with minimum 12 mm rebated joints. The finished work with a tolerance ± 1 mm in thickness and $\pm 3/2$ mm in width of battens etc. shall be accepted. The ends of battens shall be feather tongued into stiles and rails, which shall be provided with 12 mm groove to fit in the battens.

The specification for fixing, wooden cleats and blocks, fittings and measurements shall be as described under 9.6.

9.36.2. **Rate** - It includes the cost of materials and labour involved in all the operations described above.

9.37. SPECIFICATIONS FOR LEDGED AND BATTENED, OR LEDGED BRACED AND BATTENED DOOR AND WINDOW SHUTTER (FIG. 4 A)

9.37.1 Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made, before assembly. Patching or

plugging of any kind shall not be permitted except as provided. Thickness of the doors shall be the thickness of the battens and braces.

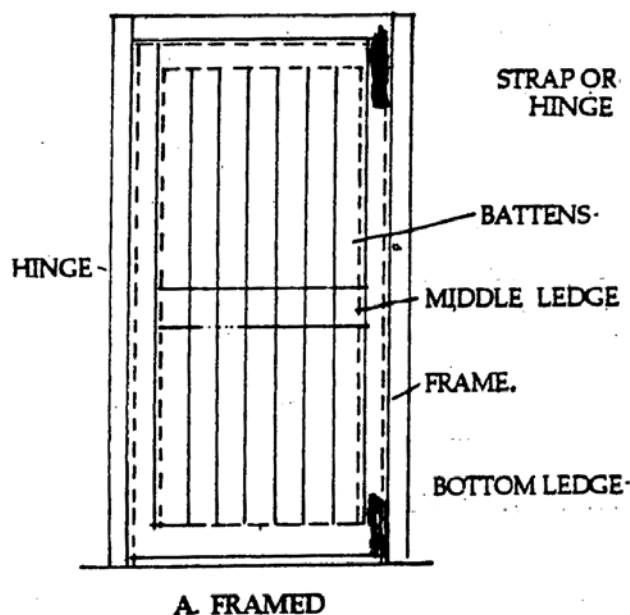


Fig. 4A Frames

9.37.2 Planks for battens shall be 20 mm thick unless otherwise specified and of the uniform width of 75 to 100 mm. These shall be planed and made smooth, and provided with minimum 12 mm rebated joints. The finished work with a tolerance ± 1 mm in thickness and $\pm 3/2$ mm in width of battens etc. shall be accepted. The ends of battens shall be feather tongued into stiles and rails, which shall be provided with 12 mm groove to fit in the battens.

9.37.3. **Ledges and braces** - The battens shall be fixed together by 25 mm thick ledges and braces fixed to the inside face of door shutters with screws. The ledge shall be 175 mm wide and brace 125 mm wide unless otherwise specified. The braces shall incline downwards towards the side on which the door is hung as shown in Fig. 4 of Chapter 9. Edges and ends of ledges and braces shall be chamfered. Tee hinges shall be provided in ledges only. The finished work with a tolerance of ± 1 mm in the thickness and $\pm 3/2$ mm in width of battens, ledges etc shall be accepted.

The specifications for fixing wooden cleats, blocks, fittings and measurements shall be as described under 9.6.

9.37.4. **Rate** - It includes the cost of materials and labour involved in all the operations described above.

9.38. SPECIFICATIONS FOR LEDGED BRACED AND BATTENED GARAGE DOOR SHUTTERS (FIG. 4B, 4C & 4D)

9.38.1. Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided. The thickness of the doors shall be the thickness of the battens only and not the combined thickness of battens and braces.

9.38.2. **Battens** - Planks for battens shall be 20 mm thick unless otherwise specified and of uniform width of 125 to 175 mm. These shall be planed and made smooth, and provided with minimum 12 mm rebated joints. The joint lines shall be chamfered. The finished work with a tolerance of ± 1 mm in thickness and $\pm 3/2$ mm in width of battens etc. shall be accepted.

9.38.3. **Ledges and braces** - The battens shall be fixed together by 30 mm thick (unless otherwise specified), ledges and braces on the inside face of door shutter with minimum two numbers of 50 mm

long wood screws per batten. The ledges shall be 225 mm wide and braces 175 mm wide, unless otherwise specified. The braces shall incline downwards towards the side on which the door is hung. Edges and ends of ledges and braces shall be chamfered.

9.38.4. Fittings and fixing - Garage door shutter shall be fixed to the wall masonry with six pintle sets. Each set shall consist of a pin clamp of 50 x 6 mm flat iron 45 cm long, bent and forked at one end and provided with 20 mm dia. M. S. pin on the other end and 50 x 6 mm double strap 60 cm long. The pin shall be firmly riveted or welded to the pin clamp, the other end of which shall be embedded in masonry by means of cement concrete block 40 x 20 x 20 cm 136 mix (1 cement 3 coarse sand 6 graded stone aggregate 20 mm nominal size). These shall be so placed that the bottom pin shall face upwards and the top pin downwards, in order that the gate may not be removed by lifting over pins. The fixing shall be so done that the door shutter can open on the outside by 180 degree.

The double strap shall fit in the pin side and shall be fixed to the shutter at ledges on the other side with 4 bolts and nuts of 12 mm diameter. One hook and eye 450 mm size of mild steel shall be provided for each shutter to keep it fixed in open position. A cement concrete (size) mix shall be embedded in the floor at junction of two shutters so that the door shutters open only on the outside and not on the inside. An iron sliding bolt (aldrop) 450 x 16 mm in diameter shall be provided and fixed. Tolerance of +/- 0.5 mm in diameter may be allowed.

9.38.5. Measurements - The over all length and width of the shutter shall be measured nearest to a cm in fixed position (overlaps not to measure in case of double leaved shutters) and area calculated in square metres correct to two places of decimal.

9.38.6. Rate - It includes the cost of materials and labour required for all the operations described above. Nothing extra shall be paid for cement concrete blocks, nor anything deducted from the measurement of masonry of wall on account of cement concrete blocks etc.

block 15 x 10 x 20 cm in 124 (1 cement 2 coarse sand 4 graded stone aggregate 20 mm nominal

9.39. SPECIFICATIONS FOR LOUVERED SHUTTERS

9.39.1. Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

9.39.2. Frames - Where the shutters have to be provided in the same frames as for the ordinary door or window, the thickness of the frame shall be increased by the specified thickness of the shutters, which shall be paid for separately under the relevant items of work.

9.39.3. Stiles and rails - It shall be as specified in 9.3.4.

9.39.4. Venetians - The panel space shall be fitted with Venetians which shall be 12 mm thick, unless otherwise specified. The Venetian blades shall slope down towards the outside at angle as shown in the drawings and shall be fixed in stiles. These shall overlap each other by about half of their widths. The Venetians, may be fixed or movable as specified. The finished work with a tolerance of +/- 1 mm in thickness and +/- 3/2 mm in width of battens etc shall be accepted.

The specifications for fittings, wooden cleats and blocks and measurements shall be as specified.

9.39.5. Rate - It includes the cost of materials and labour involved in all the operations described above. The rate for frame work includes the cost of butt hinges and necessary screws as specified. The rate for Venetian / louvers shall include the cost of beading if specified.

9.40. SPECIFICATIONS FOR LOUVERS FIXED TO FRAMES

9.40.1. The louvers shall be of wood, glass, AC sheet or any other material as specified.

9.40.2. Fixing - These shall be fixed in grooves of minimum 1.25 mm depth, made in the frame. The Venetian blades shall slope down towards the outside at an angle of 45 degree or as shown in the drawings. These shall overlap each other by about half of their widths.

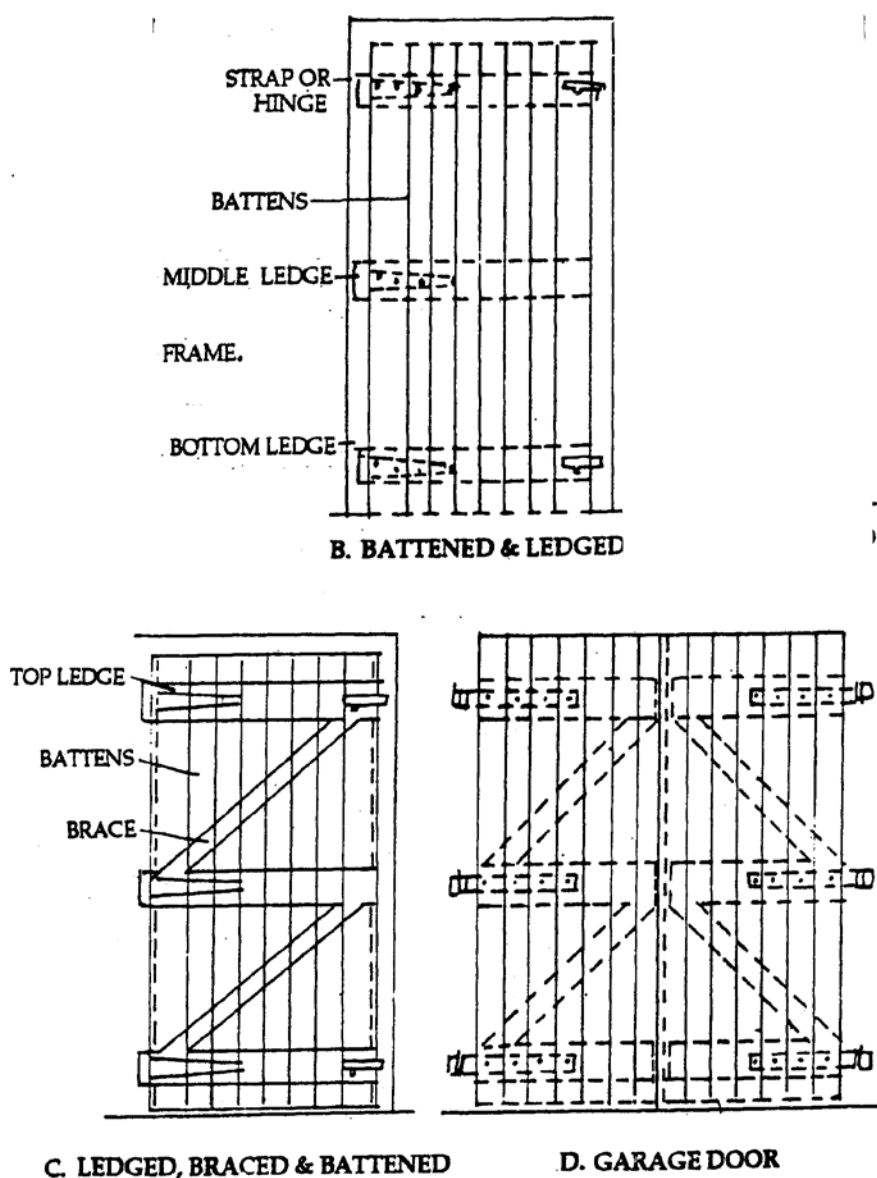


Fig. 4 B, C, D. Ledged, Braced and battened doors

9.40.3. **Measurements** - The width and height of the clear opening shall be measured to the nearest cm and area calculated in square metre correct to two places of decimal for the purpose of payment.

9.40.4. **Rate** - The rate is inclusive of the cost of materials and labour required for all the operations described above.

9.41. SPECIFICATIONS FOR WIRE GAUZE FLY PROOF SHUTTERS

9.41.1. Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

9.41.2. **Stile and rails** - The Specifications shall be as described. The stiles and rails shall be given a rebate to receive the wire gauze which shall form the panels.

9.41.3. **Wire gauze** - This shall be unless specified otherwise conform to clause 9.26.10. The wire gauze shall be bent at right angles in the rebates of stiles and rails, turned back and fixed tight with the blue tacks at about 75 mm centres, fixed alternatively in the two faces of the rebates. Over this, wooden heading shall be fixed with brads or small screws at about 75 mm centres. The space between the beading and rebates, where the wire gauze is bent, shall be neatly finished with putty, so

that the end of the wire gauze may not be visible. Fixed Fittings, Wooden cleats, blocks and Measurement shall be as specified.

9.41.4. **Rate** - This includes the cost of materials and labour involved in all the operations described above, and as specified.

9.42. SPECIFICATIONS FOR GLAZING

9.42.1. **General** - Glazing is an important item in building construction and glass has to be selected to cater to several requirements, such as, in multistoreyed buildings, industrial structures, etc. Therefore fixing of glass is a specialized operation and has to be done carefully; otherwise it will lead to hazards of broken glass. Besides the types of glass and exposure conditions have to be taken into account,

9.42.2. Patent glazing - As already mentioned, it is covered by IS: 10439 -1983.

9.42.3. Materials

- a) The glass shall conform to (1) IS: 2835-1987 for sheet glass. (2)IS: 2553-1990 for safety glass.
- (3) IS: 5437-1994 for wired and figured glass.
- b) Glazing compound shall conform to
 - 1) IS: 419-1967 for putty. (2) IS: 11433 (Part I)-1985, IS: 11433 (Part 2)-1986 for polysulphide based sealants.
 - 3) Compounds for glazing in concrete, stone, brick or asbestos cement are needed to be sealed to prevent absorption of oil from the glazing compound, unless the compound has been specifically formulated; resistance to alkali is important. A non-setting compound may be used, provided it is pointed.
 - 4) Non-setting compounds are needed for use with colour and heat absorbing glasses which will become hot in sunshine and which are therefore liable to expand and contract much more than ordinary glass. The fact that non-setting compounds are easily finger marked make it undesirable to use them without beads except in relatively inaccessible situations.
 - c) The design criteria like thickness, durability, fire resistance, thermal expansion and contraction, light transmission and heat insulation, sound insulation are to be satisfied as per IS 3548 -1988 on glazing practice.

9.42.4. **Glazing** - The size of glass shall allow for a clearance between the edges of glass and surround as specified below

For wood or metal surrounds	-2.5 mm
For stone or brick	-3.0 mm

The clearance may be increased, provided in depth of the rebate or groove is sufficient to provide not less than 1.5 mm cover to the glass.

9.42.5. **Rebates and grooves** - Rebates shall be rigid and true. The rebates shall be as follows

- 6 mm for small panes.
- 8 mm for normal panes.
- 10 mm at tops and sides and 12 mm at bottom for large windows, such as, shop windows.
- 16 mm deep for double or multiple glazed seal units, unless otherwise advised by the manufacturer.
- A wider rebate is required for bent glass than for flat glass; rebate for flat glass without beads shall be enough to accommodate the back putty, the glass and front stripped at an angle.
- For glazing with beads rebates shall be wide enough to accommodate glass and beads and to allow a minimum clearance of 1.5 mm at both back and front of the glass.
- Rebates and grooves shall be clean and un-obstructed before glazing.

9.42.6. Location of glass in frame

- a) The glass shall rest on two blocks to locate the pane properly within the surround. In case of small panes, the blocks may not be necessary, when glazing in side-hung windows or door, the glass
- b) shall be located by blocks so that it bears on the bottom of the surround at a point near the hinge but is not brought into contact with surround and does not suffer undue stress.

c) When glazing in horizontal hung sashes, which may turn through about 180 degree, additional blocks shall be placed between the top edge of glass and the surround to prevent movement of the glass when the sash is inverted. When the panels are more than 90 mm high, the glass shall be located at two pivoting points by blocks of suitable material, like chloroprene.

9.42.7. Preparation of rebates and grooves in wood

a) Rebates or grooves should be primed to prevent excessive absorption of oil from the putty. If shellac varnish or gloss paint is used, the wood may be completely sealed and setting of putty unduly delayed.

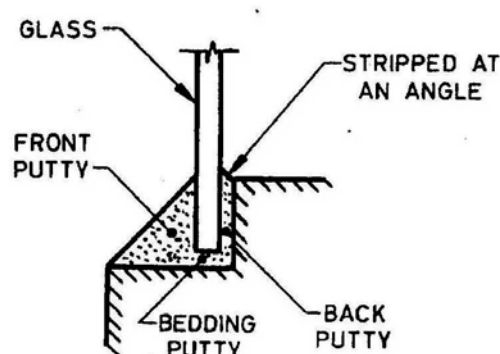
b) Absorbent hardwood frames that are not to be painted should either be primed with a medium composed of equal parts of exterior varnish and white spirit and glazed with linseed oil putty; or be completely sealed with a coat of un-thinned exterior quality varnish and glazed with a metal casement putty (which will need to be painted); or with a non-setting compound.

c) When completely non-absorbent hardwoods, such as, teak frames are used, metal –casement putty shall be used.

d) If the wooden frame has been treated with a preservative, preparation of rebates and grooves shall be made as per instructions of the manufacturer of glazing compound.

e) In case of stone, concrete, brick or other materials, the rebates or grooves should be sealed with an alkali resisting sealer and allowed to dry before glazing. The compound shall be metal-casement putty.

9.42.8. **Glazing with compound** - This method is suitable for window or door panes where the combined height and width do not exceed the maximum prescribed for appropriate exposure grading.



GLAZING WITH COMPOUND

Fig.5. Typical illustrations showing glazing details

9.42.9. **Glazing with beads** - This method should be used for window and door panes where the combined height and width exceed the maximum prescribed; glazing in unpainted hardwood frames and framed shop fronts for double and multiple glazing units as defined, and wherever a non-setting compound is used in a position where it is liable to be disturbed.

9.42.10. **Glazing with compound into rebates** - Sufficient compound should be applied to the rebate so that, when the glass has been pressed into the rebate, a bed of the compound (known as back putty) not less than 1.5 mm thick will remain between the glass and rebate; there shall be a surplus of compound squeezed out above the rebate which would be stripped at an angle and not undercut to prevent water accumulating.

a) The glass should be secured by springs or spring clips spaced not more than 350 mm apart measured around the perimeter of the pane, and afterwards fronted with the compound to form a triangular fillet stopping 1.5 mm short of the sight line so that the edge of the compound may be sealed against the glass by painting, without encroaching over the sight line.

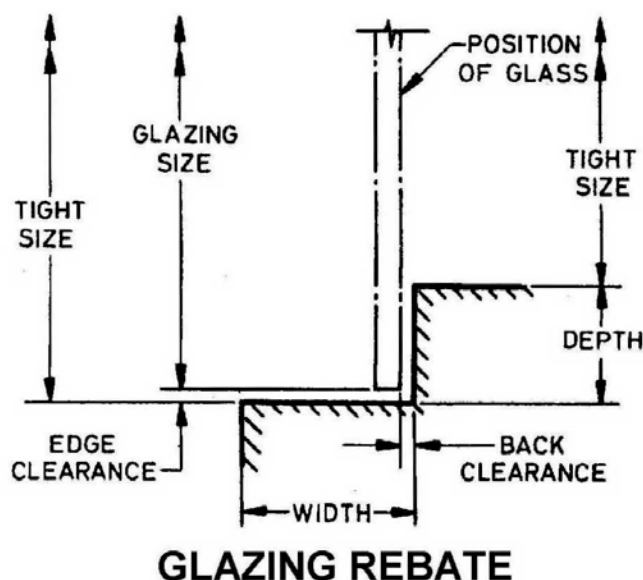


Fig 6 – Glazing details

9.42.11. **Glazing with compound into grooves** - The glass should be pressed into the glazing compounds previously placed in the groove. The space between the glass and sides of the groove should be filled with the compound which should then be stopped at an angle and not undercut.

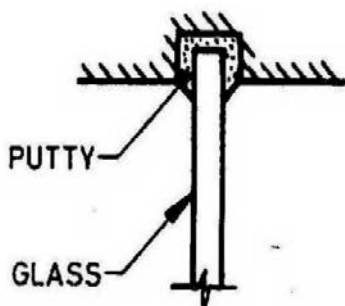


Fig.7 – Glazing details

9.42.12. **Glazing with beads along with compound** - Sufficient compound should be applied to the rebate so that when the glass has been pressed into the rebate, a bed of compound (known as back putty) not less than 1.5 mm thick will remain between the glass and the rebate. There should also be a surplus of compound squeezed out above the rebate which should be stripped at an angle not undercut, to prevent water accumulating. Bends should be bedded with the compound against the glass and wood beads should also be bedded against the rebate.

- Care should be taken to see that no voids are left between the glass and the bead. For outside glazing, hollow beads are undesirable unless they can be completely filled.
- With non-setting compound and where there is a risk of glazing compound being dislodged by pressure, front and back distance pieces (to maintain face clearances) should be used. Distance pieces should be completely embedded in the compound.
- Beads should be secured to the wooden frame with either panel pins or screws and to metal frames in the way provides for in the frame. In securing wooden frames, an adequate number of pins or screws for fixing the beads should be used as to prevent flexing or movement of beads.
- The external glazing should as far as possible be fixed from outside with beads as stated.

e) Where it is not possible to fix the glass from outside, especially in a multi-storeyed buildings, it may be fixed from inside with sealing compound.

f) Figured glasses are used to avoid direct sunrays and to get diffused light. This can be achieved advantageously by placing rough surface of the glass facing outside. As the surface of the glass from inside is smooth, it will facilitate in pasting colour plastic film on the inside surface, whenever required. In that case, it will be difficult to clean the rough surface of the glass outside, but it can be cleaned by a water jet.

9.42.13. **Double and multiple glazing** - The problems connected with application of double and multiple glazing are briefly as follows

a) **Two separate window frames, each single glazed** - These are preferable for sound insulation. To avoid problems of dirt and moisture in the air space, means of access to the cavity should be provided.

b) **One window frame carrying two sashes coupled together, each separately glazed** - The glazing may be in separate rebated, one inside glazed and the other outside glazed; or in single wide rebates with spacing beads. The former method has the advantage that either pane can be replaced without disturbing the other. However carefully such glazing is done, it may be necessary to open the cavity at frequent intervals for the purpose of cleaning.

c) **One window frame of sash single-glazed provided with clip to permit attachment of second glass** - This system involves no serious cleaning problems since the slipped – on panes can be quickly detached. Their main use is on existing windows, which cannot otherwise be modified.

d) **Double or multiple factory made hermetically sealed units** - Problems of cleaning of inner surfaces do not arise. Adequate rebate shall be provided in accordance with manufacturer's instruction.

9.42.14. **Double glazing other than factory made units** - To minimize the entry of moist air from the interior of the building or penetration of rain from outside into the cavity, the glazing should be done carefully. When opening sashes are provided, it is essential that they should fit closely. A small breathing hole should be provided from the bottom of the cavity to the outside to ensure that such breathing vents are kept clear of paint or other obstructions.

Where separate panes are glazed in one sash, it is preferable to use performed strip of compound for the back putty in glazing the second pane, in order to provide full back putty with a neat finish. Usually it is better to glaze the outer pane first.

9.42.15. **Factory made double or multiple sealed units** - When ordinary factory-made units or multiple units the following points may be taken into account

a) Both tight size and glazing size should be specified and not the glazing size.

b) Sealed units should be checked in the opening for edge clearance consistent with the manufacturer's recommendations. It is essential to follow any recommendation given by the manufacturer concerning the correct edge to be glazed at the bottom. Units should be positioned in the compound approximately one quarter of the total length from each end. The width of the blocks should not be less than the thickness of the sealed units and their thickness should be such as to position the units centrally in the opening. The thickness of glazing compound between the glass and the back of the rebate, and between the glass and bead should be about 1 mm.

c) Special techniques of glazing are required to protect the seal and reference shall be made to the manufacturer of glazing units.

d) A non-setting glass compound having good adhesion to glass and frame should be used. All absorbent rebates and beads should be treated with a sealer (priming is not sufficient).

e) Glazing with beads should always be used. Hollow beads are not recommended.

f) Where there is a risk of the glazing being dislodged by pressure, front and back distance pieces should be used to maintain face clearance.

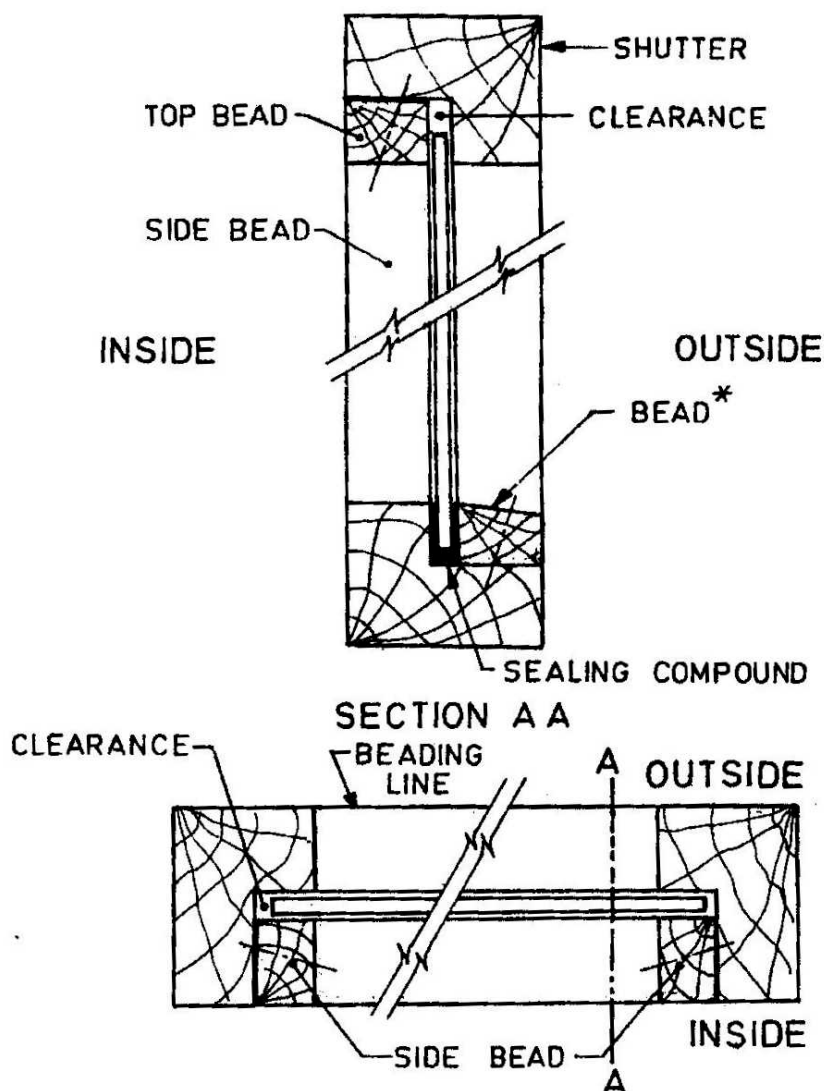


Fig 8. Inside glazing

9.42.16. **Louvered glazing** - This type of fixed glass louvres are recommended for toilets, stores, etc, where permanent ventilation is required.

a) **Louvered glazing (horizontal)** - Glass strips with rounded edges are inserted from outside into the grooves shall be angular preferably at 45 degree on the frame. The grooves shall overlap each other by at least 20 mm.

(b) **Louvered glazing (vertical)** - Glass strips are placed angularly and vertically, and inserted as described.

9.42.17. **Measurements** - Frame work and paneling shall be measured separately.

9.42.18. **Rate** - Rate includes the cost of materials and labour involved in all operations described above. The frame work and paneling of each type or glazed panel shall be paid separately. The rate for frame work includes the cost of hinges and screws. Extra shall be paid for providing moulded beading where specified. Nothing extra shall be paid for plain beading when specified in drawing.

9.43. SPECIFICATIONS FOR FITTINGS OR BUILDERS HARDWARE

9.43.1. Fitting shall be of mild steel brass, aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. List of Indian Standards on Builders Hardware is given below. (See also Annexure 9 A.7)

List of Indian Standards on Builders' Hardware

IS No.	Title
204 (Part 1)-1991	Tower bolts (ferrous metals)
204 (Part 2)-1992	Tower bolts (non ferrous metals)
205-1992	Non-ferrous metal bull hinges
206-1992	Tee and strap hinges
207-1964	Gate and shutter hooks & eyes (1 st revision) (Amendment 1) (Reaffirmed in 1990)
208-1987	Door handles
281-1991	Mild steel sliding door bolts for use with padlocks
362-1991	Parliament hinges
363-1993	Hasps and staples
364-1993	Fanlight catch
452-1973	Door springs, rat-tail type
453-1993	Double acting spring hinges
729-1979	Drawer locks. Cupboard locks and box locks
1019-1974	Rim latches
1341-1992	Steel butt hinges
1823-1980	Floor door stoppers
1837-1966	Fanlight pivots
2209-1976	Mortise locks (vertical type)
2681-1993	Non-ferrous metal sliding door bolts for use with padlocks
3564-1995	Door closer (hydraulically regulated)
3818-1992	Continuous (Piano) hinges
3828-1966	Ventilator chains
3843-1995	Steel back flap hinges
3847-1992	Mortise night latches
4992-1975	Door handles for mortice lock (vertical type)
5187-1972	Flush bolts
5899-1970	Bathroom latches
5930-1970	Mortise latch
6315-1992	Floor springs (hydraulically regulated) for heavy doors
6318-1971	Plastic window stays and fasteners
6343-1982	Door closers (Pneumatically regulated) for light doors weighing up to 40 kg.
6607-1972	Rebated mortise locks
7196-1974	Hold fast
7197-1974	Double action floor springs (without oil check) for heavy doors
7534-1985	Sliding locking bolts for use with padlocks
7540-1974	Mortise dead locks
8756-1978	Mortise ball catches for use wooden almirah
8760-1978	Mortise sliding door locks, with level mechanism
9106-1979	Rising butt hinges
9131-1979	Rim locks
9460-1980	Flush drop handles for drawer
9899-1981	Hat, coat and wardrobe hooks
10019-1981	Mild steel stays and fasteners
10342-1982	Curtain rail system

12817-1997	Stainless steel butt hinges
12867-1989	PVC hand rail covers

9.43.1. These shall be of the following types according to the material used.

a) **Mild steel fittings**

These shall be bright satin finish black stone enameled or copper oxidised (black finish), nickel chromium plated or as specified.

b) **Brass fittings** - These shall be finished bright satin finish or nickel chromium plated or copper oxidised or as specified.

c) **Aluminium fittings** - These shall be anodised to natural matt finish or dyed anodic coating not less than grade AC 10 or IS: 1868-1996.

The fittings generally used for different type of doors and windows are indicated in Annexure 9-A.8 attached. The fittings to be actually provided in a particular work shall, however, be decided by the engineer.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings. These shall be of the size as indicated in respective figures. Fittings shall be fixed in proper position as shown in the drawings or as directed by the engineer. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driven and not hammered in. Recess shall be cut to the exact size and depth for the counter-sinking of hinges.

9.43.2. **Butt hinges** - (These shall be of the following types according to the material used.

(a) Mild steel butt hinges (Medium) (b) Cast brass butt hinges light/ordinary or heavy. (c) Extruded aluminium alloy butt hinges.

9.43.2.1. **Mild steel (medium)**

a) These shall be medium type manufactured from M. S. Sheet. These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS: 1341.

b) **Hinge pin** - Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

c) **Knuckles** - The number of knuckles in the hinges of different sizes shall be as per IS: 1341-1992. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

d) **Screw holes** - The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws.

9.43.2.2. **Cast brass**

a) These shall be light/ordinary or heavy as specified. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidised or as specified. These shall generally conform to IS: 205-1992.

b) **Hinge pin** - Hinge pin shall be made of brass or of phosphor bronze. The hinge pins shall be firmly riveted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.

c) **Knuckles** - The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

d) **Screw holes** - The screw holes shall be suitable for counter sunk head wood screws and of the specified sizes for different types of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

9.43.2.3. **Extruded aluminium alloy** - These shall be manufactured from extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall conform to IS: 205.

a) **Hinge pin** - Hinge pin shall be made of mild steel (galvanised) or aluminium alloy. The aluminium alloy hinge pin shall be anodised. The hinge pin shall be finally riveted and shall be properly finished. The movement of hinges shall be free, easy and square and shall not have any play or shake.

b) **Kunckies** Number of kunckles in each hinge pin shall be less than 5. The number of kunckles in case of sizes less than 40 mm be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy working shall not have any play or shake.

c) **Screw holes** The screw holes shall be suitable for counter sunk head wood screws and of specified sizes for different types of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

9.43.2.4. **Sampling and criteria for conformity** - The number of butt hinges to be selected from a lot shall on the size of lot and shall be in accordance with Table 10. Butt hinges for testing shall be taken at random from at least 10 percent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table given below.

Lot size	Sample size	Permissible No. of defective hinges
Upto 200	15	0
201 to 300	20	1
301 to 500	30	2
501 to 800	40	2
801 and above	55	3

Note: Any hinge which fails to satisfy the requirements of any one more of the characteristics shall be considered as defective hinge.

9.43.3. **Parliament hinges**

These shall be of mild steel cast brass or as specified, and shall generally conform to IS: 362. The size of parliament hinges shall be taken as the width between open flanges. Mild steel parliamentary hinges shall be copper oxidized (thick finish) or as specified. The brass parliament hinges shall be finished bright, chromium plated or oxidized or as specified

a) The hinges pin shall be made of mild steel in the case of brass hinges. The hinge pin shall be mild steel (galvanised) in the case of aluminium alloy hinges. The hinge pin shall be firmly riveted and shall be properly finished. The movement of the hinges shall be free, easy and square, and shall not have any play or shake.

b) All screw holes shall be clean and counter sunk to suit the counter sunk head of wood screws specified.

c) **Sampling and criteria for conformity** - It shall be same as specified in 9.43.2.4

9.43.4. **Spring hinges - (Single or double acting)**

These shall be single acting when the shutter is to open on one side only or double acting when the shutter opens on both sides. These shall be made of M.S or brass as specified, and shall generally conform to IS: 453-1993.

a) Hinges shall work smoothly and shall hold the door shutter truly vertical in closed position. Each double-acting spring hinges shall withstand the following tests which shall be carried out after fixing it to a swing door in the normal manner.

(1). When the door is pushed through 90° and released 2000 times on each side in quick succession the hinge shall show no sign of damage or any appreciable deterioration of the components during or on completion of the test.

(2) The door shall require a force 2.0 ± 0.5 kg for 100 mm hinges and 3.0 ± 0.5 for 125 mm and 150 mm hinges at a distance of 4.5 cm from the hinge pin to move the door through 90° .

b) The size of spring hinge shall be taken as the length of the plate..

c) These shall be of the following type

1) **Mild steel** The cylindrical casing shall be made either from M.S. sheet of 1.60 mm thickness, lap jointed and brazed, welded and riveted, or from solid drawn tube of thickness, pressed to form the two casing. It shall be stove enameled black or copper oxidized or as specified.

2) **Cast brass** The cylindrical casing shall be made either from brass sheet of 1.60 mm thickness, lap jointed and brazed, or from solid drawn brass tube of not less than 1.60 mm thickness. It shall be satin, bright nickel-plated or copper oxidized or as specified.

e) Sampling - The number of spring hinges shall be selected from the lot and this shall depend on the size of the lot and shall be in accordance with Table given below.

Lot size	Sample size	Permissible No. of defective hinges
1 to 25	3	0
26 to 50	6	0
51 to 100	12	0
101 to 200	15	0
201 to 300	20	1
301 to 500	30	2
501 to 800	40	2
801 and above	55	3

9.43.5. Rising hinges

a) These shall be made of brass, finished bright or chromium plated or oxidized or as specified. Its shape and pattern shall be approved by the engineer. The size of the rising hinge shall be taken as the length of its plate.

9.43.6. Continuous piano hinges

These shall be made from mild steel or aluminium alloy sheet; these shall generally conform to IS 3818. All screw holes shall be clean and counter sunk. Piano hinges shall be fixed in the entire length of the cup board shutters. Its size will be the width of the two flaps when open.

9.43.6.1. M.S piano hinges –

(1) These shall be made from 1 mm or 0.80 mm thick M.S. sheets and shall be protected with anti-corrosive treatment, such as bright polished, chromium plated or oxidized finish.

(2) Hinge pin shall be of galvanised mild steel. It shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge, but shall not cause looseness.

(3) The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake.

9.43.6.2. **Aluminium piano hinges** - These shall be made of aluminium alloy sheet and shall be anodised. The anodic coating shall not be less than the grade AC 15 of IS: 1868 - 1996. Hinge pin shall be made of aluminium alloy with anodic coating not less than grade of AC-15 of IS: 1868-1996. The hinge pin shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge but shall not cause looseness. The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake.

9.43.6.3. **Sampling and criteria for conformity** - It shall be same as specified in 9.43.2.4

9.43.7. Tee hinges

These shall be made from M.S. sheets and shall be either bright finished or stove enameled black or as black or specified. These shall generally conform to IS: 206. Tee hinges shall be well made, free from burrs, flaws, and defects of any kind. The movement shall be square, and the working shall be

free and easy without any play or shake. The hole for the hinge shall be central to the bore and shall be square.

a) The hinge pin shall be firm and riveted over, so that the heads are well formed. All screw holes shall be clear and counter sunk and shall be suitable for the counter sunk head of wood screws.

b) **Sampling and criteria for conformity** - It shall be same as specified in 9.43.2.4

9.43.8. Sliding door bolts (Aldrops)

9.43.8.1. These shall be of mild steel, cast brass, aluminium or as specified, and shall be capable of smooth sliding action.

9.43.8.2. **M.S. sliding door bolts** - These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS: 281-1991. M.S. sliding door bolts shall be copper oxidized (black finish) or as specified.

9.43.8.3. **Cast brass sliding door bolts**- These shall be made from rolled brass and shall generally conform to IS: 2681. The hasp shall be of cast brass and secured to the bolt as shown in Fig.8. Alternatively, the hasp and the bolt may be cast in one piece. The fixing and staple bolts shall be cast with 6 mm studs. Bolts shall be finished to shape and shall be finished smooth and polished before assembly. Cast brass sliding bolts shall be finished bright or chromium plated or oxidized or as specified.

9.43.8.4. **Aluminium sliding door bolts** - These shall be made of aluminium alloy and shall generally conform to IS: 2681-1993. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door frame and an iron or brass plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

9.43.8.5. **Sampling and criteria for conformity** - It shall be same as specified in 9.43.2.4.

9.43.9. **Tower bolts** These shall generally conform to IS: 204-1992 (Part I) & (Part.II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 meter.

9.43.9.2. Tower bolts shall be of the following types

(a) Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

(b) Brass tower bolts with cast brass barrel and rolled or cast brass bolt. or

Brass tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt.

The knobs of brass tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

(c) Mild steel barrel tower bolts with mild steel barrel or mild steel bolt or

Mild steel tower bolts with mild steel barrel and cast iron bolts.

The plates and straps after assembly shall be firmly riveted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

9.43.9.3. Unless otherwise specified bolt shall have finish as given below

(a) Mild steel tower bolts (Types 1 and 2) Bolts bright finished or plated as specified and barrel and stock stove enabled black.(b)Brass tower bolts (Type 3 to 5) Bolt and barrel polished or plated as specified.(c) Aluminium alloy tower bolts (type 6) Bolt and barrel anodized.

The anodic film may either transparent or dyed as specified. The quality of anodized finish shall not be less than grade AC-10 of IS: 1868-1996.

9.43.9.4. **Sampling and criteria for conformity** - It shall be same as specified in 9.43.2.4.

9.43.10. Flush bolts These should generally conform to IS: 5187-1972. These shall be of cast brass, cast aluminium alloy or extruded aluminium alloy as specified. Only one material shall be used in the manufacture of all the components of flush bolts except spring which shall be of phosphor bronze or steel strip.

When the rod is completely in its maximum bolting position it shall be retained in that position by the spring. The length of the bolt shall be such that, when the bolt is pulled down, the top of the bolt shall be flush with the top of the lip face. The top of the bolt shall be given a taper of 45° to enable easy pull or push.

Brass flush bolts shall be satin or bright polished. Alternatively they may be nickel or chromium plated as specified in IS: 4827-1983 or copper oxidized in accordance with IS: 1378-1987. Aluminium flush bolts shall be anodized and the quality of the anodized finish shall not be less than grade AC15 of IS: 1868-1996.

Note: The working of flush bolts is found satisfactory only in case of shutters made of high quality timber like teakwood properly seasoned and when there is no warping due to changes in weather. Brass flush bolts which give a more satisfactory performance are costly and uses scarce materials. Hence use of flush bolts is too discouraged.

9.43.11. M.S. locking bolt with holes for pad locks

This shall conform to IS: 7534-1985. This shall be of mild steel polished bright or copper oxidized batch electro galvanised or stove enameled. In case of stone enameled locking bolts. The bolt may be finished bright.

9.43.12. Pull bolt locks

These shall be of M.S. cast brass or aluminium as specified. M.S. pull bolt locks shall be copper oxidized (black finish) or as specified.

Brass pull bolt locks shall be finished bright, chromium plated or oxidized as specified. Aluminium pull bolt locks shall be anodised and the anodic coating shall not be less than grade. A.C. 10 of IS: 1968-1961. The bolt shall be 10 mm in diameter and the fixing plate 3 mm thick. The stop block shall be screwed to the fixing plate by a small ball and spring over which the bolt shall slide.

The fixing plate shall have four holes for fixing it to the door leaf, two of which shall be square to receive 6 mm dia. Bolts with round heads the remaining two shall receive machine screwed with lock nuts. The receiving plate shall be of the same width and thickness as the fixing plate and shall have 3 counter sunk holes. Where the bolt slides into wooden members, like the chowkhat, which have a rebate, the receiving plate shall also is correspondingly shaped so as to fit into the rebate. The screws and bolts shall have the same finish as the main bolt. The leading dimensions of pull bolt locks are given in the drawing. The denominating size of the pull bolt locks shall be length of the fixing plate between guides plus the thickness of the guides.

9.43.13. Door latch

This shall be of mild steel, cast brass, or as specified and shall be capable of smooth sliding action. In case, of mild steel latch, it shall be copper oxidized (black finish) or as specified and in case of brass, it shall be finished bright, chromium plated or oxidized or as specified. The size of door latch shall be taken as the length of the latch.

Indicating bolt (vacant/engaged) - These shall be of cast brass finished bright chromium plated, or oxidized or as specified. The shape and pattern shall be approved by the engineer.

9.43.15. Mortice lock and latch

This should generally conform to IS: 2209-1976.

The size of the mortice lock shall be denoted by the length of the body towards the face and it shall be 65 mm, 75 mm and 100 mm as specified. The measured length shall not vary more than 3 mm from the length specified.

Non-interchangeable Keys Testing of non-interchangeable keys shall be as per IS: 2209-1976.

The clear depth of the body shall not be more than 15 mm. The fore end shall be firmly fitted to the body suitably by counter sunk head screw. The latch bolt shall be of specified material and of section

not less than 12x16 mm for all sizes of locks. If made of two piece construction both parts shall be riveted. Ordinary lever mechanism with not less than two levers shall be provided. False levers shall not be used. Lever shall be fitted with one spring of phosphor bronze or steel wire and shall withstand the tests as provided in IS: 2209-1976.

Locking bolts, spring and strike plate shall conform to IS: 2209-1976.

Handles these shall conform to IS: 4992-1975.

Keys each lock shall be provided with two keys.

Sampling, criteria for conformity It shall be the same as specified in 9.43.2.4.

Tests - The finally assembled locks shall be tested as prescribed..

9.43.16. Mortice latch (with locking bolt)

These are generally used in doors of bath rooms, WC's and private rooms.

Mortice latch shall, in respect of shape, design and mechanism of the latch and its components parts, generally conform to IS: 5930-1970. The material used for the different component parts of the latch shall comply with Tables 1 and 2 of IS: 5930-1970, unless otherwise specified.

The size of the latch shall denoted by the length of the body towards the face and shall be 65 mm, 75 mm or 100 mm as specified. The depth of the body shall not be more than 15 mm.

The latch shall be of size 10x10 mm of shape as shown in IS: 5930-1970. The locking bolt shall be of section not less than 8x25 mm for all size of locks. The mechanism of the latch bolt, its spring, striking plate etc. shall be described in IS: 5930-1970.

The handles provided shall conform to IS: 4992-1975.

Sampling, criteria for conformity shall be as per 9.43.2.4.

9.43.17. Mortise lock and latch (rebated)

These are slightly different from mortice lock described in 9.43.15 and are designed for use in double leaved doors. These should generally conform to IS: 6607-1972.

Handles, keys, sampling, criteria for conformity and test

These shall be as specified in 9.43.2.4.

9.43.18. Mortise night latch

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS: 3847-1992.

It shall be cast or sheet brass, cast or sheet aluminium alloy or Mild steel as specified and of best quality of approved make. These shall be bright finished or copper oxidised (black) finish as specified. Nominal size of the latch shall be denoted by the length of the face over the body in millimeter. These shall have not less than two levers. False (Dummy) levers shall not be allowed.

Keys - Each latch shall be provided with keys which should work smoothly and without any appreciable friction in the lock.

9.43.19. Cupboard or wardrobe lock - This should generally conform to IS: 729. The size of the cupboard lock shall be 40, 50, 65 & 75 mm. This shall be made of cast brass and shall be of the best make of approved quality. These shall be finished bright or chromium plated or oxidized or as specified. The size of the lock shall be denoted by the length of the face across the body in mm.

These locks shall be fitted with four, five or six levers as specified. False (dummy) levers shall not be used.

9.43.20. Ball catches for wooden almirah

This should generally conform to IS: 8756-1978. These may be brass sheets or cast brass with steel balls of sizes 6, 7, 5, 9.5 or 12 mm dia as specified. The size shall be denoted by the external diameter of the cylinder holding the steel ball with spring. When the almirah is in the closed position it shall be retained in that position by the spring action of the ball catch and shall be so in continuous usage. The door shall open only when it is pulled open.

Sampling, criteria for conformity and test shall be as specified in 9.43.2.4.

9.43.21. Finger plate

This shall be finished bright, chromium plated, oxidized of brass, or anodised aluminium or transparent plastic or as specified. This shall be made from brass or aluminium plate of 1.6 mm thickness with bevelled or square edges as specified.

The size of the plate shall be 300x65 mm unless otherwise specified. The shape and pattern shall be approved by the engineer.

9.43.22. Kicking plates

This shall be of brass (finished bright or chromium plated or oxidized) bronze, stainless steel, aluminium or as specified. Aluminium kicking plates shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868. It shall be made from a plate of minimum thickness 3.0 mm & 1.5 mm in case of stainless steel. Shape of the plate shall be as specified. This shall have bevelled or straight edges and shall be fixed buy means of counter sunk or rounded screws of the same material and finished as that of the plate. The shape and pattern shall be according to the drawings and as approved by the engineer.

9.43.23. Handles (doors and windows)

These should generally conform to IS 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

Door handles shall be of the following types according to the material used

(1). **Cast or sheet aluminium alloy handles** - These shall be of aluminium of specified size, and of shape and pattern as approved by the engineer. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No.6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC 15 of IS: 1868-1996 as specified. The finish can be bright natural, matt or satin or dyed as specified.

(2). **Cast brass handles.** These shall be of cast brass of specified size and of the shape and pattern as approved by the engineer. The size of the handle shall be determined by the inside grip of the handle. Door handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No.6. Brass handles shall be finished bright satin or nickel chromium plated or copper oxidized or as specified.

(3). **Mild steel handles.** These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Iron handles shall be copper oxidized (black finish) or stove enameled black or as specified.

Sampling and criteria for conformity - It shall be as specified in 9.43.2.4.

9.43.24. Floor door stopper The floor door stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the engineer. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body or housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs

and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodised and anodic film shall not be less than grade AC-10 of IS: 1868.

The rubber for the floor door stopper shall meet the requirements as per Table given below.

Requirements for rubber

Particulars	Requirements	Testing procedure
Relative density Max	1.3	IS-3400 (part IX)
Hardness	60 \pm 5	IS-3400 (part II)
Change in initial hardness ageing for 24 hours at 100° \pm 1°	+5	+5 (part II)

9.43.25. Hanging rubber door stopper

These shall be of cast brass, finished bright, chromium plated or as specified. Aluminium stopper shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868. The size and pattern of the door stopper shall be approved by the engineer. The size shall be determined by its length.

9.43.26. Universal hydraulic door closer (exposed type)

These shall be made of cast iron / aluminium alloy / zinc alloy and of shape and pattern as approved by the engineer. These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS: 3564. The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodised and the anodic coating shall be not to be less grade AC 15 of IS: 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, dust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphate treatment in accordance with IS: 3618.

The nominal size of door closers in relation to the weight and the width of the door size to which it is intended to be fitted shall be given in the Table below.

Type and designation of door closers

Designation of Closers	Weight of the door (kg)	Size of the door (mm)	Remarks
1	Upto 35	700	For light doors such as double leaved and toilet doors
2	36 to 60	850	Interior doors, such as of bed rooms, and kitchen and store
3	61 to 80	1000	Main doors in a building, such as entrance doors

Sampling and Criteria for Conformity - All these closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance.

Performance requirements - After being fitted in its position when the door is opened through 90°, the same should swing back to angle 20° \pm 5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in final position the door smoothly negotiates with the latch.

9.43.27. Hooks and eyes

9.43.27.1 These shall be mild steel or hard drawn brass or as specified. Mild steel hooks and eyes shall be copper oxidized (black finish) or as specified. Cast brass hooks eyes shall be finished bright or chromium plated. These shall be well made and free from defects these shall be finished to the correct shape and dimensions so as to function properly when they are in use. Cast hooks eyes and plates shall be free from casting and other defects. All these shall generally conform to IS: 207-1964. All size

of hooks and eyes shall be determined by the length of the hooks measured out to out. Unless otherwise specified the articles shall be finished bright.

9.43.28. Casement window fasteners

These shall be made of cast brass. Finished bright, chromium plated or oxidized or of nylon or as specified. Casement fasteners for single leaf window shutter shall be left or right handed as specified. These shall not weight less than 0.20 kg per fasteners. Nylon window fasteners shall conform to IS: 6318-1971.

9.43.29. Casement brass stays (straight peg type)

These shall be made of mild steel, cast brass, aluminium (extruded section) or plastic (polypropylene) as specified. Mild steel casement stays shall be a copper oxidized (black finish) or as specified. Cast brass stays shall be finished bright or chromium plated or as specified. Aluminium stays shall be anodised and the anodic coating shall not be less than grade AC-10 of IS: 1868. Aluminium and M.S. stays shall be made from channel section. The stays shall not weight less than that indicated below

20 mm	0.24 kg each
250 mm	0.28 kg each
300 mm	0.33 kg each

The shape and pattern of the stays shall be approved by the engineer. The size of stays shall be determined by its length as shown in the plate. The plastic (Polypropylene) stays shall conform to IS 6318-1971.

9.43.30. Fan light pivots

These shall generally conform to IS 1837-1966. These shall be of mild steel or cast brass or Aluminium or as specified. The brass, fan light pivots shall be finished bright, chromium plated or as specified. M.S. fan light pivot shall be copper oxidized (black finish) or as specified. The base and socket plate of M.S. fan light pivots shall be made from minimum 3.0 mm M.S. sheet and the pivot shall be of round M.S. bar of minimum 10 mm diameter projecting out by minimum 12 mm length and firmly riveted to the base plate. The base and socket plate of cast brass fan light pivots shall be made from minimum 3.0 mm thick brass plate and the projected pivot shall not be less than 12 mm diameter and 12 mm length, cast in single piece with the base plate.

9.43.31. Fan light catch

This shall conform to IS: 364-1993. This shall be made of mild steel or cast brass or Aluminium or as specified. M.S. fan light catch shall be copper oxidized (black finish) or as specified. Brass catch shall be finished bright, chromium plated or oxidized or as specified.

9.43.32. Chain with hook for ventilator.

This shall generally conform to IS: 3828. This shall be made of mild steel, hard drawn brass or cast brass welded or twisted or as specified. The brass chain shall be finished bright, chromium plated or oxidized or as specified. M.S. chain shall be copper oxidized (black finish) or as specified. One end of the chain shall be provided with an eye and the other end with a staple. The minimum thickness of plates shall be 3 min. the chain shall be 300 mm long made from minimum 4 mm hard drawn wire with properly joined or twisted ends.

9.43.33. Quadrant stays 300 mm - These shall be made of cast brass and finished bright or chromium plated or as specified. The shape and pattern shall be approved by the engineer. It shall not weight less than 0.20 kg each.

9.43.34. Hasp and staple safety type

9.43.34.1. This shall be made of mild steel, cast brass or aluminium as specified. This shall generally conform to IS: 363. M.S. Hasp and staples shall be finished black enameled, or copper oxidized (black finish) or as specified. Brass hasp and staples shall be finished bright chromium plated or oxidized or as specified. Aluminium hasp and staples shall be anodized and the anodic coating shall not be less than grade AC-15 of IS: 1868-1996.

M.S. hasp and staples shall be manufactured from M.S. sheet and brass hasp and staples by casting and Aluminium hasp and staples shall be made from dye section. The hinge pin which in all cases

shall be of mild steel, shall be firm and its riveted heads well formed. The movement of hasp shall be free, easy and square and shall not have any play or shake. The hasp shall fit, in the staple correctly. The size shall be determined by the length of the bigger of the hasp.

The staple except in the case of cast one, shall be riveted properly to its plate. The ends of the hinge pin for the safety type hasp shall be riveted and properly finished. All screw holes shall be clean and counter sunk to suit counter sunk wood screw. All edges and corners shall be rounded.

Annexure 9-A.1

TABLE FOR PERMISSIBLE DEFECTS FOR VARIOUS GRADES OF TIMBERS (Clause 9.5.2)

Sl. No	Defects	First Grade	Second Grade
i)	Cross-grain	Not steeper than 1 in 15	Not steeper than 1 in 10
ii)	Sound knots and live knots	i) stiles and rails a) Short exposed face Not more than 15 mm size and not more than 1 knot/metre b) Long exposed face not more than 15 mm size and not more than 1 knot/m. No knot shall occur within 20 mm of the edges ii) Panels-not more than 20 mm size and not more than 2 knots/m ² . No knot shall occur on edge of any component of a panel	i) stiles and rails a) Short exposed face- not more than 15 mm size and not more than 3 knots per stile and 1 knot per rail. b) Long exposed face-not more than 20 mm size and not more than 3 knots per stile and 1 knot per rail. ii) Panels- not more than 20 mm size and more the 4 knots/m ² . Not knots shall occur on edge of any components of a panel.
iii)	Dead and loose knots (plugged)	i) stiles and rails-not more than 10 mm size, centrally located and not more than 1 knot/m ii) Panels-not more than 15 mm size and not more than 2 knots/m ² . Not shall occur on edges of any component of a panel	i) stiles and rails-not more than 10 mm size. Centrally located and not more than 3 knots per stiles and 1 knot per rail. ii) Panels-Not more than 15 mm size and not more than 4 knots/m ² No knot shall occur on edge of any components of a panel.
iv)	Pitch pockets or streaks	None	Permissible except on exposed edges provided that they are clean and filled up with suitable putty or filler when pitch pockets or streaks are located on the exposed edges of the core, they shall be cut and filled with piece of wood or similar species with grain running in the same direction. The piece shall be well glued.
v)	Sapwood	Total not exceeding 5 mm wide and 150 mm long per metre. (This restriction applies only to super group species)	Total not exceeding 10 mm wide and 300 mm long per metre. (This restriction applies only to super group species.)
vi)	Pin holes	Permitted provided they are not in cluster	Permitted.

vii)	Worm holes	None	Permitted provided they are not more than 10 mm in diameter and not more than one per metre and provided such worm holes are plugged with similar timber in such a manner that the plugging merges with the surrounding area both as to colour and grain.
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Notes: (i) Dead and loose knots are permitted only if they are suitably plugged.(ii) Knot shall not occur where hinges or locks are to be FIXED

Annexure 9-A.2

MOISTURE CONTENT OF TIMBER (clause 9.8)

C-1. Moisture content of timber shall be checked for every 1 cum or part thereof by electrical moisture meters as per IS: 287.

C-2. Electrical moisture meters are of resistance type and shall be used when the moisture content is within a range of 8 to 25 per cent. When checking moisture content with electrical moisture meter, it shall be measured that

(a) Timber is not hot or surface wet and the moisture gradient is not large due to wet cores.

(b) Electrode probes are of adequate depth (not less than one-fifth the thickness of timber).

C-3. Sufficient number of readings at different positions are taken on each piece of timber to eliminate localised variations in surface moisture and species corrections are applied for the use of electrical resistance, type moisture meter.

C-4. If for any reason, whatsoever, the result of electrical moisture is not to be relied upon the moisture content shall be checked by the oven drying method.

C-5. For checking for moisture content by oven drying method, a complete test cross section, 12 to 19 mm long in the direction of timber grain, free from all defects shall be cut from each piece of timber selected for test as follows

(a) If weighing can be done immediately, the test section shall be cut from a point at least 45 cm from one end of the piece or from its centre. (b) If weighing cannot be made immediately, a sample of 30 cm long shall be cut from a point at least 45 cm from one end of the piece or from its centre. Subsequently (within 24 hours), the test section shall be cut from the centre of this sample. (c) In case cutting of test section from the piece is not permissible the moisture content in the whole section can also be determined by collecting a boring to a depth of half of the thickness of the piece by means of an auger, in a pre-weighed weighing bottle which should then be securely stoppered.

C-6. The test sections obtained above shall be weighed, immediately after cutting, on a balance the sensitivity of which is not less than 10 mg. They shall be dried in a ventilated, and preferably thermostatically controlled, oven at a temperature of 100° C to 105°C until the weight is constant. The weight of the test section shall be deemed to have become constant if successive weighing at intervals of 2 to 5 hours do not differ from one another by more than 50 mg. The test weight shall be taken to the oven dry weight of the test section.

C-7. The percentage moisture content in the test section shall be calculated as follows

$$\text{Moisture content (Percent)} = \frac{W_1 - W_0}{W_0} \times 100$$

Where

W_1 = initial weight of test section and

W_0 = oven dry weight of test section

C-8. When moisture content of timber is checked by oven drying method, results of electrical moisture metre shall be ignored.

Annexure 9-A.3

LIST OF BUREAU OF INDIAN STANDARD CODES (ISI)

Sl. No.	IS. No.	Subject
1	287-1993	Recommendations for maximum permissible moisture content of timber used for different purposes (3 rd Revision)
2	401-1982	Code of practice for preservation of timber (3 rd Revision) (Amendments 2) (Reaffirmed 1990)
3	419-1967	Putty for use on window frames (1 st Revision) (Amendments 3)
4	420-1953	Putty for use on metal frames
5	451-1999	Technical supply condition for wood screws (2 nd Revision) (Amendment 1) (Reaffirmed 1991)
6	723-1972	Specification for steel countersunk head wire nails (1 st Revision) (Amendments 3) (Reaffirmed 1990)
7	848-1974	Specification for synthetic resin adhesives for plywood (phenolic and aminoplastic) (1 st Revision) (Amendments 3) (Reaffirmed 1990)
8	851-1978	Specification for synthetic resin adhesives for construction work (non structural) in wood (1 st Revision) (Amendment 1) (Reaffirmed 1990)
9	852-1994	Specification for animal glue for general wood working purposes (2 nd Revision)
10	1003 (Part1)-1991	Specification for timber paneled and glazed shutters (Part 1) Door shutters (3 rd Revision) (Amendment 1)
11	1003 (Part II) 1994	Specification for timber paneled and glazed shutters (part ii) window and ventilator shutters (3 rd Revision)
12	1141-1993	Specification for code of practice for seasoning of timber (2 nd Revision)
13	1200-(Part XIV)1984	Wood work and joinery (2 nd Revision) (Amendment 1) (Reaffirmed 1992)
14	1378-1987	Specification for oxidized copper finishes (3 rd Revision) (Reaffirmed 1992)
15	1566-1982	Specification for hard-drawn steel wire fabric for concrete Reinforcement (2 nd Revision) (Amendments 2) (Reaffirmed 1995)
16	1568-1970	Specification for wire cloth for general purpose (1 st Revision) (Amendment 1) (Reaffirmed 1992)
17	1708 (Part.1 to 18) 1986	Method to testing of small clear specimens of timber (2 nd Revision) (Amendment 1) (Reaffirmed 1991)
18	1734-1983	(pt. 1 to 20) Methods of test for plywood (2 nd Revision) (Reaffirmed 1993)
19	1761-1960	Transparent steel glass for glazing and framing purposes (Superseded by IS: 2835)
20	1868-1996	Specification for anodic coating on aluminium and its alloy (2 nd Revision) (Reaffirmed 1991)
21	2095-1982	Specification for gypsum plaster boards (1 st Revision) (Amendment 1) (Reaffirmed 1991)
22	2096-1992	Specification for asbestos cement flat sheets (1 st Revision)
23	2202(Part 1)-1991	Specification for wooden flush door shutters (Solid core type) plywood face panels (5 th Revision) (Amendments 2)
24	2202 (PartII)-1983	Specification for wooden flush door shutters (Solid core type) (Reaffirmed 1991)
25	2380-1981	Method of test for wood particle boards from other lingnocellulosic

		material (parts 1 to 23) (1 st Revision) (Amendment 3) (Reaffirmed 1993)
26	2547 (Part 1) 1976	Gypsum building plaster (Parii) Excluding premixed light weight plaster (1 st Revision) (Amendment 1) (Reaffirmed 1990)
27	2547 (Part1)-1976	Gypsum Plaster (Part ii) premixed light weight plaster (1 st Revision) (Reaffirmed 1992)
28	2835-1987	(2835-1987) Flat transparent sheet glass (3 rd Revision) (Reaffirmed 1992)
29	3400(Part II)-1995	Methods of test for vulcanized rubbers (hardness) (1 st Revision) (Reaffirmed 1991)
30	3400 (PartIV)1987	Methods of test for Vulcanized rubbers Accelerated ageing (2 nd Revision) (Reaffirmed 1993)
31	3400 (Part X)1978	Methods of test for vulcanized rubbers Density (1 st Revision) (Amendment 1) (Reaffirmed 1987)
32	3618-1966	Phosphate treatment for iron and steel for protection against corrosion (Reaffirmed 1991)
33	3813-1967	'C' hooks for use with swivels (Reaffirmed 1992)
34	4835-1979	Specification for polyvinyl acetate dispersion based adhesives for wood (1 st Revision) (Amendment 2) (Reaffirmed 1990)
35	4948-1974	Specification for welded steel wire fabric for general use (1 st Revision) (Reaffirmed 1992)
36	6760-1972	Slotted countersunk head wood screws (Amendments 2) (Reaffirmed 1988)
37	12406-1988	Specification for medium density fiber boards for general purposes (Amendment 4) (Reaffirmed 1992)
38	5523-1983	Method of testing anodic coating on aluminium and its alloys. (1 st Revision) (Reaffirmed 1991)
39	707-1976	Glossary of terms applicable to timber technology and utilization (second revision)
40	2366-1983	Code of practice for Nails-jointed timber construction (first revision)
41	2700-1974	Code of practice for roofing with wooden shingle.
42	2911-(Part ii)-1980	Timber pile (first revision)
43	2911-(Part4)-1985	Load test on piles (first revision)
44	3337-1978	Ballies for general purpose (first revision)
45	3386-1979	Wooden fencing post (first revision)
46	3639-1966	Structural timber in building (first revision)
47	3670-1989	Code of practice for construction of timber flow (first revision) with Amendment No.1.

Annexure 9-A.4

TESTS FOR FLUSH SHUTTERS (Clause 9.35.1 to 9.35.10)

F-1.End immersion test - Door shutters shall be tested for resistance of their base to immersion in water as follows

The door shutter shall be immersed vertically to height of 30 cm in water at room temperature for 24 hours and then allowed to dry for 24 hours at $27 \pm 2^\circ$ and relative humidity of 65 ± 5 percent. The cycle shall be repeated eight times. There shall be no delaminating at the end of the test

F-2. Knife test

(i) **Apparatus** - The type of knife required to be used in the test may be made from a 250 X 25 mm file. The cutting edge should be chisel sharp. The test shall be carried out on a stout table to which a wooden batten is screwed against which the edge of test piece is placed.

(ii) **Procedure** - The knife is inserted with its cutting edge parallel to the grain of the outer veneer and worked into, or if possible along glue line and the veneers are prised upwards. Hard and dense species of plywood requires considerable force to effect entry and to prise the veneer. In a soft timber the knife tends to follow an easy course through the wood and in this case it is essential that the knife be firmly guided along the glue.

The bond should just pass the requirement, it is judged by the relative amount of wood fibre left on the core veneer, and the area prised off. The grading is assessed chiefly on the appearance of the break. The force needed to effect separation is also an accompanying requirement.

The bond is 'Excellent', when it is difficult to find the glue line and impossible to keep the tool within it for more than 6 mm without cutting adjacent wood. On prising upwards, the veneer usually breaks off over a width slightly greater than that of the tool.

The bond is 'poor' when knife meets little opposition in the glue line and the prise results in the easy removal of almost all the veneers from one side of the test piece. The separated veneers are usually almost free from adherent fibre.

(iii) **Reporting of test results** - The results shall be reported as 'pass standard' 'excellent' or 'poor'.

F-3. Glue adhesion test - Four square sections. 150 x 150 mm shall be cut from the corners of the door. These four corner sections as cut from the door shall be immersed in boiling water for 4 hours, then dried at $27 \pm 2^\circ \text{C}$ and relative humidity of $65\% \pm 5$ per cent for 24 hours. At the end of the drying period, the samples shall be examined for delamination. In the case of the glue lines in the plywood, all the four exposed edges of the plywood on both faces of a specimen shall be examined for delamination.

A specimen shall be considered to have passed the test if no delamination has occurred in the glue lines in the plywood and if no single delamination more than 50 mm in length and more than 3 mm in depth has occurred in the assembly glue lines between the plywood faces and the stile and rail. Delamination at the corner shall be measured continuously around the corner. Delamination at a knot, knot hole, a pitch pocket and worm hole or other permissible wood defects shall not be considered in assessing the sample. A door shall be deemed to have passed this test if three of the four specimens tested pass the test.

Annexure 9-A.5

**LEDGED, BRACED AND BATTENED
TIMBER DOOR SHUTTERS**

(Extract of IS: 6198-1971)

1. **Scope** – Requirements regarding, material, sizes, construction, workmanship and finish of ledged, braced and battened timber door shutters.

Note: This is a simple form of door, and is frequently used for temporary sheds, warehouses, stores, etc, where appearance is not the main criterion. It is relatively cheap, but has a tendency to twist if timber is not good quality, and if thinner ledges are used.

2. Materials

2.1. Timber shall be of four classes, namely, (a) Teak wood, (b) Deodar wood. (c) Hard woods other than Teak, (d) Softwoods other than Deodar.

Note: For classification of species of timber see Appendix A of the standard.

2.2. **Moisture content, max** – 10 to 16 percent for timber of 50 mm and above, and 8 to 14 percent for timber thinner than 50 mm.

2.3. **Defects prohibited** – Shall be free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, slits and cracks.

2.4. **Grades of timber and permissible defects** – Shall be graded as Superior Grade, First Grade and Second Grade on the basis of permissible defects in timber.

Note: For permissible defects for various classes of timber see Table 1 of the standard.

3. **Designation** – By symbols denoting width, type and height of door in succession. Width – Indicated by the number of modules of 10 cm in the width of door opening. Type D= Door S= Single shutter, T= Double shutter. Height – Indicated by the number of modules of 10 cm in the height of door opening.

Example – 8 DS 21 would mean a shutter suitable for a single shutter door of 8 modules width and 21 module height,

4. Standard sizes (in mm)

Designation	Width	Height
8 DS 20	700	1 905
8 DS 21	700	2 005
9 DS 20	800	1 905
9 DS 21	800	2 005
10 DS 20	900	1 905
10 DS 21	900	2 005
12 DT 20	560	1 905
12 DT 21	560	2 005

Note 1: For two shutter doors, only sizes of one shutters has been given.

Note 2: In arriving at standard widths and heights, an allowance of 6 cm has been made for timber doorframes, 4 cm for floor finish, 0.5 cm for clearance all round between door opening and door frame and 1.5 cm for rebate all round for the shutter into the frame. Tolerance on size of door shutter ± 3 mm.

5. **Dimensions of components** – Finished dimensions shall be as follows

Top and bottom ledges 150X30mm;

Middle ledge 2200X30 mm;

Braces 110 to 125X30 mm.

Battens 140 to 160X25 mm.

All battens in a shutter shall be of uniform width.

6. **Rebating** – In case of double leaved shutters, meeting of the stiles shall be rebated 20 mm (splayed or square type).

7. **Fittings** – There tee hinges for each shutter (one at centre and others 20 cm from top and bottom). Each shutter shall also have 2 barrel bolts and one sliding bolt for locking.

8. **Finish** – Well planed and finished smooth. Surfaces to be painted, polished or varnished shall be given a suitable priming coat before delivery.

Defective knots, where permitted in surfaces exposed to view, shall be completely bored or cut out and tightly plugged with a cross-gained plug (round or dovetailed) of similar species of timber and shall be properly glued in.

Annexure 9-A.6

TEST FOR MORTISE LOCKS (Clause 9.43.15 - 9.43.18)

The finally assembled lock shall withstand the test given as below

The locking bolt shall be first locked in the forward position. A load of 40 kg shall be applied without shock in the direction perpendicular to securing face as well as on both the locking faces of protruding bolt in turn. Then the load shall be applied by means of a fixed steel board 3 mm thick by rounded edge held in such a position that the centre line is approximately 3 mm from the fore end.

When the spindle with handle is inserted into hole in the follower and turned, the latch bolt shall draw smoothly into the lock body and shall be within one millimetre from the face of the fore end.

When the latch bolt is pressed in to the lock body by pressure, the action shall be smooth and when fully pressed the latch bolt shall not project more than one millimetre from the face of the fore end.

When a key is inserted in key hole from one side of the lock and turned to withdraw the locking bolt the action shall be smooth and without impediment. When the direction of turn is reversed to lock the locking bolt then also the action shall be smooth and without impediment. In the locked position the locking bolt shall project 12 mm from the face of the fore end, although one millimetre free movement is permissible. In the withdrawn position the locking bolt shall be worked by turning key in both the direction 6000 times. At the end of the test, the lock shall continue to work smoothly.

The test shall be repeated with the key inserted from the other side of the lock.

Note: The clearance for levers while in the operating condition shall not exceed 0.25 mm.

When the key is turned to lock the locking bolt at the same time applying a reasonable pressure by finger on it, after completion of the key rotation the locking bolt shall be positively locked in the forward position. This test shall be repeated with the key inserted from the other side of the lock.

Annexure 9-A.7

SCHEDULE OF FITTINGS FOR DOORS AND WINDOWS (Clause 9.43)

Serial No.	Name of fittings	Double leaf doors shutters panelled or glazed	Single leaf door shutters external paneled or glazed	Single leaf door shutter inter communicating paneled or gauzed	Single leaf wire gauge door shutters	Single leaf wardrobe/cupboard shutters	Single leaf window shutters paneled or glazed	Fan light/ clear storey window shutters	Designation No. of wood screw	Length in mm of wood screw IS 6760-1972	Remarks
1	Butt Hinges 100 mm	6	3	3	3	-	-	-	9	40	For fixing Wooden cleat
2	Butt Hinges 75 mm	-	-	-	-	-	2	2	8	30	
3	Butt Hinges 50 mm	-	-	-	-	-	1	-	6	20	
4	Piano Hinges	-	-	-	-	1	-	-	6	20	
5	Tower Bolt 250 mm	3	2	3	2	-	1	-	10	30	
6	Tower Bolt 150 mm	-	-	-	-	-	1	-	8	30	
7	Tower Bolt 100 mm	-	-	-	-	-	-	-	6	30	
8	Sliding door Bolt 300mm	1	-	-	-	-	-	-	9	35	
9	Sliding door Bolt 250mm	-	1	-	-	-	-	-	9	35	
10	Floor door stopper	2	1	1	-	-	-	-	9	30	
11	Door handle with plate 100 mm	2	2	2	1	1	-	-	6	25	
12	Window handle in with plate 75 mm	-	-	-	-	-	1	-	6	20	
13	Casement stay 300 mm	-	-	-	-	-	1	-	6	30	
14	Helicat door spring (Superior quality)	-	-	-	-	-	-	-	6	30	
15	Cupboard/Wardrobe Lock	-	-	-	1	1	-	-	6	20	
16	Fanlight Catch	-	-	-	-	-	-	1	8	30	

Nos

A Door shutters

1. Door of room adjoining the veranda, corridor, lobby or hall, shall be considered as external door.
2. Where the length of the door leaf exceeds 2.15 meters above the floor level, one extra hinge shall be provided for every additional height of 0.50 metre, or part thereof and the length of top bolts shall be increased by the height of the leaf above 2.15 metres from floor level.
3. Single leaf door shutters of more than 0.80 m in width shall be provided with one extra hinge.
4. Fan light shutters of more than 0.80 metre width shall be provided with one extra hinge and extra quadrant stay.
5. In double leaf shutters of doors, two door bolts shall be fixed to the first shutter and one to the closing shutter at the top.
6. In case of single leaf inter communicating, paneled, glazed or paneled door shutter for bath and w.c. one tower bolts will be replaced by a bathroom latch.
7. For shutter exceeding 40 mm thickness, heavy type M.S. but hinges of 125 x 90 X4 mm shall be used.
8. In case of external door shutters, instead of sliding door ball mortice lock can be provided where specified.
9. Cupboard and wardrobe shutters will have ball catches where specified.
10. Finger plates shall be provided in case of bath and W.C. shutters in office buildings.

B Window shutters

1. In case of windows with double shutters, two tower bolts shall be fixed to the closing shutters and one tower bolt to the first shutter at the top.
2. In case of window shutters, hooks and eyes may be provided in lieu of casement stays where specified.
3. Where the height of window shutter exceeds 1.20 meters one extra hinges shall be provided and length of top bolts shall be increased by height of the leaf above 2.15 meters from the floor level.
4. Window shutter with steel frames shall be provided with six hinges in case of double leaf shutters and three hinges in case of single leaf shutters, irrespective of height and width of shutters.

C Fanlight and clerestory widow or ventilator

15. Centrally hung and bottom hung CS windows and fan lights, will be provided with chain and hook bamboo pole with hook for opening ventilators shall be provided for each residence or for set of 4 rooms in case of office building.
 16. Centrally hung clerestory windows or fan lights will have fan light pivots in lieu of hinges.
- Dimensions of door handles shall be taken from the IS standards

Annexure 9-A.8

SPECIFICATIONS FOR TIMBER DOOR, WINDOW AND VENTILATOR FRAMES

(Extract of IS: 4021-1995)

1. Scope

- 1.1. This section lays down the requirements regarding material, construction, workmanship and sizes of timber door, window and ventilator frames generally used in residential and institutional buildings.
- 1.2. This standard does not cover timber door, window and ventilator frames for commercial, industrial and other special buildings, such as workshops and garages.

2. **References** - The Indian Standard listed in Annex A are necessary adjuncts to this standard.

3. **Terminology** - For the purpose of this standard, the definitions given in IS: 10428-1983 and IS: 707-1976 shall apply (see Fig.1).

4. Materials**4.1. Timber**

4.1.1. Indian timber suitable for the manufacture of door and window frames shall be in accordance with IS: 12896-1990. Imported timbers, to be used are listed in Annex B. door frames shall be made from all heart stock of a decay resistant species of wood treated to make it decay-resistant. Vertical timber posts or head/sill of the frame shall be of the same species excepting in case of frames made

out of non-porous wood (softwood) when the bottom sill of the window and the ventilator frame shall be of porous wood (hardwood).

4.1.2. **Moisture content** - The maximum permissible moisture content in timber shall be as specified in IS: 287-1993.

4.1.3. **Seasoning and treatment** - Timber shall be well seasoned by a suitable process conforming to IS: 1141-1993, before being planed and shaped to the required dimensions. Sapwood of durable species and hardwood and sapwood of non-durable species shall be treated with suitable preservatives (except the water soluble leachable types) as specified in IS: 402-1982. The portions expected to remain concealed in joinery or in masonry shall be given an additional coat of wood preservative.

4.1.4. **Defects prohibited** - Timber for frames shall be free from decay, fungal growth, boxed heart, splits, pitch pocket or streaks on the exposed faces.

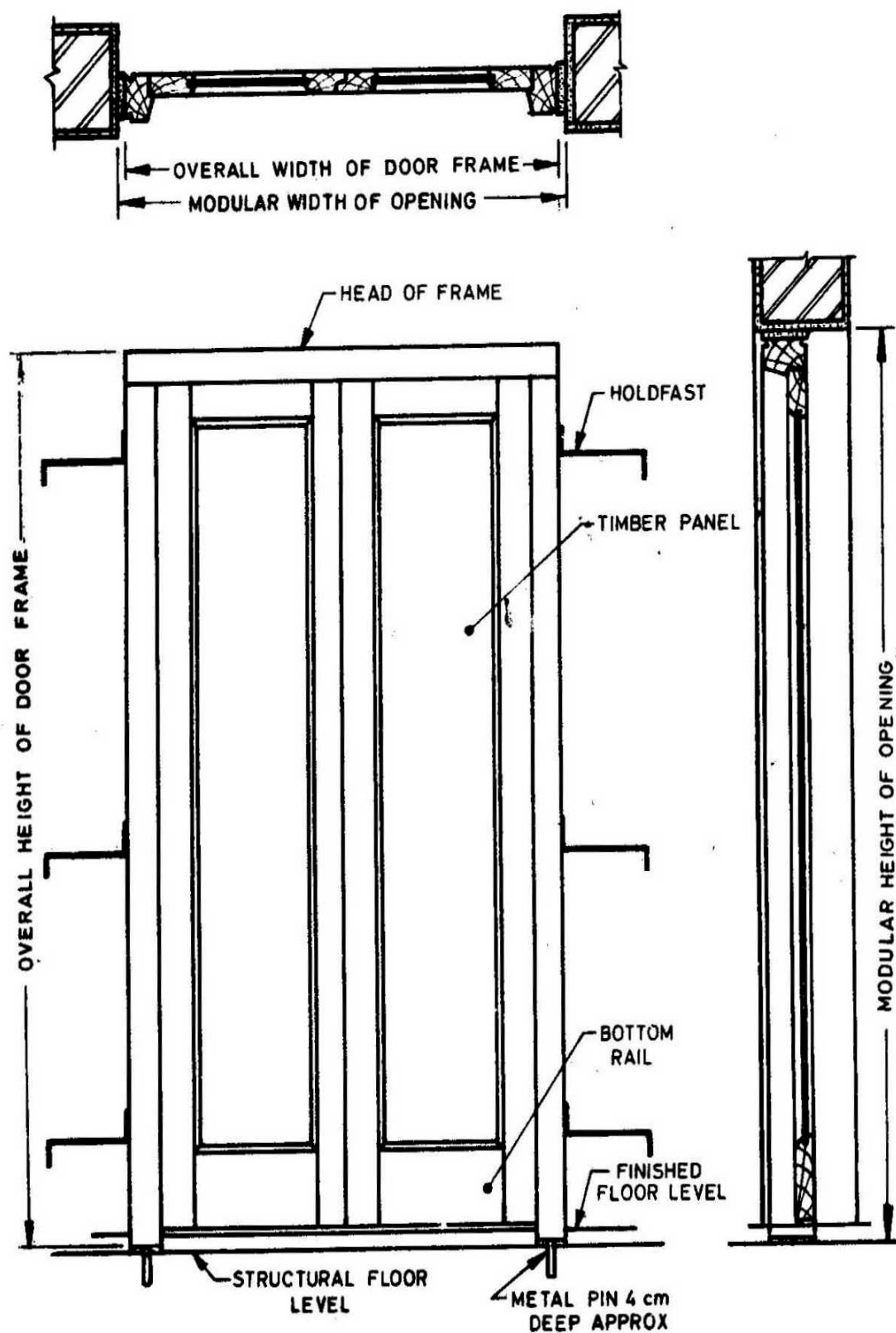
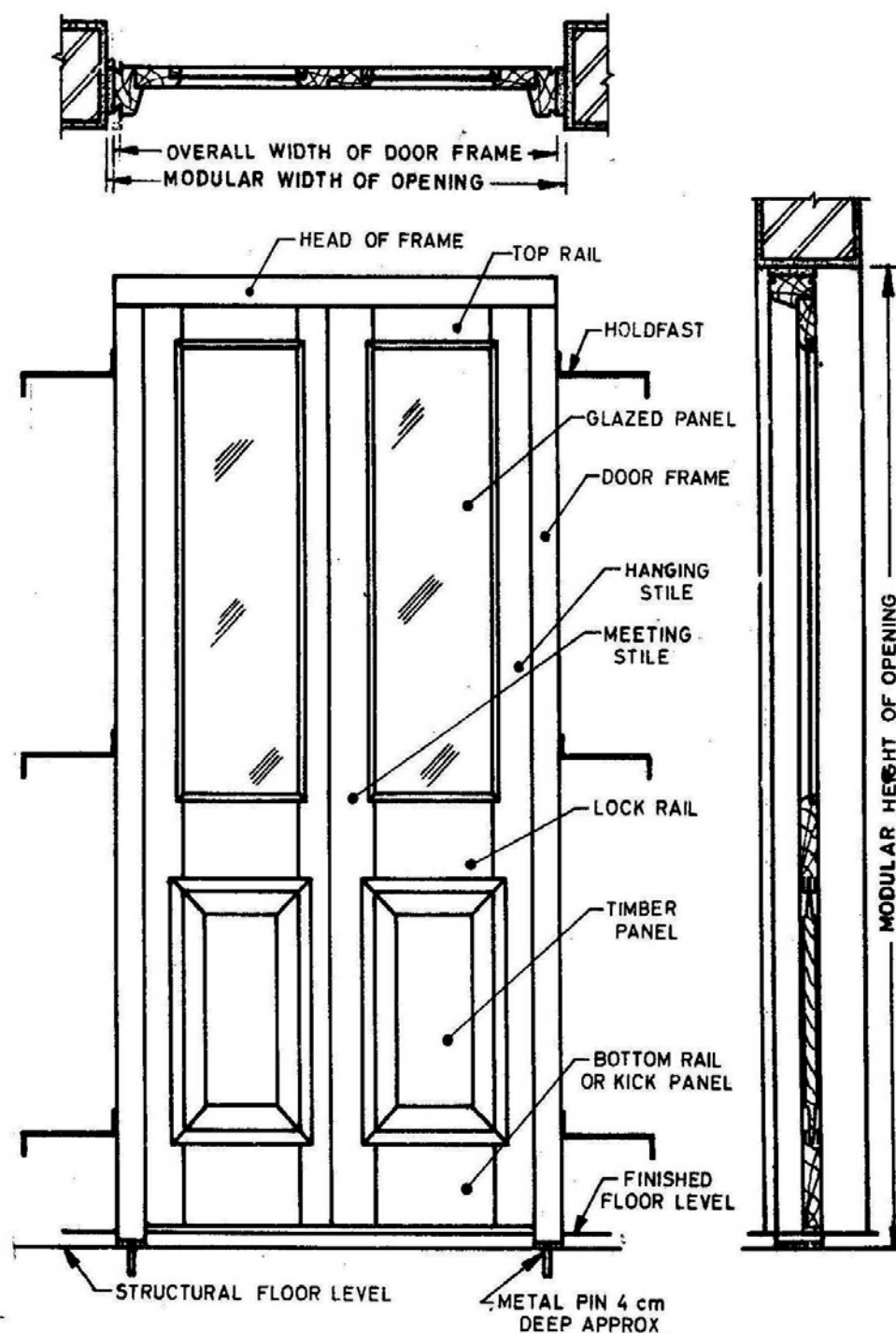


Fig. 1 Terminology for Timber door, window and ventilator components (contd)

4.1.5. **Defects permitted** - The timber shall be graded as First Grade or Second Grade on the basis of the permissible defects in timber as given in Table 1. For both the grades, knots shall not occur at joint or at locations where holdfasts/hinges are to be fixed.



1B Glazed and Panelled Door

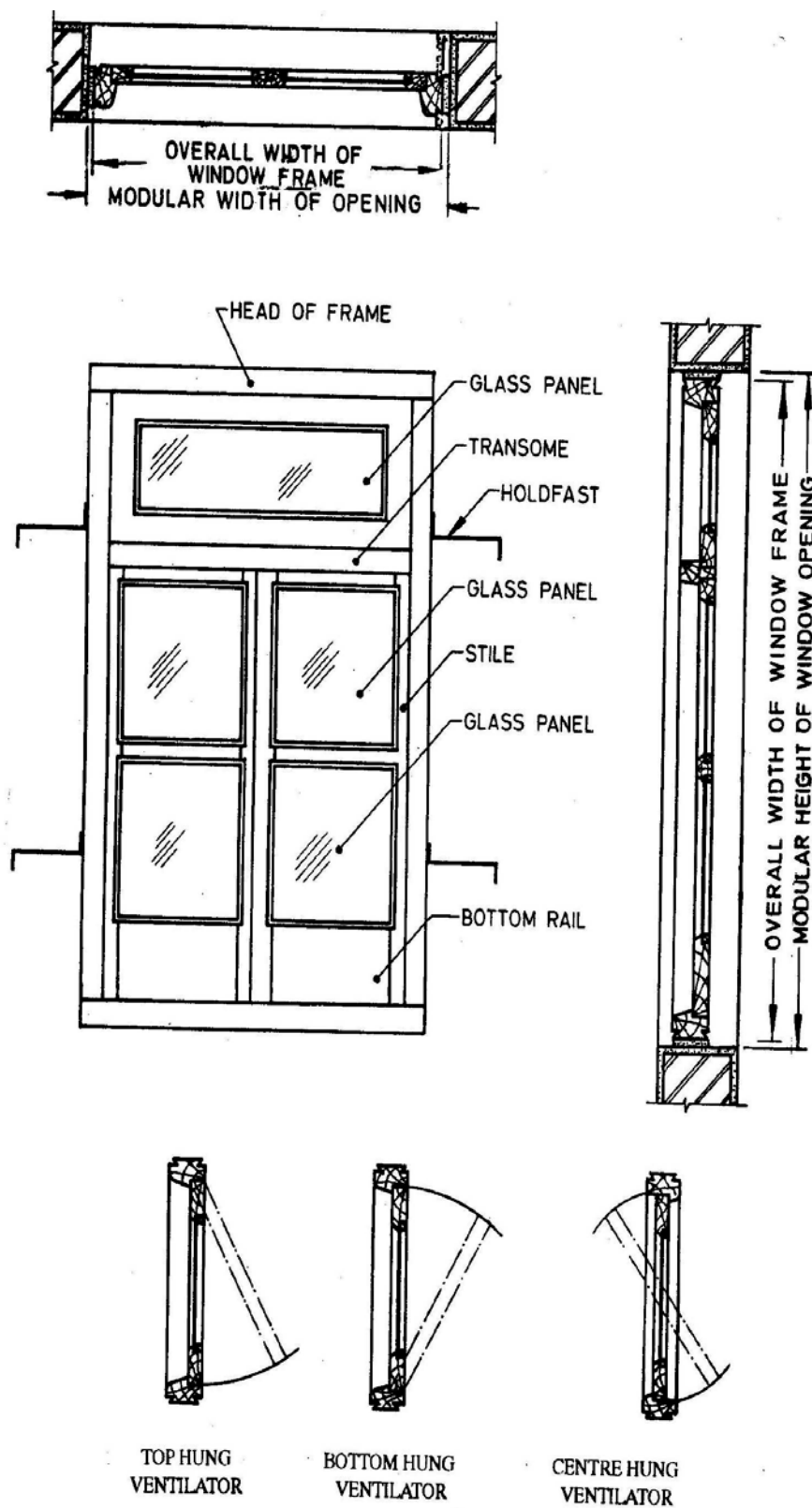
Fig. 1B – Terminology for timber door, window and ventilator components (contd)

5. Construction and workmanship

5.1. Timber shall be sawn in the direction of grain. Sawing shall be truly straight and square. The scantling shall be planed smooth and accurate to the full dimensions, rebates, etc. before assembly. The surface touching the walls may not be planed unless it is required to straighten up the member or

to obtain the overall size within the specified tolerances; Patching or plugging of any kind shall not be permitted except as provided herein.

5.1.1. All members of frame shall be exactly at right angles. The right-angles shall be checked from the inside surfaces of the respective members.

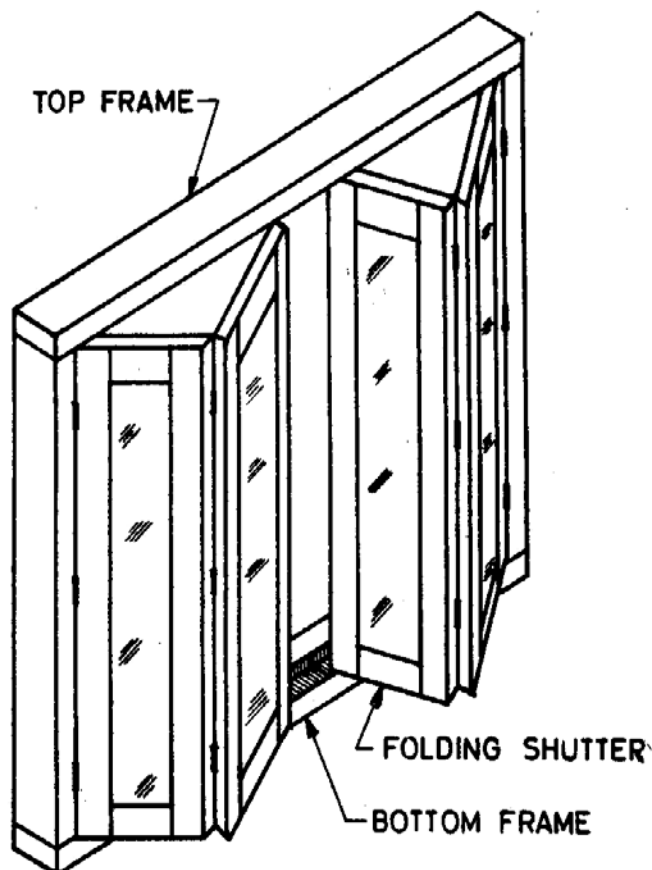


1C Window and Ventilators

Fig. 1C Terminology for timber door, window and ventilator components (contd)

5.1.2. All members of frame shall be straight without any warp or bow and shall have smooth, well-planed on three sides exposed at right angles to each other.

5.1.3. The depth of rebate in frame for housing the shutter shall in all cases be 15 mm except for small window and ventilator frames where it shall be 12mm.



1D Window with Folding Shutters

Fig. 1D- Terminology for timber door, window and ventilator components

5.2. Joinery

5.2.1. Frames of timber doors, windows and ventilators shall be assembled by any of the following simple, neat and strong joints (a) Single dovetail joint (Fig. 2), (b) Closed mortice and tenon joint (Fig.3) and (c) Haunched mortise and tenon joint (Fig.4).

5.2.1.1Divetail joint is formed at the corner of two pieces in such a way that the notch made on one is fitted exactly into projection of corresponding size and shape made in the other. This is a wedge shaped dovetail joint made in a way which will resist withdrawal except in the direction in which it was assembled (This joint is usually adopted when the frame is not built-in as the work proceeds).

Table 1 Permissible defects for various grades of timber (Clause 4.1.5 IS: 4021-(1995))

Sl. No.	Defects	First Grade	Second Grade
I	Cross grain	Not steeper than 1 in 15	Not steeper than 1 in 10
ii	Sound knots and live knots a) Size, Max	20 mm	35 mm

	b) Number per metre	1	2
lii	Decay knots, dead knots and knot holes	Not more than 10 mm size centrally located and not more than 1 knot per metre. These shall be completely put out and tightly plugged with seasoned timber of the same species and properly glued, so that its grains run in the direction of main pieces	Not more than 10 mm size centrally located and not more than 2 knot per metre. These shall be completely put out and tightly plugged with seasoned timber of the same species and properly glued, so that its grains run in the direction of main pieces
lv	Pitch pockets or streaks	None	Permissible except on exposed edges, provided they are clear and filled up with putty or filler. When these are located on exposed edges of the core, they shall be cut and plugged with similar species of timber with grains running in the same direction as that of the pieces. The pieces shall be well glued.
v	Sapwood	Total not exceeding 5 mm wide and 150 mm long per metre (This restriction applies only to group 1 timbers)	Total not exceeding 10 mm wide and 300 mm long per metre (This restriction applies only to group 1 timbers)
vi	Pin holes (other than due to live infestation).	Permitted provided they are not in clusters	Permitted
vii	Worm holes	None	Permitted provided they are not more than 10 mm in diameter and not more than one per metre and provided such worm holes are plugged with similar timber in such a manner that the plugging merge with the surrounding area both as to colour and grains.
viii	Checks, depth, Max	3 mm, provided it fully stopped	One-fourth of the total thickness of piece or 6 mm whichever is less, provided it is fully stopped.

5.2.1.2. For closed mortice and tenon joint the head is mortised to receive the tenon on the post. The mortice and tenon must be correctly proportioned. Thickness of tenon should be equal to 1/3 that of the member and width of tenon not exceeding five times the thickness. (In this case the head usually

projects from 50 to 100 mm beyond the post and these projections called 'horns' assist in making the frame secured when it is built into the wall). Mortice and tenon joint shall fit in fully and accurately preferably without wedging or filling. The joints shall be glued, framed, put together and pinned with hardwood or bamboo pins not less than 8 mm dia after frames are put together and pressed.

5.2.1.3. Haunched mortise and tenon joint is adopted when the frame is not built-in as the work proceeds. Horns are not required (These are removed after wedging has been completed) and therefore width of tenon is reduced to facilitate wedging. This haunch increases the strength of tenon at its roots and prevents twisting of post. The joint shall however be glued.

5.2.1.4. Transom shall be tennoned to the frame.

5.2.1.5. In the case of door frames without sill, the vertical members (Posts) shall be held in position at specified distances by means of spacers, which may be removed after fixing of the frame in position.

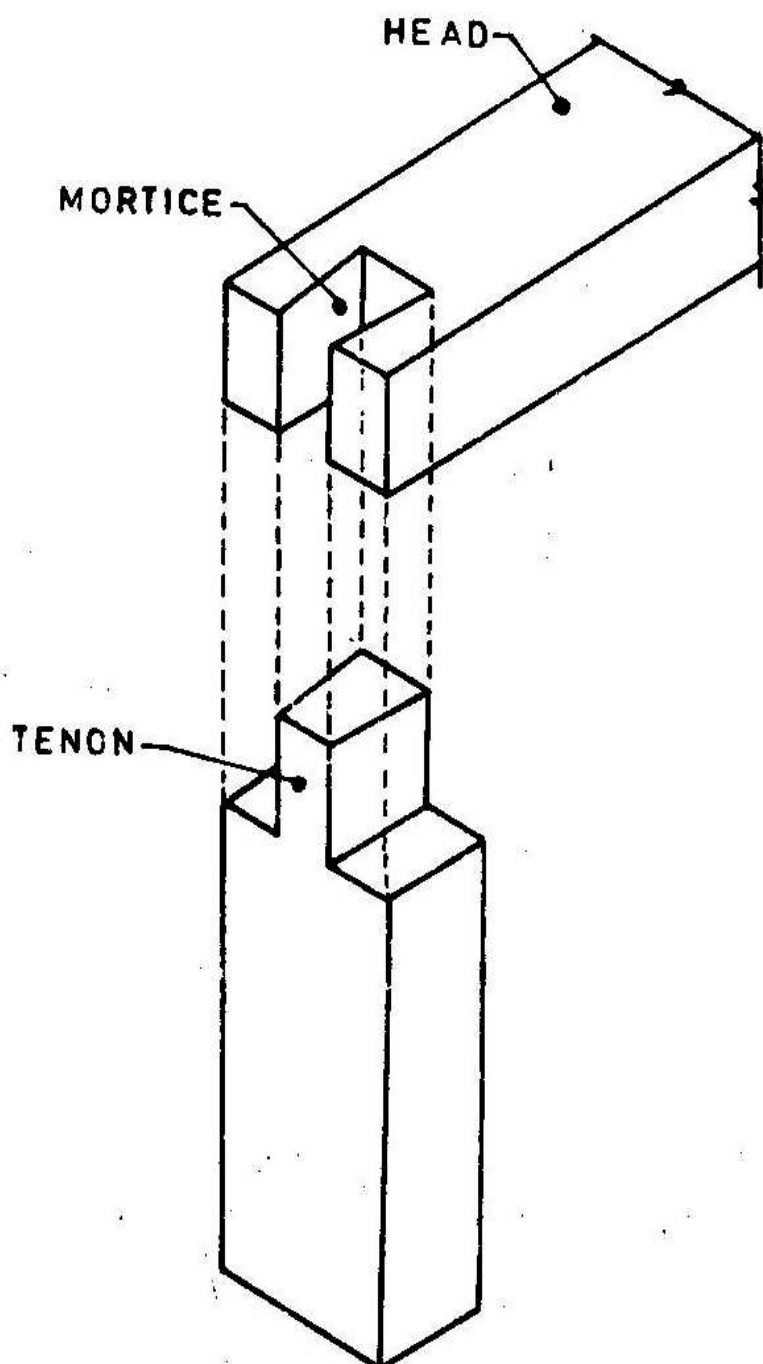


Fig. 2 Simple dove-tail joint

5.3. **Gluing of joints** - The contact faces of tenon and mortice shall be treated, before putting together, with bulk type synthetic adhesives conforming to IS: 851-1978 suitable for construction work in wood or synthetic resin adhesive (Phenolic and aminoplastic) conforming to IS: 848-1974 suitable for plywood or animal glue for general wood working purposes conforming to IS: 852-1994 or polyvinyl acetate dispersion based adhesive for wood conforming to IS: 4835-1979.

5.4. **Fixing of frame** - The frame shall be fixed either during construction of wall (built-in) or after the wall has been completed / the frame shall be placed in proper position and secured to wall or column as the case may be with metallic fastener or iron hold-fasts. In case of door frame without sill, the vertical members shall be embedded in the flooring to its full depth and preferably anchored with metal pin as shown in Fig.1. It shall be suitably strutted or wedged in order to prevent warping during construction.

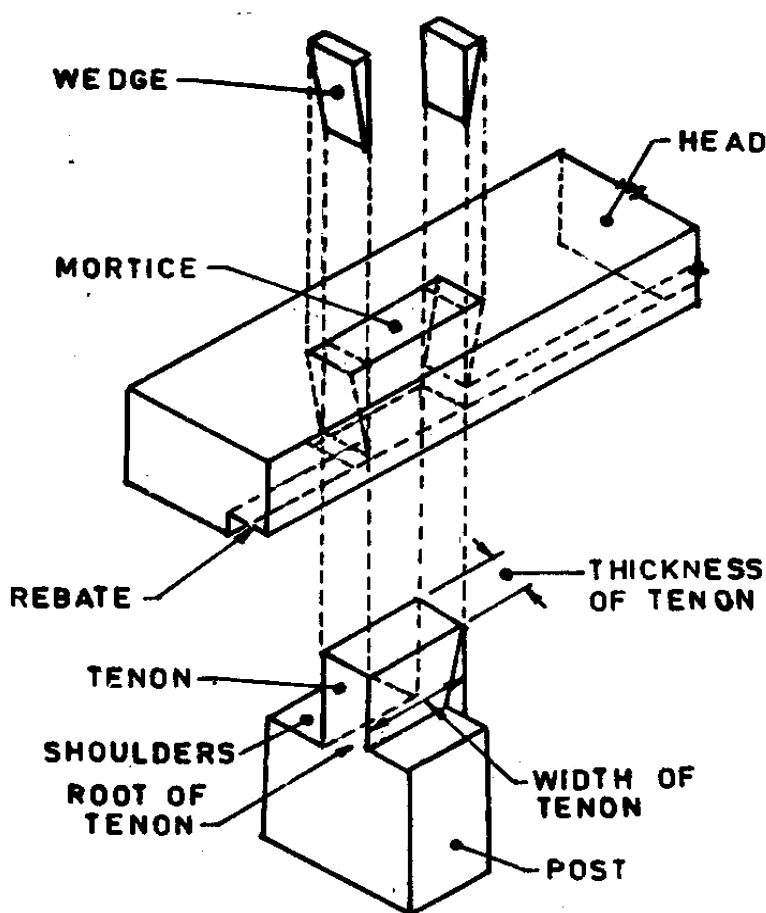


Fig. 3 Closed mortise and tenon joint

5.3.1. External wood-work shall be primed before being fixed.

6. Dimensions, sizes and tolerances

6.1 **Dimensions of frames and tolerances** - The finished dimensions of timber sections in frames for doors, windows and ventilators shall be as given in Table 2 (see Fig.5, 6, 7 and 8) subject to a general tolerance of $^{+3}_{-0}$ mm for width and $^{+2}_{-3}$ mm for thickness.

6.2. **Sizes and types** - Sizes of the door shutters shall generally conform to the modular sizes as shown in Fig.9. Sizes other than modular sizes, as agreed to between the manufacturer and the purchaser, may also be permitted.

Note: The size shown in Fig.9 is overall height and width on the outside of frames. This size is desired after allowing margin of 5 mm all round for fitting and fixing to fit up to modular openings based on 10 cm module. The sizes marked with asterisk in Fig.9 will be given preference

6.3. **Designation** - Frames of doors, windows and ventilators shall be designated by symbols denoting their width, type and height in succession in the following manner

a) **Width** – It shall be indicated by the number of modules in the width of opening.

b) **Type** – It shall be indicated by the following letters of alphabet

D -for door, W for window, V for ventilator, S for single shutter, T for double shutter

Note: Where a frame is intended to carry two sets of shutters, the frame shall be designated as DD, WW and VV.

c) **Height** – It shall be indicated by the number of modules in height of opening.

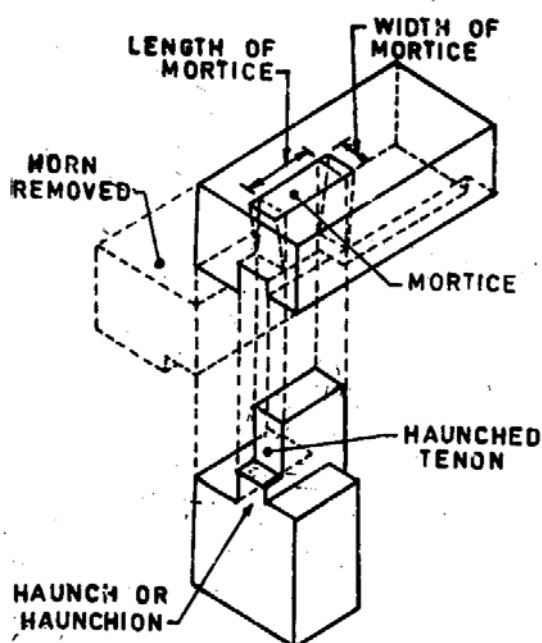


Fig. 4 Haunched mortice and tenon joint

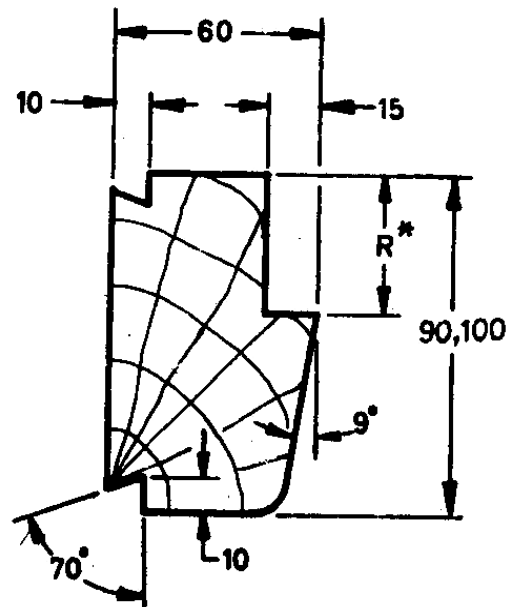


Fig. 5 Typical cross section of frame for doors and large windows carrying one set of shutters

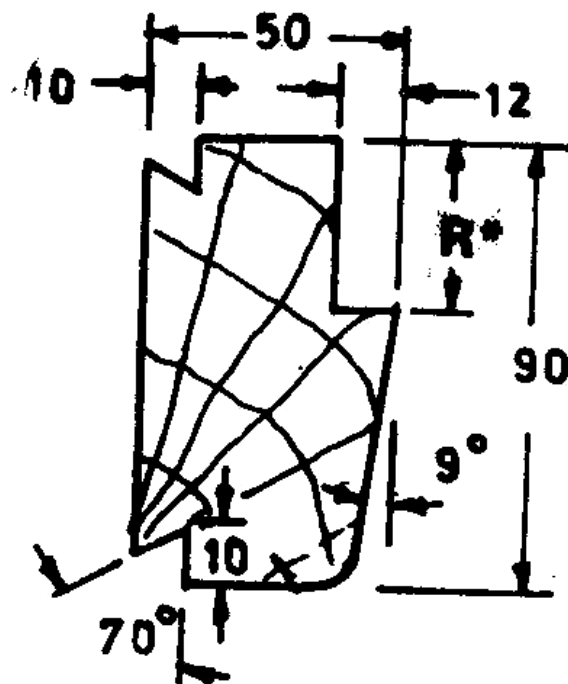


Fig. 6 Typical cross section of frame for small window and ventilator carrying one set of shutters

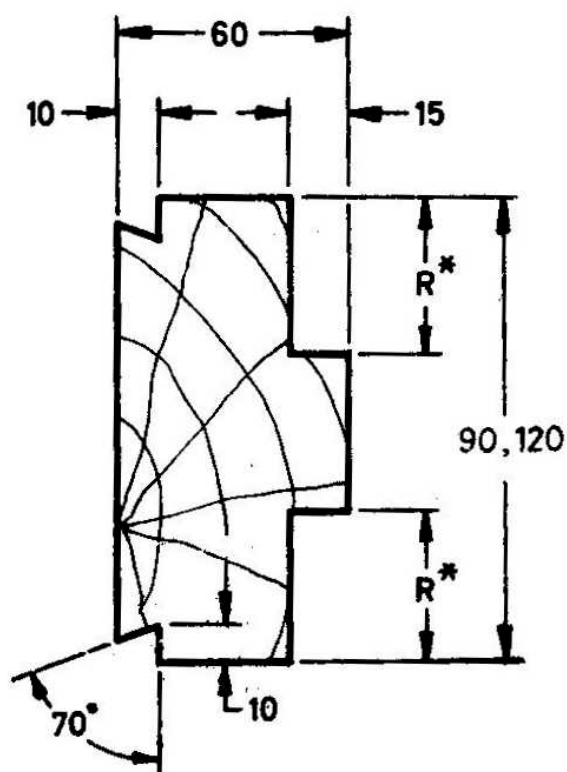


Fig. 7 Typical cross section of frame for door and large windows carrying two set of shutters

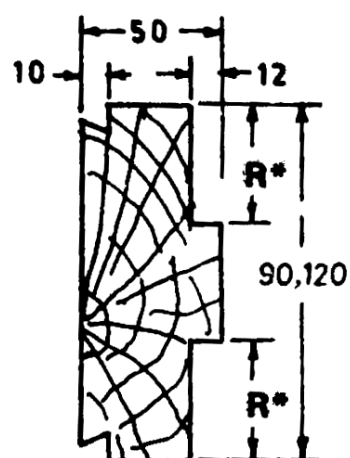


Fig. 8 Typical cross section of frame for small windows and ventilators carrying two sets of shutters

Example

'12 DT 20' would mean a frame of double shutter door width of 12 modules (119 cm) and height of 20 modules (199cm).

Table 2 Dimensions of doors, windows and ventilators (Clause 6.1)

Requirements		Dimension (mm)		
		Door	Window	
			Size > 120 cm	Size < 120 cm
A	Width of frame carrying one set of			

	shutters				
	i) for 35, 40 mm shutter	100	100	90	90
	ii) for 25.30 mm shutter	90	90	90	90
B	Width of frame carrying two sets of shutters				
	i) for 30,35 and 40 mm shutter	120	120	120	120
	ii) for 25 mm shutter	90	90	90	90
C	Thickness	60	60	50	50

6.3.1. **Combination of frames of doors, windows and ventilators** - When frames of doors and windows are combined with those of windows and ventilators, they shall be designated as illustrated below. However size of frame for such combination shall be uniform for doors, windows and ventilators, by choosing the height recommended dimension vide 6.1.

Example 1:

'6 WS 12/12 DT 20/6 WS 12' means 12 modules wide and 20 modules high double shutter door frame combined in its two sides with two windows, 6 modules wide and 12 modules high.

Example 2:

$$\begin{array}{cc} 6V6 & 6V6 \\ \hline 6WS\ 12 & 6WS\ 12 \end{array}$$

means frames of two single-windows of 6 modules wide and 12 modules high combined side by side and with two ventilators at top 6 modules wide and 6 modules high.

6. **Location of holdfasts** - A minimum of three holdfasts shall be fixed on each side of the door frame, one at the centre point and other two at 30 cm from the top and bottom of frame excepting in case of horned head when two equally spaced holdfasts shall be provided. In case of windows and Ventilators one holdfast on each side centrally placed shall be fixed up to a height of 60 cm. In case of height more than 60 cm, with or without horns two holdfasts shall be suitably fixed at each side.

8. Finish

8.1. Defective knots, when permitted on surfaces exposed to view, shall be completely bored or cut out and tightly plugged with same timber species and properly glued in. the grain of the plug shall run in the direction of the grain of the piece.

8.2. The unexposed surfaces in contact with either wall or lintel shall be properly painted with coat tar pitch (conforming to IS: 216-1961) before delivery.

8.3. All surfaces of door, window and ventilator frames which are required to be painted ultimately shall be covered evenly by brush painting with a priming coat of a wood primer as specified in IS: 3536 -1966.

8.3.1. In the case of frames to be polished or varnished, a priming coat of suitable polish or varnish shall be given before delivery.

Notes 1: Priming alone does not provide full protection against weather and, therefore, all work should receive coats of paint, polish or varnish, as the case may be, within a reasonable period. Any cut surface, particularly that exposing end grain should be primed before the joinery is set in position.

2. When aluminium primer is used, the user should assure himself that it is of a type especially prepared for this purpose. Unless suitable aluminium primers are used, it is not possible to obtain satisfactory finish.

9. **Sampling-** The method of drawing representative samples of timber door, window and ventilator frames and the criteria for conformity shall be as given in Annex C.

10. **Marking** - All door, window and ventilator frames shall be hammer-marked on the exposed surface with the following information

(a) Name of the manufacturer or trade-mark, if any; (b) Whether the size of the frame is 'Modular; or 'Non-modular'; and (c) Designation (showing width and height in modules) with Types as specified in

Fig. 9; or the actual size (width and height in case of non-modular sizes) along with appropriate symbols for type of frame as given in 6.3 (b) and Fig.9.

10.1. BIS certification marking - The frame may also be marked with Standard Mark.

10.1.1. The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11. Information to be supplied by the purchaser - The purchaser shall supply the following information at the time of placing the order

- a) The size and the type of frames with particulars regarding the way the door-shutter is required to open (inward or outward). The thickness of the shutter and whether to be used on exterior or interior door shall also be indicated.
- b) In frames without sills, whether pins are required to be provided.
- c) The group and grade of timber to be used.
- d) Whether the door is to be polished or painted.
- e) If there is a ventilator on the top it may be stated whether it is top hung, bottom hung or centre hung so that the rebate in the frame is cut accordingly.

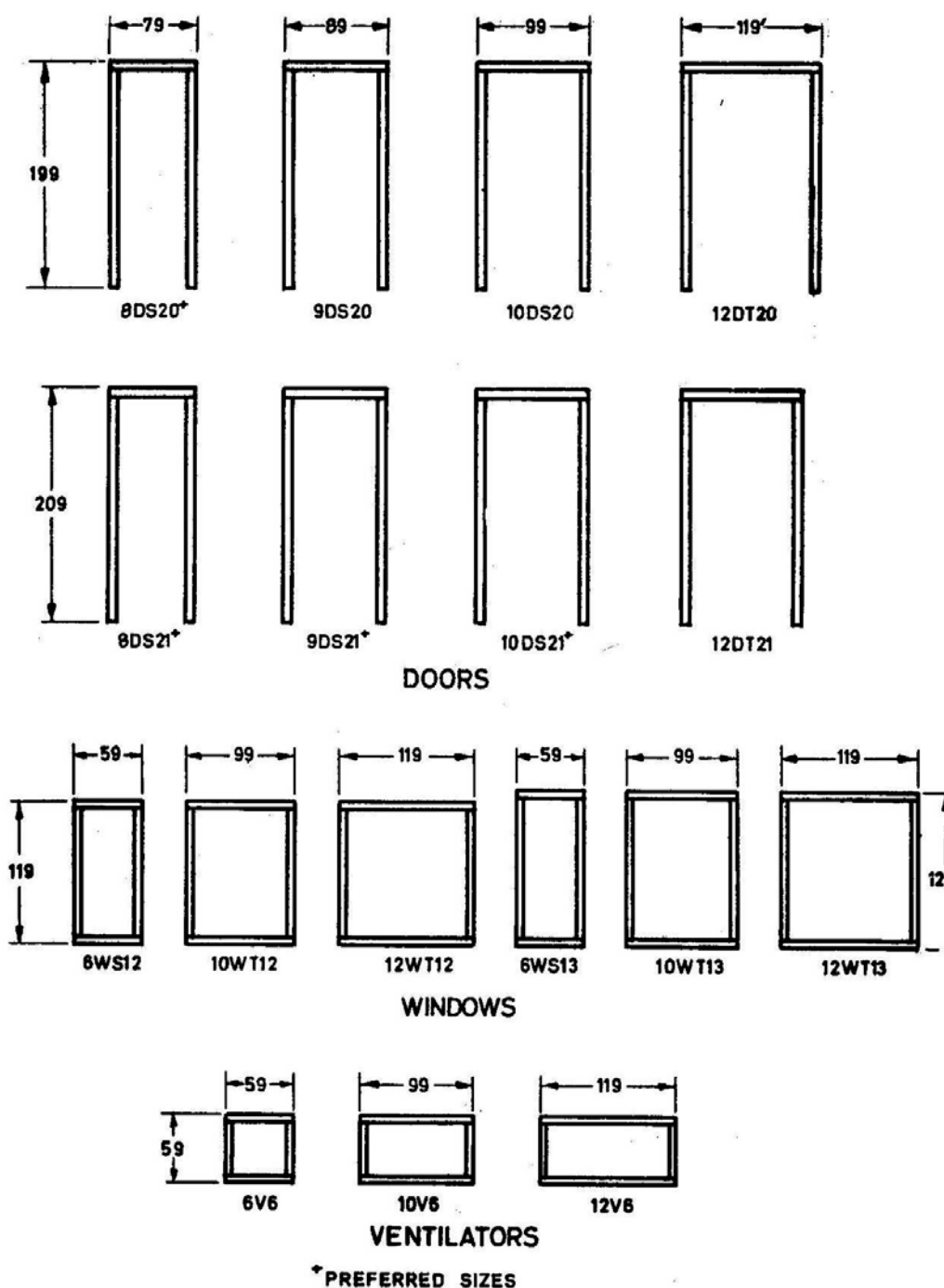


Fig. 9 Type and size of frame of timber doors, windows and ventilators

Annexure 9-A.8 (contd)

SPECIFICATIONS FOR TIMBER DOORS, WINDOWS AND FRAMES

[Extract of IS: 4021-1995 (Annexure-B)]

List of species of timber being imported for frames of doors and windows considered suitable from the foreign literature available (Clause 4.1.1)

Sl.No	Trade name	Botanical name	Country from where imported
I.	Abura	Mitragyna Stipulosa	Africa (A)
II.	Afrormosia*	Afrormosia angolensis	A

III.	Alan Balu	Shorea albida	Malaysia (M)
IV.	Dark red Meranti	Shorea spp.	M
V.	Iroko*	Chlorophora excelsa	A
VI.	Keruing	Diaterocarpus spp.	M
VII.	Kwila*	Instia bijuga	PNG
VIII.	Merawan*	Hopea spp.	M
IX.	Merbau*	Intsia palembanica	M
X.	Nyatoh*	Ganua spp. Palaquium spp. And Payuena spp.	M
XI.	Terminalia red Brown group*	Terminali spp.	PNG
XII.	Utile*	Entandophragma utile	A
XIII.	Vitex*	Vitex cofassus	PNG

Note : Above imported species shall be used for frames only after proper treatment as prescribed in IS : 401 1982 and concerned clauses of this standard, as suitable and sufficient information regarding their durability is not available and whatever is available may not fully hold good in India conditions. However, heartwood of species marked ‘*’ does not require treatment as the same is reported to be very durable. Further, where sufficient retention/absorption/penetration of preservative is not obtained as per IS: 401-1982 due to poor treatability character of the species, the frame shall be treated with PCP solvent system after construction to ensure minimum penetration of preservative to the depth of 2 mm in the finished product by soaking in 5% PCP solution for 24 h or pressure treatment. Such species which are refractory to treatment are marked ‘*’.

Annexure 9-A.8 (contd)

SPECIFICATIONS FOR DOORS, WINDOWS AND FRAMES

[Extract of IS: 4021-1995 (Annexure-C)]

Sampling of timber door, window and ventilator frames (Clause 9)

C-1. Lot

C-1.1. In any consignment all the frames of the same type, size and manufactured from the same species of wood under similar conditions of production shall be grouped together to constitute a lot.

C-1.1.1. Samples shall be selected and tested from each lot separately to determine its conformity or otherwise to the requirements of this standard.

C-2. Sampling

C-2.1. The number of frames to be selected at random from a lot for inspection shall depend upon the size of the lot (the number of frames in the lot) and shall be in accordance with col 1 and 2 of Table 3.

C-2.2. The samples from the lot shall be selected at random and to ensure the randomness of selection, procedures given in IS: 4905 -1968 may be followed.

C-2.3. All the frames selected in the sample shall be inspected for material (see 4), dimensions and tolerances (see 6) and workmanship and finish (see 5 and 8).

Table 3 Sample Size and Permissible Number of Defectives (Clause C-2.1)

Lot size	Sample size	Permissible number of defectives
Upto 50	8	0
51 to 100	13	1
101 to 150	20	2
151 to 300	32	3
301 to 500	50	5
501 and above	80	7

C-3. Criteria for conformity

C-3.1. A frame which is found not meeting any one or more of the requirements inspected as in C-2.3 shall be considered as defective.

C-3.2. A lot shall be considered as conforming to the requirements of this standard in case the number of defective frames found in the sample does not exceed the permissible number of defectives given in col 3 of Table 3.

Annexure 9 -A.9.

SPECIFICATIONS FOR STRUCTURAL PLYWOOD

(Extract of IS: 10701-1983)

0.1. Structural plywood is specialty plywood different from other grades and types of plywood's as covered by other Indian Standards. In this plywood, apart from these of high grade BWR and BWP adhesives, special emphasis is made on the species of timber to be used, the veneer quality and most importantly on the construction details to be observed in the manufacture. With proper specifications and guidelines, this structural grade plywood can be mass-produced under the routine production schedule. Engineers, architects and other consumers will then have a material which is readily available off the shelf and whose structural behavior and other engineering characteristics are well established so that they can confidently use it.

0.2. This standard covers the general properties of structural plywood, its constructional details for strength and dimensional stability. It also covers testing and quality control procedures. However, the values given in this standard for strength characteristics represent only basic strength data, arrived at after following extensive statistically designed test procedures. The basic design values to be used in structural applications of this plywood have to be evolved separately from the basic strength values depending upon the type and nature of application at hand.

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

0.4. 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

- Rules for rounding off numerical values (revised).
- Glossary of terms applicable to timber technology and utilization (Second revision).

† Specification for plywood for general purposes (second revision).

‡ Specification for synthetic resin adhesives for plywood (Phenolic and aminoplastic) (first revision)

1. Scope

1.1. This standard covers the requirements of plywood for structural purposes, such as stressed skin panels, plywood web beams, and sheathing, silos, rail and ship containers.

2. Terminology

For the purpose of this standard, definitions given in IS 707-1976* and IS 303-1975= shall apply.

3. Material

3.1. **Timber** – The species of timber recommended for use for the manufacture of plywood for structural purposes shall be from the species mentioned in Appendix A and have been chosen keeping in view the strength, availability and other characteristics.

3.2. Adhesive

1.1.1 Adhesives used for bonding the veneers of structural plywood shall be of the hot press unextended synthetic resin, phenol-formaldehyde type and shall conform to BWP type specified in IS: 848-1974‡.

4. Plywood

4.1. Plywood for structural purposes shall conform to BMP grade in accordance with IS: 303-1975§.

5. Treatment

1.1. Structural plywood panels shall be given preservative treatment with fixed type of preservatives as specified in IS: 5539-1969.

1.2. The preservative treatment might cause some problems in the subsequent gluing of the plywood panels to other structural members and hence the glue compatible with the preservative shall be chosen for gluing structural plywood to any other member.

6. Manufacture

6.1. Veneers for the manufacture of plywood for structural purposes shall be rotary cut or sliced. However, sliced veneers may be used after splicing. The veneers shall be dried to a moisture content not exceeding 6 percent and shall be smooth to permit even spread of glue. The glued veneers shall be assembled with the grain direction in alternate layers at right angles to each other and hot pressed under controlled conditions of temperature, pressure and pressing time. The two face veneers shall run in the same direction and the assembly shall be balanced around the central line of the plywood cross-section.

6.1.1. The thickness of all individual veneers shall be uniform within a tolerance of ± 5 percent. The veneer shall be straight grained within a tolerance of $\pm 10^\circ$.

6.1.2. Core gaps, overlaps and warp shall not be permitted.

6.1.3. The quality requirements on veneers used in the manufacture of structural plywood shall be as specified in Table 1.

6.2. Construction details

6.2.1. Structural plywood should be constructed symmetrically. The possible combinations for using the two groups of species given in Appendix A for obtaining balanced constructions are given in Appendix B. Examples of possible constructions for different thickness of structural plywood panels using veneers of different thickness are given in Appendix C.

6.2.2. When the panels of a size larger than the available press size are required, they may be made by scarf jointing the finished panels. Annexure A, B & C may be referred to, wherever necessary from IS: 10701-1983.

6.2.3. All scarf joints shall be bonded with adhesive conforming to IS: 848-1974* having similar properties to that used for bonding the plywood. Scarf joints shall be made with an inclination not greater than 1 to 10.

6.3. After pressing, the finished plywood shall be reconditioned to a moisture content of not less than 5 percent and not more than 15 percent.

7. Dimensions and tolerances

7.1. The dimensions of structural plywood panels shall be as given in 7.2 to 7.3.

7.2. Size

7.2.1. Unless otherwise specified, structural plywood panels shall be of the sizes given below

240 x 120 cm	210 x 120 cm	180 x 120 cm
240 x 90 cm	210 x 90 cm	180 x 90 cm

Table 1 Quality requirements on veneers used in manufacture of plywood for structural purposes (Clause 6.1.3)

Sl.No.	Defect	Requirement	
		Face	Core
i)	Blister	Nil	Nil
ii)	Checks	Nil	No restriction
iii)	Discolouration	3 percent of the area if it will not impair to the board properties.	6 percent of the area if it will not impair the board properties.

iv)	Date	Nil	5 cm/m ²
v)	Insect holes	Nil	No restriction

Vi)	Knots (dead)	Nil	2 upto 12 mm dia/m ²
	Pin knots (dead)	Nil	2/m ²
	Pin knots (live)	Permitted provided they do not mar the appearance	No restriction
	Knots (light)	3 upto 25 mm dia/m ²	6 upto 25 dia/m ²
Vii)	Split on each panel	One split not more than 0.8 mm dia and length 50 mm provided it is filled with suitable filler.	2 splits not more than 6 mm wide and length 200 mm provided it is filled with suitable filler.
Viii)	Swirl	Upto 4/m ² provided they do not mar the appearance	No restriction

1.3. Thickness

1.3.1. Unless otherwise specified, the thickness of plywood panels shall be given below

No of Plies	Thickness mm
3	4
5	6 9
7	12 16
9	16 19
11	19 25

1.4. Tolerances

1.4.1. The tolerances on the nominal sizes of finished panels shall be as given below

Length	+6 mm -0 mm
Width	+3 mm -0 mm
Thickness upto and Excluding 6 mm	_ ⁺ 10 percent
6 to 9 mm	_ ⁺ 7 percent
Above 9 mm	_ ⁺ 5 percent

Annexure 9-A.10

SPECIFICATIONS FOR COMMERCIAL VENEERS

(Extract of IS: 14315-1995)

- 1. Scope** - The section covers the requirements for commercial veneers used for faces, core and cross bands in the manufacture of plywood, blockboard, veneered boards and flush door.
- 2. References** - The Indian Standards listed in Annexure 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. Classification by appearance** - Veneers shall be classified into two types of surfaces namely; type A and Type B. the quality requirements in terms of permissible defects for the two types of surface shall be as given in Table 1. However, the maximum number of categories of defects permitted on the veneer surface shall be restricted in accordance with the requirement given in Table 2.

Table 1 Quality requirements of veneers (Clause 4, 6 and 7 of IS: 14315-1995)

Sl. No	Defects categories	Types of surfaces	
		A	B
i)	Discolouration	Nil	5 percent
ii)	Dote	50 mm/m ²	150 mm/m ²
iii)	Insect holes	Scattered up to 12 holes/m ²	Scattered up to 12 holes/m ²
iv)	Joints	One joint for every multiple of 200 mm provided no individual piece is less than 100 mm in width	No restriction
v)	Knots(dead)	2 No. up to 12 mm dia/m ²	4 No. up to 20 mm dia/m ²
vi)	Pin knots (dead)	2 no/m ²	6 No./m ²
vii)	Pin knots(live)	No restriction	No restriction
viii)	Knots(tight)	6 No. up to 25 mm dia/m ²	No restriction
ix)	Patches	4 patches/m ² provided they are all tight patches and do not mar the appearance	Any number provided they are all tight patches and do not mar the appearance
x)	Splits	2 splits each not more than 1 mm wide and length not more than 100 mm	3 splits, each not more than 4 mm wide and length not more than 150 mm
xi)	Swirl	Unlimited, provided they do not mar the appearance	No restriction

Table 2 Permissible categories of defects (Clause 4, 6 and 7)

Types of surfaces	Maximum number of categories of permissible defects per square meter
A	3
B	5

5. Manufacture

5.1. The veneers shall be either rotary cut or sliced. The veneer shall be tight, smooth and uniformly thick and free from other machining defects such as corrugation, wood lines, waviness, bulging of knots, buckle, knife-pressure bar marks, raised or torn grain, etc. One of the most important quality requirements of veneer is tightness. The veneer is called tight or loose on the basis of depth of penetration of checks which are small breaks known as lathe or slicer or knife checks formed on the knife side during cutting of veneer. Figure 1 shows the tight and loose side of veneer during peeling. The veneer is classified as tight if the depth of penetration of checks does not exceed 50 percent of veneer thickness when measured as per the procedure given in Annex B. Treatment as specified in 5.2 shall be given wherever necessary. Surface smoothness of veneer is directly related to tightness. As the tightness increases, smoothness of the veneer increases. The uniformity in thickness along and across the grain shall be checked with the help of dial thickness gauge, which is suitably spring loaded and suitable for this purpose. Veneers intended to be glued with phenolic and urea resins shall dried to a moisture content of 4 percent to 6 percent and 6 percent to 8 percent respectively. The dried veneer should be free from drying defects such as buckle, end waviness, splits, checks and case hardening.

5.2. **Treatment** - Veneers from non-durable species and sapwood of all species *see also IS: 401 - 1982) shall be soaked in 1.25 percent solution of boric acid or 1.9 percent solution of borax at a temperature of 85°C to 90° C for a period of 10 to 40 minutes depending upon the thickness of the veneers or the veneers shall be dipped in 2 percent solution of boric acid or 3 percent borax solution for 2 minutes and block stacked at least for two hours before drying.

6. **Face veneer** - Face veneer shall be of Type A and / or Type B conforming to the requirements specified in Table 2.

7. **Core and cross band veneer** - Core and cross band veneer shall be of Type B conforming to the requirements specified in Table 1 and Table 2.

8. **Joints in veneers** - Veneers that require jointing to form Type A or Type B surface shall be spliced (edge joint). Alternatively, the veneers may be taped on the face of the outer veneers in which case the tape shall be removed at a later stage. Metal clips or staples, if used shall be removed. Perforated taped may be used on the glue side of the veneers.

9. Dimensions and tolerances

9.1. Unless otherwise specified, the first dimension is the dimension along the grain direction of the veneer and the second dimension is the dimension across the grain direction of the veneer.

9.2. Unless otherwise specified, the dimensions of veneers shall be as obtained by adding 50 mm (for trimming) to the dimensions for general purpose plywood given in IS: 12049-1987.

9.3. Maximum thickness of veneer shall be 6 mm.

9.4. Tolerances

9.4.1. The following tolerances shall be permissible on the dimensions

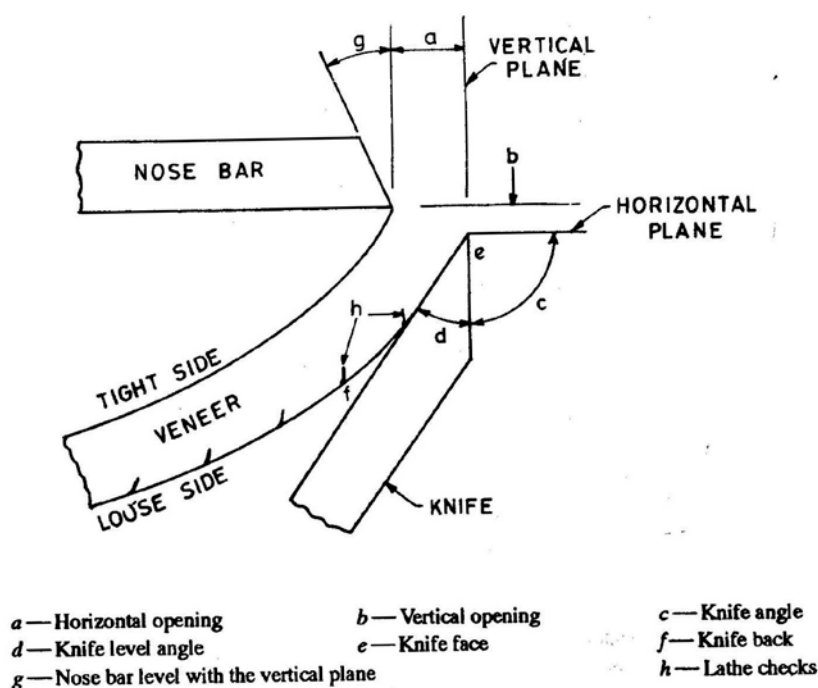


Fig. 1 Relative positions of knife, nose bar and veneer

Dimension	Tolerance
Length	+ 6 mm 0 mm
Width	+ 3 mm 0 mm

9.4.2. **Squareness** - 0.2 percent

9.4.3. **Edge straightness** - 0.2 percent

10. **Sampling** - The method of drawing representative samples and criteria for conformity shall be as prescribed in IS: 7638-1986 for general purpose plywood (IS: 303-1989).

11. Marking

11.1. Each veneer shall be legibly and indelibly marked or stamped with the following

(a) Indication of the source of manufacture; (b) Year of manufacture; (c) Batch No; and (d) Type of the veneer, that is, Type A or Type B.

11.2. All markings shall be done on the face of the veneer near one corner.

11.3. **BIS certification marking** - The product may also be marked with the Standard Mark.

11.3.1. The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the bureau of Indian Standards.

12. **Method of Evaluation of Lathe Checks.** (Clause 5.1) [Extract of IS: 14315-1995]

Apply an alcohol-soluble dye to the checks by brushing it on the loose side of dry veneer surface. The dye penetrates into the checks. The depth of checks as a percentage of veneer thickness can be estimated from scarfed sections of the samples, using a magnifying glass as shown in the Fig.2.

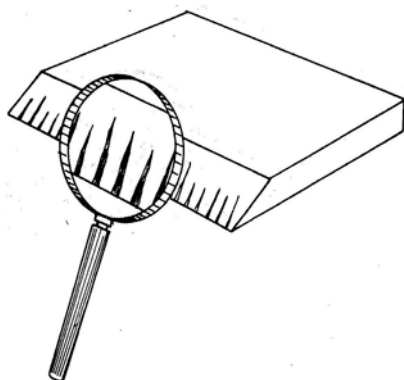


Fig. 2 Scarred sample of veneer viewed through magnifying glass to show lathe checks on which dye was applied prior to scarfing to make the checks stand out

Annexure 9-A-11

BLOCK BOARDS

(Extract of IS: 1659-1979)

1. **Scope** – Requirements of commercial and decorative block boards meant for interior and exterior uses.

2. **Grades and types**

2.1. **Grades**

(a) **Grade 1** – Exterior grade meant for bus bodies, railways coaches, prefabricated houses, where it is likely to be exposed to rain, high humidity, etc.

(b) **Grade 2** – Interior grade meant for furniture, partition, paneling, ceiling, etc.

2.2. **Types** – Each grade shall be of the following types

(a) **Type 1** – Decorative type with faces of ornamental veneers on one or both faces for use in high class furniture, paneling, interior decoration, partitions, etc.

(b) **Type 2** – Commercial type with faces of commercial timber for use for ordinary furniture, table tops, partitions and paneling, seats of bus bodies, railway carriages, etc.

2.3. **Representation by symbols**

Grade and Type	Symbol
Grade 1, Type 1	XDEC
Grade 1, Type 2	XCOM
Grade 2, Type 1	IDFC
Grade 2, Type 2	ICOM

3. **Materials**

1.1. **Adhesive** – BWP Type for grade 1 and BWR or WWR Type for Grade 2.

Note : For details regarding timber for core, cross bands and face veneers of commercial types, refer to Appendix A and B of the standard.

4. Dimensions and tolerances

Dimensions

(a) Length – 300, 270, 240, 210, 180, 150 and 120 cm;

(b) Width – 150, 120 and 90 cm; and

(c) Thickness – 12, 16, 20, 25, 30, 32, 35, 38, 40, 45 and 50 mm.

Tolerances

(a) Length ± 6 mm (b) Width ± 6 mm (c) Thickness ± 5 percent up to 35 mm thickness ± 2.5 percent above 25 mm thickness.

Note: Length of diagonals shall not differ by more than 2.5 mm per meter length of diagonal

5. Tests

5.1. **Dimensional changes caused by humidity** – Dimensions shall not change by more than ± 1 mm at relative humidity of 90 percent and 40 percent compared to the dimensions of the block board conditioned at 65 percent relative humidity. There shall be no delamination and the changes in local planeness shall not be more than 1/150.

5.2. **Resistance to water** – Shall satisfy the prescribed test.

5.3. **Adhesion of plies** – Veneers shall offer resistance to separation and the fractured surface shall show some adherent fibre distributed more or less uniformly.

5.4. **Mycological test** – Shall show no appreciable signs of separation at the edges.

5.5. If required by the purchaser, additional tests, namely, central loading of plate test, flexural strength and deflection under sustained load test may be performed.

Annexure 9-A-12

PLYWOOD FOR GENERAL PURPOSES

(Second revision) (With Amendments No. 1 to 3)

(Extract of IS: 303-1975)

1. **Scope** – Requirements of different grades and types of plywood used for general purposes.

2. **Grades** (Depending on type of adhesive used for bonding veneers)

AC, AD, BB, BC, BD, CC, CD, and DD based on quality of face and back surface in terms or permissible defects. For quality requirements see Table 1.

a) Boiling water proof or BWP Grade	}	Species of timber used shall be those given in Class I of Appendix A of the standard.
b) Boiling water resistant or BWR grade		
c) Warm water resistance or WWR Grade	}	Species of timber used shall be those given in Class I and II of Appendix A of the standard.
d) Cold water resistance or CWR Grade		

Types based on classification by appearance – Classified into 10 types, namely, AA AB, B 3, 6, 9 and 'no limit' for surface types A, B, C, D respectively.

Table 1 Quality requirements of plywood for general purposes

Sl. No	Defect	Types of surfaces			
		A (3)	B (4)	C (5)	D (6)
i)	Blister	Nil	Nil	Nil	Occasional
ii)	Checks	Individual check not more than 25 mm in length, and the total length not more than 3000/m ²	Individual check not more than 50 mm in length, and the total length not more than 600 mm/m ²	Individual check not more than 100 mm in length, and the total length not more than 1000 mm/m ²	Individual check not more than 125 mm in length, and the total length not

					more than 1200 mm/m ²
lii)	Discoloration (sound not injurious)	3 percent of the area	25 percent of the area	50 percent of the area	75 percent of the area
lv)	Discoloration (unsound)	Nil	Nil	Nil	20 percent of the area.
v)	Dote	Nil	5 cm/m ²	15 cm/m ²	15 cm/m ²
Vi)	Insect Hole	Nil	Scattered upto 12 holes per m ²	Scattered upto 24 holes per m ²	Scattered upto 50 holes per m ² may be permitted.
Vii)	Joints	None in 250 mm wide face and in wider faces, one joint for every multiple of 200 mm in width provided no individual piece is less than 125 mm in width	Not more than one in 250 mm wide face and in wider faces one joint for every multiple of 200 mm provided no individual piece is less than 100 mm in width	No restriction	No restriction
Viii)	Knots (dead)	Nil	2 up to 12 mm dia/m ²	4 up to 20 mm dia/m ²	8 knots up to 20 mm in dia/m ² including drop out knot holes may be permitted
Ix)	Pin knots (dead)	Nil	2/m ²	6/m ²	10/m ²
x)	Pin knots (dead)	Permitted, provided they do not mar the appearance	No restriction	No restriction	No restriction
Xi)	Knots (tight)	3 up to 25 mm dia/m ²	6 up to 25 mm dia/m ²	No restriction	No restriction
Xii)	Patches	Nil	4 patches per m ² provided they are all tight patches and do not mar the appearance	Any number, provided they are all tight patches and are matched for colour	Any number, provided they are all tight patches and properly made
Xiii)	Splits	One split, not more than 1.0 mm wide and not longer than 50 mm provided it is filled with a suitable filler	2 splits, not more than 6 mm wide and total length not more than 200 mm provided they are filled with suitable veneer inserts	3 splits, not more than 10 mm wide and total length not more than 300 mm provided they are filled with suitable veneer inserts. Splits up to 25 mm long and 0,8 mm wide may be ignored provided they are suitably filled	6 splits, not more than 25 mm wide and total length not exceeding 400 mm
Xiv)	Swirl	Up to 4/m ² provided they do not mar the appearance	Unlimited, provided they do not mar the appearance	No restriction	No restriction

3. Dimensions and tolerances

a)	Size (in cm)	300 x 150	180 x 90
		240 x 120	150 x 120
		240 x 90	150 x 90
		210 x 120	120 x 120
		210 x 90	90 x 90
		180 x 120	
b)	Thickness (in mm)		
		Board	Thickness
		3-ply	3,4,5,6
		5-ply	5,6,8,9
		7-ply	9,12,15,16
		9-ply	12,15,16,19
		11-ply	19,22,25
c)	Tolerance		
	Length 120 cm & below	+ 3 mm and - 0 mm	
	Above 120 cm	+ 6 mm and - 0 mm	
	Width 90 cm & below	+ 3 mm and - 0 mm	
	Above 90 cm	+ 6 mm - 0 mm	
	Thickness upto 5 mm	± 10 percent	
	6 to 9 mm	± 7 percent	
	Above 9 mm	± 5 percent	

4. **Finish** – Edge of the boards shall be trimmed square within 3 mm and sanded to a smooth finish.

5. Tests

5.1. **Glue adhesion** – Shall have the following minimum shear strength (kg)

Sl No.	Grade	Dry state	Mycological	Resistance to moisture
i)	BWP Average	135	100	100
	Individual	110	80	80
ii)	BWR Average	135	100	100
	Individual	110	80	80
iii)	WWR Average	100	80	80
	Individual	80	65	65
iv)	CWR Average	70	35	35
	Individual	55	30	30

5.2. **Moisture content** – Not less than 5 percent and not more than 15 percent.

Annexure 9-A-13

VENEERED DECORATIVE PLYWOOD
(Extract of IS: 1328-1982)

2. **Scope** - Requirements of types of plywood with ornamental veneers on one or both faces used for decorative purposes, such as furniture making, paneling of all kinds, including paneling for railway coaches, buses and ships.

3. **Types** – Shall be two types, namely, Type 1 and Type 2.

Type 1 – Open splits, checks or open joints up to 150 x 0.5 mm permissible, provided these are rectified with a veneer insert bonded with synthetic resin adhesive. Shall be free from torn grain, dead knots, dot, discolouration and sapwood. Veneers shall be matched or mismatched to achieve decorative effect.

Type 2 – Same as Type 1 except that the rectified open splits, checks or open joints may be up to 200 x 1 mm. Tight knots and patches not more than 25 mm in diameter, and pin knots not more than 4 mm in diameter shall be permissible. Sapwood would be permissible, if it does not affect appearance.

4. **Material** – Species of timber for decorative face shall be specified by the purchaser. Timber for cores and bricks shall be either of Class I or II specified in IS: 303-1985*. Adhesive shall be BWR or WWR synthetic resin. Decorative veneer shall be rotary cut or sliced not more than 1 mm thick.

- Specification for plywood for general purposes (second revision)

Note: For species of timber commonly used for decorative veneers or decorative plywood, see Table 1 of the standard.

4. Tolerances

Length		
	Upto 120 mm	± 3 mm
	Above 120 mm	± 6 mm
Width		
	Upto 90 mm	± 3 mm
	Above 90mm	± 6 mm
Thickness		
	+ 10 percent of nominal thickness	
	- 5 percent of nominal thickness	

5. Tests

- Moisture content** – Not less than 5 percent and not more than 15 percent.
- Water resistance test** – Shall not show delamination or blister formation after the specified test.
- Test for adhesion of plies** – shall show a minimum of 'pass' standard.

Note: For methods of tests see 9.1.2.1 of the standard.

6. **Finish** - Edges of decorative plywood shall be trimmed square within 3 mm and sanded to a smooth finish.

Annexure 9-A.14

SPECIFICATIONS FOR VENETIAN BLINDS FOR WINDOWS

(Extract of IS: 1826-1961)

0.1. Protecting against excessive daylight and glare inside buildings without restricting ventilation is one of the problems confronting an architect. While a certain minimum area of window space is necessary from the point of view of adequate natural ventilation during daytime, the required window space creates often excessive glare and discomfort in the room. Window blinds, curtains, coloured glass and similar devices have been adopted to reduce the glare and cut down excessive daylight.

0.2. This section deals with window blinds of the Venetian type made of either wood or metal slats.

0.3. The components that go with a Venetian blind are of various materials and serve different purposes. In addition to the description of these components, illustrative sketches are also given in

this standard. It is, therefore, to be appreciated that for the same purpose, any other shape or design of the component is permissible and the sketches as now included are only illustrative.

0.4. The preparation of this standard has taken into consideration the views of producers, consumers and technologists and has related the standard to the manufacturing and trade practices followed in the country in this field. Due weightage has also been given to the need for international compression-ordination among standards prevailing in different countries of the world.

0.5. Where a reference to any Indian Standard appears in this specification, it shall be taken as reference to the latest version of the standard.

0.6. Metric system has been adopted in India and all quantities and dimensions appearing in this standard have been given in this system.

0.7. 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, 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 of value should be the same as that of the specified value in this standard.

0.8. This standard is intended chiefly to cover the technical provisions relating to Venetian blinds for windows, and it does not include all the necessary provisions of contract.

1. Scope

1.1. This standard covers material, constructional details, sizes and requirements of open head custom-made Venetian blinds made of either wood or metal slats.

2. Terminology

2.0. For the purpose of this standard, the following definition shall apply.

2.1. **Venetian blind** – A blind capable of being raised or lowered, having thin parallel slats placed horizontally one above the other with two or more heavier cross members carrying operating devices, one at the top and one at the bottom. It is equipped with a mechanical tilting device and a cord lock which will permit simultaneous adjustments of slats and bottom rails at any desired angle and height, thereby giving maximum control of light and privacy while allowing ventilation.

3. Grade

1.2. The Venetian blinds shall be two grades, namely. Grade 1 and Grade 2; and the requirements of the two grades shall be as specified in 3.2 and 3.3.

1.3. Venetian blinds of Grade 1 (see Fig.1) shall

(a) have aluminum slats, (b) have a suitable provision either for locking the slats to the ladders or have a dual ladder for each slat so that the slats may not flutter, (c) be capable of being removed instantaneous from their mountings without the need of any tools for cleaning, repairs and replacements,

1.4. Venetian blinds of Grade 2 (see Fig 2) shall have wooden slats. They neither need be removable instantaneously nor have a provision for interlocking of the slats as in Grade 1 blinds.

4. Material

4.1. **Timber** – Timber used for the slats, top rails, tilting rails and bottom rails shall be free from knots and insect holes. The wooden slats and rails shall be made from any of the timbers having durability of Class I and an II timber as given in IS: 399-1952 Classification of Commercial Timber and Their Zonal Distribution (Tentative).

4.1.1.. All timbers shall be seasoned to an average moisture content not exceeding 14 percent except for slats in which case it shall not exceed 10 percent.

4.2. Metal

4.2.1. Aluminium alloy used for rolling of slats shall conform to NS 4 of IS: 737-1955 Specification for Wrought Aluminium and Aluminium Alloys, Sheet and Strip and shall have the following properties

Hardness	Zero
Ultimate tensile strength	17.3 to 22 kg/cm ²

Elongation	18 percent, Min
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4.2.2. All hardware including pulleys, guide channels and other fittings, unless otherwise specified, shall be of corrosion-resistant materials; if made of steel the hardware shall be hot galvanized. All screws used for mounting hardware and installation of blinds and guide channels shall be of brass suitably electroplated.

5. Sizes

5.1. The size of Venetian blind shall be defined by the width (length) and height (drop) of the blind as ordered for the position of fixing (see 5.2)

5.2. The size of Venetian blind shall depend upon the method of fixing. Venetian blinds may be fixed in any one of the three positions. Depending upon the method of fixing, the size shall be as defined for each position and each individual Venetian blind shall made to the required size of the corresponding window or opening.

5.3. Maximum sizes of Venetian blinds

5.3.1. Venetian blinds of Grade 1 shall not exceed 500 cm in width and 10 m² in area.

5.3.2. Venetian blinds of Grade 2 shall not exceed 275 cm width and 7.5 m² in area.

6. Construction

6.0. **Components** – Components of Venetian blinds shall be as specified in 6.1 to 6.13.

6.1. Installation brackets

6.1.1 The installation brackets (see Fig.4A and 4B) shall be of such a design as to provide a minimum back clearance of 16 mm to the blind. They shall have provision to hold the fascia board in position and in a manner that would facilitate the easy removal and refixing of the fascia boards.

6.1.2 The installation brackets shall be of sufficient strength to support the weight of the entire Venetian blind and shall be so designed as to install the blind in any of the positions as specified in 5.2

6.2. Title rail, bottom rail and top rail

6.2.1. **Material** – Tilt, bottom and top rails for both the grades of blinds shall be made from any of the timbers specified in 4.1.

6.2.2. Sizes

- Tilt rails shall be 50 ± 1 mm wide and 20 ± 1 mm thick (see Fig. 4C).
 - Bottom rails for blinds of Grade 1 and for blinds of Grade 2 up to a width of 250 cm shall be 50 ± 1 mm wide and 20 ± 1 mm thick. For blinds of Grade 2 exceeding 250 cm in width, the thickness of the rail shall be increased to 25 mm (see Fig, 4D).
 - Top rails, wherever required, shall be 62 ± 1 mm wide and 22 ± 1 mm thick. (see Fig. 4E)
- 6.2.2. The rails shall be free of twist and shall be reasonably straight.

6.3. Slats

6.3.1. Wooden slats shall be made from the timbers specified in 4.1. Wooden slats shall be reasonably flat and be free twist and cup or bow in width. The slat shall be held at ends on a base board of an angle of 85° to the horizontal and the slat shall not be clear of the base board by more than 1/500th of the width of the slat.

6.2.3. Aluminium slats shall be of convex, M or S shape and shall be made from aluminium alloy of quality specified in 4.2.1.

6.3.4. Sizes

- Wooden slats (see Fig. 4F) shall be 48 ± 0.5 mm wide and 2.5 ± 0.3 mm thick.
- Aluminium slats shall be 48 ± 0.5 mm wide when formed (see Fig. 4G). The thickness of coated aluminium slats shall be 0.300 ± 0.004 mm.

6.1.3 The number of slats per blind of different heights (drops) shall be as shown in Table 1.

6.4. Route holes

6.2.5. Route holes in the slats for the passage of lifting cord shall conform to the size and shape shown in Fig. 4H. The route holes shall be clean-cut with all edges free from burrs.

6.2.6. Route holes in top, tilt and bottom rails shall be of sufficiently large size to accommodate the pulley and provide for free passage of lifting cords.

6.5. Ladder web

6.5.1. The face and cross tapes shall be made of high grade cotton or synthetic yarn. Yarn shall be clean and free from moths.

6.5.2. **Construction** – the ladder web shall consist of two vertical tapes with cross tapes placed within them. The ends of the cross tapes shall be interwoven in the back of the face tapes to form ladders 50 mm long (see Fig. 4J)

6.5.3. The successive ladder shall be placed on alternative sides of 40 ± 0.5 mm centres to permit 10-mm overlap of the slats. The cross tapes shall be interwoven at a minimum distance of 3 mm from the edge of the face tapes and shall on each side be in a straight line one over the other. (see Fig.4J).

6.5.4. The ladder webs shall be so spaced in Venetian blinds as not exceed 75 cm between centres. The number of ladder webs per blind of different widths shall be as shown in Fig.5A to 5F.

6.6. Tilting device

6.6.1. The tilting device shall be of synchronized worm and gear design capable of lifting the blind including the slats from one extreme to the other. It shall allow slats to be changed from horizontal plane to vertical plane when tilted both frontward and backward. The tilting operation shall be smooth and positive.

6.6.1.1. Where tilting device is of a type in which the tilting cord is locked to the tilting pulley to provide a positive pull, the minimum gear ratio shall be 7:1.

6.6.1.2. In other cases, the tilting device shall have a self-adjusting clutch mechanism for maintaining the level of the tilting cord, the cord having limit beads attached at its two ends to avoid its slipping beyond a given height and the pulley carrying the tilt cord shall be so designed and finished that there is no undue wear on the tilt cord. The minimum gear ratio in such a type of tilter shall be 17:1.

6.7. **Cord lock** - The blind shall be provided with automatic cord lock so designed that it will hold the blind at any desired height without the need for fastening the lifting the cords on hooks. The cord lock shall lock both the ends of the lifting cord simultaneously without slippage and with a single pull of the lifting cords. The cord lock shall be so mounted that the lifting cords can be operated without interference and without undue wear and tear.

6.8 .Tilting and lifting cords

6.8.1. The cords shall be made of good quality cotton yarn or a combination of cotton and rayon or of nylon yarn.

6.8.2. The cords shall be of sufficient length for convenient and efficient use.

6.8.3. Cords shall be attached in a neat and secure manner and shall be easily detachable and replaceable. Unless otherwise indicated, the tilting cords shall be near the end of the left side of the blind and the lifting cords shall be near the end of the right side of the blind.

6.8.4. Cords shall be No. 4 ½, hollow or filled, uniformly braided and of smooth finish to minimize wear, stretch and abrasion. Cord No 4 ½ shall be 3.5 ± 0.4 mm in diameter

Table 1 Number of slats per blind of different heights (drops) (Clause 6.3.4)

Height (Drop)	Total no. of slats	Height (Drop)	Total No. of slats	Height (Drop)	Total No. of slats	Height (Drop)	Total No. of slats
Cm		cm		cm		Cm	
30	4	32.5	5	35	6	37.5	6
40	7	42.5	8	45	8	47.5	9
50	10	52.5	10	55	11	57.5	12
60	12	62.5	13	65	13	67.5	14
70	14	72.5	15	75	16	77.5	16
80	17	82.5	17	85	18	87.5	19
90	20	92.5	20	95	21	97.5	21

100	22	102.5	22	105	23	107.5	24
110	24	112.5	25	115	26	117.5	26
120	27	122.5	27	125	28	127.5	29
130	30	132.5	30	135	31	137.5	31
140	32	142.5	32	145	33	147.5	33
150	34	152.5	35	155	35	157.5	36
160	37	162.5	37	165	38	167.5	39
170	39	172.5	40	175	41	177.5	42
180	42	182.5	42	185	43	187.5	44
190	44	192.5	45	195	45	197.5	46
200	47	202.5	48	205	49	207.5	49
210	49	212.5	50	215	50	217.5	51
220	51	222.5	52	225	52	227.5	53
230	54	232.5	54	235	55	237.5	56
240	56	242.5	57	245	58	247.5	58
250	59	252.5	59	255	60	257.5	61
260	61	262.5	62	265	63	267.5	63
270	64	272.5	64	275	65	277.5	66
280	66	282.5	67	285	67	287.5	68
290	69	292.5	69	295	70	297.5	71
300	71	302.5	72	305	72	307.5	73
310	74	312.5	74	315	75	317.5	75
320	76	322.5	77	325	78	327.5	78
330	79	332.5	79	335	80	337.5	80
340	81	342.5	82	345	82	347.5	83
350	84	352.5	85	355	85	357.5	86
360	86						

6.9. **Cord equalizer** – The lifting cord of each blind shall be provided with a cord equalizer for maintaining equal pull on both the ends of the cord.

6.10. Pulleys

6.2.7. The pulleys shall be made of a suitable material, that is, strong and hard and which needs no oiling.

9.2.8. Multi-lift blinds shall have ball bearing pulleys on the bottom rail.

6.11. Centre supports

6.11.1. **Title rail supports** – Every blind over 90 cm in width shall have one tilt rail centre support for the tilt rail; and for each additional width of 75 cm, an additional centre support as shown in Fig. 5A to 5F shall be provided.

6.11.2. **Installation support** – There shall also be provided installation centre support brackets of a design and shape as to allow for ample safety factor and to prevent sagging of the blind.

Every blind without top rail shall be provided with equal number of installation centre supports of a suitable design as the tilt rail centre supports and shall be suitably attached to the same.

Every blind with top rail but 135 cm and over in width shall be provided with installation centre supports for every additional width of 90 cm suitably attached to the top rail.

The installation centre supports shall be screwed to the back wall or the ceiling as may be found convenient.

The installation centre support shall be so designed as to hold the fascia board in line.

6.12. **Side guide channels** – wherever specially ordered, blinds shall be provided with side guide channels (see Fig. 4M). the side guide channels shall consists of guide rails and slat-end clips (see Fig. N) and wherever required, wooden battens. The guide rails shall permit free up and down

movement of the slats without allowing undue play of the slat-end clips. The slat-end clips shall be of nylon, stainless steel or equivalent non-rusting material and shall be of a design that will hold the slats firmly without damaging or deforming them. The slat-end clips shall be removable easily. One slat-end clip shall be provided for each alternate slat at opposite ends.

6.13. Facia boards (pelmets) – Facia board (see Fig.4P) shall be of wood, metal or plastic of sufficient width and thickness to fit the installation bracket, and shall be of the colour matching the blind, unless otherwise specified.

6.14. General

6.14.1. Venetian blinds shall be generally assembled as shown in Fig. 1.

6.14.2. The route holes in the top rail and /or tilt rails, slats and bottom rail shall match each other so that they are centered correctly in relation to each other and the width of the blind.

6.14.3. The ladder webs shall be centered equidistant from the ends of the blind and from each other.

6.14.4. The slats after assembly shall be parallel to each other in horizontal position.

7. Installation

7.1. All blinds shall be secured to their proper places with screws conforming to IS 451-1953 Specification for Wood Screws and all Work shall be performed in a workmanlike manner. Installation brackets and installation centre supports shall be fixed in a workmanlike manner. If installed on wood, 2.5 cm No. 8 screws or larger size may be used. If installed on masonry, plaster, brick, cement blocks or tile, drill a neat hole 2.5 cm deep by using a No.8 drill, insert a fibre or plastic plug or lead shield and use 2.5 cm No.8 screw or larger as in wood.

7.2. Nails shall not be used in the installation of brackets and centre supports.

8. Finish

8.1. **Aluminium slats** – The aluminium slats shall be given a pretreatment to provide a permanent bond between the aluminium and the finishing paint and then given suitable coats of primer and upper coats of paint which shall be high gloss and of a baked enamel type.

8.2. **Wooden slats and rails** – The wooden slats and rails shall be sanded smooth before painting. For finishing wooden slats and rails, one end coat of sealer, one coat of primer-surfacer, putty and two coats of paint shall be applied. The paint used shall be semi-gloss good quality enamel or cellulose paint.

8.3. The final paint finished surface shall be smooth and even.

9. Testing

9.1. Aluminium slats

9.1.1. **Physical tests** – the finished aluminium slats shall be tested for the following properties before painting

Tensile strength, Min	3375 kg/cm ²
Yield stress, Min	3100 kg/cm ²
Elongation, Max (5cm gauge)	2.5 percent

9.1.2. **Salt water test** – Aluminium slats shall be sprayed with 5 percent salt solution at 40°C for 500 hours and shall not show blistering, corrosion, chalking, change of colour and loss of gloss or adhesion (between metal and finish) after a recovery period of 30 minutes.

9.1.3. **Cold and hot water test for enamel** – The backed enamel finish shall resist soaking in cold water for 48 hours and for 30 minutes in boiling water. The enamel shall not blister and shall recover the same hardness after being out of water for 2 hours

9.1.4. **Light test** - The enamel finish shall withstand exposure to a twin-arc weatherometre operated on a cycle of 17 minutes to light without water spray and 3 minutes to light with water spray, for a minimum period of 200 hours without blistering, corroding, chalking, loss of gloss, changing of colour, and without loss of adhesion after a recovery period of 30 minutes.

9.1.5. **Rigidity test** – The slats shall be of flexible aluminium having sufficient flexibility to permit a 180 degree bend around a 7.5 cm diameter cylinder without harm or permanent deformation of the

slats, or injury to the finish when released to their original shape. Bend test shall be made on both the convex and concave sides, but shall not include the route holes. After the bend test, the slat shall be placed on a plane surface with the concave side down, and in this position the perpendicular distance from the supporting surface to any point on either edge of the slat shall not exceed 3 mm. With the slats similarly supported, the maximum difference in the perpendicular distance from the supporting surface to the edge of the slats for any two points 75 mm apart, along either edge, shall not exceed 1 mm. The crown of the slat shall be sufficient to support an extended length of at least 90 cm.

9.2. Ladder web

9.2.1. Colour fastness and shrinkage – The face and cross tapes of the ladder web shall have good colour fastness to light and water, and shall not shrink more than 7 percent. Colour fastness shall be determined by standard Fadometre tests for at least 200 hours.

9.2.2. Breaking strength – Face tapes of ladder web when tested individually shall have a breaking strength of not less than 100 kg. Cross tapes (or ladders) when tested of individually shall have minimum strength 7 kg without breaking or tearing away from the face tapes. The testing procedure shall be in accordance with IS: 243-1951 Method of Determination of Breaking Load (strength) and Elongation of Woven Cotton Fabrics (by constant-rate-of traverse machine).

9.3. Breaking strength of cords – When tested on single strand method, the breaking strength of cords shall be least 80 kg.

10. Inspection and testing

10.1. The manufacturer shall provide all facilities for the inspection of the blinds at his premises.

10.2. The manufacturer shall, at the request of the purchaser or his representative, give free of charge a certificate to the effect that the blinds supplied conform to the requirements of this standard.

10.3. The purchaser shall have the option of rejecting or asking for replacement of any article found to be defective or not complying with the requirements of this standard during assembly, irrespective of his prior inspection and approval provided the defect is found to have been in existence in the manufacturer's works and stores and not due to subsequent handling.

10.4. The purchaser shall have the right to conduct tests to determine the quality of material, construction and finish as agreed to between the purchaser and the manufacturer.

11. Packing

11.1. All Venetian blinds shall be supplied duly assembled.

11.2. When Venetian blinds are to be dispatched, each assembled blind shall be suitably warped in paper. Slats coming into contact with hardware shall be suitably protected guide channels, when ordered, shall be separately warped. The blinds shall be separately warped. The blinds shall be packed in cases with gross weight not exceeding 55 kg.

11.3. All packing shall be done in such a way that it will not lead to damage to the finished assembly or its components.

12. Information to be furnished by the purchaser

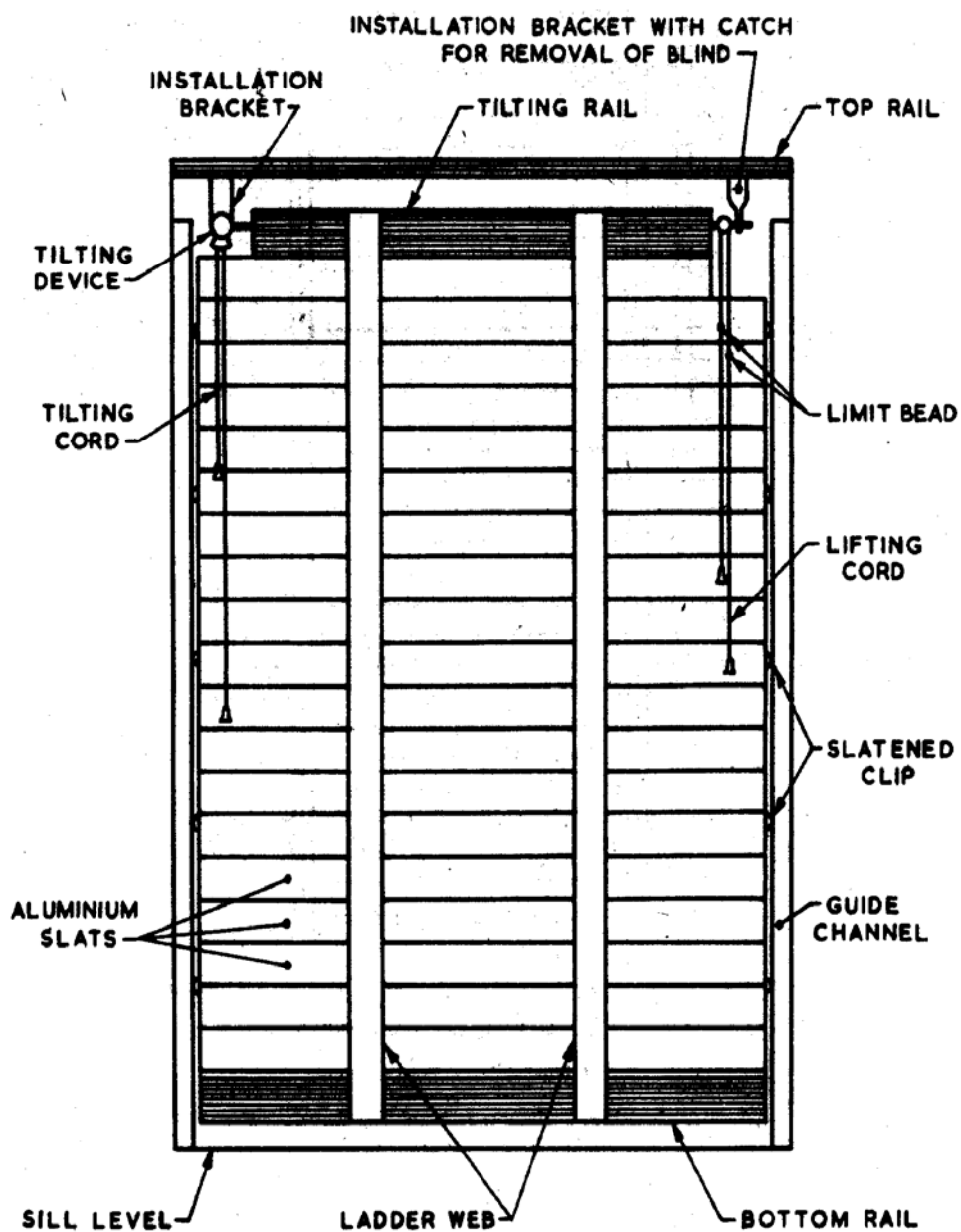
12.1. The purchaser shall specify the following information to the supplier

(a) Type and class of Venetian blinds, (b) Size of Venetian blinds [width x weight (outside dimension)], (c) Size of opening and position of fixing, (d) Whether guide channels are required or not, and (e) Colour of slats, ladder web and cord.

13. Marking

13.1. All Venetian blinds shall be marked on top rail (tilt rail) with a suitable mark identifying the manufacturer, type and size of blind.

13.2. The Venetian blinds may also be marked with the ISI Certification Mark.



(Full blind shown in closed position)

Fig.1 Venetian blind assembly (Fixed type-wooden slats)

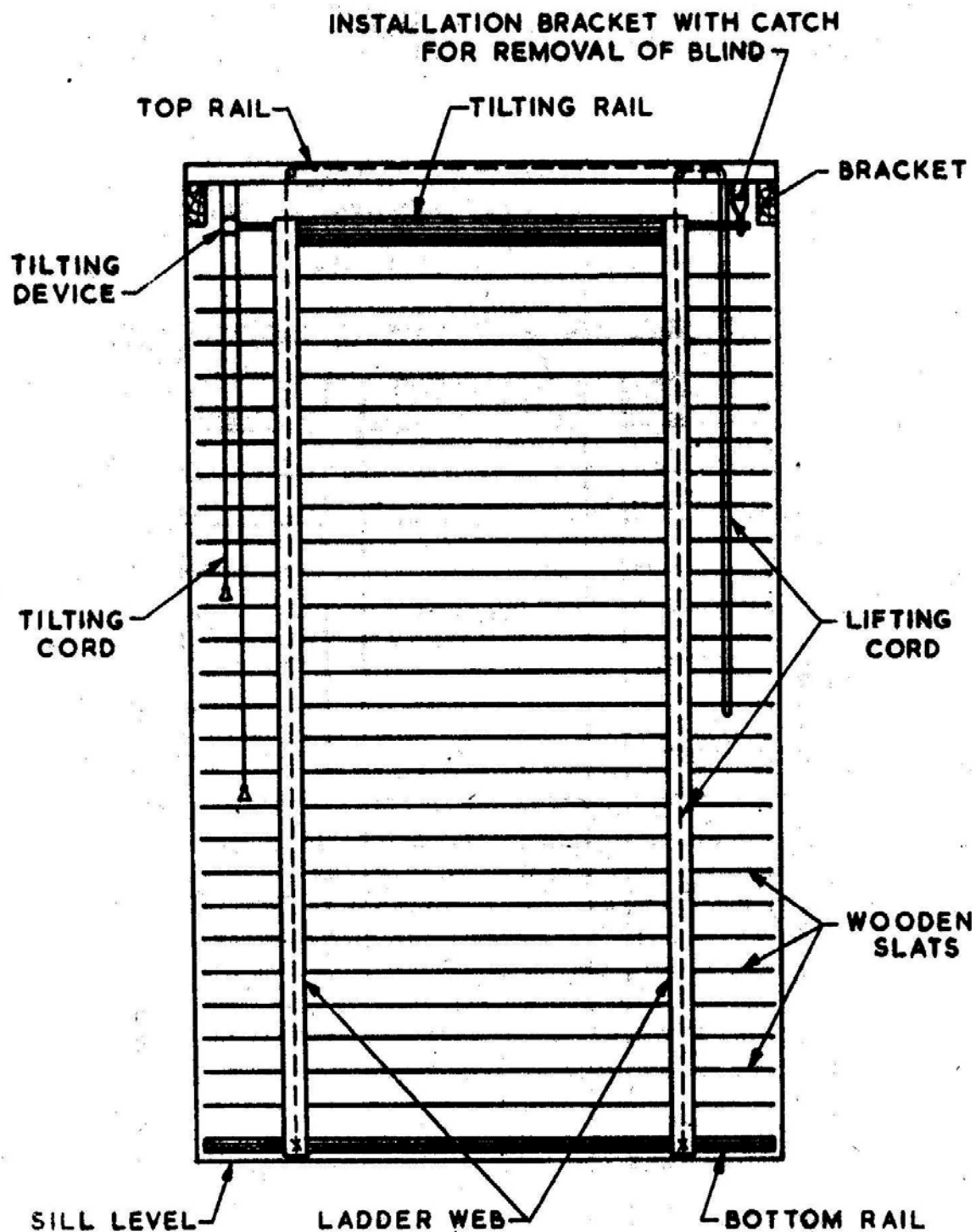
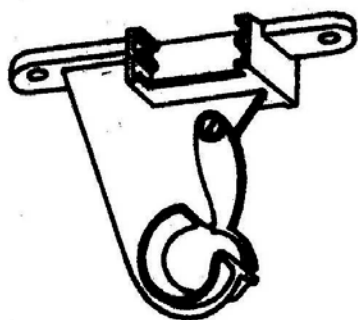
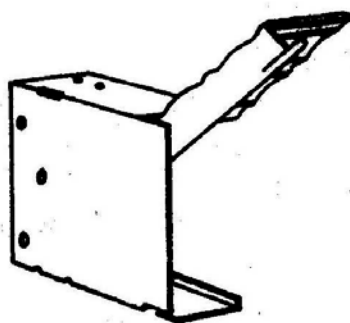
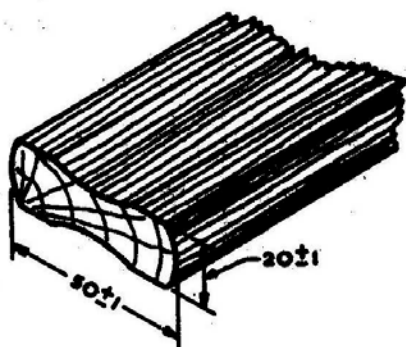


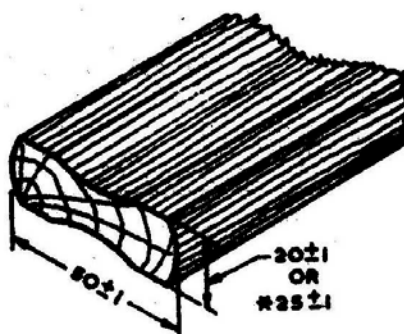
Fig. 2 Venetian blind assembly
(Fixed type-wooden slats)



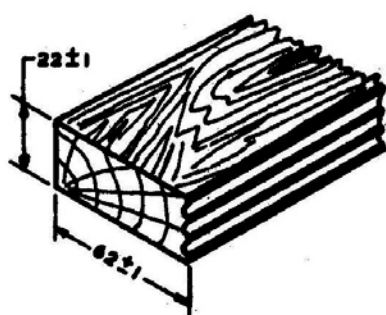
A Installation Bracket

B Installation Bracket
(With Provision for Pelmet)

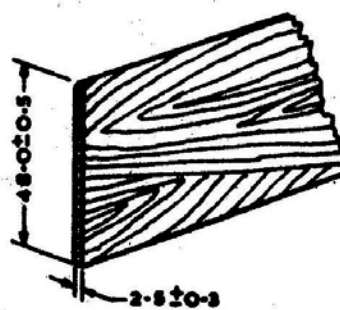
C Tilt Rail

* FOR BLINDS OF GRADE 2
OVER 250 cm WIDE

D Bottom Rail



E Top Rail



F Wooden Slat

Fig. 4 A to F. Typical illustration of components of Venetian blinds (contd)

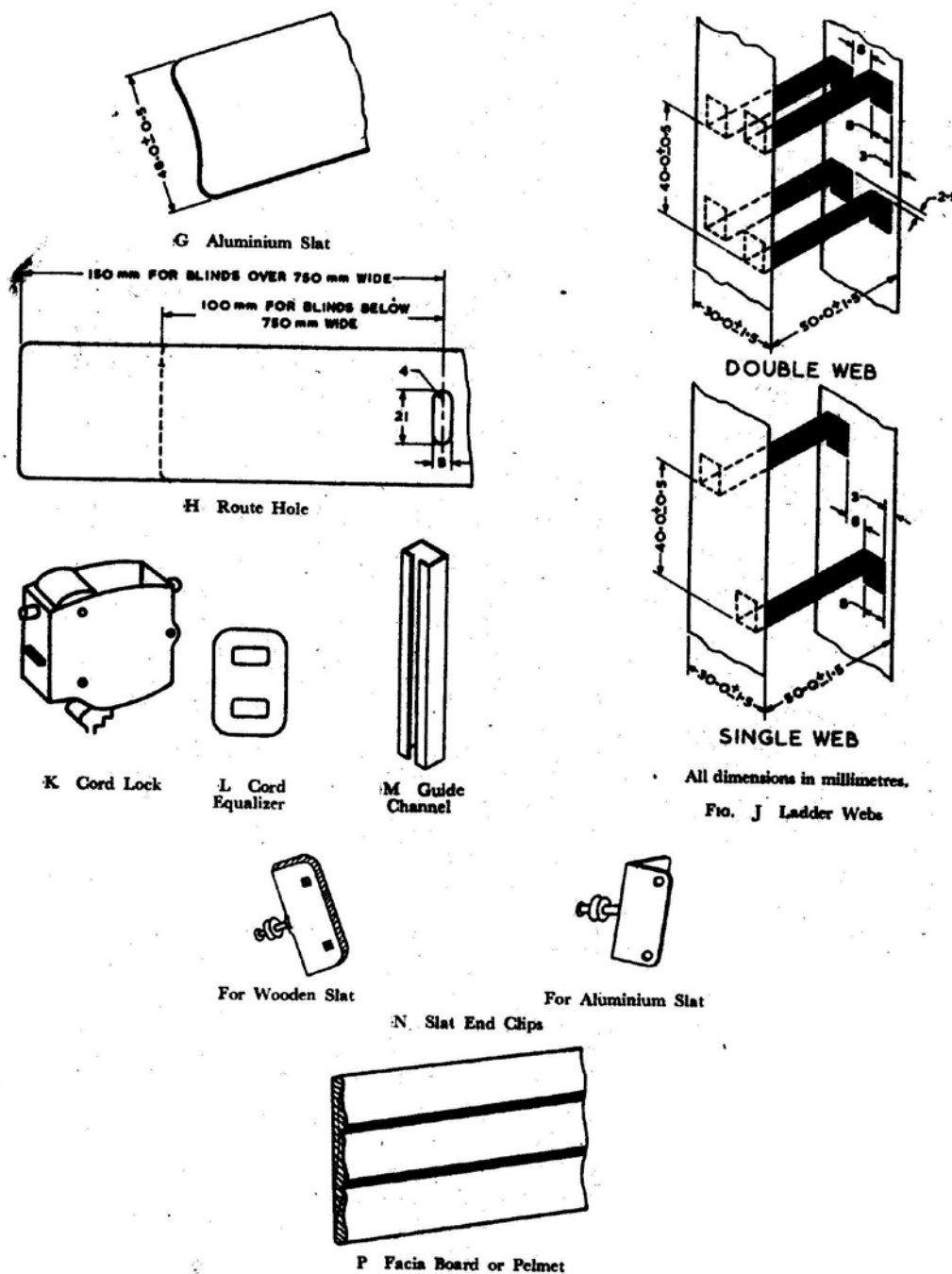


Fig. 4G to 4P

Fig. 4 Typical illustration of components of Venetian blinds

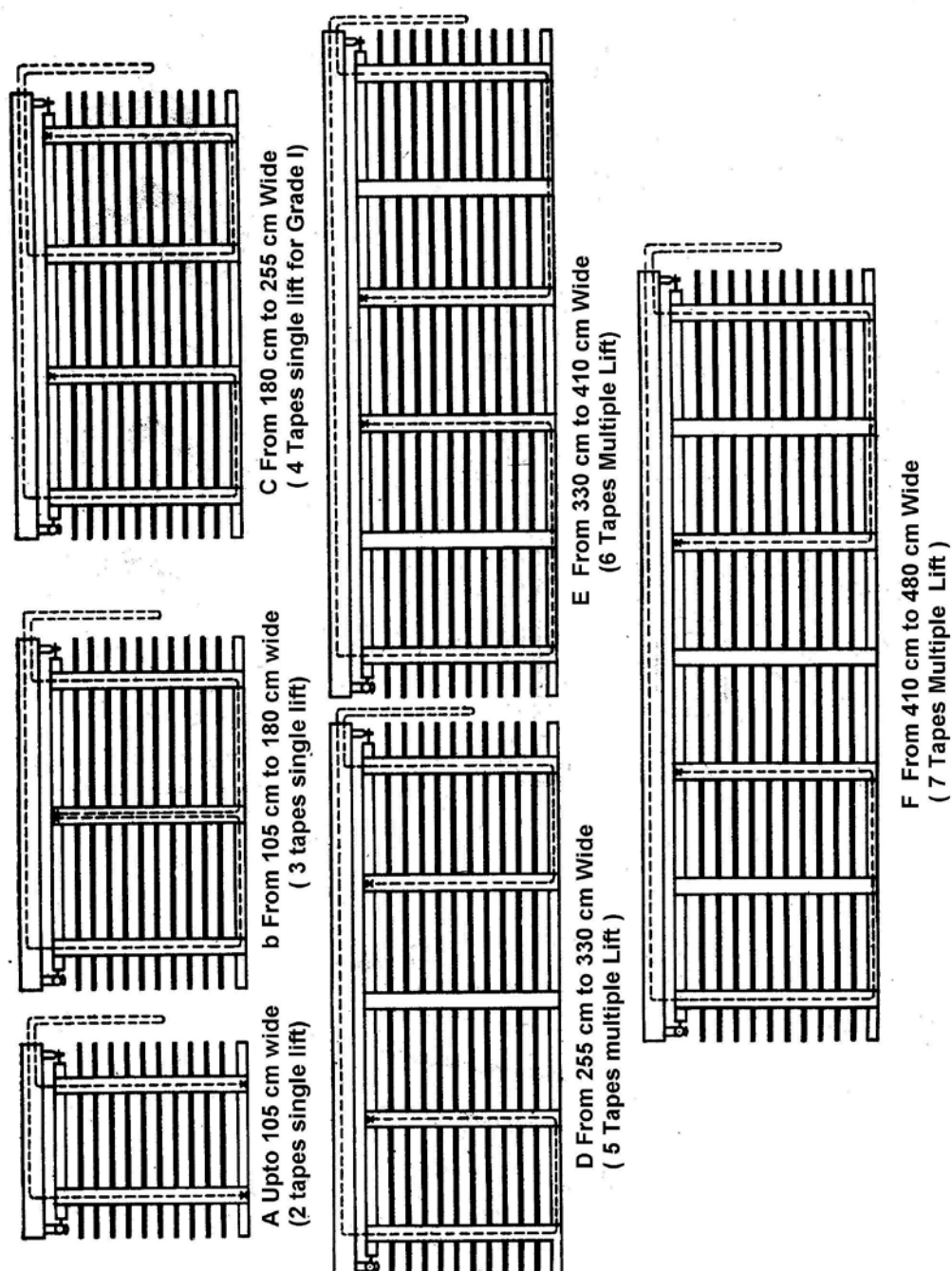


Fig. 5 A to F Multi-lift Venetian blinds

Annexure 9-A-15

PLYWOOD FOR CONCRETE SHUTTERING WORK

(Extract of IS: 4990-1981)

1. **Scope** – Requirements of plywood for concrete shuttering work.
 - 1.1. Recommended method for handling, storing and use of plywood of concrete shuttering and formwork is covered in Appendix A of the standard.
2. **Dimensions and tolerances**

2.1. **Size (length x width)** - 240 x 120, 240 x 90, 210 x 120, 210 x 90, 180 x 120, 180 x 90, 150 x 120, 150 x 90, 120 x 120, 120 x 90, 120 x 60 and 90 x 90 cm.

2.2. **Thickness** - 4, 5, 6 mm for 3-ply; 6, 8, 10 mm for 5-ply; 13, 16 mm for 7-ply; 16, 19 mm for 9-ply; 22, 25, 30, 35, 40 mm for more than 9-ply.

2.3. Tolerances

Length upto 120 cm and Width upto 90 cm	± 3 mm
Length above 120 cm and Width above 90 cm	± 6 mm
Thickness upto 5 mm	± 10 percent
Thickness above 5 mm	± 15 percent

3. Finish

3.1. Shall be smooth and the faces and back shall be free from harmful discolouration, plates overlaps and loose knots. Edges shall be of smooth uniform finish.

3.2. Gaps and open joints shall be permitted as follows

a) **Inface** – Provided the gap or opening does not exceed a width of 0.4 mm, if it exceeds 0.4 mm, this may be rectified by well fitted veneer inserts of a minimum width 4.8 mm provided the grain of the veneer does not exceed in deviation by more than 10 percent from the grain direction of the surrounding veneer.

b) **In Core (cross-band)** - Width of opening shall not exceed 0.8 mm in the case of 3- ply or 3.2 mm in the case of multi-ply, provided the openings are not less than 30 cm apart in any veneer and staggered not less than 15 cm between any veneer and the next one with the same grain direction.

3.3. Face with plastic coating, or with suitable overlay shall be dense, smooth, without blister and without patch marks and shall be of uniform colour.

4. Tests

4.1. **Moisture content** – Shall be between 5 and 15 percent,

4.2. Glue adhesion in dry state

4.2.1. **Glue shear strength** – Average failing load shall be not less than 1323.9 N and no individual value shall be less than 1078.7 N.

4.2.2. Adhesion of plies – The veneers shall offer appreciable resistance to separation and the fractured samples shall be show some adherent fibres distributed more or less uniformly.

4.3. Water resistance test

4.3.1. **Glue shear strength** – Average failing load shall be not less than 980.7 N and no individual value shall be less than 784 N.

4.3.2. **Adhesion of plies** – Requirements shall be same as given in 4.2.2.

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

4.5. Plywood manufactured from species not naturally durable, shall show more or less uniform absorption of preservative on the entire surface,

4.6. Tensile strength

(a)Not less than 318 kN/m², parallel to grain direction of face veneers; (b)Not less than 220kN/m² at right angles to grain direction of face veneers; and (c)Sum of tensile strengths in both directions not less than 588 kN/m².

4.7. **Mycological test** – Test piece shall show no appreciable signs of separation at edges of veneers and shall comply with requirements given in 4.3.1 and 4.3.2.

Note – for test procedures, refer to IS: 1734 Method of test for plywood

IS: 1734 (part I)-1983 Part I Determination of density and moisture content (first revision)

IS: 1734 (part IV)-1983 Part IV Determination of glue shear strength (first revision)

IS: 1734 (part V)-1983 Part V Test of adhesion of plies (first revision)

IS: 1734 (part VII)-1983 Part VII Mycological test (first revision)

IS: 1734 (part IX)-1983 Part IX Determination of tensile strength (first revision)

Annexure 9-A.16

FIRE RETARDANT PLYWOOD

(Extract of IS: 5509-1980)

1. **Scope** – Fire retardant formulations, method of treatment retentions and requirements of fire retardant plywood.

2. Flame retardants

Type 1 Ammonium phosphates

Type 2 Boron compounds

Type 3 Ammonium sulphate

Type 4 Combination of ammonium phosphates and boron compounds

Type 5 Combination of ammonium sulphate and ammonium phosphate

2.1. Where flame retardant and preservative treatment is required together, types of chemical and their retention shall be as follows

Type	Flame Retardant	Preservative	Retention of Preservative kg/m ² Min.
6	Ammonium phosphate	Copper / chrome	6
7	Ammonium phosphate/ammonium sulphate	Copper / chrome	6
8	Ammonium phosphate/ammonium sulphate / boron compounds	Copper / chrome	6
9	Ammonium phosphate/ammonium sulphate/boron compounds	Copper / chrome	8

3. Preparation of plywood for Treatment – Plywood for treatment shall conform to BWR type and shall have moisture content not over 16 percent.

4. Recommendation treatment for different situations

a)	For interior use against fire hazard, namely, interior linings, partitions and filaments of ship cabins, boiler houses, kitchen, ceiling of houses, kitchens, ceiling of rail coaches, vehicle body interiors, exhibition stall etc.	Type 1 to 5 with retention of fire retardant 20 kg/m ² Min.
b)	For interior or exterior use not subject to leaching by rain and water against fire hazard and high risk of decay or insect attack; namely wall and roof linings, external roofing, cladding or ceilings of building, vehicle bodies etc.	Type 6 to 9 with of fire retardant and preservative. 15 kg/m ² Min.

5. **Workmanship and finish** – Finished plywood shall be reasonably clean to handle and free of dirt and stain other than any uniform colour of flame retardant solution.

6. Test requirements

6.1. **Moisture content** – Shall be between 5 and 15 percent.

6.2. **Flammability** – Time taken for second ignition, not less than 30 minutes.

6.3. **Flame penetration**- Not less than 15 minutes for every 6 mm thickness.

6.4. **Rate of burning** – Time taken to lose weight from 30 percent to 70 percent shall be less than 20 minutes.

6.5. Retention of preservatives – Not value shall not be less than the values specified in 2.1 and 4.

Note 1: Dimensions and tolerances of fiber retardant plywood shall conform to IS: 303-1975 Specification for plywood for general purposes (second revision)

Note 2: For test procedures for the tests specified, refer to IS: 1734 (part I)-1983 Method of test for plywood part I Determination of density and moisture content (first revision); IS: 1734 (part III) -1983 Method of test for plywood part III Determination of fire resistance (first revision) ; and IS: 2753 (part I)-1991 Methods of estimation of preservatives in treated timber and in treating solution Part I Determination of copper, arsenic, chromium, zinc, boron, creosote and fuel oil.

Note 3: Plywood when tested for glue shear strength in dry state, mycological test, water resistance test and for any other mechanical property as agreed to shall meet requirements of BWR grade general purpose plywood conforming to IS: 303-1975 Specification for plywood for general purposes (second revision).

Annexure 9-A.17

PRESERVATIVE TREATED PLYWOOD

(Extract of IS: 5539-1969)

1. **Scope** –Treatment of plywood for protection against fungi, termites and other insects and marine bores and requirements of preservative treated plywood.

2. Types of preservatives

a) **Type I (oil type)** – Coal tar creosote with or without admixture with various grades of petroleum and other oils having high boiling point.

b) **Type 2 (organic solvent type)** – Copper/ zinc naphthenate, pentachlorophenol, benzene hexachloride and DDT.

c) **Type 3 (water soluble non-fixing type)** – Zinc chloride, boric acid, borax, sodium fluoride and sodium pentachlorophenate.

d) **Type 4 (water soluble 'fixed' type)** – Copper-chrome arsenic composition, acid-copper-chrome composition, chromated zinc chloride and copper chrome boric composition.

3. **Preparation of plywood for treatment** – plywood for preservative treatment shall have moisture content not exceeding 16 percent and shall have been bonded with water resistant glue of BWR type.

4. **Choice of treatment** – This is governed by the timber species in the plywood, sapwood content and use after treatment. Recommended practice on choice of preservative and amount of absorption and service conditions is given in Table 1.

Note: For information regarding natural durability and degree of treatability of different species of timber see Appendix B of the standard.

5. Modes of treatment

(a) By pressure impregnation after manufacture. (b) By soaking or surface application after manufacture (c) By treatment of dry or wet veneers before assembly.

6. **Conditioning** – Plywood after treatment shall be conditioned to a moisture content of not more than 14 percent for interior use and 18 percent for exterior uses. If the plywood is to be painted subsequently, the moisture content shall be between 6 and 14 percent.

Table 1 Recommendation practice for preservative treatment of plywood for various service conditions

Sl. No	Service conditions for treated plywood	Timber used in plywood according to the relevant IS on plywood required to be treated	Types of preservative recommended	Mode treatment recommended	Minimum retention
i)	Plywood in direct contact	All	Type 4 (Copper-	Pressure	12.0

	with water or ground and required to be painted as for pontoons, boats, rafts, tugs, fence posts, box, columns, etc (IS: 710-1976*)		chrome arsenic composition or acid copper chrome composition)	process Veneer treatment	12.0
ii)	Plywood in direct contact with water or ground and required to be painted as for pontoons, boats, rafts, tugs, fence posts, box, columns, etc (IS: 710-1976*) but plywood requiring light painting or only back coal tar base (IS: 1976*)	All	a) Type 4 (Copper-chrome arsenic composition or acid copper chrome composition) b) Type 1 [Creosote or creosote fuel oil mixture(5050)]	Pressure process Pressure process	12.0 100.0
iii)	Marine structures exposed to marine borer danger (IS: 710-1976*)	All	b) Type 1 [Creosote or creosote fuel oil mixture(5050)]	Pressure process	200.0
iv)	Concrete shuttering plywood (IS: 4990-1969†)	All	Type 4 (Copper-chrome arsenic composition or acid-copper chrome-composition)	Pressure process Veneer treatment	12.0 12.0
v)	Plywood for outer cladding of houses, roofing, bunkers and shutters, and in other conditions exposed to rain, sun and outer weather but requiring painting (IS: 303-1989 BWR Grade)	All	-do-	Veneer treatment	12.0
vi)	Plywood for outer cladding of houses, roofing, bunkers and shutters, and in other conditions exposed to rain, sun and outer weather but requiring painting, but paint and colour not important (IS: 303-1989‡ BWR grades)	All	Type 1 [Creosote or creosote fuel oil mixture(5050)]	Pressure process	100.0
vii))	Plywood for buses flooring or rail coach flooring (IS: 303-1989 BWR grades)	All	Type 4 (Copper-chrome-arsenic composition or acid copper chrome -	Pressure process	75.0

			composition) Type 1 [Creosote or creosote fuel oil mixture(5050)]		75.0
viii)	Plywood not indirect contact with ground or water but exposed and given paint or varnish regularly as in plywood for rail coach ceiling, partitioning and other interior use, bus interior, ammunition boxes, exterior, doors, etc(IS: 303-1989† BWR grades)	All timbers except when only heartwood of durable timber is used	Type 4 (Copper- chrome-arsenic composition or acid copper chrome- composition)	Pressure or soaking	5.5
ix)	Decorative paneling on rail coaches and ship building (IS: 303-1975‡ BWR grades)	Do	Type 2 or type 3 not colour imparting	Pressure process or soaking	4.0
x)	Plywood for internal uses in dry localities, such as inner partitions, paneling, wall boarding, ceiling and furniture (IS: 303-1989 and IS: 1328-1970§))	Do	Type 2 or Type 3 or Type 4	Pressure process or soaking	4.0

- Specification for marine plywood (first revision).

† Specification for plywood for concrete shuttering work.

‡ Specification for plywood for general purposes (second revision).

§ Specification for veneered decorative plywood (first revision)

Note: For information regarding natural durability and degree or treatability of different species of timber see Appendix B of the standard.

Annexure 9-A.18

DECORATIVE PLYWOOD USING PLURALITY OF VENEERS FOR DECORATIVE FACES

(Extract of IS: 7316-1974)

1. **Scope** – Covers decorative plywood with ornamental faces produced by use of plurality veneers meant for decorative use, such as interior paneling of buildings, buses, ships, etc, and for decorative furniture of all types.

2. **Material**

2.1 **Timber** – Class I, II or III specified in IS: 303-1975*. Non-durable timbers and sapwood of all other timbers shall be given a preservative treatment.

2.2 **Adhesive** – synthetic resin adhesive BWR or WWR.

2.3 Plywood, when used, shall be BWR or WWR synthetic resin bonded type.

3. **Permissible defects** – Open splits, checks or open joints not more than 150 mm long and 0.5 mm wide, provided the same are rectified with a matching veneer insert bonded with BWR or WWR adhesive. Decorative veneered surface shall be free from torn grain, dote, worm hole, discoloration or other visual defect

4. **Standards dimensions**

Length 240, 210, 180, 150, 120 and 90 cm
 Width 120 and 90 cm
 Thickness 3,4,6,12,19 and 25 mm

* Specification for plywood for general purposes (second revision).

5. Tolerances

Length up to 120 cm + 3 mm
 - 0 mm
 Length above 120 cm + 6 mm
 - 0 mm
 Width up to 90 cm + 3 mm
 - 0 mm
 Width above 90 cm + 6 mm
 - 0 mm

Thickness +0.2 mm + 5 percent of nominal thickness

-0.1 mm + 2.5 percent of nominal thickness

Rectangular panels shall have their diagonal lengths not varying beyond 9 mm.

6 .**Finish** - Trimmed square and sanded to a smooth finish.

7. Tests

7.1. **Moisture content** - Not less than 5 percent and not more than 15 percent when tested in accordance with IS: 1734 (part I)-1983*.

7.2 .**Water resistance test** – Shall not show delamination or blister formation

*Methods of test for plywood part I Determination of density and moisture content (first revision)

Annexure 9-A.19

WOOD PARTICLE BOARDS (MEDIUM DENSITY) FOR GENERAL PURPOSES

(Extract of IS: 3087-1985)

1. **Scope** – Material, methods of manufacture, grades, types, sizes, construction and finish of medium-density wood particle boards for general purposes. It does not cover high-density practical boards of specific gravity exceeding 0.9, veneered particle board and also specially treated boards like moulded particle boards, compregnated boards or particle boards faced by impregnated paper surface.

2. Types and designation

	Type	Designation
a)	Flat pressed, single-layer board	FPSI
b)	Flat pressed, three-layer board	FPTH
c)	Extrusion pressed, solid board	XPSO
d)	Extrusion pressed, tubular core board	XPTU

3. Materials

(a) Wood particles shall be produced by cutting wood into shaving, flakes, splinters or slivers on a chipping machine.(b) Adhesive shall be BWR, WWR or unextended CWR type.(c) Sizing material (introduced primarily to increase water resistance) – Paraffin wax.

4. Dimensions and tolerances

a) **Length** – 485 (480), 365 (360). 300. 270, 240, 210, 180, 150, 120, 100 and 90 cm.

Tolerance ± 6 mm up to 150 cm and ± 9 mm above 150 cm.

b) **Width** – 180, 150, 120, 100, 90, 60 and 45 cm.

Tolerance ± 6 mm up to 150 cm and ± 9 percent above 150 cm.

c) **Thickness** – 6, 9, 12, 16, 19, 20, 21, 22, 25, 27, 30, 35, 40, 45 and 50 mm.

Tolerance ± 5 percent up to 25 mm and ± 2.5 percent above 25 mm.

d) Length of two diagonals of a wood particle board, rectangular panel, shall not differ by more than 2.5 mm.

e) Edges of the board shall be straight with a tolerance of 3 mm.

Strength and other characteristics of various types of wood particle boards are given in Table 1 of the IS: 3087-1965 may be referred.

5. Physical characteristics

5.1. **Density** – shall be between 500 to 900 kg / m³. Variation in density shall not exceed 10 percent.

5.2. **Moisture content** – Shall be between 7 and 16 percent. Variation of individual from mean shall not exceed ± 3 percent.

5.3. Water absorption (see Table 1 of IS: 3087-1965)

5.4. Swelling in water (see Table 1 of IS: 3087-1965)

5.5. Swelling due to surface absorption (see Table 1 of IS: 3087-1965)

5.6. Modulus of rupture (see Table 1 of IS: 3087-1965)

5.7. Tensile strength perpendicular to surface (see Table 1 of IS: 3087-1965)

5.8. Thermal conductivity (see Table 1 of IS: 3087-1965)

5.9. Workability – shall not crack or split when drilled, sawed and nailed perpendicular to the surface.

6. **Finish** – Shall be of uniform thickness and density throughout the length and width. These shall be flat and sanded to a smooth finish on both the faces.

Note: 1) For test procedures, IS: 2380-1963 Methods of test for wood particle boards and boards from other lignocellulosic materials and IS: 3129-1965 Specification for particle board for insulation purposes may be referred.

Annexure 9-A.20

VENEERED PARTICLE BOARDS

(Extract of IS: 3097-1980)

1. **Scope** – Requirements such as grades and types, materials, manufacture, dimensions and tests for veneered particle boards.

2. **Grades and types** – Shall be two grades, namely, exterior (Grade I) or interior (Grade II).

2.1 Each grade of veneered particle boards shall be of the following four types

a) **Type 1** – Solid core, general purpose (boards with faces of veneer of general purpose type).

b) **Type 2** – Solid core, decorative (boards with solid core but faced with ornamental veneers on one or both sides).

c) **Type 3** – Tubular core, general purpose (boards with tubular core and faced with veneer of general purpose type).

d) **Type 4** – Tubular core, decorative (boards with tubular core faced with decorative veneers on one or both sides).

2.2 **Designation** – The grades and types shall be designated as follows

Sl No.	Grade	Type	Designation
1.	Exterior (Grade I)	Solid core, general purpose	EX SO GP
2.	Exterior (Grade I)	Solid core, decorative	EX SO D
3.	Exterior (Grade I)	Tubular core, general purpose	EX TU GP
4.	Exterior (Grade I)	Tubular core, decorative	EX TU D
5.	Interior (Grade II)	Solid core, general purpose	IN SO GP
6.	Interior (Grade II)	Solid core, decorative	IN SO D
7.	Interior (Grade II)	Tubular core, general purpose	IN TU GP
8.	Interior (Grade II)	Tubular core, decorative	IN TU D

3. Material

a) Particle boards shall be of medium density.

- b) Veneers for cross-band and faces shall be either sawn or rotary cut or sliced and shall be smooth.
- c) Adhesive used for bonding veneers shall be BWP or BWR for exterior grade (Grade I) boards and WWR or CWR for interior grade (Grade II) boards.

4. **Finish** – All boards shall be flat and squarely cut. Both faces shall be sanded to a smooth even surface.

5. Dimensions and tolerances

- a) Length – 480, 365, 300, 270, 240, 210, 180, 150, 120, 100 and 90 cm. Tolerance ± 5 mm up to 150 cm and ± 10 mm above 150 cm.
- b) Width – 180, 150, 120, 100, 90 and 45 cm. Tolerance same as for length.
- c) Thickness – 6, 10, 12, 20, 25, 30, 35, 40, 45 and 50 mm. Tolerance ± 1 mm.
- d) Length of two diagonals shall not differ by more than 2.5 mm.
- e) Edges shall be straight with maximum deviation of 3 mm.

6. Tests

6.1. Density – Density of each specimen shall not vary from mean density by more than ± 10 percent.

6.2. Moisture **content** – Average values shall be between 7 to 16 percent.

6.3. Water **absorption** – Value shall not exceed 25 percent for 2 h soaking and 50 percent for 20 h soaking.

6.4. **Water resistance test** – Boards shall not show signs of disintegration and/or shall not delaminate.

6.5. **Swelling in water** - Swelling in thickness in percentage of original thickness shall not be more than 7 percent due to general absorption and this shall be 5 percent in case of swelling due to surface absorption.

6.6. **Adhesive of piles** – Adhesive of face veneers to the board core shall offer appreciable resistance and the exposed surface of veneer shall show sizes of some adherent fibres distributed more or less uniformly.

6.7. **Static bending strength (maximum transverse strength or modulus of rupture in bending)**
Average value of modulus of rupture shall not be less than 300 kg/cm².

6.8. **Deflection under sustained load (long time loading test)** – The deflection under load and residual deflection after removal of load shall be as agreed to mutually.

Note: For test procedures, refer to the standard and IS: 2380 Method of test for wood particle boards and boards from other lignocellulosic materials

Annexure 9-A.21

PARTICLE BOARD FOR INSULATION PURPOSES

(Extract of IS: 3129-1965)

Scope – Requirements of insulation type of particle boards.

2. Materials

- a) Timber or other lignocellulosic material like bagasse and solapith and jute sticks of density not exceeding 400 kg/m³.
- b) Following materials may be added to the particle mix
 - (1) A preservative such as sodium pentachlorophenate or pentachlorophenol to the extent of 0.2 percent.
 - (2) Sizing material like paraffin wax emulsion (to increase water resistance), not exceeding 1.5 percent.
 - (3) Flame retardant chemical like ammonium phosphate and borax.

Adhesive – BWR or WWR (unextended) type.

3. Dimensions and tolerances

- a) **Length** – 365, 300, 270, 240, 210, 180, 150, 120, 100, 90, 60, 45 and 30 cm.
- b) **Width** – 180, 150, 120, 100, 90, 60, 45 and 30 cm.
- c) **Thickness** – 50, 45, 40, 35, 30, 27, 25, 22, 20, 16 and 12 mm.
- d) **Tolerance**

Length and width ± 9 mm up to 150 cm and ± 15 mm above 150 cm.

Thickness ± 0.8 mm up to 25 mm and ± 1 mm above 25 mm.

4. Physical requirements

4.1. **Density** – Shall not exceed 400 kg/m³. Variation shall be..... ± 10 percent.

4.2. **Moisture Content** – Shall not exceed 16 percent

4.3. **Thermal Conductivity** – K value shall not exceed 7 kcal.cm/m²h° C thickness (or 0.81 mW/cm.°C).

4.4. **Transverse Strength** – Modulus or rupture not less than 15 kgf/cm².

4.5. Sound absorption

Frequency, c/s 125 250 500 1000 2000

Absorption 0.1 0.2 0.3 0.5

Coefficient, Min

Note: For test procedures, refer to IS: 2380 (Parts I to XXI)-1977 Methods of tests for wood particle boards and boards from other lignocellulosic materials (first revision), IS: 330 -1969 Methods of wood wool building slabs and Appendix A of the standard.

Annexure 9-A.22

WOOD WOOL BUILDING SLABS

(Extract of IS: 3308-1981)

1. **Scope** – Requirements regarding dimensions, weight and strength for wood wool building slabs.

2. Types

a) Type 1 – Light weight slabs, intended for non-load bearing partitions, ceilings, wall linings, permanent shuttering and roof insulation.

b) Type 2 – Heavy duty slabs, intended for load bearing situations and for use in roof construction.

3. **Form and texture** – Slabs shall be of uniform thickness with rectangular parallel faces and shall have clean reasonably square edges and shall be of uniform texture.

4. Dimensions, weight and tolerances

Length	Width	Type	Thickness	Weight of the Slab, Max
Mm	Mm		Mm	Kg
2 000	500	1	12	5
			20	8
			25	11
			40	12.5
			50	16
			75	22
			100	27.5
2000	500	2	40	25.0
			50	30.0
			75	40.0
1220	610	1	12	3.5
			20	6
			25	8
			40	9.5
			50	12
			75	16
			100	20
1220	610	2	40	18.5
			50	22
			75	30

4.1. Tolerances

± 6 mm in length, ± 4 mm in width and ± 2 mm in thickness,
Deviation from rectangular shape not more than 5 mm.

5. Requirements**5.1. Deflection under Test Load** – Shall not exceed the following

Type	Size Mm x mm	Thickness Mm	Test Load Kg	Test Span Cm	Deflection (Max)
1	2000x500	25	100	45	6
	1220x610	25	165	27.5	6
	2000x500	40	90	75	6
	1200x610	50	90	75	6
		75	120	75	5
		100	150	75	5
2	2000x500	40	120	75	6
	1200x610	50	160	75	6
		75	240	75	5

5.2. Thermal conductivity – Shall not exceed 0.08 W/m. °C.**5.3. Sound absorption**

Frequency Hertz	Minimum Sound Absorption Coefficient For 25 mm Thickness with Rigid Backing
125	0.1
250	0.2
500	0.2
1000	0.3
2000	0.5
4000	0.5

Note: For test procedures, refer to Appendix B of the Standard, IS: 3346-1966 Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot-plate method) and IS: 8225-1976 Method of measurement of absorption coefficient in a reverberation test.

Annexure 9-A.23

FIBRE INSULATION BOARDS

(Extract of IS: 3348-1965)

1. **Scope** – Requirements for insulating boards made of wood or sugar cane fibre. It also covers the following special types of fibre insulation boards

- Bitumen** – Bonded fibre insulating board, and
- Flame** – Retardant treated fibre insulating board.

2. Dimensions and tolerances

Types of board	Nominal Thickness Mm	Tolerance on Thickness Mm	Length Cm	Width Cm
Fibre insulation	9	± 0.75	365, 300	180, 150

Board, ordinary or flame retardant type.	12	± 0.75	270, 240	120, 100
	18	± 1.00	210, 180	90, 60
	25	± 1.25	150, 120	45 and 30
Bitumen-bonded Fibre insulation Board	<div> <div>9</div> <div>12</div> <div>18</div> <div>25</div> </div>	<div> <div>± 0.50</div> <div>± 0.50</div> <div>± 0.75</div> <div>± 0.75</div> </div>	100, 120 60, 45 and 30	30

Tolerance on ± 3 mm upto 120 cm and

Length and width ± 6 mm above 120 cm

3 . Requirements

3.1. Density – shall not exceed 0.4g/cm³.

3.2. Transverse strength

Types of boards	Thickness Mm	Mean breaking load Min. kg	Approximate modulus of rupture for nominal thickness.kg/cm ²
Fibre insulation Board ordinary or flame retardant type	9	7.2	20
	12	12.8	20
	18	23	16
	25	44	16
Bitumen bonded fibre insulating board	9	13	38
	12	23	38
	18	45	32
	25	86	32

3.3. Water absorption

Types of board	Nominal Thickness Mm	Mean water absorption At 27 ± 2° C. Max
Fibre insulation board, Ordinary or flame Retardant type	9	30
	12	30
	18	25
	25	25
Bitumen-bonded fibre Insulation board	9	25
	12	25
	18	20
	25	20

3.4. **Thermal conductivity** – Shall not exceed 5.6 kcal.cm/m²h°C.

3.5. Sound absorption

Frequency, c/s	125	250	500	1000	2000
Absorption Coefficient, Min	0.1	0.1	0.2	0.3	0.5

4. **Special requirement for flame-retardant boards** – Average maximum area of char, when tested for surface spread of flame, shall not exceed 75 cm².

Note: For test procedures, refer to IS: 3308-1981 Specification for wood wool building slabs and Appendix A to E of the standard.

Annexure 9-A.24

HIGH DENSITY WOOD PARTICLE BOARDS

(Extract of IS: 3478-1966)

1. **Scope** – Requirements of high density wood particle boards in flat sheet or moulded forms.
2. **Types** (depending on Synthetic Resin Used) and Grades (depending on extent of resin content)

Type 1 – BWR type of resin – Grades A and B.**Type 2** – WWR or CWR type of resin – Grades A and B.

Each type and grade may be in flat sheet form or moulded form.

3. Materials3.1. **Timber** – Any suitable species.3.2. **Adhesive** – As in Grade A resin content is 20 to 50 percent and in grade B, 8 to 12 percent.3.3. **Sizing** – Paraffin wax up to 1 percent. Max.**4. Dimensions and tolerances for flat sheets**a) **Length** – 180, 150, 120, 100, 90, 60 and 45 cm.b) **Width** – 150, 120, 100, 90 and 45 cm.c) **Thickness** – 50, 45, 40, 35, 30, 25, 22, 20, 16, 12, 9, 6 and 4 mm.**d) Tolerance**Length and width, ± 6 mm.Thickness ± 5 percent up to 25 mm, ± 2.5 percent above 25 mm.

Length of diagonals of a board shall not differ by more than 2.5 mm/m length of diagonal. Edges shall be straight with tolerance of 3 mm.

5. Physical requirements – Shall be as specified in the IS standard.

Note: For test procedures, refer to IS: 2380 (Part I to XXI)-1977 Methods of test for wood particle boards and boards from other lignocellulosic materials (first revision) and 9.3 of the standard.

Annexure 9-A.25

TIMBER PANELLED AND GLAZED SHUTTERS**PART I DOOR SHUTTERS**

(Extract of IS: 1003 (Part 1)-1977)

1. **Scope** – Requirements regarding material, sizes, construction, workmanship, finish, inspection and testing of timber door shutters with timber, plywood, blockboard, veneered particle board, hardboard and asbestos cement board panels used in domestic buildings, offices, schools, hospitals, etc. This standard does not cover timber door shutters for industrial and other special buildings, such as workshops and garages.

2. **Timber** – Moisture content 10 to 16 percent for thickness 50 mm and above and 8 to 14 percent for thickness below 50 mm. All timbers shall be kiln-seasoned. Sapwood of durable species and heartwood and sapwood of non-durable species shall be treated with suitable non-leachable type preservative.

Note – For suitable species of timber see Table 1 of the standard.

3. Requirements3.1. **Timber paneling** – No single panel shall exceed 0.5 m² in area.3.2. **Plywood paneling** – Shall be of BWP grade minimum thickness 12 mm for single panel construction and 9 mm for 2 or more panel construction.3.3. **Blockboard paneling** – Thickness not more than 10 mm.3.4. **Particle board paneling** – Shall be made of one piece of veneered particle board. Thickness shall be 12 mm, Min.3.5. **Hardboard paneling** – Tempered quality. Thickness 12 mm, Min.3.6. **Asbestos cement paneling** – Minimum thickness 12 mm in case of single panel shutters and 10 mm in case of 2 more panels' construction.

3.7. **Lock rail centre line** – 80 cm from bottom of shutter.

4. Dimensions, sizes and tolerances

4.1. Dimensions of door shutters (in mm)

Type	Width	Height
8 DS 20	700	1 905(1945)
8 DS 21	700	2 005(2045)
9 DS 20	800	1 905(1945)
9 DS 21	800	2 005(2045)
10 DS 20	900	1 905(1945)
10 DS 21	900	2 005(2 045)
12 DT 20	1 100*	1 905(1 945)
12 DT 21	1 100*	2 005(2 045)

Note 1: In arriving at the standard widths and heights for panel doors, and allowance of 6 cm has been made for door frames, 4 cm for floor finish and 0.5 cm for clearance all round between door opening and door frames and 1.5 cm for rebate all round for the shutter into the frame. In case the modular height is taken from the finished floor level, the height shall be as given in bracket.

Note 2: Type of shutter is designated by symbols denoting, in sequence, width (number of modules in width of door opening); type (D= door, W = Window, S= single shutter, T = Double shutter) and height (number of modules in height of door opening).

4.3. **Tolerance** – Shall be ± 3 mm on size of door.

4.4. Dimensions of components (finished dimensions in mm)

	Width	Thickness
Vertical Stile, top and Freeze rail	100 \pm 3	40 \pm 1
Lock rail	160 \pm 3	40 \pm 1
Bottom rail	250 \pm 3	40 \pm 1
Mounting	100 \pm 3	40 \pm 1
Glazing bar	40 \pm 1	1

5. **Glazing** – Glass used for panels shall weigh not less than 7.5 kg/m².

6. Finish

6.1. Defective knots, when permitted on surfaces exposed to view shall be completely bored or cut out and tightly plugged with the same timber species and properly glued in. Grains of plug shall run in direction of the grains of the piece.

6.2. Surfaces of door shutters which are required to be painted ultimately shall be covered by brush painting with a priming coat. Doors to be polished or varnished shall be given a priming coat of polish or varnish.

*Combined width of two shutters in closed position.

For detailed information, refer to BIS: 1003 (Part I)-1977 Specification for timber paneled and glazed shutters Part I Door shutters (second revision).

Annexure 9-A.26

TIMBER PANELLED AND GLAZED SHUTTERS PART II WINDOW VENTILATOR SHUTTERS

(Extract of IS: 1003(Part II)-1966)

1. **Scope** – Requirements regarding material, construction, sizes, workmanship, finish, inspection and testing of timber window and ventilator shutter with timber plywood, particle board, hardboard and asbestos cement panels used in domestic buildings, offices, schools, hospitals, etc. It does not cover timber window and ventilator shutters for industrial buildings, workshops and garages.

2. Dimensions**a) Window shutters**

Type	Width (mm)	Height (mm)
6 WS 12	500	1 100
10 WT 12	460	1 100
12 WT 12	560	1 100
6 WS 13	500	1 100
10 WT 13	460	1 100
12 WT 13	560	1 200

b) Ventilator shutters

Type	6V6	10V6	12V6
Width (mm)	500	900	1 100
Height (mm)	500	500	500

c) Components

Vertical stiles, top and freeze rails	Width 80 mm
Bottom rails	Width 80 mm
Glazing bars	Width 40 mm
Mounting width for window shutter	60 mm

d) Thickness of shutter 20, 25 or 30 mm depending on size.Tolerance ± 1 mm.**e) Tolerances** ± 1 mm on dimensions up to 40 mm ± 3 mm on dimensions over 40 mm.

Note 1: Size are divided after allowing for thickness of frame and a margin of 5 mm all round for fitting into a modular opening based on 10 cm module.

Note 2: Type of shutter is designated by symbols, denoting width (number of modules in width of opening); type W=window; V=Ventilator, S=single shutter, T=double shutter, and height (number of modules in height of opening).

f) Tolerance on overall dimensions ± 3 mm.

Note: For details regarding materials, finish and glazing refer to IS: 1003(Part I)-1977 Specification for timber paneled and glazed shutters Part 1 Door shutters (Second revision)

Annexure 9-A.27

WOODEN FLUSH DOOR SHUTTERS**(CELLULAR AND HOLLOW CORE TYPES) PART I PLYWOOD FACE PANELS**

(Extract of IS: 2191(Part 1)-1980)

1. **Scope** – Requirements regarding types sizes, materials, construction, workmanship and finish, and tests of cellular and hollow core wooden flush door shutters with face panels of plywood for cross-band face veneers.

2. Types

(a) Cellular decorative type (CD) (b) Cellular non-decorative type (CN) (c) Hollow decorative type (HD) (d) Hollow non-decorative type (HN)

3. Sizes**a) Width and height**

Designation	Width (mm)	Height (mm)
8 DS 20	700	1 905
8 DS 21	700	2 005
9 DS 20	800	1 905

9 DS 21	800	2 005
10 DS 20	900	1 905
10 DS 21	900	2 005
12 DT 20	1 100*	1 905
12 DT 21	1 000*	2 005

Note: If modular height is taken from the finished floor level, the height of door shall be 40 mm more.

b) **Thickness** – 25, 30 or 35 mm, nominal.

Tolerances- On nominal width and height shall be +3 and -0 mm tolerance on nominal thickness shall be ± 1.2 mm. Thickness of door shutter shall be uniform throughout with a permissible variation of 0.8 mm maximum.

Note 1: In arriving at standard widths and heights, an allowance of 6 cm has been made for door frames, 4 cm for floor finish and 0.5 cm for clearance all round and 1.5 cm for rebate all round for the shutter into the frame.

Note 2: Type of shutter is designed by symbols denoting width (number of modules in width of door opening) type (D= door; S= single shutter; T= double shutter) and height (number of modules in height of door opening).

4. Materials

4.1. **Timber** – Moisture content shall not exceed 12 percent.

Note: For species of timbers see Appendix A of the standard.

Timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross section may be permitted. Pitch pockets, pitch streaks and harmless pin-holes shall be permissible except in the exposed edges of the core members where they shall be cut out and filled in with carefully fitted glued pieces of wood of similar species and character with their grains running in the same direction.

4.2. **Plywood** – Commercial plywood shall be of BWP grade, at least type BC. Decorative plywood shall be of Grade I.

4.3. **Cross-bands** – BWP grade.

4.4. **Adhesives** – Phenol formaldehyde synthetic resin, BWP type.

4.5. **Particle board** – Flat-platen pressed or extrusion pressed type. Swelling of particle board in thickness and length shall not exceed 5 percent.

5. Requirements

5.1. Plywood for face panels

Minimum thickness for cellular core shutters – 3 mm,

Minimum thickness for hollow core shutters for 25 mm thickness – 4 mm,

Minimum thickness for hollow core shutter over 25 mm thickness – 6 mm,

5.2. **Rebating** – One third thickness for double leaved shutters.

5.3. Shutters shall be shop-prepared for taking mortice locks or latches.

6. **Workmanship and Finish** – All the four edges shall be square. Shutter shall be free from twist or warp.

7. Tests

7.1. **End immersion test** – There shall be no delamination.

7.2. **Knife Test**

7.3. **Adhesive Test**

7.4. **Types Tests** - Combined width of two shutters in closed position.

Note: For test procedures, refer to BIS: 1659-1979 Specification for blackboards (second revision), IS: 4020-1967 Methods of tests for wooden flush doors Type tests and 9 of the standard.

**WOODEN FLUSH DOOR SHUTTERS
(CELLULAR AND HOLLOW CORE TYPES)
PART II PARTICLE BOARD FACE PANELS AND HARDBOARD FACE PANELS**
(Extract of IS: 2191(Part II)-1980)

1. **Scope** – Requirements regarding material, grade, types, sizes, construction, finish and tests of cellular and hollow core wooden flush door shutters with particle board face panels of veneered and un-veneered types of particle board and hardboard face panels.

2. **Types and designation**

Core	Type	Designation
Cellular	Decorative with skins of decorative veneered particle boards.	CDPV
	Non-decorative with skins of particle boards	CNP
	Un-veneered Non-decorative with skins of particle boards	CNPV
	Veneered with commercial veneers	
Hollow	Decorative with skins of decorative veneered particle boards	HDPV
	Non-decorative with skins of particle boards un-veneered.	HNP
	Non-decorative with skins of particle boards veneered with	HNPV
	commercial veneers.	

3. **Sizes and tolerances** – Shall be same as given in IS: 2191 (Part I)-1980*

4. **Material**

4.1. **Timber** – Same as in IS: 2191 (Part I)-1980*.

4.2. **Particle Board** – Shall be made with phenol-formaldehyde adhesive. Swelling in thickness and length shall not exceed 5 percent.

4.3. **Fibre Hardboard** – Tempered.

4.4. **Adhesive** – Phenol formaldehyde synthetic resin, BWP type.

5. **Requirements**

5.1. **Face Panel** – Particle board thickness not less than 6 mm for cellular core and 9 mm for hollow core shutters. Hardboard thickness not less than 4 mm for cellular core and 6 mm for hollow core flush doors.

5.2. Shutters shall be shop prepared for taking mortice locks or latches.

6. **Workmanship and Finish** – All four edges shall be square. Shutter shall be free from twist or warp in its plane.

7. **Tests** – Requirements laid down in 9 of IS: 2191 (Part I)-1980* shall be complied with.

- Specification for wooden flush door shutters (cellular and hollow) core type Part I Plywood face panels 9th revision).

**WOODEN FLUSH DOOR SHUTTERS
(SOLID CORE TYPE) PART I PLYWOOD FACE PANELS**
(Extract of IS: 2202(Part 1)-1980)

1. **Scope** – Requirements regarding types, sizes, material, construction, workmanship and finish, and tests of solid core wooden flush door shutters with face panels of plywood or cross-band and face veneers.

2. **Types**

(a) Blockboard, decorative, BD (b) Blockboard, non-decorative, BN (c) Particle board with or without blockboard, decorative, PD. (d) Particle board with or without blockboard, non-decorative, PN.

3. **Sizes**

a) Dimensions

Designation	Width (mm)	Height (mm)
8 DS 20	700	1 905
8 DS 21	700	2 005
9 DS 20	800	1 905
9 DS 21	800	2 005
10 DS 20	900	1 905
10 DS 21	900	2 005
12 DT 20	1 100*	1 905
12 DT 21	1 100*	2 005

Note: If Modular height is taken from finished floor level, height of flush door shall be 40 mm more.

b) **Thickness** – 25, 30 or 35 mm, nominal.

c) **Tolerances** – Width and height, ± 3 mm Thickness, ± 1.2 mm.

Thickness of door shall be uniform throughout with a permissible variation of not more than 0.8 mm.

Note 1: In arriving at the standard widths and heights for flush doors, an allowance of 6 cm has been made for door frames 4 cm for floor finish and 0.5 cm for clearance all round between the door opening and door frame and 1.5 cm for rebate all round for the shutter into the frame.

Note 2: Type of shutter is designated by symbols denoting width (number of modules in width of door opening) type (D=door; S= single shutter; T= double shutter) and height (number of modules in height of door opening).

4. Materials

4.1. **Timber** – Moisture content shall not exceed 12 percent.

Note: For species of timbers see Appendix A of the standard.

Knots and knot holes less than half the width of cross section of members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pin-holes shall be permissible except in the exposed edges of the core members where they shall be cut out and filled in with carefully fitted glued pieces of wood of similar species and character with their grain running in the same direction.

4.2. **Plywood** – Commercial BWP grade, at least type BC Decorative Grade I.

4.3. **Cross-bands** – BWP grade.

4.4. **Adhesives** – Phenol formaldehyde synthetic resin, BWP type.

4.5. **Particle Board** – Flat-platen pressed or extrusion pressed type. Swelling of particle board in thickness and length shall not exceed 5 percent.

5. Requirements

5.1. **Face Panel**– Thickness of cross-band as such or in plywood shall be 1 to 3 mm. Face veneer 0.5 to 1.5 mm thick for commercial and 0.5 to 1 mm for decorative.

5.2. **Rebating** – One third thickness is double leaved shutters.

5.3. **Locks** – Shutters shall be shop-prepared for taking mortise locks as may be ordered.

6. **Workmanship and Finish** – All the four edges of the door shutter shall be square. Shutter shall be free from twist or warp in its plane.

7. Tests

7.1. **End immersion test** – There shall be no delamination.

7.2. **Knife test**

7.3. **Glue adhesive test**

7.4. **Types tests**

* Combined width of two shutters in closed position.

Note: For test procedures, refer to BIS: 1659-1979 Specification for block boards (second revision), IS: 4020-1967 Methods of tests for wooden flush doors Type tests and 9 of the standard.

WOODEN FLUSH DOOR SHUTTERS
(SOLID CORE TYPE)PART II PARTICLE BOARD AND HARDBOARD FACE PANELS
 (Extract of IS: 2202 (Part II)-1980)

1. **Scope** – Requirements regarding material, grade, types, sizes, construction, finishes and tests of wooden flush door shutters of solid core type with particle board face panels of both veneered and un-veneered particle boards.

2. **Types and designation**

Core	Type	Designation
Blockboard	Decorative with skins of decorative veneered particle boards	BDPV
	Non-decorative (paintable) with skins of particle boards un-veneered.	BNP
	Non-decorative (paintable) with skins of particle boards veneered with commercial veneers	BNPV
Particle board With or without block board	Decorative with skins of decorative veneered particle board.	PDPV
	Non-decorative with skins of particle boards un-veneered.	PNP
	Non-decorative with skins of particle boards veneered with commercial veneers.	PNPV

* Where particle board headed core is used, the designations will be PED, PV, PE, NP and PE N PV respectively.

3. **Sizes and tolerances** –Same as in BIS: 2202 (Part I)-1980*

4. **Material**

1.1. Species of timber, moisture content and permissible defects therein and preservative treatment required for use in core and lipping shall conform to relevant requirements laid down in BIS: 2202(Part I)-1980†.

1.2. **Particle boards** –Made with phenol formaldehyde adhesive. Swelling in thickness and length not exceed 5 percent.

1.3. **Hardboard** – Tempered.

1.4. **Adhesive** –For bonding particle board or hard board face panels to the core shall be phenol formaldehyde synthetic resin (BWP type).

5. **Requirements**

5.1. **Face panel** – Thickness of each face panel of particle board shall be at least 4 mm and of hardboard at least 3 mm.

5.2. Shutters shall be shop-prepared for taking mortice locks or latches.

6. **Workmanship and finish** – All the four edges of door shall be square. Shutter shall be free from twist or warp in its plane.

7. **Test**- Same as given in IS: 2202 (Part I)-1980*.

- Specification for wooden flush door shutters (solid core type) Part I Plywood face panels (third revision).

† Specification for wooden flush door shutters (solid core type) Part I Plywood face panels (third revision).

WOODEN SIDE SLIDING DOORS

(Extract of IS: 4962-1968)

1. **Scope** – Requirements regarding material, type, shape, fabrication, assembly and finish of wooden side sliding doors (of the straight sliding type), its gear components and fittings.
2. **Type and size** – Classified in accordance with mode of sliding of panels into the frame unit. Types 1 to 5 of the IS standard gives clear opening, while Types 6 and 7 need no space at the sides. Overall size of door shall be such as to cover modular opening completely.
Note For typical arrangement of panels of side sliding door see Fig. 2 of the standard.
3. **Materials**
 - 3.1. Rolled steel sections shall be of weldable quality conforming to IS: 2062-1969*.
 - 3.2. **Tracks** – Made of 2 mm thick structural steel sheet galvanized.
 - 3.3. **Roller** – Grade 15 of BIS 210-1970†. Prelubricated or self-lubricating type.
 - 3.4. **Guides** - Gun metal.
 - 3.5. **Brackets** – cast iron.
 - 3.6. **Shutter** – Made of wood in accordance with IS: 1003 (Part I)-1977, IS: 2191 (Part I)-1973, IS: 2191 (Part II)-1966, IS: 2202 (Part I)-1973 and IS: 2202 (Part II)-1966.
4. **Operation** – Shall be capable of being operated in either direction with force not exceeding 3 kg / m of panel width, when panel is in motion.
5. **Finish** – All components machined and finished smooth. Roller guides, fittings for locking arrangements, brackets, etc, may be hot-dip galvanized.

SPECIFICATIONS FOR FINISHING OF WOOD AND WOOD-BASED MATERIALS**PART I OPERATIONS AND WORKMANSHIP**

(Extract of IS: 2338(Part I)-1967)

1. **Scope**
 - 1.1 This standard (Part I) deals with operations and workmanship for the finishing of wood and wood-based materials with the pigmented and clear finishes.
 - 1.1.1 In this standard clear finishes, such as nitro-cellulose, polyester, polyurethane, acid catalysed cold cure amino-plast and similar type of finishes are not covered.
 2. **Terminology**
 - 2.1 For terms relating to paints and allied materials reference may be made to IS: 1303-1983†.
 - 2.2 For terms relating to wood and wood-based materials reference may be made to IS: 707-1976‡.
 3. **Necessary information**
 - 3.1. For the efficient application of finishes on wood and wood-based materials the following information is necessary and shall be furnished to the person in-charge of the work:
 - a) The type of wood and wood-based materials; the nature of their pretreatment, namely, preservation, seasoning, etc;
 - b) The location of the member to give an idea of the extent of exposure to weather;
 - c) The type of finish to be applied pigmented, clear, etc;
 - d) Information on the nature of previous finish would be desirable for re-decoration; and
 - e) Atmospheric conditions in the locality, namely, temperature, humidity, incidence of sunlight, etc.
 - 3.2. Necessary drawings and instructions shall also be furnished to the person in-charge of the work.
 - 3.3. Arrangement shall be made for proper exchange of information between those engaged in woods finishing work and those whose work will affect or will be affected.
- † Glossary of terms relating to paints (revised).
- ‡ Glossary of terms applicable to timber, plywood and joinery.
4. **General characteristics of wood and wood based materials**

4.1 The decorative and protective value of a finish may be influenced by the nature of the surface on which it is applied. There are several species of wood and an increasingly large number of wood-based panel products often differing from each other in surface characteristics. They may be hard, soft, resinous or porous in varying degrees.

4.1.1. Wood is a hygroscopic material and tries to reach a state of equilibrium with the atmosphere in so far as its moisture content is concerned. Changes in moisture content are accompanied by swelling and shrinkage, which is most pronounced across the grain of the wood. Due to moisture movement the summerwoods swell to a greater extent than springwoods and this sets up stress-concentration at the sharply defined junctions between one year's summer growth and the next year's spring and the failure commences about this region. The resulting stresses on the film of finishing material are such as to cause fissures to develop along the grain under adverse circumstances.

4.1.2. Before painting, wood shall be properly seasoned and the moisture content shall be brought as near as possible to the equilibrium moisture content as given in IS: 287-1993* so as to prevent uneven shrinkage during drying which may result in distortion or even in cracks in the paint finish. It is also advisable not to finish excessively dry wood.

4.1.3. The cellular structure of wood has a strong influence on the absorption of liquid components of finishes. Non-uniform absorption of vehicle by the wood upsets pigment-binder ratio, impairing the appearance and life of the coating.

4.1.4. Plywood, blockboard, hardboard and particle board have greater dimensional stability than solid wood and provides more uniform surface for finishing.

4.1.5. The trade and botanical names of different Indian timbers are given in IS 399-1963. The painting characteristics of some of the soft and hardwoods are given in Appendix A.

5. Design considerations

5.1. **Design and detailing of joinery timber** – Since water can find access through unpainted surface or joints and may encourage decay, in all cases where the wood surface is in contact with surfaces which are likely to get wet, such as brickwork or concrete, one or two priming coats shall be applied to wood surfaces before fixing to minimize absorption of water. Special attention is drawn to the following:

* Recommendations for maximum permissible moisture content of timber used for different purposes for different climatic zones (revised).

† Classification of commercial timbers and their zonal distribution (revised).

a) Window and door frames, flush with the wall face may allow ingress of moisture between the structural walling and the woodwork, and the paint is then likely to fail unless two prime coats are applied to the surface and allowed to dry before fixing.

b) The rails of gates shall preferably be beveled to shed water and help to prevent it from entering the joints between vertical and horizontal members.

c) Door posts and sash frames resting on steps or sills are liable to absorb water unless the steps or sills are so designed and built as to drain away water. Door posts, sash frames and similar joinery shall be adequately primed all over, taking special care to prime any cut surfaces before fixing.

d) Wherever required, in joinery exposed to weather, tenons and other concealed surfaces shall be primed before assembly. Members shall be assembled while the paint is wet. When surfaces are to be glued, priming may not be possible and hence the use of waterproof glue is recommended. Any painted beads or stops shall be primed on the underside and fixed in position while the paint is wet.

e) In design, consideration shall always be given to the grain direction and the effects of shrinkage; swelling and warping which may tend to open joints and break the paint film. Wide boards shall be fixed centrally or at one edge only, bearing in mind that movement may be sufficient to rupture the paint film or may cause the board, and with it the paint to split if the movement is unduly restrained in fixing. End grain shall receive special care in painting.

5.2. Selection of coating materials

5.2.1. Prime coat

5.2.1.1. A suitable wood primer shall adhere firmly to the surface, form a sound foundation for further coating and fulfill special functions, such as acting as a sealer on porous wood and hardboard.

5.2.1.2. Wherever the timber has large pores, a preliminary priming with a quick drying varnish of the gold size type conforming to IS: 198-1978* is desirable. The varnish shall be forced with a brush well into the pores so that the pores are completely filled. This filling of the pores shall not be regarded as a substitute for normal priming and shall be followed by a coat of the primer.

5.2.1.3. Pink wood primer (see IS: 3536-1966**) or the mixture of white and red lead primer may be used in painting structures containing a slight excess of moisture as they allow minute quantities of moisture to pass through without disrupting it.

* Specification for gold size varnish.

** Specification for ready mixed paint, brushing, wood primer, pink.

5.2.1.4. Aluminium primer may be used for priming wood having knots and resinous matter. The primer prevents the resin of the wood from bleeding.

5.2.2. **Stoppers and fillers** – For deep holes, plastic wood conforming to IS: 423-1961† shall be used. Stopping may be generally confined to large holes or cavities. Shallow indentations shall be made up with the paste filler conforming to IS: 426-1961‡. For high class work filling operation shall be done over the whole surface by using the filler conforming to IS: 110-1983§. For clear finishes, filler conforming to IS: 345 - 1952|| shall be used.

5.2.3. **Undercoat and finishing coat materials** – Before considering the application of undercoat and finishing coat it shall be made sure that those selected are compatible with each other. If a non-elastic finishing coat is applied over an elastic primer coat it may lead to cracking or alligating of the finishing and the primer coat may become visible through cracks in the finishing coat. Similarly, if the finishing coat contains a strong solvent, it may attack the primer coat and lead to shriveling (wrinkling) of the entire paint structure. It is, therefore, essential to specify and ensure that the various types of paints to be used are compatible with each other, and as Indian Standard specifications on paints allow enough latitude for the manufacturer to adjust his materials, it is advisable to consult the paint manufacturer and obtain his guarantee that the paints purchased not only satisfy the specified requirements but are also compatible with each other. As a general rule, it is safer to use primer and finishing paints made by the same manufacturer.

6. Painting new wood work

6.1. Surface preparation

Wood that is to be painted should be well seasoned and free from discoloured sapwood and from large resinous or loose knots. If the wood is not properly seasoned, the surface may become uneven on drying and cracks may also develop. Paint applied over discoloured sapwood is liable to become discoloured; resin from knots tends to exude through the paint. Any such unsound portions should, therefore, be cut out and replaced with sound wood.

Nails should be punched well below the surface to provide a firm key for stopping.

Moldings should be carefully smoothed with abrasive paper and projecting fibres left after machining should be removed. Quirks need particular attention since paint collects on any rough projections and the finished appearance is then marred.

* Specifications for ready mixed paint, wood primer, pink.

† Specification for plastic wood for joiner's filler (revised).

‡ Specification for paste filler for colour coats (revised).

§ Specification for ready mixed paint, brushing, gray filler, for enamels for use over primers.

|| Specification for wood filler, transparent, liquid.

Flat portions should be smoothed off with abrasive paper used across the grain prior to painting and with the grain prior to staining or if the wood is to be left in its natural colour. Woodwork which is to be stained is sometimes smoothed by scrapping instead of by glass papering.

Any knots, resinous streaks or bluish sapwood that are not large enough to justify cutting out should be treated with two coats of pure shellac knotting, applied thinly and extended about 25 mm beyond

the actual area requiring treatment. Aluminium primer may be used in the place of shellac knotting. If the area is small and the wood is not highly resinous, it is permissible instead of applying two coats of knotting, to apply one coat slightly pigmented with aluminium powder.

6.2. Priming

If there is dirt or any other extraneous material this shall be removed. If the woodwork is not already primed, a priming coat shall be applied. In case there is already a primer coat but an unsatisfactory one, it shall be rubbed down to bare wood and the surface reprimed. Primer shall be applied by brushing.

Care shall be taken to prime not only the surface of the wood that will be visible after fixing but also any surface which will be in contact with materials, such as brickwork or concrete from which the wood may absorb moisture. It would be an advantage to give such surfaces a further coat of primer, before fixing.

Unless specified otherwise, all joinery work, which is intended to be painted, shall receive at least two priming coats. It is particularly important that end grains be so treated and, if it is necessary to cut the joinery before fitting, all cut ends shall be painted with two priming coats.

6.3. Stopping and Filling – Stopping and filling should be done after priming. If the surface is not first primed, the filler or stopping may shrink and fall away, owing to absorption of some of the binder. Stopping is made to the consistency of stiff paste and is used to fill holes and cracks, while the function of the filler is to level up slight irregularities of surface. Filler is usually applied with a putty knife and is subsequently rubbed down to a level surface with abrasive paper, pumice stone or other suitable abrasive. For certain work, fillers are mixed to the consistency of thick paint and applied with a brush.

The filler coat should be of an optimum thickness and should be allowed to fully harden and flatten before subsequent coat is applied. Apply as many layers as necessary allowing the coats to harden and flatten between coats.

6.4. Application of undercoat – Undercoat shall be applied after the surface has been primed, stopped, filled and rubbed down to a smooth surface. Undercoat may be brushed or sprayed. After drying the coat shall be carefully rubbed down and wiped clean before the next coat is applied.

6.5. Finishing – The application paint varies according to the type of paint employed. Cleanliness is essential and as far as possible the application should be carried out in normal dry conditions. The finishing coat may be applied either with the brush or sprayed.

7. Application of clear finishes

7.0. General – Clear finishes for wood are generally used for interior surfaces as their durability when used on external surfaces is less than that of pigmented coating. This is mainly because of the destructive action on the clear finishes by the ultraviolet rays present in the sunlight. The ultraviolet radiation is to a great extent absorbed by the pigments present in the coatings while it may cause considerable damage to clear finishes.

7.1. For the application of clear finishes the following procedure shall generally be adopted:

(a) Filling, (b) Staining, (c) Sealing, and (d) Finishing.

7.2. Filling

The primary function of fillers is to fill the opened cells of the wood in the surface layer. This is necessary to prevent the excessive penetration of the finish, that is, subsequently applied and to level off the surface of a porous wood to make a smooth top finish possible.

On hardwood with large open vessels a suitable filler conforming to BIS: 345 – 1959* may be used. For special stain effects coloured fillers shall be used.

A combination of filler and stain may be used for reasons of cost, that is, to eliminate a separate staining operation. However, the result lacks the grain and colour contrast characteristic of wood stains.

One fine-textured woods having minute pores that do not require filling, unfilled drying oils, thin varnishes, lacquer or shellac may be used.

Filler or stain filler shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It may be rubbed when still wet to get better penetration. After 5 to 10 minutes it shall be wiped off by hand across the grain followed by a light wipe with the grain. Picking out of corners and carvings may be done with a rag wrapped around the end of a sharpened wood dowel. The filled surface shall be dried preferably overnight, and smoothened with abrasive paper. Wipe with a clean soft rag to remove dust and nibs.

* Specification for wood filler, transparent, liquid.

7.3. Staining

Staining of wood may be resorted to for indoor fittings and even then only for subsequent clear finishes. The object of staining wood is to darken it as part of a decorative scheme. If skillfully carried out, staining may be used with good effect to enhance the natural grain or figuring of the wood.

The depth of colour produced by staining will depend not only on the concentration of the stain but also on the extent to which it is absorbed by the surface. Stain is readily absorbed by soft porous springwood but comparatively little by the harder and denser summerwood. Hardwoods, being less absorbent, will present less difficulty; the stain may be applied liberally and allowed to remain until sufficient quantity is absorbed, the excess being then wiped off, if necessary. The effects produced by knots, resinous portions and other markings may be similarly accentuated. The different types of stains as water, spirit and oil stains have different penetrating properties and, therefore, shall be selected to suit the performance required.

7.3.1. Water stains – Water stains are made with water-soluble dyes. They emphasize the grain, especially that of softwoods, since they are readily absorbed by the porous portions but less readily by the denser, more resinous portions. They will raise the grain of the wood thus spoiling the smoothness of the finish if a highly polished effect is required; this difficulty can be overcome by first wetting the surface with water to raise the grain and then, after drying, smoothing it with abrasive paper before staining. Where it is necessary to provide a temporary staining treatment on wood, that is, damp or unseasoned, water stain is preferable to other types of stain.

7.3.2. Spirit stains – Spirit stains are solutions of spirit soluble dyes in industrial methylated spirit. Like water stains, spirit stains penetrate more into the softer portions of the wood and so accentuate the grain but they do not cause the fibres to swell nor raise the grain. They will dry very quickly and shall be applied quickly and skillfully to avoid patchy effects. If applied to damp wood the dyes in the stains are liable to be thrown out of solution. The surface after staining with spirit stains may be finished in the same way as after treating with water stains.

7.3.3. Oil stains – Oil stains may be solutions of oil soluble dyes in linseed oil but usually, to give a range of colours, they consist of insoluble, semi-transparent pigments ground in linseed oil and thinned with turpentine or other solvent. Sometimes wax is added to make the stain less penetrating. Oil stains will give a softer effect than water stains or spirit stains. Generally they may be finished with gloss or flat oil varnish. If wax polished, the stain shall first be given time to dry hard. If applied to damp wood they are likely to develop a milky effect or bloom. The application of oil stains and varnish will retard the drying of the wood. Oil stains will not take well on certain resinous or oily woods, such as teak. Sometimes, these woods are pretreated with solvents to remove the greasy matter from the surface prior to oil staining or varnishing.

7.3.4. Wash Coating – If grain raising stains have been employed or if it is desired to reduce to a minimum the risk of stain bleeding into top coats and to prevent discoloration of wood by absorption of oil and stains from the filler, a thin coat of shellac or lacquer shall be applied on the stained surfaces before sanding.

The stain may also be mixed with varnish to produce the combined effect in one operation; the result will, however, not be as satisfactory as when the 'finishing' follows as a separate operation after staining. Alternatively, the stain may also be mixed with wax so that after application in one operation the wax may be polished. Here again the results will not be as satisfactory as in a two-stage system.

7.3.5. Preparation of wood for staining

Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothing with fine abrasive paper, used in the direction of the grain; scratches across the grain are likely to become stained darker than the rest of the surface and so spoil the finished appearance. If water stain is to be used, the surface of the wood shall be wetted with water to raise the grain and then be allowed to dry before finally smoothing.

Small cracks or nail holes may be stopped with plastic wood, fine plaster of paris or other suitable stopping, if water stain or spirit stain is to be used. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a little thinned knotting before staining. Where oil stain is to be used, stopping shall preferably be done after staining, using tinted putty or wood filler.

If necessary, softwood may be treated with hot weak size before staining to prevent undue absorption of stain, but an excess of size should be avoided. To a certain extent the degree of penetration of a stain may be controlled by pretreatment of the absorbent surface with a hot weak size of thinned shellac varnish. Size shall preferably be not used where the stained surfaces are likely to come into contact with water, which may smear it. To control the depth of colour, however, diluted stain may be made to soak well into the wood. Where size is used, the surface shall be allowed to dry thoroughly before staining. In general, flat surfaces shall be treated first and mouldings and edges last, that is, reversing the order recommended when applying paint, the object being to avoid double staining along the edges.

7.3.6. **Application of stains**

Stains may be applied by brushing and wiping or by spraying. The stain shall be so thinned that it can be applied fairly liberally without over-staining. Care shall be taken, especially on absorbent softwoods, to apply the stain evenly and without overlapping. Spirit stains; in particular require careful and quick application as they dry very quickly.

The stained surface shall be varnished, wax-polished or french polished as required after it has dried. For reasons of economy, the surface shall be sized before varnishing, in which case it is important to allow the size to dry thoroughly. Where a more durable finish is required two or three coats of finishing clear varnish is recommended.

7.4. Sealing – A suitable sealer shall be applied on the filled and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

Sealer may be sprayed on taking care not to flood the surface. It is allowed to dry hard.

A stain (toner) may be incorporated with the sealer for special colour effects.

When fully dry the surface shall be sanded taking care not to cut through at corners and edges. Dust shall be blown off and surface wiped with a clean rag.

7.5. **Varnishing**

7.5.1. Surfaces to be varnished should be prepared to produce a smooth, dry, matt surface. Previous coats of paint or stain, if any, should be allowed to dry and be rubbed down lightly, wiped off and allowed to dry.

The operation of varnishing calls for careful attention to cleanliness. All dust and dirt should be removed from the surface to be varnished and also from the neighborhood. If the surfaces are dampened to avoid rising of the dust, they should be allowed to dry thoroughly before varnishing is commenced. Damp atmosphere and draughts should be avoided. For exterior work, a normal dry day should be chosen. Exposure to extremes of heat or cold or to a damp atmosphere will spoil the work.

In handling and applying varnish care should be taken to avoid forming froth or air bubbles. Brushes and containers should be kept scrupulously clean.

7.5.2. **Application** – The varnish should be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It should be allowed to flow out while the next section is being laid-in. Excess varnish should then be scraped out of the brush and the first section be crossed, re-crossed and then laid off lightly. Too much or too little varnish left on the

surface will mar the appearance of the finish. The varnish, once it has begun to set, should be retouched. If a mistake is made, the varnish should be removed and the work started afresh.

Where two coats of varnish are specified, the first should be a hard-drying undercoating or flattening varnish; this should be allowed to dry hard and then be flattened down before applying the finishing coat. If two coats are applied, sufficient time should be allowed between coats.

When flat varnish is used for finishing, a preparatory coat of hard drying undercoating or flattening varnish should first be applied and should be allowed to harden thoroughly. It should then be lightly rubbed down before the flat varnish is applied. Sections of the work, such as panels, should be cut in clearly, so as to avoid any overlapping during application, as this is likely to impart some measure of gloss to partially dried areas, worked up in lapping. On larger areas, the flat varnish should be applied rapidly, and the edges of each patch applied should not be allowed to set, but should be followed up whilst in free working condition.

8. French polish

Pure shellac varying from pale orange to lemon yellow colour, free from resin or dirt should be dissolved in methylated spirit at the rate of 0.15 kg of shellac per litre of spirit (see BIS: 348 – 1952*). Suitable pigment should be added to get the required colour.

8.2. Preparation of surface – All unevenness should be rubbed down to smoothness with sandpaper and the surface should be well dusted. Fill up the pores in the wood with a filler made of a paste of whiting in water or methylated spirit (with a suitable pigment like burnt seinna or umber, if required) otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.

8.3. Application of polish – A pad of woolen cloth covered by a fine cloth should be used to apply the polish. The pad should be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface should be allowed to dry and the remaining coats applied in the same way. To finish off, the pad should be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface should have a uniform texture and high gloss.

9. Finishing of wood-based materials

9.1. Plywood – Plywood is similar to solid wood in its finishing characteristics.

9.2. Hard board

9.2.1. Painting characteristics – hard board is made up of fibres which are capable of swelling under the influence of oil paints. Tempered hard board may be varnished or painted, if required.

9.2.2. Treatment – A suitable treatment to prevent swelling under the influence of oil paints is necessary; one such treatment is to use plastic emulsion paint thinned with water, another is shellac varnish as the first coat and when dry rub down with fine grade glass paper and follow with required undercoating and finishing coats as for solid wood.

9.3. Particle board – The surface shall be filled with a thin brushable filler and finished as for solid wood.

* Specification for French polish.

9.4. Insulation board – Two thin coats of water-based paints shall be applied by spraying

9.5. Wood treated with preservative

9.5.1. Painting characteristics – Wood treated with the commonly used water soluble preservatives may be painted satisfactorily after it is dried. The life of the coating may, in some instances, be slightly less than it would have been on untreated wood, but the loss in durability is not such as to offer any practical objection to the use of treated wood for purposes where preservation against decay is necessary and the appearance of painted wood and protection against weathering are desired. Coal-tar creosote or other dark oily preservatives tend to bleed through paint unless the treated wood has been exposed to the weather for many months before it is painted.

9.5.2. Treatment – Fairly satisfactory results may be obtained on creosoted wood with rough surfaces (sawed or weather-beaten surfaces) by applying exterior water thinned paints, such as case-in paints or resin emulsion paints.

Creosote-treated wood shall not be painted with ordinary paint as discolouration of the latter may result. One or two sealing coats of aluminum paint or shellac knotting clear or pigmented with aluminium powder shall be applied before it is finished with other paints.

In the case of wood treated with other preservatives, such as copper naphthenate, chlorophenol and zinc silico fluoride, a high quality aluminium primer is desirable.

Alternatively, advice may also be sought of the manufacturers of these preservatives for information as to the suitable primer that may be applied over these.

10. Inspection

10.1. While the finishing is in progress, inspection shall be made to ascertain that the right type of finishing material is being used, and the number of coats and the sequence of operation are carried out as specified. The points as laid down in 10.1.1 to 10.1.4 shall be specially noted.

10.1.1. As the first signs of failure of paint may not appear until some time after the work has been completed, inspection of work can only be directed towards ascertaining as far as possible that the types of paints and number of coats applied are as specified, and that the standard of work is satisfactory.

10.1.2. The chief points on which the general quality of paint work should be judged by visual inspection are as follows:

(a) Uniformity of finish and colour; (b) Uniform and complete obscuration of the ground; (c) Freedom from blemishes (for example, runs, sags, wrinkling, fat edges, entrained paint skins, dust, bare or starved patches and cracks); (d) Freedom from tackiness; (e) Freedom from brush marks and ladders; and (f) General cleanliness and neatness of finish.

10.1.3. Should the paint appear faulty during application any defects in the following properties should be noted and the matter reported to those responsible:

(a) Colour, (b) Consistency, (c) Drying time, or (d) General quality of finish.

10.1.4. Since it is the final coat of paint which claims attention it is a common error to blame the paint or workmanship for any defects. These are by no means the only factors which may influence the final result. In attempting to diagnose a paint failure the following details should be ascertained and taken into consideration:

(a) Nature, history and condition of the painted surface; (b) Materials used; (c) Climatic conditions before, during and after painting; (d) Technical correctness of work in relation to conditions; and (e) Workmanship.

11. Maintenance

The principle given in Table 3 of IS: 2338 (Part II) -1967* shall generally be adopted for maintenance work. All unsound work should be burnt off or otherwise removed and brought forward as for new work.

The surface should be cleaned and rubbed down with pumice stone or abrasive paper. All holes and cracks should be prepared for stopping by touching them up with primer paint, with undercoat paint; when dry, the stopping should be completed with a suitable filler and the appropriate paint as given in IS: 2338(Part II)-1967* should then be applied.

* Code of practice for finishing of wood and wood-based materials: Part II Schedules.

APPENDIX A

(Clause 4.1.5)

PAINTING CHARACTERISTICS OF TIMBERS

A-1. Some of the soft and hard woods given in A-1.1 and A-1.2 are resinous or show oily exudation occasionally and hence they require special treatment. In general, hardwoods are porous and require filling. However, some of the hardwoods given in A-1.3 do not require filling as their pores are less than about 100-microns in diameter or are filled with gum.

A-1.1. The following softwoods are resinous and may exude resin through paint films;

Trade name	Botanical name
Chir	Pinus roxburghii Sargent
Cypress	Cupressus torulosa Don
Deodar	Cedrus deodara Loudon
Kail	Pinus wallichiana A.B.Jacks
Spruce	Picea smithiana Boiss

Annexure 9-A.33

SPECIFICATIONS FOR FINISHING OF WOOD AND WOOD - BASED MATERIALS

PART II SCHEDULES

(Extract of IS: 2338 (Part II)-1967)

1. Scope

1.1. This standard (Part II) lays down schedules for finishing of wood and wood-based materials with paints, varnishes, polishes and other organic coatings.

2. Terminology

2.1 For the purpose of this standard, the terms pertaining to painting material, finishes, tools and accessories as given in IS: 1303-1963* and IS: 707-1958 shall apply.

3. Necessary information

3.1 The necessary information required for the efficient application of finishes on wood and wood-based materials shall be provided as given in 3 of IS: 2338 (Part I)-1967.

4. Schedules for finishing woodwork

4.1. New woodwork

4.1.1. **Preparation** – The surface shall be prepared as specified in IS: 2338 (Part I)-1967. However, the following points shall be noted;

- The surface shall be cleaned and smoothened with abrasive paper,
- The surface shall be primed,
- Knots shall be treated with two coats of shellac knotting, and
- Deep holes shall be filled with plastic wood conforming to IS: 423-1961.

4.1.2. **Finish** – The different coats as specified in Tables 1 and 2 shall be applied along with stopping and filling where necessary for the corresponding type of finish.

4.2. **Maintenance Work** – In the case of painting or finishing relating to maintenance work, the principles given in Table 3 should generally be adopted.

Table 1 Schedules for finishing new woodwork –Interior

Sl. No.	Final finish required	Primer (one or two coats as required)	Undercoat	First finishing coat	Second finishing coat
i	Enamel	IS:103-1962 or IS:3536E-1966 or IS:106-1962 or IS:3585-1966	IS:133-1965	IS:133-1965	IS:133-1965
ii	Oil Gloss	IS:103-1962	IS:3539E-	IS:3537E-1966	IS:3537E-1966

		or IS:3636E-1966 or IS:3585-1966	1966 or IS:113-1950 or IS:114-1950	or IS:129-1950	or IS:129-1950
iii)	Flat	IS:103-1962 or IS:3536E-1966 or IS:3585-1966	IS:133-1965 or IS:3539-1966 or IS:113-1950 or IS:114-1950	IS:137-1965 or IS:3537E-1966	IS:137-1965 or IS:3537E-1966
iv)	Varnish	IS:345-1952	IS:338-1958 or IS:339-1952	IS:337-1952 or IS:524-1954 or IS:525-1954	IS:337-1952 or IS:524-1954 or IS:525-1954
v)	Grained Work	----	Merging type glaze or Stains (see Appendix B)	Merging type glaze or Stains	IS:337-1952 or IS:524-1954 or IS:525-1954

Note 1: For finishes (i), (ii) and (iii) fillers conforming to IS: 426-1961 or IS: 110-1950 may be applied after the prime coat as required.

Note 2: When proprietary materials are used the finishing and the adjuncts shall be obtained from the same manufacturer.

Note 3: When French polish is used for finishing, it shall conform to IS: 348-1952 and the finishing shall be carried out as given in IS: 2338 (Part I)-1967.

Note 4: Titles of Indian Standards referred to in this table are given in Appendix A.

Table 2 Schedules for finishing new woodwork – Exterior (Clause 4.1.2)

Sl. No.	Final finish required	Primer	Undercoat	First finishing coat	Second finishing coat
i	Enamel	IS:103-1962 or IS:3536E-1966 or IS:106-1962 or IS:3585-1966	IS:2932-1964 or IS:2933-1964	IS:2932-1964 or IS:2933-1964	IS:2932-1964 or IS:2933-1964
ii	Oil Gloss	IS:103-1962 or IS:3636E-1966 or IS:3585-1966	IS:3539E-1966 or IS:111-1950 or IS:112-1950	IS:3631E-1966 (alkyd) or IS:117-1964 or IS:119-1962 or IS:124-1962 or IS:125-1962 or IS:127-1962 or IS:128-1962 or IS:1188-1957	IS:3631E-1966 (alkyd) or IS:117-1964 or IS:119-1962 or IS:124-1962 or IS:125-1962 or IS:127-1962 or IS:128-1962 or IS:1188-1957
iii	Flat	Proprietary materials to be used			

iv	Varnish	IS:345-1952	IS:339-1952 Or IS:339-1952	IS:524-1954	IS:524-1954
v	Grained Work	----	Merging type glaze or Stains (see Appendix B)	IS:524-1954	IS:524-1954

Note 1: For finishes (i), (ii) and (iii) fillers conforming to IS: 426-1961 or IS: 110-1950 may be applied after the prime coat as required.

Note 2: When proprietary materials are used the finishing and the adjuncts shall be obtained from the same manufacturer.

Note 3: Titles of Indian Standards referred to in this table are given in Appendix A.

Table 3 Recommended practices for maintenance painting (Clause 4.2)

Sl. No.	Condition of surface				Cleaning and painting practice
	Blistering	Cracking	Checking	Chalking	
i)	Nil	Nil	Nil	Yes	Clean; rub with sand paper, apply one reviver coat
ii)	Nil	Nil	Yes	Nil	Flat down to remove checked film; clean; apply one or two reviver coats
iii)	Nil	Yes, localized	Nil	Nil	Rub down with steel wool/sand paper to remove cracked/crazed film; touch up with primer where damaged; apply two coats of finishing
iv)	Yes, localized	Nil	Nil	Nil	Scrape and rub down (with sand paper) the spot to bare wood, feather out the edges of paint, allow the surface to breathe out; touch up with primer; apply two coats of finishing (with a coat of under-coat, if necessary)
v)	Yes, localized	Nil	Nil	Yes	Treatments in (i) and (iv) combined
vi)	Yes, localized	Nil	Yes	Nil	Treatments in (i) and (iv) combined
vii)	Yes, localized	Yes, deep	Nil	Nil	Completely remove paint to bare wood and follow the full schedule
viii)	Nil	Yes, deep	Nil	Nil	---do---
ix)	Yes, heavy	Nil	Nil	Nil	---do---

Note: Quality of paints for interior and exterior as in tables 1 & 2.

APPENDIX A

(Tables 1 and 2)

INDIAN STANDARDS ON PAINTS, ENAMELS, FILLERS, ETC

A.1. The titles of Indian Standards on paints, enamels, fillers, etc, referred to in Tables 1 and 2 are given below;

IS:103-1962	Specification for ready mixed paint, brushing, white lead, for priming and general purposes (revised)
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IS:106-1962	Specification for ready mixed paint, brushing, priming, for enamels, for use on wood (revised)
IS:110-1983	Specification for ready mixed paint, brushing, gray filler, for enamels, for use over primers
IS:111-1950	Specification for ready mixed paint, brushing, undercoating, exterior to Indian Standard colours
IS:112-1950	Specification for ready mixed paint, spraying, undercoating, exterior, to Indian Standard colours
IS:113-1950	Specification for ready mixed paint, brushing, undercoating, interior, to Indian Standard colours
IS:114-1950	Specification for ready mixed paint, spraying, undercoating, interior, to Indian Standard colours
IS:117-1964	Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes, to Indian Standard colours
IS:119-1962	Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian Standard colours
IS:124-1962/ IS: 125-1962	Specification for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, to Indian standard colour No.106 Royal blue (revised)Part I-1976, Part II-1979, Part IV 1979
IS:127-1962	Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes, white (revised)
IS:128-1962	Specifications for ready mixed paint, brushing, finishing, semi-gloss, for general purposes, black (revised).
IS:129-1950	Specification for ready mixed paint, brushing, finishing, interior, oil gloss, for general purposes, to Indian Standard colours
IS:133-2004	Specification for enamel, interior (a) undercoating, (b) finishing, colour as required (revised)
IS:137-1965	Specification for ready mixed paint, brushing matt or egg shell flat, finishing, interior, to Indian Standard colour, as required (revised)
IS:138-1992	Specification for varnish, finishing, interior
IS:338-1952	Specification for varnish, undercoating, exterior, natural resin
IS:339-1952	Specification for varnish, undercoating, exterior, synthetic resin
IS:345-1952	Specification for wood filler, transparent, liquid
IS:348-1968	French polish
IS:426-1961	Specification for paste filler for colour coats (revised)
IS:524-1983	Specification for varnish, finishing, exterior, type1 (synthetic (tentative)
IS:525-1968	Specification for varnish, finishing, exterior, and general purposes, type 2 (tentative)
IS:1188-1957	Specification for ready mixed paint, brushing, oil gloss, genuine zinc oxide, for general purposes
IS:2338 (Part I)-1967	Code of practice for finishing of wood and wood based materials; Part I operations and workmanship
IS:2932-2003	Specification for enamel, synthetic, exterior, type 1 (a) undercoating, (b)finishing, colour as required
IS:2933-1975	Specification for enamel, exterior, type 2 (a) undercoating, (b) finishing, colour as required
IS:3536E-1999	Specification for ready mixed paint, brushing, wood primer, pink
IS:3537E-1966	Specification for ready mixed paint, finishing, interior, for general purposes, to Indian Standard colours

IS:3539E-1966	Specification for ready mixed paint, undercoating, for use under oil finishes, to Indian Standard colours, as required
IS:3585-1966	Specifications for ready mixed paint, aluminium, brushing, priming, water resistant, for woodwork.
IS:3631E-1966	Specification for ready mixed paint, finishing, exterior, (i) Alkyd and (ii) Non-alkyd, for general purposes, to Indian Standard colours

APPENDIX B

[Table 1 and 2 (Item V)]

MERGING TYPE GLAZE AND STAINS**B-1. Merging type glaze**

B-1.1. **Merging type glaze** - (Which facilitates the blending of various colour after application) is transparent pigment bound with a medium having good flowing properties, thinned with volatile solvent.

B-2. Stains

B-2.1. Stains are soluble fast dyes or transparent, pigment, dissolved or suspended in an oil, water or spirit medium. The consistency shall be such as to ensure complete penetration.

B-2.2. Stains are supplied either in liquid form ready for application or as powders to be dissolved in a suitable medium (water, spirit or oil) as indicated. If the medium is oil, driers and thinners may also be needed.

B-2.3. Water stains are solutions of vegetable dyes in water. Solution of certain chemicals in water, although not normally classed as water stains, are often used to darken wood, such as floor-boards. Potassium permanganate is a well-known example.

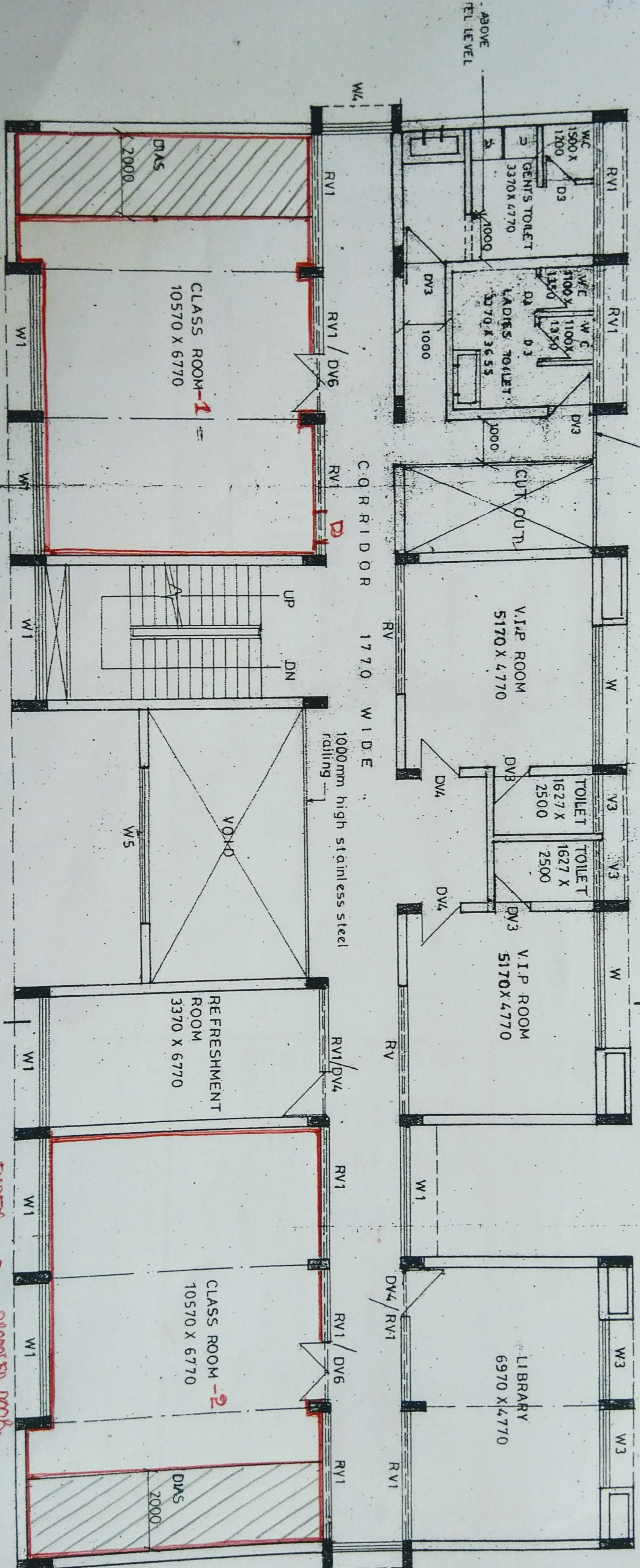
B-2.4. Spirit stains are solutions of spirit-soluble dyes in industrial methylated spirit.

B-2.5. Oil stains may be solutions of oil-soluble dyes in linseed oil but usually, to given a wider range of colours, they consist of insoluble, transparent semi-pigments ground in linseed oil and thinned with turpentine or other solvents. Sometimes, wax is added to make the stain less penetrating.

B-2.6. Oil stains are sometimes supplied mixed with varnish and sold as varnish stains, but where it is desired to enhance and not to conceal the appearance of the wood, better results can be obtained by staining and varnishing separately.

FIRST FLOOR PLAN

INDEX
 D - PROPOSED DOOR
 W - ACCEPTABLE
 WOODEN FLOORING - D1A



D1A

