NRDA F-1



NAYA RAIPUR DEVELOPMENT AUTHORITY

# Tender Document for the Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

(Following Three-Envelope Tender Procedure)

# **TENDER DOCUMENT (PART ONE)**

NIT No.: 75 / OC P78 P1 /S-24/ EE C-I / CE (E) / NRDA / 2013-14, Raipur,

Dated: 01.03.2014

Issued by: Chief Executive Officer, Naya Raipur Development Authority (NRDA) Utility block, Capitol Complex, Sector- 19, Naya Raipur- 492 002, Chhattisgarh Tel No: + 91 771 2511500; Fax No.: +91 771 2511400. Website: www.nayaraipur.com

# **Tender Document Contains**

- (a) Only schedule "A" and Section-I of schedule "D" are to be filled & singed by the tenderer
- (b) All the certificates as per pre qualification criteria shall be appended with relevant forms of schedule"D"

#### 1. PART ONE (NRDA F-1)-(Attached herewith, to be submit along the tender)

Part (A)

- a) Press Notice
- b) Detailed NIT

#### Part (B)

- a) Schedule-A
  - (i) Cost Abstract
  - (ii) Bill of Quantities
- b) Schedule-B --NIL
- c) Schedule-C –NIL
- d) Schedule-D

#### Section-I..... Technical tender forms

(i) Letter of Technical Tender

- (ii) Tenderer's Information Sheet
- (iii) Annual Turnover
- (iv) Specific Construction Experience
- (v) Declaration
- (vi) Check list for Technical tender evaluation
- Section -II .....Scope of work
- Section -III..... Technical specifications of work
- Section -IV..... Special Conditions of Contract
- Section -V..... List of approved makes.
- Section –VI..... Drawings
- e) Schedule-E
- f) Schedule-F
- 2. PART TWO (NRDA F-2/3) )-Standard form (Not Attached herewith, and not to be submitted along the tender) Important note: - Link site http:// nayaraipur.com/documents/gcc.pdf
  - 1. General Guidelines
  - 2. Tender
  - 3. General rules and directions
  - 4. Conditions of contract
  - 5. Clauses of contract
  - 6. Model rules relating to labour, water supply and sanitation in labour camps safety code
  - 7. Sketch of cement Godown
  - 8. Contract forms
    - (a) Draft Format for Performance Security
    - (b) Earnest Money Deposit Form (Bank Guarantee)
    - (c) Format of Contract Agreement
    - (d) Draft Format for Performance Guarantee for Water Proofing and Anti-termite Works
    - (e) Indemnity Bond
    - (f) Indenture Bond
    - (g) Notice for Appointment of Arbitrator
  - 9. Proforma of schedules (Schedule 'A' to Schedule 'F')



## NAYA RAIPUR DEVELOPMENT AUTHORITY

Utility block, Capitol Complex, Sector- 19, Naya Raipur- 492 002, Chhattisgarh Tel No: + 91 771 2511500; Fax No.: +91 771 2511400., Website: <u>www.nayaraipur.com</u>

## Tender Notice

NIT No.: 75 / OC P78 P1 /S-24/ EE C-I / CE (E) / NRDA / 2013-14, Raipur,

Dated: 01.03.2014

Sealed tenders are invited from contractors registered with any Central/ state Govt. /local body or PSU in appropriate class, who fulfill the Pre-Qualification criteria, for the work of **"Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur"** 

Registered Contractor in CGPWD or in appropriate class in other dep't.	Time allowed inc. rainy season	Estimated Cost (INR Crore)	EMD (INR Lacs)	Cost of Tender Doc. (INR)	Avg. Annual turnover in last three financial years (INR Crore)
A-5	24Months	59	59	25,000	30

Bids are invited in three envelope system. Eligibility and qualification criteria are available in the detailed NIT. Detailed NIT and tender documents can be downloaded from the website <u>www.nayaraipur.com</u>. While submitting the tender, the tenderer should submit documentary proof in support of eligibility and qualification. Duly completed documents shall be submitted by speed post/registered post/ courier so as to reach the office latest by **15.00hrs on 28.03.2014.** Technical Documents shall be opened thereafter on same day after **16.00hrs. Amendment in tender, if any, will only be uploaded on the website and shall not be published in any newspaper.** 

नया रायपुर – मेरा रायपुर

**Chief Executive Officer** 

# NAYA RAIPUR DEVELOPMENT AUTHORITY (NRDA) RAIPUR, CHHATTISGARH

# DETAILED NIT

NIT No.: 75 / OC P78 P1 /S-24/ EE C-I / CE (E) / NRDA / 2013-14, Raipur, Dated: 01.03.2014

## Last date and time for submission of tenders: 15.00 hrs on 28.03.2014

1. Item Rate Tenders are invited in the prescribed tender documents by the Chief Executive Officer, Naya Raipur Development Authority (NRDA), Raipur Chhattisgarh from eligible contractors registered with any Central / state /semi Government of India or public sector undertaking. Who fulfill the prequalification criteria.

## 2. The detailed NIT is as under:-

Name of work	Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur
Estimated Cost (INR in Crore)	59
EMD (INR in Lacs)	59
Time allowed including rainy season	24months
Cost of Tender (In INR)	25,000.00
Tender to be uploaded on NRDA website to enable download	03-03-2014
Last Date of submission of pre bid quarries	15-03-2014
Pre tender Clarification/ amendments	Available in the NRDA Website
Last Date and time of submission of Tender	28-03-2014 at 15.00Hrs
Date and time of opening of Tender	28-03-2014 at 16.00Hrs

- 3. Intended eligible Tenderers may obtain further information from the office of Employer and inspect the Tender Document at, NRDA Raipur from 11 AM to 4 PM on all working days.
- 4. **Pre Qualification Criteria** -To be eligible under the contract, the intending tenderer should meet the following mandatory criteria **4.1 and 4.2 (A & B):**

#### 4.1 Financial Criteria

**Average Annual Turnover:** Minimum average annual gross turnover of the bidder shall be INR 30Crores during last three complete financial years (i.e 2010-11, 2011-12 & 2012-13). (Audited balance sheet duly signed by CA should be enclosed).

Annual turnover is total certified payments received for contracts in progress or completed during the financial year

For above, the Tenderer has to submit audited balance sheets of their financial turn over/ accounts along with profit and loss acount for the last three(3) years, along with the Tender. Where necessary, the Employer can make enquiries with the Tenderer's Bankers.

#### 4.2 Technical Criteria

A	Intending tenderer shall be registered contractor with any Central/ state Govt/ Local Body or PSU in unlimited class in CG PWD or in appropriate class in any other departments/ PSU/Local body.
	AND
	Intending tenderer should have completed satisfactorily following works during last five years i.e after 31/01/2009, in any Government. or Public sector undertaking as below: -
В	<ul> <li>(a) One similar work costing not less than INR 47.00Crore</li> <li>(b) Two Similar work costing not less than INR 30.00Crore each.</li> </ul>

Note: -

- a) Similar work shall mean a project consisting of Building work in a Single Contract
- b) For the purpose value of executed works and financial turnover shall be bought to current costing level by enhancing the actual value of work at the rate of 10% per annum (compounded annually), calculated from the date of completion to last date of receipt of applications for tenders.
- c) Ongoing project / part project experience shall not be considered for evaluation.
- d) For the benefit of the intending tenderers a checklist is enclosed at Schedule-D (vi), for the documents to be submitted along with tender.
- e) The tenderer shall be required to appoint sub vendor in respect of the following specialized work.
  - i. Electrical works
  - ii. Plumbing and Fire Fighting

That sub vendor should completed work in any central/ state Govt. / Local Body or PSU in respect of particular component of significant magnitude. The same shall be got approved from NRDA, before appointment.

#### Certificates:

- a) All tenderers should submit the valid registration certificate. Commercial tax certificate, balance sheet with profit and loss statement for at least 3 years.
- b) The tenderers shall also submit satisfactory completion certificates in support of each quoted experience along with work order. The satisfactory completion certificate should be signed by an officer not below the rank of Executive Engineer concerned in case of Government department or the rank of General Manager in case of public sector as the case may be.
- c) All the documents to be submitted shall be duly notarized.
- 5. The tender document for the above work is available on NRDA's websites: www.nayaraipur.com and www.cg.gov.in Tenderer will have to download the tender document, and shall submit the tender along with the tender cost as mentioned in the Para 2 above. For tender cost, DD drawn in favor of "CHIEF EXECUTIVE OFFICER, NRDA" should be enclosed. The tenderers shall attach the cost of tender document along with EMD as mentioned in the Para 2 above.
- 6. Three envelope Tender procedures shall be followed. Tenderer has to submit three sealed envelopes containing the documents as detailed below simultaneously, enclosed in a Fourth Envelope duly mentioned in the top the name of work, NIT No. and firm address.

ENVELOPE-1	EMD & Cost of tender in the prescribed format
ENVELOPE-2	Technical Tender consisting of the documents/ certificate in proof of prequalification criteria PART ONE (NRDA F-1) excluding schedule-A
ENVELOPE-3	Financial Tender PART ONE (Schedule-A) ( Price Bid should also be submitted as soft copy in MS Excel 2007,in CD)

Signature of Contractor.....

All the three tenders shall be put in a fourth envelope which shall be dully sealed. All the 4 envelopes shall be super-scribed with the Name of Work and Name of intending tenderer. Respective envelopes shall also be marked as envelope 1, envelope 2, and envelope 3 as detailed above. Tenders who do not conform to the specified requirements will be held non-responsive.

Initially, only the **envelope** -1 shall be opened, if found responsive then the **envelope**-2 (Technical tender) shall be opened at the date and time given in the Tender Document. The Price tender shall remain sealed and unopened in the custody of NRDA.

After technical evaluation, date and time of opening of price bid shall be communicated by NRDA to the successful tenderer in technical evaluation. The Price tenders of only the tenderer found qualified as per the PQ criteria shall be opened in presence of the tenderer who wish to be present. The Contract shall be awarded to the tenderer whose tender has been determined to be the lowest evaluated as per tender conditions.

- 7. All Tenders must be accompanied with the
  - a) Earnest money as mentioned in the Para 2 above. The Earnest money shall be payable in favour of *Chief Executive Officer NRDA*, in the form of a Bank Draft payable at Raipur/ Bank Guarantee operatable at Raipur drawn from a nationalized bank/ Scheduled Bank which shall be valid for a period of 3 (three) months from the date of submission of tender.
  - b) Cost of tender as mentioned in the Para 2 above. The Cost of tender money shall be payable in favour of *Chief Executive Officer NRDA*, in the form of a Bank Draft payable at Raipur drawn from a nationalized bank/ Scheduled Bank which shall be valid for a period of 3 (Three) months from the date of submission of tender.
- 8. Tenders shall be submitted at the address below on or before due date. Tenders received after the due date or time for tender submission (Late tenders) will either not be accepted or if inadvertently accepted, will not be opened and shall be rejected and returned back to the tenderer subsequently.
- 9. (a) NRDA reserves full rights to reject any or all the tenders without assigning any reason, and to seek any further information from the tenderers. The selection shall be at the entire discretion of NRDA and the NRDA's decision in this respect shall be final and binding. Further NRDA reserves right to split the contract in two or more parts. This shall be at the entire discretion of NRDA and NRDA's decision in this matter shall be final and without appeal.

(b) The competent authority on behalf of NRDA does not bind himself to accept the lowest or any other tender, and reserves to himself the authority to reject any or all of the tenders received without the assignment of a reason. All tenders in which any of the prescribed conditions is not fulfilled or any condition including that of conditional rebate is put forth by the tenderer, shall be summarily rejected.

- 10. Tenders shall be valid for 90 (Ninety) days from the last date of submission of the tender. NRDA will not be responsible for any costs or expenses incurred by Tenderers in connection with the preparation or delivery of Tenders. If any tenderer withdraws his tender before the said period or issue of letter of acceptance/intent, whichever is earlier, or makes any modifications in the terms and conditions of the tender which are not acceptable to the NRDA, then the NRDA shall, without prejudice to any other right or remedy, be at liberty to forfeit entire amount of Earnest Money as aforesaid.
- 11. Pre tender meeting with the tenderers will be held as mentioned above in the Office of **Chief Executive Officer**, NRDA, Raipur. Tenderers are advised to participate in the pre-tender meeting. The intending tenderers are advised to send their queries to NRDA either by post or by email to <u>ceo@nayaraipur.com</u> and <u>cee@nayaraipur.com</u> upto the date mentioned in the Para 2 as above.
- 12. Clarification/ amendments, if any shall be uploaded on website only.
- 13. Period for completion of work as mentioned above at Para 2 is inclusive of rainy season.
- 14. Approved hard copy of the standard document is available in the office of the employer and could be seen on any working day during office hours at the following address:-

#### Chief Engineer (Engg), NRDA

Opp. Police Station, Near Water Tank, VIII, New Rakhi, Naya Raipur-492002, Phone: 0771-4066189

Signature of Contractor.....

- 15. The intending tenderers are advised to cross check the downloaded version of the tender document with the hard copy available with NRDA.
- 16. In case of any discrepancy between the downloaded tender and the approved hard copy, the approved hard copy shall hold good for contractual as well as legal purposes.
- 17. Tenderers are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders, as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general, shall themselves at their own cost obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect the execution of work and shall incorporate the cost of such effects while quoting the tender, A tenderer shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed, The tenderer shall be responsible for arranging and maintaining at his own cost all materials tools & plants, water, electricity, access facilities for workers and on all other services required for executing the work unless otherwise specifically provided in the contract documents. Submission of tender by a tenderer implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and local conditions and other factors having a bearing on the execution of the work.
- 18. Canvassing whether directly or indirectly, in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable to rejection.
- 19. The successful tenderer shall be required to execute an agreement on a non judicial stamp paper of appropriate value with the **Chief Engineer (Engineering)**, **NRDA** in the Proformas annexed to the tender document, within 7 days of the issue of letter of acceptance/ award by the NRDA. The cost of non judicial stamp paper shall be borne by contractor. In the event of failure on the part of the successful tender to sign the agreement within 7 days, the entire earnest money will be forfeited and tender shall be cancelled.
- 20. The successful tenderer, upon issue of letter of acceptance, in addition to execution of an agreement on a non judicial stamp paper of appropriate value, shall also be required to furnish an irrevocable Performance Bank Guarantee of requisite amount to the **Chief Engineer (Engineering)**, **NRDA** in the Performa annexed to the tender document, within 7 days of the issue of the letter of acceptance /award of Tender by the NRDA. In the event of failure on the part of the successful tenderer to furnish the Performance Bank Guarantee within 7 days, the earnest money will be forfeited and tender shall be cancelled.
- 21. This Notice Inviting Tender shall form a part of the contract document. In accordance with clause 1 of the contract, the letter of acceptance/ award shall be issued in favour of the successful tenderer/ contractor. After submission of the performance guarantee, by the contractor, the General arrangement drawings and other details for commencement of work shall be issued. The contract shall be deemed to have come into effect on issue of communication of letter of acceptance of the tender. On such communication of acceptance, the successful Tenderer/ Contractor shall, within 7 days from such date, formally sign the agreement consisting of:
  - a) PART ONE of the Tender documents along with detailed NIT as issued to the contractor at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto and
  - b) PART TWO of the Tender document i.e. "General conditions of contract duly modified / corrected to the extent as specified under PART ONE (though not issued to the contractor but always available for inspection on written demand at the office of the officer inviting tenders specified under Schedule F of PART ONE of the Tender Document) and deemed to have been consulted, inspected, understood and considered by the tenderer before quoting and submitting his tender.
  - c) Agreement signed on non-judicial stamp paper of appropriate value as per prescribed proforma of tender documents.
- 22. GCC is available as a standard NRDA Publication and can also be downloaded free of cost from the NRDA web site under title "General conditions of contract" for Contractors in construction Contracts" However contractors are advised to refer to PART ONE of the tender document carefully and

Signature of Contractor.....

thoroughly for corrections/ modifications in the "General conditions of contract" Standard form NRDA F-2/3 is also available for inspection in the office of the Engineer in charge on written demand from contractors. Link site http:// nayaraipur.com/documents/gcc.pdf

- 23. While submitting the tender the contractor shall clearly and legibly write his full mailing address including PIN code, Telephone/ mobile no./ Fax Numbers/ e-mail address etc for communication purposes and shall inform the Engineer in Charge about any change from time to time in his postal/ mailing address. The communication shall be dispatched only at the contractor's such latest informed address and NRDA shall in no way be responsible for non-receipt of correspondence by the contractor.
- 24. It is found that the contractor has misrepresented that facts or has attempted to secure or has secured the work by misrepresenting the facts or by submitting false or forged documents then the Entire Earnest Money submitted by the contractor and or the Performance Guarantee and/ or the Security Deposit as the case may be, shall be liable to be absolutely forfeited and such contractor/ individuals shall also be liable to be prosecuted for cheating/ forgery/ fraud etc as per law.
- 25. Bill of quantities is enclosed with tender document, the rate shall be quoted against each item separately in figures as well as in words

During price Tender evaluation, the Employer will correct arithmetical errors on the following basis:

- a) if there is a discrepancy between words and figures, following procedure shall be followed:
  - i. the unit price which correspond to the total price for the item worked out by the Tenderer shall be followed;
  - ii. If the total price of an item is not worked out by the Tenderer or it does not correspond with the rates written either in words or figures then the rate quoted by the Tenderer in words shall be taken as correct.
- b) if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected;
- c) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.
- d) The unit wise amounts will be rounded to the nearest rupee
- e) The tendered rates of items against which no rate or price is entered by the tenderer will be taken as zero and the price of the same shall be deemed to have been covered by the rates/amount quoted in other items.
- 26. The tender document shall be written legibly and free from erasure, overwriting or conversion of figure. Any correction where unavoidable shall be made by crossing out, rewriting and attestation by the tenderer.
- 27. All royalties be paid by the contractor as also all tolls, duties, local and other levies including sales tax, insurances & workman compensation act etc.
- 28. Applicable service tax shall be reimbursed separately on production of receipt of payments of Service Tax.
- 29. Contractor will be bound to follow CG Model rules relating to its water supply & sanitation in labour camp.
- 30. The contractor shall pay not less than the minimum wages to labours engaged by him on the work.
- 31. Department reserves the right to take up the work departmentally or to award any work on contract in the vicinity without prejudice to the terms of contract.
- 32. If the rate quoted by the lowest (L1) of the tenderer is considered unbalanced (in relation to the Department's estimate of cost of work to be performed under the contract) by the CEO, NRDA, then tenderer shall submit detail price/rate analysis of major items of the work within 7 days of such notice so as to demonstrate the internal consistency of these price/rate(s) with his quoted price/rate(s). After evaluation by tender sanctioning authority CEO, NRDA may require the tenderer to submit additional Security upto 5% of the estimated cost put to tender for the performance of the agreement in the shape

of F.D. Or a BG receipt in favor of the CEO, NRDA before signing of the agreement, which shall be refunded along with the normal S.D. after Completion of work. If he fails to complete the work or leave the work in complete, this 5% additional SD, shall also be forfeited by the department, in addition to other provision of the contract & the agreement shall be terminated and action shall be taken in accordance of relevant contract clause of the agreement.

- 33. **Important Instructions to Tenderers :**The tenderers who have down loaded the tender documents from the web site, should read the following important instructions carefully before actually quoting the rates & submitting their tender on the tender document downloaded from the web site:
  - a) The tenderer should see carefully & ensure that all the pages of PART ONE (NRDA F-1) of the tender document including schedule of quantities of items of work (NRDA F-1 Schedule-A) has been down loaded properly & completely.
  - b) The printout of the downloaded tender document shall be taken on A-4 size plain white paper only & the printer settings shall be dept to ensure that the downloaded document is printed in the same manner and pattern/ setting as appearing on the web site & there is no change in the formatting, number of paras etc.
  - c) The tenderer should ensure that no page in the down-loaded tender document is missing and all pages in the down-loaded tender document as printed are legible & clear & are printed on a good quality paper.
  - d) The tenderer should ensure that every page of the down-loaded tender document is signed by tenderer himself.
  - e) The tenderer should ensure that the down loaded tender document is properly bound and wax sealed before submitting the same in the envelope. **Loose/ Spiral binding** shall be liable to be rejected.
  - f) In case of any correction/ addition/ alteration/ omission in the downloaded tender document Vis a Vis that in the Standard DRAFT Tender Document available in the office of NRDA, it shall be liable to be rejected.
  - g) The tenderer shall furnish a declaration to this effect that no addition/ deletion/ corrections have been made in the downloaded tender document being submitted by him and it is identical to the tender document appearing on the Web-site and with the **Standard DRAFT Tender Document** available in the office inviting the tenders.

#### Chief Executive Officer, NRDA

Utility block, Capitol Complex, Sector- 19, Naya Raipur- 492 002, Chhattisgarh Tel No: + 91 771 2511500; Fax No.: +91 771 2511400.

Signature of Contractor.....

# SCHEDULE-D

Section-I Technical Tender Forms

# Schedule-D Section I - Tender Forms Technical

This Section contains the forms which are to be completed by the Tenderer and submitted as part of his PART ONE (NRDA F-1).

# Table of Forms

LETTER OF TECHNICAL TENDER	2
TENDERER'S INFORMATION SHEET	4
ANNUAL TURNOVER	5
SPECIFIC CONSTRUCTION EXPERIENCE	6
DECLARATION CHECK LIST FOR TECHNICAL TENDER EVALUATION	7 8

# (i) Letter of Technical Tender

Date: \_\_\_\_\_

NIT No.: \_\_\_\_\_

To:

Chief Executive Officer, Utility block, Capitol Complex, Sector- 19, Naya Raipur- 492 002, Chhattisgarh Tel No: + 91 771 2511500; Fax No.: +91 771 2511400

Ref for NIT no:-----

Subject: Name of the work:- -----

Dear Sir,

I/We, the undersigned, declare that:

- (a) I/We have examined and have no reservations to the Tender Document, including Addendum if any, minutes of meeting, clarification to the queries etc.
- (b) I/We offer to execute the subjected under in conformity with the Tender Documents and the addendums.
- (c) I/We have satisfied ourselves as to the location of the site and working conditions, examined the requirements of NRDA and have obtained all the information necessary for the successful and timely completion of the work.
- (d) I/We have submitted the Earnest Money Deposit as specified in the tender document which will not bear any interest and shall be subjected to forfeiture on following defaults.
  - (i) if we withdraw our Tender during the period of tender validity as specified in Detailed NIT Para 9 or
  - (ii) if we fail to:
    - furnish a Performance Security in accordance with Detailed NIT Para 19 or
    - sign the Contract in accordance with Detailed NIT Para 18; or
    - Accept the correction of its Tender Price pursuant to Detailed NIT Para 24.
  - (iii) If we have given the false documents in support of qualification with the technical tender.
- (e) My/Our Tender shall be valid for a period of 90 days from the date fixed for the tender submission deadline in accordance with the Tender Document, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (f) If my/our Tender is accepted, we commit to obtain a Performance Security in the amount as specified in the tender document for the due performance of the Contract and sign the agreement;
- (g) I/We are not participating, as Tenderers, in more than one Tender in this Tendering process, in accordance with the Tender Document;
- (h) My/our firm, its affiliates or subsidiaries, including any subcontractors or suppliers for any part of the Contract, has not been declared ineligible by NRDA, Raipur;

Signature of Contractor.....

- I/We understand that this Tender, together with your written acceptance thereof included in your letter of acceptance, shall constitute a binding contract between us, until a formal Contract is prepared and executed;
- (j) I/We understand that you are not bound to accept the lowest evaluated tender or any other tender that you may receive.
- (k) I/We hereby pay the Earnest Money Deposit of required amount in the form of a demand draft on a nationalized bank/ Scheduled Bank (-----Bank Name and address) and operatable at Raipur in favour of the 'Chief Executive Officer, NRDA, Raipur' for the said amount and is attached.
- (I) I/We hereby declare that, the entire work including Addendum/ Corrigendum, if any, shall be completed in all respect within the time limit specified in the NIT.
- (m) I/We here by authorize the Employer to get all bank guarantee verified and got confirmed from concerned Bank.

Signature: -----

Signed by: -----(Name)

Designation: -----

For and on Behalf of -----(Name of Tenderer)

Date:

Signature of Contractor.....

# (ii)Tenderer's Information Sheet

	Tenderer's Information				
Tenderer's legal name					
Tenderer's legal address					
Tenderer's authorized representative	Name:	Address:			
(name, address, telephone numbers, fax numbers, e-mail address)	Telephone : Fax :	E-Mail:			
Tenderer's details of Incorporation	Place of incorporation/ registration:	Year of incorporation:			
Attached are copies of the following original documents.					
<ol> <li>Articles of incorporation or constitution of the legal entity named above.</li> </ol>					
<ul> <li>In the case of government-owned entity, documents establishing legal and financial autonomy and compliance with commercial law.</li> </ul>					

# Details of the office closest to Raipur (if available)

1.	Address of Office	
2.	Telephone :	Contact :
3.	Fax :	E-Mail :

Signature of	Tenderer
--------------	----------

Date:\_\_\_\_\_

# (iii) Annual Turnover

Annual Turnover Data for the Last 3 Years					
	Amount and	Exchange	INR		
fear	Currency	Rate if any	Equivalent		
2010-11					
2011-12					
2012-13					
	Average Annual Turnover for th				

All Tenderers are requested to complete the information in this form

The information supplied should be the Annual Turnover of the Tenderer in terms of the amounts billed to clients for each year for contract in progress or completed, converted to INR at the rate of exchange at the end of the period reported.

As a proof of the above, the contractor shall submit the copies of the balance sheet for last three years along with audited profit & loss statement duly signed by the charted accountant.

Signature of Tenderer

Date:\_\_\_\_\_

Signature of Contractor.....

# (iv) Specific Construction Experience

Fill up one (1) form per contract.

	Details of	f Contract	
Contract No of	Name of work		
Award Date		Completion Date	
Role in Contract	Contractor	Sub-contractor	
Total Contract Amount			INR
Employer's Name Address Telephone/Fax Number E-mail			
	Description of th	e work executed	

**Note:** Attach copies of work order and satisfied completion certificates in support of each quoted experience. The completion certificate should be signd by the officer not below the rank of concerned Executive Engineer in case of Government department or in the rank of General Manager in case of public sector/private sector as the cases may be.

Signature of T	Tenderer
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Date:\_\_\_\_\_

# (v)DECLARATION

## (TO BE SIGNED BY THE TENDERER SUBMITTING THE TENDR ON DOWNLOADED TENDER DOCUMENT)

I/We hereby declare and certify that:

- 1. I/We are submitting the tender in the tender document downloaded by me /us from the website & we certify that there is no change in formatting, numbering of pages etc. In the downloaded documents.
- 2. I/We are submitting the tender in the tender document which is exactly similar and identical to the one available on the website and also as available with the officer inviting tenders.
- 3. I / We have not made any modifications / corrections / additions / omissions etc in the tender documents downloaded from web by me / us.
- 4. I / We have checked that no page in the downloaded tender document is missing and all the pages as per web site are available & that all the pages of tender document submitted by us are clear & legible.
- 5. I / We have signed (with stamp) all the pages of the tender document before submitting the same.
- 6. I / we have wax sealed the tender documents properly before submitting the same.
- 7. I / We have submitted the application for issue of tender documents on the prescribed format separately along with the cost of tender documents and also the attested Xerox copies of the eligibility documents prescribed for respective work in the NIT.
- 8. I / We have read carefully & understood the entire Tender document including important instructions to the tenderers submitting the downloaded tender.
- 9. In case at any stage whatsoever at a later date it is found/ revealed that there is a difference in our downloaded tender documents from the original Standard DRAFT Tender Document, NRDA shall have the absolute right to take any action as deemed fit without any prior intimation to me / us.
- 10. In case at any stage whatsoever at a later date it is found that there is difference in our downloaded tender document from the Standard DRAFT Tender Document, we clearly understand that our work shall be liable to be cancelled and Earnest Money/ Performance Guarantee / Security deposit etc all are liable to be forfeited by NRDA and in such an eventuality I / We shall have no right or claim for any damages / compensation from NRDA on this account. Further in such case I / We may also be debarred by NRDA for further participation in the tendering in the concerned NRDA & be removed from the approved list of contractors of NRDA.

Dated.....

(TENDERER) (SIGNATURE WITH SEAL/ STAMP)

Signature of Contractor.....

# (vi) CHECK LIST FOR TECHNICAL TENDER EVALUATION

Name	of the Agency:					
S.		Details			Enclosed at annexure	
No	Document				Page	No
					From	10
		Downloade	Downloaded from NRDA Website			
		Amount			_	
1	Tender Document	Name of the Bank &				
	COST	Branch			_	
		Date		1	_	
		D.D no &	Yes	No		
					-	
		Amount				
	Earnest Money	Form of EMD				
2	Deposit (EMD)	Issuing Bank &				
		Branch No & Date	Vos	No		
		Photo copy attached	163	NO		
			11			
		Class in which				
		registered				
	Contractor	Department				
	Registration	Registration				
	Certificate	Number & Date				
		Validity				
		Notarized	Yes/N	0		
			,			
		Registration				
	Commorcial Tay	Number:				
4	Certificate	Name of the				
		Office	Voc/N	•		
		Notalizeu	163/1	0		
		2010-2011				
		2011-2012				
5	Average Annual Turnover in Lacs	2012-2013				
		Charted accountant o	Charted accountant certificate in original or			
		photo copy duly	photo copy duly notarized can be			
		subn				

Signature of Contractor.....

Name of the Agency:						
s	Document	Details		Enclosed at annexure		
S. No				Page No		
				From	То	
6	Details of the projects/works completed as pre- qualification criteria	Name of the Work				
		Work Completed	Yes/No			
		Year of completion				
		Cost of the Project				
		Certificate Enclosed	Yes/No			
		Notarized	Yes/No			
		Name of the Work				
		Work Completed	Yes/No			
		Year of completion				
		Cost of the Project				
		Certificate Enclosed	Yes/No			
		Notarized	Yes/No			

Note: The above check list only provides for those documents which are mandatory for the tender prequalification criteria. Tenderers are required to append, other documents also with the technical tender as required in the detailed NIT or elsewhere in the PART ONE (NRDA F-1).

Signature of Tenderer

Date: \_\_\_\_\_

Signature of Contractor.....

# SCHEDULE– D Section-II Scope of work

Signature of Contractor.....

# WORKS REQUIREMENT

This section contains the brief idea of scope of work, supplementary information drawings etc. regarding the work to be executed under instant tender, may vary as per site requirement. In case of any change the decision of Engineer-in-charge will be final and binding to the contractor. The work however shall be executed as per BOQ and working drawings.

# A. GENERAL REQUIREMENTS APPLICABLE FOR ALL SCOPES OF WORK

- 1. WORKING DRAWINGS :The Contractor shall at all times maintain on site, in good order and condition, a complete set of all drawings duly laminated and documents necessary for the proper execution and checking of the Works. These drawings and documents shall be made available on request to the Engineer in Charge or other authorized persons on site. Any amendment shall be indicated on the drawing, dated and signed by the Authorized person in charge, with reasons stated if possible.
- 2. AS-BUILT DRAWINGS: The Contractor will supply four hard copies & a soft-copy of the approved built up drawings on completion of work. The cost of preparing all such items of work shall be deemed to have been included in the respective rates/ prices quoted by the Contractor in the "Bill of Quantities.
- **3. SHOP DRAWINGS:** The contractor shall also provide shop drawings for various sub-parts of the tender for approval by the Engineer in Charge. Areas of detailing shall include (but will not be limited to) Plumbing, HVAC, Electrical, Fire-Protection, Structural Glazing, Landscaping Works .The shop drawings shall be conformance to the actual site conditions.
- **4. SAMPLES:** The contractor shall submit to the Engineer in Charge samples of all materials for approval and no work shall commence before such samples are duly approved. The cost of the samples shall be borne by the contractor.
- 5. TESTS: The entire mandatory test shall be carried out at the frequency as mentioned in the specification. All materials and methods of tests shall conform to the latest rules, regulation and/or individual specifications as laid out in the technical specifications. The Engineer in Charge will have the option to have any of the materials tested and if the test results show that the materials do not conform to the specifications, such materials shall be rejected. A reasonable number of representative tests will be deemed to be included in the rates tendered.
- 6. SITE CLEANING: Upon completion of the scope of the work all the areas should be cleaned. All floors, doors, windows, surface, etc. shall be cleaned down in a manner which will render the work acceptable to the Engineer in Charge and employer. All rubbish due to any reason, shall be removed daily from the site at the cost of the contractor and all such costs are deemed to have been included in the price quoted by the contractor.
- 7. MAINTENANCE IN DEFECT LIABILITY PERIOD: The Contractor shall be obliged to remove / repair / replace/ the defects for the entire system during defect liability period (DLP) of twenty four (24) months after the final official hand over date of the civil work/other installation, duly approved by the consultants and project managers. This period shall include maintenance replacement of parts, regular periodic visit by qualified personnel of the Contractor and attending to emergency call at short notice.

Signature of Contractor.....

- 8. WARRANTEES/GAURANTEES- The contractor shall also make available to NRDA all the warrantees/guarantees by the respective manufacturers for all material and equipment installed in the project along with the user/training manuals, test reports, contact details etc. as along with the built-up drawings of the project upon completion of project.
- **9.** Maintaining the work in finished condition against defects for a minimum of specified defect liability from the date of commissioning and imparting training to the workers/staff as asked for maintaining the work as per IS requirement and exercising.
- **10.** Items not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications or the latest N.B.C. manual up to date amendments as applicable in the work.
- **11.** The contractor shall be responsible for making good the wall/slab/beam/column chases and cut-outs wherever provided on account of plumbing, fire protection, electrical & HVAC work cross-over and shall hand-over the site in finished condition.

# **B. GENERAL SCOPE OF WORK**

## **1.1 SCOPE OF WORK:**

The scope of work for the buildingwill include-

- (i) Civil Works including structural works, finishing works
- (ii) **Plumbing, Sanitation & firefighting works**
- (iii) Electrical Works
- (iv) HVAC work

Involving various building structures and built-up areas of the Building all other structure shown in the drawing.

## **1.2** Proposed Work Components:

The above scope of work will include following work components as per tender specifications and drawings-

## 1.2.1 Civil Works:

## a) Structural works:

- Site Clearance and preparation
- Establishment of Site Levels through proper survey of the site and co-coordinating the road level benchmark data with NRDA.
- Site investigation-Supplementary site investigation will be carried out by the contractor to ensure proper bearing capacity &levels as required by construction documents and also confirming to the requirements of NRDA.
- Earthwork including excavation and levelling
- Casting of R.C.C. foundations
- R.C.C work in Framed Structure including necessary formwork and scaffolding
- RCC waterproofing for Roof /Retaining wall and water tanks.
- Construction of Underground and overhead RCC water tanks
- Construction of Special Architectural Design elements.

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# b) Finishing works:

- Internal and external plaster work
- Dry Stone cladding in Granite and Bilha Stone
- External Cladding in granite tiles
- Structural Glazing
- Aluminium windows and joinery including all necessary hardware
- MS pressed sheet frames
- Provision and installation Stainless steel railing work
- Glass Reinforced Concrete Screens/ Jalis
- Aluminium Louvers.

# c) Common Area Interior works:

- False ceiling work in Gypsum Mineral Fibre, Glass Fibre Ceiling
- Flooring work using Natural stone( Italian Marble, Granite, Kota stone, Vitrified tiles/Ceramic tiles)
- Italian & Granite Cladding on walls
- Dado work in toilets/pantry area using Ceramic tiles
- Panelling work on walls.
- Wall finishing using Putty, Acrylic emulsion and Textured paint finishes

# d) Site Development including road network:

- Cutting, filling and levelling of the site as per the site layout and achieving the desired site levels.
- Preparation and laying of Road work in WMM, Paver Blocks, Brushed Concrete as per the specification laid down in the detailed site drawings.
- Road side kerb stone, appropriate road marking sand signage
- Clearingandfinishingthesiteinamannerthatitshallbedeemedtobecompletely fitforoperationanduseaccordingtothesatisfactionoftheEngineerincharge.

# **1.2.2** Plumbing, Sanitation& firefighting works:

- **Plumbing and Sanitation works** Provision and installation of complete Chinaware, CP fitting including all necessary accessories required for installation and proper functioning of the supplied equipment.
- Laying of Internal Soil, Waste, Rain Water & Water Supply Lines as per the approved makes & specifications of quality.
- Installation of Pumps in the Underground Water Tank complete as required starting from suction line from underground tank to Overhead Water Tank/ distribution Ring Main Ball Valves, N.R.V, Elect-Panel & Wiring for Motor Necessary Foundation work for Pumps, Supports for Piping Bends, Tee's Dead ends, Valves, etc. as required.
- Supports for vertical risers/vertical pipes. Painting etc. as required.
- Pump & equipment's, accessories and fitting as required.
- Installation, testing and commissioning of the entire Plumbing installations to the satisfaction of engineer in charge.
- Sprinkler work in the common area.

Signature of Contractor.....

- FHC work on each floor.
- External hydrant work.
- All Fire equipment work.

## 1.2.3 Electrical Works:

The work to be carried out under this contract comprises of internal and external electrical Installation of the project as called in the tender documents. The Electrical Contractor shall include for the supply of the whole of the materials in accordance with the Specifications and the whole of the work of fixing necessary for the complete installation as set out in these Specifications and with the accompanying schedule and drawings, commencing from the supply authority's terminals. This also include any material, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make the installation complete in all respects. In general the work to be performed under this contract shall comprise supply, installation, testing & commissioning of the following-

- All conduit work including junction boxes, outlet boxes, wiring &earthing for lighting & power.
- All conduit work including junction boxes, outlet boxes & wiring for ELV systems such as voice, data, fire alarm, Access control.
- Switches, plug sockets, cover plates and wiring accessories.
- Emergency lighting, wiring, Inverter/UPS.
- Earthing System comprising of Earth pits & earth strip for earthling the body of the equipment's.
- External lighting work.
- Fire alarm work.
- All HV & MV cabling work.
- Distribution Boards, Panels, meter boards & final DB's.
- Training of owner's staff/representative.
- Preparation of "As Built Drawings & Documents".
- Lightning protection work.
- Installation, testing & commissioning of all above said work.

## 1.2.4 HVAC Works:

The work to be carried out under this contract comprises of HVAC Installation of the project as called in the tender documents. The HVAC Contractor shall include for the supply of the whole of the materials in accordance with the Specifications and the whole of the work of fixing necessary for the complete installation as set out in these Specifications and with the accompanying schedule and drawings, commencing from the supply authority's terminals. This also include any material, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make the installation complete in all respects. In general the work to be performed under this contract shall comprise supply, installation, testing & commissioning of the following-

## Basement ventilation work.

- Toilet ventilation.
- Fresh Air provision on each floor.
- Terrace provision for ODU.

Signature of Contractor.....

## Note: -

- For carrying the topographic survey for establishing the levels and site layout of all the components, no payment shall be made to the contractor.
- The successful Tenderer will be expected to complete the Works within **24Months** from the date of commencement of the Works.

Signature of Contractor.....

# SCHEDULE– D Section-III Technical Specification of Works

# CONTENTS

S. NO.	DESCRIPTION
Α	Civil work
В	Electrical work
С	PHE & FIRE work
D	HVAC work

# (A). CIVIL WORKS

**General** -All the specification for item of works for Building works, Road works and Electrical works has been followed with reference to the CG PWD, CPWD, MOSRTH, CPHEEO and relevant IS Specifications.

**Material of construction** - The materials of construction to be used in the work shall be governed by the MORTH/ IRC specifications for Rural roads/ other IRC Publications and their manual/ latest CPWD specifications/ PWD specifications/ IS codes, for buildings and the relevant Indian standard specification with amendments and revisions Issued Lip to the date of tender notice Where ever any material has ISI mark such material alone has to be used.

## Workmanship -

The work shall be carried out according to the specification referred to hereinafter and according to sound engineering practice. The decision of the Executive Engineer, in respect of workmanship will be final.

**Specification for Building Work: -** (**Including water Supply and sanitary fittings.**) - The contractor shall execute the work In conformity with the standards and procedure land down latest CPWD specifications/PWD specifications/IS codes for buildings or special specification when ever enclosed separately and in accordance with the approved drawings.

The rates quoted for items of work shall include working in all conditions at all heights/ depths including in/ under water, liquid mud, foul conditions etc.

The EIC/PROJECT MANAGER reserves the right to withdraw from the scope of work and/or to order to any other agency for any item or group of work, or to split the work between two or more sub-CONTRACTOR if necessary. Such a step shall not constitute a breach of the contract.

All the items of work shall be carried out as per description given in the Bill of Quantities and as shown in the drawings. All materials to be got approved from the EIC/PROJECT MANAGERS.

#### Clearing

The contractor shall clear the site of all rubbish and old buildings remove all grass and low vegetation and remove all bush wood, trees, stumps of trees, and other vegetation only after consultation with the EIC/Project Manager as to which bushes and trees shall be saved. All disused foundations, drains or other obstructions met with during excavation shall be dug out and cleared.

#### Site Levels

The contractor shall carry out the survey of the site and shall establish sufficient number of grids and level marks to the satisfaction of the EIC/Project Manager, who shall decide on the basis of this information, the general level of the plot and the plinth.

#### **Bench-marks**

Prior to commencement of construction, the contractor shall in consultation with the EIC/Project Manager, establish several site datum bench-marks, their number depending on the extent of the site. The bench-marks shall be sited and constructed so as to be undisturbed throughout the period of construction.

The soil investigation report is attached with tender for their scrutiny. The contractor shall however inspect the site and study the findings from the trial pits or bores in order to assess the problems involved in and methods to be adopted for excavation and earthwork. The contractor shall ascertain for himself all information concerning the sub-soil conditions, Ground water table periods and intensity of rainfall, flooding of the site and all data concerning excavation and earthwork.

#### Setting out the work

The contractor shall set out the works and during the progress of the building shall amend at his own cost any errors arising from inaccurate setting out.

During the execution of the work contractor must cross check his work with the drawings. The contractor shall be responsible for all the errors in this connection and shall have to rectify all defects and/or errors at his own cost, failing which the EIC/Project Manager reserves the right to get the same rectified at the risk and cost of the contractor.

#### Cleaning up and handing over

Upon completion of the work all the areas should be cleaned. All floors, doors, windows, surface, etc. shall be cleaned down in a manner which will render the work acceptable to the EIC/Project Manager. All rubbish due to any reason, shall be removed daily from the site and an area of up to ten metres on the outer boundaries of the premises will be cleaned by the contractor as a part of the contract. Upon completion of the project, the contractor shall turn over to the EIC/Project Manager the following:

- a) Written guarantee and certificates.
- b) Maintenance manuals, if any, and
- c) Keys.

#### **Samples & Shop Drawings**

The contractor shall submit to the EIC/Project Manager samples and shop drawings of all materials for approval and no work shall commence before such samples or shop drawings are duly approved. Samples of precast concrete panels, masonry units, building insulation, finished hardware, metal window and door frames, flooring, kota stone, marble, granite, ACP, glass, various fittings, fasteners etc. and every other work requiring samples in the opinion of the EIC/Project Manager shall be supplied to the EIC/Project Manager, and these samples will be retained as standards of materials and workmanship. The cost of the samples shall be borne by the contractor.

Throughout this specification, types of material may be specified by manufacturers' name in order to establish standard of quality, price and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the tenderers may assume the price of 'approved equivalent' except that the burden is upon the contractor to prove such equality, in writing.

A detailed programme shall be submitted by the Contractor for the material approvals, within four weeks of the EIC/Project Manager's order to commence. The detailed programme shall include but not limited to:

Date/s of submitting the various material samples & shop drawings. Date/s by which the EIC/Project Manager's approval is required. Date/s of placing orders on the Manufacturers/Suppliers. Date/s of arrival of the approved material/s on to the site.

Date/s of the completion of the `Mock-ups', wherever required, and the Date/s by which the EIC/Project Manager's inspection of such `Mock-ups' should be completed and the Date/s by which the EIC/Project Manager should fully approve the said Mock-ups.

#### Tests

A Quality Assurance Plan(QAP) shall be finalise by PMC, Client & Contractor before start of the work .QAP shall be based upon IS codes/CPWD specification/BS and good engineering practice to decide various material for testing/ method of testing and their frequency and various format for quality control to be adopted. Once QAP is finalise, all the materials needs to be tested accordingly and if results are not as per the desired result than such materials shall be rejected. All the test shall be done at govt approved testing facilities and cost shall be borne by contractor. The testing facilities shall be approved by Client before any sample is being sent for testing.

#### **Mode of Measurements**

All measurements will be taken in accordance with IS 1200 latest issue unless otherwise specified in the BOQ and specifications.

#### MAKING GOOD

The contractor shall cut, leave or form holes, recesses, chases etc, in concrete, MASONRY work, walls, ceilings, floors and in any other situations as required or as directed by the EIC/Project Manager and make good in cement and sand mortar (1:3)/PCC (1:2:4) as decided by EIC/Project Manager and finish to match the adjoining surfaces. No extra payment shall be admissible in this regard.

# GUIDELINES TO BE FOLLOWED BY CONTRACTORS DURING CONSTRUCTION

The Contractor should follow the Erosion and Sedimentation Control (ESC) plan as per Annexure – A of these technical specifications.

The Contractor should follow the Air Quality Management Plan (AQMP) as per Annexure B of these technical specifications.

The Contractor should have the First Aid kit as per the provisions listed in Annexure C of these technical specifications.

All the above are in addition to the conditions prescribed anywhere else in the tender. The Contractor is supposed to quote rates considering the above provisions in contract and nothing extra on any account shall be admissible to the contractor.

# **1. EARTHWORK**

## **EXCAVATION:**

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one meter or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead. During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical up to a depth of 2 meters from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 meter.

The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer-in-Charge. Only the excavation shown on the drawings with additional allowances for centering and shuttering or as required by the Engineer-in-Charge shall be measured and recorded for payment.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for leveling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of lab our /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor will any extra payment be made on this account.

## **Excavation in Ordinary/Hard Rock:**

All excavation operations shall include excavation and 'getting out' the excavated matter. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the

excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge or excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the item of excavation stating lead.

During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to the blasting operations. Blasting operations shall be done and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in-Charge and nothing extra shall be payable for chiseling.

Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the Engineer-in-Charge in writing but nothing extra shall be paid for this blasting.

If the excavation for foundations or drains is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge. The excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for leveling/ bed concrete for foundations. Soft/ defective spots at the bed of foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, filling wherever required on this account shall be done by the contractor at his own cost.

Only the excavation equal to PCC in foundation shown on the drawings or as required by the Engineer-in-Charge shall be measured and recorded for payment except in case of hard rock, where blasting operations have been resorted to, excavation shall be measured to the actual levels, provided the Engineer-in-Charge is satisfied that the contractor has not gone deeper than what was unavoidable. Bottom width of PCC shall be measured as given in foundation drawings and details showing the width of the bedding concrete only and any side clearance or offsets considered for excavation will not measured separately for payment for excavation. The contractor should cover this in his rate. Contractor may make such allowances in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation. Margin for stepping, slopes, space for providing & removing of shuttering, shoring etc, are deemed to have been considered in the rates.

The excavation shall be done manually or by mechanical means as desired by Engineer-in- Charge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor will any extra payment be made on this account.

**Planking and Strutting:** When the depth of trench in soft/loose soil exceeds 2 meters, stepping, sloping and/ or planking and strutting of sides shall be done. In case of loose and slushy soils, the depths at which these precautions are to be taken shall be determined by the Engineer-in-Charge according to the nature of soil.

Planking and strutting shall be 'close' or 'open' depending on the nature of soil and the depth of trench. The type of planking and strutting shall be determined by the Engineer-in-Charge. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. Engineer-in-Charge should take guidance from IS: 3764 for designing the shoring and strutting arrangements and specifying the profile of excavation Close planking and strutting shall be done by completely covering the sides of the trench generally with short upright, members called 'poling boards'. These shall be 250x38 mm in section or as directed by the Engineer-in-Charge.

The boards shall generally be placed in position vertically in pairs. One boards on either side of cutting. These shall be kept apart by horizontal walling of strong wood at a maximum spacing of 1.2 metres cross strutted with ballies, or as directed by Engineer-in-Charge. The length and diameter of the ballies strut shall depend upon the width of the trench. Where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical 'wallings' which shall be strutted to similar timber pieces on the opposite face of the trench. The lowest boards supporting the sides shall be taken in the ground for a minimum depth of 75 mm. No portion of the vertical side of the trench shall remain exposed. The withdrawal of the timber members shall be done very carefully to prevent collapse of the trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged while removing the planks. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried, unless required by the Engineer-in-Charge to be left permanently in position.

**Open Planking and Strutting:** In case of open planking and strutting, the entire surface of the side of the trench is not required to be covered. The vertical boards 250 mm wide & 38 mm thick shall be spaced sufficiency apart to leave unsupported strips of 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engineer-in-Charge. In all other respect, specifications for close planking and strutting shall apply to open planking and strutting.

During excavation and trenching work etc. the contractors shall ensure compliance to the guidelines in such matter laid down by the authority to ensure that there is minimum hazard to the operating personnel and user, minimum inconvenience to users, minimized damage to the underground plant / services of other utilities in a coordinated way in the interest of public inconvenience and overall safety of the adjoining structures etc.

Any trenching and digging for laying sewer lines/waterlines/cables etc. shall be commenced by the contractor only when all men, machinery's and materials have been fully arranged and closing of the trench (s) thereafter shall be ensured within the least possible time.

Surplus excavated earth which is beyond the requirement of NRDA shall have to be disposed of by the contractor at his own cost beyond the NRDA boundary or at places identified by engineer in Charge and no payment shall be made by the department for such disposal of surplus excavated earth.

The contractor shall, at his own expenses and without extra charges, make provisions for all shoring, pumping, dredging or bailing out water, if necessary, irrespective of the source of water. The foundation trenches shall always be kept free from water by continuous pumping out of water by contractor at his own cost while all the works below ground level are in progress, without any extra payment.

**Measurements:** The dimensions shall be measured correct to the nearest cm and the area of the face supported shall be worked out in square meters correct to two places of decimal.

Works shall be grouped according to the following:

(a) Depth not exceeding 1.5 m.

(b) Depth exceeding 1.5m in stages of 1.5 m.

Planking and strutting to the following shall be measured separately:

(a) Trenches.

(b) Areas- The description shall include use and waste of raking shores.

(c) Shafts, walls, cesspits, manholes and the like.

(d) Where tightly driven close but jointed sheeting is necessary as in case of running sheeting is necessary as in case of running sand the item shall be measured separately and packing of cavities behind sheeting with suitable materials included with the item.

(e) Planking and strutting required to be left permanently in position shall be measured separately.

**Rates:** Rates shall include use and waste of all necessary timber work as mentioned above including fixing and subsequent removal.

## > FILLING IN TRENCHES, PLINTH, UNDER FLOOR ETC.

**Earth:** Normally excavated earth from same area shall be used for filling. Earth used for filling shall be free from shrubs, rank, vegetation, grass, brushwood, stone shingle and boulders (larger than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials, salt peter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the earth is used for filling.

**Earth Filling**: The space around the foundations and drains in trenches shall be cleared of all debris, brick bats etc. The filling shall be done in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches. In case of filling under floor, the finished level of filling shall be kept to the slope intended to be given to the floor.

#### **Measurements:**

**Filling Side of Foundations:** The cubical contents of bed concrete leveling course and masonry/ concrete in foundations up to the ground level shall be worked out and the same deducted from the cubical contents of earthwork in excavation for foundations already measured under the respective item of earth work to arrive at the quantity for filling sides of foundation. The quantity shall be calculated correct to two places of decimal.

**Filling in Plinth and under Floors:** Depth of filling shall be the consolidated depth. The dimensions of filling shall be on the basis of pre-measurement correct to the nearest cm and cubical content worked out in cubic meters correct to two places of decimal.

**Compaction Quality**: Compaction of earth and sand filling in areas where foundation & floors are located, the degree of compaction achieved shall be minimum 95% of maximum dry density. As obtained by proctor compaction as per IS: 2720 (Part-IIV). In road and other areas the degree of compaction shall be 90%.

**Testing of Filling Layer:** After the compaction of each layer, samples shall be taken from compacted layer and tested for dry density as per IS practice. The next layer of filling shall not be permitted until the engineer in charge is satisfied that pervious layer has achieved required

compaction. If any particular layer fails to meet the required compaction, it shall be re-compacted as directed by the engineer in charge and fresh samples shall be taken to ascertain the compaction density. Such re-compaction shall be continued till the desired compaction is achieved. The thickness of each compacted layer shall not exceed 200mm.

**Rates:** The rates include cost of all the operations described above.

# > SAND FILLING IN PLINTH

**Sand:** Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV or V.

**Filling:** Sand filling shall be done in a manner similar to earth filling in plinth except that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered till the Engineer-in-Charge has inspected and approved the sand filling.

**Measurements:** The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic metres correct to two places of decimal.

**Rates:** The rates include the cost of material and labour involved in all the operations described above.

## **SURFACE DRESSING:**

Surface dressing shall include cutting and filling up to a depth of 15 cm and clearing of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30 cm measured at a height of one meter above the ground level and removal of rubbish and other excavated material up to a distance of 50 meters outside the periphery of the area under surface dressing. High portions of the ground shall be cut down and hollows depression filled up to the required level with the excavated earth so as to give an even, neat and tidy look.

**Measurements:** Length and breadth of the dressed ground shall be measured correct to the nearest cm and the area worked out in square meters correct to two places of decimal.

Rates: The rates shall include cost of labour involved in all the operations described above.

# > JUNGLE CLEARANCE:

Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm measured at a height of one meter above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately.

**Clearance of Grass:** Clearing and grubbing operation involving only the clearance of grass shall be measured and paid for separately and shall include removal of rubbish up to a distance of 50 m outside the periphery of the area under clearance.

**Measurements:** The length and breadth shall be measured correct to the nearest cm and area worked out in square meters correct to two places of decimal.
Rates: The rate includes cost of all the operation described above.

# > ANTI-TERMITE TREATMENT:

Termite control in existing as well as new building structures is very important as the damage likely to be caused by the termites to wooden members of building and other household article like furniture, clothing, stationery etc. is considerable. Anti-termite treatment can be either during the time of construction i.e. pre-constructional chemical treatment or after the building has been constructed i.e. treatment for existing building .Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide.

**Materials:** Chemicals: Any one of the following chemicals in water emulsion to achieve the percentage concentration specified against each chemical shall be used:

(i) Chlorphriphos emulsifiable concentrate of 20%

(ii) Lindane emulsifiable concentrate of 20%

Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. For example to dilute chemical of 20% concentration, 19 parts of water shall be added to one part of chemical for achieving 1% concentration.

Engineer-in-Charge shall procure the chemical of required concentration in sealed original containers directly from the reputed and authorized dealers; chemical shall be kept in the custody of the Engineer in- Charge or his authorized representatives and issued for use to meet the day's requirements. Empty containers after washing and concentrated chemical left unused at the end of the day's work shall be returned to the Engineer-in-Charge or his authorized representative.

**Pre Constructional Chemical Treatment:** This is process in which chemical treatment is applied to a building in the early stages of its construction. Hand operated pressure pump shall be used. Proper check for uniform spraying of chemical, graduated container shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

**Time of Application:** Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the oil and the surface is quite dry. Treatment should not carried out when it is raining or soil is wet with rain or sub soil water

**Disturbance:** The treated soil barrier shall not be disturbed after they are formed. If by chance, treated soil barrier is disturbed, and immediate steps shall be taken to restore the continuity and completeness of the barrier system.

**Treatment of column-pits, wall-trenches and Basement-excavations**: The bottom surface and the sides (up to height of about 300mm) of the excavations made for column pits, wall trenches and basements shall be treated with the chemical at the rate of 7.5 litres per sqm of the surface area.

**Treatment of Top Surface of plinth filling:** The top surface of the filled earth with in plinth walls shall be treated with chemical emulsion at the rate of 5 litres per sqm. of the surface before the sand/ subgrade is laid.

**Measurements**: Concentrated chemical in sealed containers shall be measured in liters. Chemicals of different types and concentration shall be measured separately.

**Rate:** The Rate for the concentrated chemical shall include the cost of material, containers and all the operations involved in transportation and delivery at the place specified

# 2. FORM WORK

## **FORM WORK (CENTERING & SHUTTERING)**

**Form Work:** Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

**General Requirement:** It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.

### Material for Form Work:

### Centering/Staging:

(a) *Propping and Centering*: All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

Staging should be as designed with required extension pieces as approved by Engineer-in-Charge to ensure proper slopes, as per design for slabs/ beams etc. and as per levels as shown in drawing. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made from rolled structural steel sections.

(b) In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

(c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

*Shuttering:* Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberized lining of material as approved by the Engineer-in-Charge shall be provided in the joints. Steel shuttering used or concreting should be sufficiently stiffened.

Two qualities of form work shall be used i.e Rough form work and wrought form work, as noted on the Project Manager's drawings or described hereafter.

Rough form work may be constructed of sawn timber or other material as agreed by the Project Manager. The edges of the boards shall be planned or otherwise rendered grout tight. Provided it remain grout tight, rough formwork may be used any number of time. This form work shall be adopted for surfaces not exposed/buried needing no surface finish viz. Foundations/Pile caps.

Wrought form work, to all surfaces for which a smooth fair faced finish is required, shall be constructed of plastic coated plywood so that tight joints can be formed which will prevent loss of liquid from the concrete. The use of a particular material for wrought form work shall be consistently maintained throughout the structure. The surfaces of the form work in contact with the concrete shall be smooth and free from all blemishes. The number of times wrought form work may be used shall be subject to the surfaces, joints and edges being clean and undamaged.

*Camber:* Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per meter (1 to 250) or as directed by the Engineer-in-Charge, so as to offset the subsequent deflection, for cantilevers the camber at free end shall be  $1/50^{\text{th}}$  of the projected length or as directed by the Engineer-in-Charge.

**Removal of Form work (Stripping Time):** In normal circumstance and where various types of cements are used, forms may generally be removed after the expiry of the following periods:

Type of Form work	Minimum period Before Striking Form work for OPC 43 grade	
(a) Vertical form work to columns, or as directed by	16-24 hr	
EIC Walls, beams		
(b) Soffit form work to slabs (Props to be fixed	3 days	
immediately after removal of formwork)		
(c) Soffit form work to beams (Props to be re-fixed	7 days	
immediately after Removal of formwork		
d) Props to slabs:		
(1) Spanning up to 4.5m	7 days	
(2) Spanning over 4.5m	14 days	
(e) Props to beams and arches:		
(1) Spanning up to 6m	14 days	
(2) Spanning over 6m	21 days	

*Note 1:* For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

*Note 2:* The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

### Surface Treatment

**Oiling the Surface:** Shuttering surfaces of form work are coated with suitable mould oil which acts both as a parting agent and also gives surface protections.

**Inspection of Form Work:** The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position.

General: The form work shall include the following:

- (a) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal.
- (b) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work.
- (c) Bolts, wire, ties, clamps, spreaders, nails or any other items to hold the sheathing together.
- (d) Working scaffolds ladders, gangways, and similar items.
- (e) Filleting to form stop chamfered edges of splayed external angles not exceeding 20mm wide to beams, columns and the like.
- (f) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.
- (g) Dressing with oil to prevent adhesion and
- (h) Raking or circular cutting.

**Rate:** The rate of the form work includes the cost of labour and materials required for all the operations described above.

## 3. PLAIN & REINFORCED CONCRETE WORK

### **CONCRETE MIX PROPORTIONING:**

The determination of the proportion of cement, aggregate and water to attain the required strength shall be made as follows:

(a) By designing the concrete mix: such concrete shall be called 'Design mix concrete', for details reference may be made to RCC Chapter.

(b) By adopting nominal concrete mix: Such concrete shall be called 'Nominal mix concrete'. Design mix concrete is preferred to nominal mix. If design mix concrete cannot be used for any reason on the work for grades of M-20 or lower, nominal mixes may be used with the permission of Engineer-in-Charge, which, however, is likely to involve higher cement content.

Nominal Mix Concrete: Nominal Mix Concrete may be used for concrete of M-20 or lower.

**Batching:** To avoid confusion and error in batching, consideration should be given to using the smallest practical number of different concrete mixed on any site or in any one plant. In batching concrete, the quantity of both cement and aggregate shall be determined by mass; admixture, if solid, by mass: liquid admixture may however be measured in volume or mass: water shall be weighed or measured by volume in a calibrated tank (see also IS: 4925).

Ready-mixed concrete supplied by ready-mixed concrete plant shall be preferred. For large and medium project sites the concrete shall be sourced from ready-mixed concrete plants or from on site or off site batching and mixing plants (see IS: 4926).

Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock-

piles. The material should be stock-piled for several hours preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge to ensure that the specified grading is maintained. The accuracy of the measuring equipment shall be within + 2 percent of the quantity of cement being measured and within + 3 percent of the quantity of aggregate, admixtures and water being measured.

Proportion/Type and grading of aggregates shall be made by trial in such a way so as to obtain densest possible concrete. All ingredients of the concrete should be used by mass only.

Volume batching may be allowed only where weigh-batching is not practicable and provided accurate used in concrete have earlier been established. Allowance for bulking shall be made in accordance with IS: 2386 (Part 3). The mass volume relationship should be checked as frequently as necessary, the frequency for the given job being determined by Engineer-in-Charge to ensure that the specified grading is maintained. It is important to maintain the water cement ratio constant at its correct value. To this end, determination of moisture contents in both fine and coarse aggregates shall be made as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge according to Weather conditions.

**Mixing:** Concrete shall be mixed in mechanical batch type concrete mixers conforming to IS: 1791 having two blades and fitted with power loader (lifting hopper type). Half bag mixers and mixers without lifting hoppers shall not be used for mixing concrete. In exceptional circumstances, such as mechanical breakdown of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done with the specific prior permission of the Engineer-in-Charge in writing subject to adding 10% extra cement, when hand mixing is permitted.

**Compaction:** Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of the form work. Compaction shall be done by mechanical vibrator of appropriate type till a dense concrete is obtained. The mechanical vibrators shall conform to IS: 2505, IS: 2506, IS: 2514 and IS: 4656. To prevent segregation, over vibration shall be avoided. Compaction shall be completed before the initial setting starts. For the items where mechanical vibrators are not to be used, the contractor shall take permission of the Engineer-in-Charge in writing before the start of the work. After compaction the top surface shall be finished even and smooth with wooden trowel before the concrete begins to set.

**Curing:** Curing is the process of preventing loss of moisture from the concrete. The following methods shall be employed for effecting curing.

**Moist Curing:** Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, Hessian or similar materials and kept constantly wet for at least 7 days from the date of placing concrete in case of ordinary Portland cement and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used, it is recommended that above minimum periods may be extended to 14 days.

**Membrane Curing:** Approved curing compounds may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compound shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set. Impermeable membrane such as polythene sheet covering the concrete surface may also be used to provide effective barrier against the evaporation. Freshly laid concrete shall be protected from rain by suitable covering.

**Measurements:** Dimensions of length, breadth and thickness shall be measured correct to nearest cm. except for the thickness of slab and partition which shall be measured to nearest 5 mm. **Rate:** The rate is inclusive of the cost of labour and materials involved in all the operations described above.

## > **REINFORCED CEMENT CONCRETE:**

**General:** Reinforced cement concrete work may be cast-in-situ or Precast as may be directed by Engineer-in-Charge according to the nature of work. Reinforced cement concrete work shall comprise of the following which may be paid separately or collectively as per the description of the item of work.

(a) Form work (Centering and Shuttering)

(b) Reinforcement

(c) Concreting: (1– Cast-in-situ), (2 – Precast)

Materials: Water, cement, fine and coarse aggregate shall be as specified.

Fly Ash admixed cement concrete (FACC) and fly ash Blended cements in Cement Concrete (PPCC) in RCC structures. Fly ash Blended Cements conforming to IS: 1489 (Part I) may be used in RCC structures as per guidelines given below.

(i) IS: 456- 2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Proportion and its production as under:

(a) The concrete mix design shall be done as "Design Mix Concrete" as prescribed in clause-9 of IS 456 mentioned above.

(b) Concrete shall be manufactured in accordance with above mentioned IS: 456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

(ii) Minimum M -25 grade of concrete shall be used in all structural elements made with RCC both in load bearing and framed structure.

Submittals

Along with their bid the contractors shall be required to submit the following information regarding the equipments proposed to be used by them:-

(i) Type, number, capacity, range, mounting, nature of primary power used and the operating weight of pump and mounting.

(ii) Manufacturer's specifications for pipe lines giving pressure ratings, sizes and material for straight and curved sections.

(iv) Manufacturer's certificates.

Sampling and Testing (Materials)

Aggregates

(i) Supplier of aggregates shall furnish the following information before the material is delivered to site:-

- Precise location of source from where the material is to be supplied.

- Trade group of principal rock type as per table given below:

Trade group name of	: Granite, Gabbro,
Aggregates to be used for concrete	: Dolerite, Rhyolite, Basalt, Quartzite, Gneiss

(ii) The supplier shall also furnish reports on test results giving the following information for approval to Engineer-in-Charge before delivery of material at site:Specific gravity
Bulk density
Moisture content
Absorption Value
Aggregate crushing strength
Aggregate impact value
Abrasion value
Flakiness index
Elongation index
Limits of deleterious substances in the aggregate
Soundness of aggregate
All tests shall be conducted in accordance with IS: 2386 (Part-I to VIII).

**Cement:** Supplier of cement shall furnish the following documents before the cement is delivered to site:-

(i) Certificate confirming that chemical composition and physical characteristics are within the stipulated values for types of cement supplied as per relevant codes.

(ii) Certificate confirming that the chloride content in the cement is not in excess of 0.05 percent of mass of cement.

(iii) If during subsequent testing of cement supplied in lots any of the properties are found to be outside the acceptable limits, the lot of cement shall be rejected.

(iv) Each 1000 bags or part there of the cement or each wagon load of cement shall constitute one lot of cement for the purpose of on ducting tests at site before cement is accepted.

(v) Samples for testing at site shall be taken at random from 2% of the total quantity supplied in one lot. For cement supplied in bags, samples shall be drawn from minimum of 5 bags and the 2% value shall be rounded off to the next higher integer.

For bulk cement, sampling shall be done with the help of slotted sampler to be as per IS: 3535.

(vi) Results of test conducted on samples drawn shall be submitted to the Engineer-in-Charge for his approval. If in the opinion of the Engineer-in-Charge, the test results are not within permissible limits, the lot of cement from which samples have been obtained from testing shall stand rejected and the material shall be removed from site.

(vii) Following tests shall be conducted at site on each lot of cement delivered:-

Mandatory tests	Number of test per lot		
1. Consistency of standard cement paste	5		
2. Initial and final setting time	5 each		
3. Compressive strength test	10		

Mean values of the results from the above results shall be taken as the representative value and the acceptance criteria shall be based on these test. All test procedures and computation of test results shall be as per IS: 4031.

(viii) Apart from mandatory tests specified above, the Engineer-in-Charge may at his discretion, call for any additional tests that he may consider necessary. All such tests shall be done on representative samples taken from each lot and testing and computation of test results shall be done as per IS: 4031.

### Water:

(i) Water to be used in manufacturing and curing of concrete shall be tested before use. All such test results shall be submitted to the Engineer-in-Charge for his approval before water is used. Water used for mixing & curing of concrete shall be fresh, clean, free from salt, acids, alkali, other chemicals and organic matter.

(ii) Manufacturer/ Contractor responsible for curing concrete shall identify and inform the Engineer in- Charge, precisely the location of source of water intended to be used. Each such source of water shall be separately tested. In the event of a change in the source of water all tests specified herein shall have to be repeated.

(iii) In the event water is drawn from tube wells or open-wells, water samples shall be tested for Seasonal fluctuations in water table or at intervals to be directed by the Engineer-in-charge.

(iv) Water sample from each source shall be tested as under:-

Test	Number of test for each source
Acidity	3
Alkalinity	3
Presence of solids	3

Mean values of the above test shall be taken as the representative value and the acceptance. Criteria shall be based on these test results. All testing procedure and computation of test results shall conform to IS: 3025.

### Admixtures:

(i) Suppliers of Admixtures for concrete shall supply the following before any admixtures is approved by the Engineer-in-Charge for their used:-

Certificate confirming that the use of a particular brand of admixture shall not be harmful to concrete in any way. Certificate confirming the exact dosage of admixture of a particular brand. Certificate stating the specific purpose for which the admixture is to be used. Special precautionary measures to be taken in the manufacturer of concrete when using the particular brand of admixture. Certificate confirming that the admixture conforms to specifications of IS: 9103 or to ASTM-C260, ASTM – C10, ASTM – C 595 or to ASTM-C 618.

(ii) Engineer-in-Charge at his discretion may require tests to be performed to reconfirm the Characteristic properties of any admixture. All such tests shall be done in accordance with IS: 9103.

(iii) All tests shall be done at the site laboratory or at a Laboratory to be identified by the Engineerin-Charge depending on the test to be conducted.

(iv) All tests shall be done in the presence of a representative nominated by the Engineer-in-Charge and a representative of the concrete Manufacturer/ Contractor when tests are performed at the site laboratory. All observation and reports of test shall be jointly signed by the two representatives before the test results are submitted to the Engineer-in-Charge.

(v) Expenses for all materials used for testing, sampling procedures and testing including preparing reports shall be borne by the concrete Manufacturer/ Contractor.

(vi) Rate of concrete is inclusive of cost of admixtures. The contractor shall not be paid anything extra for admixtures required for achieving direct workability without any change in specified water cement ration for RCC/CC work.

Sampling and Testing for Quality Control of Fresh Concrete: Fresh concrete shall be tested for:

(a) Slump

(b) Compacting Factor/ Workability

(c) Consistency.

(d) Weight per cubic meter, cement factor and air content

## **FORM WORK (CENTERING & SHUTTERING):**

**Form Work:** Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

**General Requirement:** It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.

## Material for Form Work:

### Centering/Staging:

(a) **Propping and Centering**: All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

Staging should be as designed with required extension pieces as approved by Engineer-in-Charge to ensure proper slopes, as per design for slabs/ beams etc. and as per levels as shown in drawing. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made form rolled structural steel sections.

(b) In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

(c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

**Shuttering:** Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberized lining of material as approved by the Engineer-in-Charge shall be provided in the joints. Steel shuttering used or concreting should be sufficiently stiffened.

Two qualities of form work shall be used i.e Rough form work and wrought form work, as noted on the Project Manager's drawings or described hereafter.

Rough form work may be constructed of sawn timber or other material as agreed by the Project Manager. The edges of the boards shall be planned or otherwise rendered grout tight. Provided it remain grout tight, rough formwork may be used any number of time. This form work shall be adopted for surfaces not exposed/buried needing no surface finish viz. Foundations/Pile caps.

Wrought form work, to all surfaces for which a smooth fair faced finish is required, shall be constructed of plastic coated plywood so that tight joints can be formed which will prevent loss of liquid from the concrete. The use of a particular material for wrought form work shall be consistently maintained throughout the structure. The surfaces of the form work in contact with the concrete shall be smooth and free from all blemishes. The number of times wrought form work may be used shall be subject to the surfaces, joints and edges being clean and undamaged.

**Camber:** Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per meter (1 to 250) or as directed by the Engineer-in-Charge, so as to offset the subsequent deflection. For cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the Engineer-in-Charge.

**Removal of Form work (Stripping Time):** In normal circumstance and where various types of cements are used, forms may generally be removed after the expiry of the following periods:

Type of Form work	Minimum period Before Striking Form work for OPC 43 grade	
(a) Vertical form work to columns or as directed by	16-24 hr	
EIC Walls, beams		
(b) Soffit form work to slabs (Props to be remixed	3 days	
immediately after removal of formwork)		
(c) Soffit form work to beams (Props to be re-fixed	7days	
immediately after Removal of formwork		
d) Props to slabs:	7days	
(1) Spanning up to 4.5m	14days	
(2) Spanning over 4.5m		
(e) Props to beams and arches:	14 days	
(1) Spanning up to 6m	21 days	
(2) Spanning over 6m		

*Note 1:* For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

*Note 2:* The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

### Surface Treatment:

**Oiling the Surface:** Shuttering surfaces of form work are coated with suitable mould oil which acts both as a parting agent and also gives surface protections.

**Inspection of Form Work:** The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position.

### Measurements:

General: The form work shall include the following:

- (a) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal.
- (b) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work.
- (c) Bolts, wire, ties, clamps, spreaders, nails or any other items to hold the sheathing together.
- (d) Working scaffolds ladders, gangways, and similar items.
- (e) Filleting to form stop chamfered edges of splayed external angles not exceeding 20mm wide to beams, columns and the like.
- (f) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.
- (g) Dressing with oil to prevent adhesion and
- (h) Raking or circular cutting.

**Rate:** The rate of the form work includes the cost of labour and materials required for all the operations described above.

## **REINFORCEMENT**:

**General Requirements:** Steel reinforcement shall be clear and free from loose mill scales, dust, loose rust, coats of paints, oil or other coating which may destroy or reduce bond in accordance with relevant IS codes as specified. It shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

Assembly of Reinforcement: Bars shall be bent correctly and accurately to the size and shape as shown in the detailed drawing or as directed by Engineer-in-Charge. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Overlapping of bars, where necessary shall be done as directed by the Engineer-in-Charge. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 11/4 times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlapping shall be staggered as per directions of the Engineer-in-Charge. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

### **REINFORCED CEMENT CONCRETE WORK:**

**Strength of Concrete:** The compressive strength on the work tests for different mixed shall be as given in Table 5.5 below:-

<b>Concrete Mix</b>	<b>Compressive Strength in (Kg/ sq cm)</b>		
(Nominal Mix on volume basis)	7 days	28 days	
1:1:2	210	315	
1:1.5:3	175	265	
1:2:4	140	210	

### 7 days' Tests:

**Sampling**: The average of the strength of three specimens shall be accepted as the compressive strength of the concrete provided the variation in strength of individual specimen is not more than 15% of the average. Difference between the maximum and minimum strength should not exceed

30% of average strength of three specimens. If the difference between maximum and minimum strength exceeds 30% of the average strength, then 28 days' test shall have to be carried out.

### 28 days' Test:

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength up to 30% then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

**Measurements:** Dimensions shall be measured nearest to a cm except for the thickness of slab which shall be measured correct to 0.5 cm. The areas shall be worked out nearest to 0.01 Sq. mt. The cubical contents shall be worked out to nearest 0.01 cubic metre.

**Rate:** The rate included the cost of materials and labour involved in all the operations described above except for the cost of centering and shuttering.

## > PRECAST REINFORCED CONCRETE

**General Requirements:** Precast reinforced concrete units such as columns, fencing posts, door and window frames, lintels, chajjas, copings, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms / moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. The contractor may precast the units on cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in form. Each unit shall be cast in one operation.

**Curing:** After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting. The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handle.

## **DESIGN MIX:**

**Definition:** Design mix concrete is that concrete in which the design of mix i.e. the determination of proportions of cement, aggregate & water is arrived as to have target mean strength for specified grade of concrete. The minimum mix of M-25 shall be used in all structural elements in both load bearing & RCC framed construction.

**Mix Design and Proportioning:** Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcement and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impermeability. Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

**Water Cement Ratio and Slump:** In proportioning a particular mix, the manufacturer/ producer/ contractor shall give due consideration to the moisture content in the aggregates, and the mix shall be so designed as to restrict the maximum free water cement ratio to less than 0.5.

## > READY MIXED CONCRETE (as per IS: 4926):

### Materials:

*Selection and Approval of Materials:* Materials used should satisfy the requirements for the safety, structural performance durability and appearance of the finished structure, taking full account of the environment to which it will be subjected. The selection and use of materials shall be in accordance with IS: 456. Materials used shall conform to the relevant Indian Standards applicable. Where materials are used which are not covered by the provisions of the relevant Indian Standard, there should be satisfactory data on their suitability and assurance of quality control.

Cement: Cement used for concrete shall be in accordance with the requirements of IS: 456.

*Mineral Admixtures:* Use of mineral admixtures shall be permitted in accordance with the provisions of IS: 456.

Aggregates: Aggregates used for concrete shall be in accordance with the requirement of IS: 456.

## > CUBE TEST FOR COMPRESSIVE STRENGTH OF CONCRETE

### **Mandatory Lab Test:**

**A-0** One sample (consisting of six cubes 15x15x15 cm shall be taken for every 20 cum or part thereof concrete work ignoring any part less than 5cum or as often as considered necessary by the Engineering- Charge. The test of concrete cubes shall be carried out in accordance with the procedure as described below. A register of cubes shall be maintained at the site of work in Appendix C. The casting of cubes, concrete used for cubes and all other incidental charge, such are curing, carriage to the testing laboratory shall be borne by the contractors.

### A-1 Test Procedure:

### A-1.1 Mould:

The mould shall be of size 15 cmx15 cm x15 cm for the maximum nominal size of aggregate not exceeding 40 mm. Each mould shall be provided with a base plate having a plane surface and made of non-absorbent material. This plate shall be large enough in diameter to support the moulds properly without leakage. Glass plates not less than 6.5mm thick or plain metal not less than 12mm thick shall be used for this purpose. A similar plate shall be provided for covering the top surface of the test specimen when moulded.

### A-1.2 Sample of Concrete:

Sample of concrete for test specimen shall be taken at the mixer or in the case of ready mixed concrete from the transportation vehicle discharge or as directed by Engineer-in-Charge. Such samples shall be obtained by repeatedly passing a scoop or pail through the discharge stream of concrete. The sampling operation should be spread over evenly to the entire discharging operation. The samples thus obtained shall be transported to the place of moulding of the specimen to counteract segregation. The concrete shall be mixed with a shovel until it is uniform in appearance. The location in the work of the batch of concrete this sampled shall be noted for further reference. In case of paving concrete, samples shall be taken from the batch immediately after deposition of the sub grade. At least five samples shall be taken from different portion of the pile and these

samples shall be thoroughly mixed before being used to form the test specimen. The sampling shall be spread as evenly as possible throughout the day.

When wide changes occur during concreting, additional sample shall be taken if so desired by the Engineer -in-Charge.

### A-1.3 Preparation of Test Specimens:

The interior surfaces of the mould and base plate shall be lightly oiled before the concrete is placed in the mould. The samples of concrete obtained as described under the test specimen shall be immediately moulded by one of the following methods as indicated below:-

When the job concrete is compacted by manual methods, the test specimen shall be moulded by placing the fresh concrete in the mould in three layers, each approximately one third of the volume of the mould. In placing each scoopful of concrete the scoop shall be moved around the top edge do the mould as the concrete there sided from it, in order to ensure a uniform distribution of concrete within the mould.

Each layer shall be rodded 35 times with 16 mm rod, 60 cm in length, bullet pointed at the lower end. The strokes shall be distributed in uniform manner over the cross section of the mould and shall penetrate into underlying layer. The bottom layer shall be rodded through its depth. After the top layer has been rodded, the surface of the concrete shall be struck off with a trowel and covered with a glass plate at least 6.5 mm thick or a machined plate. The whole process of moulding shall be carried out in such a manner as to preclude the change of the water cement ratio of the concrete, by loss of water either by leakage from the bottom or over flow from the top of the mould. When the job concrete is placed by vibration and the consistency of the concrete is such that the test specimens cannot be properly moulded by hand rolling as described above, the specimens shall be vibrated to give a compaction corresponding to that of the job concrete. The fresh concrete shall be placed in mould in two layers, each approximately half the volume of the mould. In placing each scoopful of concrete the scoop shall be moved around the top edge of the mould as the concrete there slides from it, in order to ensure a symmetrical distribution of concrete within the mould. Either internal or external vibrators may be used. The vibration of each layer shall not be continued longer than is necessary to secure the required density. Internal vibrators shall only be used when the concrete is required to be compacted in layers. In compacting the first layer, the vibrators shall not be allowed to rest on the bottom of the mould. In placing the concrete for top extent that there will be no mortar loss during vibrations. After vibrating the second layer enough concrete shall be added to bring level above the top of the mould. The surface of the concrete shall then the struck off with a trowel and covered with a glass or steel plate as specified above. The whole process of mounding shall be carried out in such a manner as to preclude the alteration of water-cement ratio of the concrete by loss of water, either by leakage for the bottom or over flow from the top of the mould.

### A-1.4 Curing and Storage of Test Specimen:

In order to ensure reasonably uniform temperature and moisture conditions during the first 24 hours for curing the specimen and to protect them from damage, moulds shall be covered with wet straw or gunny sacking and placed a storage box so constructed and kept on the work site that its air temperature when containing concrete specimens shall remain 22°C to 33°C. Other suitable means which provide such a temperature and moisture conditions may be used.

**Note:** - It is suggested that the storage box be made of 25 mm dressed tongued and grooved timber, well braced with battens to avoid warping. The box should be well painted inside and outside and should be provided with a hinged cover and padlock.

The test specimen shall be removed from the moulds at the end of 24 hours and stored in a moist condition at a temperature within 24°C to 30°C until the time of test. If storage in water is desired, a saturated lime solution shall be used.

**Expansion Joints:** Expansion joints shall be provided as shown in the structural drawings or as directed by Engineer-in-Charge, for the purpose of general guidance. However it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints. The filling of these joints with bitumen filler, bitumen felt or any such material and provision of copper plate, etc. shall be paid for separately in running metre. The measurement shall be taken two places of decimal stating the depth and width of joint.

Steel for Reinforcement: The steel used for reinforcement shall be any of the following types:

- (a) Mild steel and medium tensile bars conforming to IS: 432 (Part I)
- (b) High strength deformed steel bars conforming to IS: 1786
- (c) Hard drawn steel wire fabric conforming to IS: 1566
- (d) Structural steel conforming to Grade A of IS: 2062.
- (e) Thermo-mechanically treated (TMT) Bars.

**Stacking and Storage:** Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. Care shall be taken to protect the reinforcement from exposure to saline atmosphere during storage, fabrication and use.

## 4. WATER PROOFING

## > CEMENT WATER PROOFING COMPOUND:

It shall be used for cement mortar for plastering or concrete work.

**Water Proofing Compound:** Integral cement water proofing compound conforming to IS: 2645 and of approved brand and manufacture, enlisted by the Engineer-in-Charge from time to time shall be used.

The contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added.

Measurement: It shall be measured by weight.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

### **ROOF WATER PROOFING:**

Unless otherwise indicated waterproofing shall be brick koba chemical treatment to be carried out by an approved specialist agency.

**Preparation of surface:** The surface to be water proofed shall be cleaned of all dust and other foreign matter. It shall then be wetted before applying the treatment.

**Horizontal surface:** Cement slurry admixed with acrylic based concrete chemical of approved make and confirming to IS: 2645:1975 @ 0.5 kg per 50 kg of cement or as recommended, shall be applied on the cleaned and prepared roof surface. A layer of 20mm thick (average) cement sand mortar of ratio 1:4 (1cement: 4 coarse sand) admixed with acrylic chemical @ 0.5 kg per 50 kg of cement or as recommended by manufacturer shall be laid over the bed prepared with cement slurry. A layer of broken brick/brick bats of 40mm thickness shall be laid over the aforementioned mortar bed. after proper curing for about two days, the joints including all voids varying from 15mm to 30mm thick shall be grouted with 1:4 cement mortar admixed with acrylic water proofing chemicals and then with cement slurry admixed with acrylic water proofing chemicals. The top surface shall then be finished smoothly with cement mortar (1:4) admixed with acrylic water proofing chemicals and such topping shall not be less than 20mm thick marked with 300mm X 300mm squares. If so required, the top surface shall be finished rough to receive top finishing, as specified & directed.

Vertical surfaces: This shall be of 20 mm thickness in two coats:

The under coat shall be of 10mm thick 1:4 (1cement: 4 course sand) admixed with acrylic water proofing chemical @ 0.5 kg per 50kg of cement or as recommended and shall be applied on the prepared vertical surface. The top surface shall be brought to a true surface with wooden straight edge. The surface shall be left rough and furrowed 2mm deep with a scratching tool diagonally both ways, to form key for the finishing coat. The surface shall be kept wet till the finishing coat is applied.

The finishing coat of same mix admixed with acrylic water proofing chemical and same thickness as under coat shall be applied when the under coat has sufficiently set but not dried and in any case not letter than 48 hours. It shall be finished hereinafter including making/rounding gola with brick bat filled with cement sand mortar 1:4 admixed with acrylic chemical.

Curing: The finished surface shall be cured by flooding of water for period of two weeks.

## **WATER PROOFING ON FLOORS AND WALLS OF SUNKEN AREAS:**

**Preparation of surface:** The surface to be water proofed shall be cleaned of all dust and other foreign matter. It shall then be wetted before applying the treatment.

**Horizontal surface:** Cement slurry @ 2kg of cement per sq m of area admixed with acrylic based chemical @0.5 kg /50 kg of cement in the form of slurry shall be spread smoothly over the RCC shrunken floor which has been cleaned and prepared prior to laying the slurry. A layer of 20mm thick (average) cement sand mortar of ratio 1:4 (1cement: 4 coarse sand) admixed with acrylic chemical @ 0.5 kg per 50 kg of cement or as recommended by manufacturer shall be laid over the bed prepared with cement slurry. A layer of broken brick/brick bats of 40mm thickness shall be laid over the aforementioned mortar bed. after proper curing for about two days, the joints including all voids varying from 15mm to 30mm thick shall be grouted with 1:4 cement mortar admixed with acrylic water proofing chemicals and then with cement slurry admixed with acrylic water proofing chemicals. The top surface shall then be finished smoothly with cement mortar (1:4) admixed with acrylic water proofing chemicals and such topping shall not be less than 20mm thick. The top surface shall be finished smooth and corners rounded off.

**Vertical surfaces:** This shall be of 20 mm thickness in two coats: The under coat shall be of 10mm thick 1:4 (1cement: 4 course sand) admixed with acrylic water proofing chemical @ 0.5 kg per 50kg of cement or as recommended and shall be applied on the prepared vertical surface. The top surface shall be brought to a true surface with wooden straight edge. The surface shall be left rough and furrowed 2mm deep with a scratching tool diagonally both ways, to form key for the finishing

coat. The surface shall be kept wet till the finishing coat is applied. The surface shall be finished smooth. The junction of vertical plastered surface and floor surface shall be rounded off. The finishing coat of same mix admixed with acrylic water proofing chemical and same thickness as under coat shall be applied when the under coat has sufficiently set but not dried and in any case not letter than 48 hours. It shall be finished hereinafter including making/rounding gola with brick bat filled with cement sand mortar 1:4 admixed with acrylic chemical.

**Curing:** The finished surface shall be cured by flooding of water for period of two weeks before filling sunken areas with concrete.

**Precautions:** While filling the areas with concrete it i9s to be ensured that the floor and the wall surface treated with water proofing treatment does not get damaged.

**Guarantee:** It shall be guaranteed that the building is completely water & leak proof for a period of 5 years. Such a guarantee shall be directly given by the specialist agency to the employer in a form approved by the Engineer in Charge.

**WATER PROOFING IN BASEMENT & PODIUM AREAS:** The waterproofing in Basement & Podium areas shall be Crystalline waterproofing system as specified in the Schedule.

**EXPANSION JOINT TREATEMENT :** The Expansion Joint treatement in walls and floor and roof shall eb as specified in the Schedule. The expansion joints must be protected with suitable water proofing treatment, taking precaution to enable the joints move freely and meeting the architectural requirements.

After the initial curing, if the cured sealant is found to have pinholes / blowholes, the same has to be repaired at the locations. In case, large surface is found to have air entrapped and pin holes are observed, the affected section needs to be cut, removed and re-done

Immediately after filling the joints, the sealant should be tooled either with a stainless steel or wooden spatula. While tooling, the spatula should be wetted with a wetting agent

During tooling ensure complete removal of air bubbles and to fill up all voids by the compacting action ensuring proper adhesion to the joint sides, Remove the masking tape immediately by pulling it outwardly after tooling is done

## 5. MORTARS (NA)

## 6. STONE WORK (NA)

## **STONE WORK:**

**Dressing:** Face stones shall be hammer dressed on all beds, and joints so as to give them approximately rectangular block shape. These shall be squared on all joints and beds. The bed joint shall be rough chisel dressed for at least 80 mm back from the face, and side joints for at least 40 mm such that no portion of the dressed surface is more than 6 mm from a straight edge placed on it The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joint. The bushing on the face shall not project more than 40 mm as an exposed face and 10 mm on a face to be plastered. The hammer dressed stone shall also have a rough tooling for minimum width of 25 mm along the four edges of the face of the stone, when stone work is exposed

**Laying:** Stone shall be laid on their natural bed and shall be solidly bedded full in mortar with close joints, chips of stone spalls be wedged into the work wherever necessary. No dry work or hollow spaces shall be allowed and every stone whether large or small shall be carefully selected to fit snugly the interstices between the large stones. Masonry shall be built breaking joints in all the three directions. Bond stone and headers shall be properly laid into the work and shall be marked by the contractor with white lead paint. The bond stones shall be provided as specified.

Random rubble masonry shall be brought to the level courses at plinth, window sills, lintel and roof levels. Leveling shall be done with concrete comprising of one part of the mortar as used for Masonry and two parts of graded stone aggregate of 20 mm nominal size.

### A) Stone Type:

Stone shall be of the type specified. It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer -in-Charge.

### (B) Kota Stone for Veneering:

Kota stone shall be of selected quality, hard, sound, dense & homogeneous in texture free from cracks, decay, weathering and flaws. They shall be machine cut to requisite size and thickness. They shall be have colour indicated in the drawings or as instructed by the Engineer-in-Charge. The stone shall have the top (exposed) face polished before being brought to site unless otherwise specified. Before starting the work, the contractor shall get the samples of Kota stone approved from the Engineer-in-Charge.

**Dressing:** Every stone shall be cut to the required size and shape and fine machine dressed to the full depth so that a straight edge laid along the side of stone shall be in full contact with it. The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the item. Tolerance of  $\pm 2$  mm shall be allowed for the thickness.

### (C) Red Sand Stone & White Sand Stone Ashlar Masonry:

The stone shall be red or white as specified in the description of item. The stone shall be hard, Sound, tough, free from cracks, decay & weathering. In case of red sand stone, white patches or streaks shall not be allowed. However scattered spots up to 10 mm diameter will be permitted. Before starting the work the contractor shall get samples of stone approved by the Engineer-in-Charge.

**Size of Stone:** Normally stones used should be small enough to be lifted and placed by hand. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three fourth of the thickness of wall nor less than 15 cm. The height of stone may be up to 30 cm.

**Dressing:** Every stone shall be cut to the required size and shape chisel dressed on all beds and joints so as to be free from waviness and to give truly vertical and horizontal joints. In exposed masonry, the faces that are to remain exposed in the final position and the adjoining faces to a depth of 6 mm shall be the fine chisel dressed so that when checked with 60 cm straight edge, no point varies from it by more than 1 mm. The top and bottom faces that are to form the bed joints shall be chisel dressed so that variation from 60 cm straight edge at no point exceeds 3 mm. Faces which are to form the vertical joints should be chisel dressed so that variation at any point with 60 cm straight edge does not exceed 6 mm. Any vertical face that is to come against backing of masonry shall be dressed such that variation from straight edge does not exceed 10 mm. All angles and edges that are to remain exposed in the final position shall be true, square and free from

chippings. A sample of dressed stone shall be prepared for approval of Engineer-in-Charge. It shall be kept at the worksite as a sample after being approved.

**Mortar:** The mortar for jointing shall be 1:6 (1 cement: 6 sand) including pointing with cement mortar 1:2 (1 white cement; 2 stone dust) with an admixture of pigment matching the stone shade.

**Laying:** All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort.

The walls and pillars shall be carried up truly plumb or battered as shown in drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. In case of ashlar work without backing of brick work or coursed rubble masonry, face stone shall be laid headers and stretchers alternately unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 30 cm in height and all the courses shall be of same height, unless otherwise specified.

## **DRY STONE CLADDING:**

Material: Stone shall be of the type as specified in the item. It shall be hard, sound durable and tough free from cracks, decay and weathering and defects like cavities cracks, flaws, holes, veins, patches of soft or loose materials etc. Thickness of stone shall be as specified Stone shall be cut with the gang saw to the required size and shape on all beds and joints so as to free from any waviness and to give truly vertical horizontal surface as required. The exposed face and sides of stones forming joints shall be such that the straight edge laid along the face of the stone is in contact with every point on it. All the visible angle and edges shall be square and free from chipping. The dressed stone shall be of the thickness specified with permissible tolerance of +2mm. Before starting the work, the contractor shall get the samples of stone approved by Engineer-In charge. Approved sample shall be kept in custody of Engineer-in-Charge and stones supplied and used on the work shall conform to sample with regard to soundness, colour, veining and general texture. The stone shall be cut by gang saw into slabs of required thickness along the places parallel to the natural bed. When necessary double scaffolding for fixing the stone at greater heights, jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stone and placed them into correct positions. Care shall have to be taken that corners of the stone are not damaged. Stone shall be covered with gunny bags before tying chain or rope is passed over and it shall be handled carefully. No pieces which has been damaged shall be used that work.

**Fixing:** The size & shape of the cramps shall be as per drawing and as per directions of Engineerin-charge. The samples of steel cramps should be approved in advance before starting the stone cladding work.

The cramp shall be attached to top and bottom of the stone. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to hold support and transfer the load of stone unit to the supporting structured steel shall be designed by the manufacturer and approval of the same shall be obtained from the Engineer-in-Charge.

The minimum number of clamps required shall be as per requirement of design to carry the load of individual stone slabs. The cramps shall be spaced not more than 60 cm horizontally and vertically along the stone side for insertion of pins / bolt attached with the steel cramps. Adequate cutting in stone shall be made with precision instrument to hold the cramps pins at the joints.

Stone shall be secured with clamps with high quality workmanship. The walls shall be carried up truly plumb. All the courses shall be laid truly horizontal and all the vertical joints truly vertical. The sequence of execution for cladding work shall be approved by the Engineer-in-Charge.

**Jointing:** Joints horizontal and vertical shall be filled with weather sealant of make as approved by Engineer- in-charge with the help of pouring gun for filling the sealant. Before filling the joint with sealant, masking tape are required to be fixed on stones surface on both edges of joints of the stones, so that sealant may not spoil the surface of the stone. When all the joints are filled and sealant has dried, the masking tape may be removed.

**Protection:** Work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage and rain during construction.

**Measurement:** The length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. Any opening of area 0.01 sqm. or less shall not be deducted.

**Rate:** The rate includes the cost of materials and labour involved in all operations described above including cost of support scaffolding staging, sealant, pouring guns but excluding the cost of steel cramps drilling holes / making recesses in stones which shall be paid for separately.

# 7. BRICK WORK

## AAC MASONRY WORK

### Materials

MASONRY to be used in the Building works shall be Autoclaved Aerated Concrete Blocks of approved make of size 600mm x 200mm x 200 mm with 55-60% Fly ash, 2-3% Gypsum, 10-12% cement, Lime 12-14%, Aluminum powder and balance slurry solids generated during process. Length and height can vary as per availability; however the thickness of blocks shall be 200mm.

Fly ash to be used in the manufacturer of fly ash cement masonry shall conform to Grade 1 or 2 of IS-3812-1981.

Minimum percentage of fly ash to be used in the AAC masonry shall not be less than 40%. Manufacturers and test certificate and independent testing conforming chemical and physical requirement / characteristics and proportion of fly ash shall be produced by the contractor to the EIC/Project Manager for approval. Fly ash shall be procured from coal / lignite based thermal power plants.

Water absorption for the AAC masonry shall not be more than 20% of weight.

Efflorescence when tested according to IS-3495 (Part III) 1976 shall have the rating of efflorescence not more then 12.5%.

The Compressive strength of AAC blocks shall not be less than 4.0 N/sqm and shall conform to IS 2185.

The normal dry density shall be 550-650 kg/cum, sound absorption upto 42 dB, fire resistance of minimum 4 hours, thermal conductivity "K'0.16 W/sqmK, thermal resistance 0.46 K-sqm/W, heat transmission coefficient 2.17 w/sqmK and drying shrinkage not less than 0.02% (length of the block).

The AAC Blocks shall conform to IS 2185 (Part III) and the masonry shall be carried out as per IS 6041 (1995) and IS 1905 (1987).

All masonry work shall be built in CM (1:6).

Masonry work in panels shall be jointed with RCC columns by means of wall ties of MS flat 30mm x 3mm at every fourth course. The bonding length of reinforcement and MS flat shall be as under unless otherwise shown on drawings: -

Junction of 200 mm thick wall and RCC column etc- 20cm

Faces of masonry walls indicated to be pointed on external faces of masonry work or where shown to be provided with pointing (BFP) shall be faced with specially selected facing masonry. Masonry shall be uniform in colour, texture and shall have arises so that true horizontal and vertical joints are formed in the facing. Extra cost required for this shall be included by the contractor in his quoted rates.

Width of concrete lintels, beams, cills, columns and the like coming in conjunction with masonry walls/pillars shall be kept to the actual width of masonry work unless off sets have been specifically shown, in that case width as shown on drawings shall be maintained.

Centerline dimensions of rooms, verandahs etc as shown in drawings shall be maintained. Internal and overall dimensions if at variance from whatever is shown in drawings shall be deemed to have been amended accordingly. The dimensions of various heights shall be maintained as shown on the drawings

Mortar bed joints shall be such that four courses of masonry work and three joints taken consecutively shall measure 3 to 4cm in addition to the combined height of the masonry, themselves.

## **BRICKS:**

Bricks shall be of  $1^{st}$  class quality and confirm to the latest Indian standard specification no 1077-1992. Bricks shall be sound well burnt, free from cracks, to ring when struck and not to crack or break when shocked in water and uniform in size. They shall be best of class designation obtainable in the market and of the best quality and in every respect to be approved by the engineer in charge unless otherwise specified they shall be FPS bricks of size 230 x 110 x 70 cm. Bricks to be thoroughly cleaned well wetted or socked in fresh water before being used on the work. Specified brick quality shall be tested as per IS: 3495-1992. The course shall be laid flush in mortar and every course shall be thoroughly grouted, the joint shall be broken vertically and they shall not exceed 10mm in thickness

The horizontal joints shall not be more than 10mm in thickness. The work shall not be laid more than 12 courses per day.

Bricks used in the masonry may be of the following type:

(a) The Common Burnt Clay Bricks shall conform to IS: 1077 and 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 100 mm in length 40 mm in width and 10 mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be provided with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials

(b) Fly Ash Lime Bricks (FALG Bricks): The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS: 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side.

Fly Ash: Fly ash shall conform to IS: 3812.

**Note:** This item will be operated only for load bearing structure upto 2 storeys and for non-load bearing walls 23 cms thick for multi-storeyed buildings. 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 (b) Clay Fly Ash Bricks: The clay fly ash bricks shall conform to IS: 13757. The bricks 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. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS: 3812.

*Compressive Strength:* The bricks, when tested minimum average compressive strength for various classes as given in Table. 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 for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table for the purpose of calculating the average compressive strength.

		Compressive strength		
<b>Class Designation</b>	Not less than		Less than	
	N/mm <sup>2</sup>	(Kgf/cm <sup>2</sup> )	N/mm <sup>2</sup>	(Kgf/cm <sup>2</sup> )
100	10	(100)	12.5	125
75	7.5	(75)	10	100
50	5	(50)	7.5	75
40	4	(40)	5.0	50
35	3.5	(35)	4.0	40
25	2.5	(25)	3.0	30
20	2.0	(20)	2.5	25

**Water Absorption:** The average water absorption of bricks when tested shall be not more than 20% by weight.

Efflorescence: The rating of efflorescence of bricks when tested shall be not more than moderate.

**Laying:** Bricks shall be laid in English Bond 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.

**The brick work shall be built in uniform layers**: No part of the wall during its construction shall rise more than one metre 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.

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. In case of walls one brick thick and under, one face shall be kept even and in proper plane, while 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.

**Finishing of Joints:** The face of brick work may be finished flush or by pointing. In flush finishing either the face joints of the 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.

**Curing:** The brick work shall be constantly kept moist on all faces for a minimum period of seven days. Brick work 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.

**Measurements:** Work shall be measured in cubic meters unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall Brick be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq meters and the cubic contents shall be worked out to the nearest 0.01 cubic meters. Brick work 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.

## **HALF BRICK WORK:**

Brick work in half brick walls shall be done in the same manner as described above that the bricks shall be laid in stretcher bond. When the half brick work is to be reinforced, 2 Nos. M.S. bars of 6 mm 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 brick work to which the half brick work is joined. The mortar used for reinforced brick work shall be rich dense cement mortar of mix 1:4 (1cement: 4 coarse sand). Lime mortar shall not be used. Over laps in reinforcement if any shall not be less than 30 cm.

**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.

**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.

## > MOULDING AND CORNICES:

Mouldings and cornices shall be made with bricks as specified for brick work. The bricks shall be cut and dressed to the required shape as shown in the architectural drawings. 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 more than one fourth of the length. For cornices projecting more than 20 cm and requiring more than quarter bricks projection, metal cramps shall be used and paid for separately.

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

**Curing and Protection:** The mouldings 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.

**Measurements:** For the purpose of measurements, the sectional periphery of mouldings and cornices (excluding the portion in contact with wall) shall be measured in centimeters and length in metres. The girth and length shall be measured correct to a cm. No deduction shall be made from the masonry of wall for the bearing of the moulding and cornices.

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

## 8. WOOD WORK

## > TIMBER:

Timber is classified as under:

(i) Teak wood

(ii) Deodar wood

(iii) Non-coniferous timbers other than teak.

(iv) Coniferous timber other than deodar.

The timber shall be free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, splits and cracks. The timber shall be graded as first grade and second grade on the basis of the permissible defects in the timber as given in Appendix 'A' of. For both the grades, knots should be avoided over a specified limit.

**Teak Wood (Tectona Grandis):** It is of outstanding merit in retention of shape and durability. The heart wood is one of the most naturally durable woods of the world. It usually remains immune to white ant attack and insect attack for very long periods. It is, however, not always immune from fungus attack (rot). Taken as a whole, good quality teak is very durable, it is relatively easy to saw and work. It can be furnished to a fare surface and takes polish well. It is generally used for making furniture and all important timber construction.

Superior Class Teak Wood such as Balarsha, Malabar and Dandeli: Individual hard and sound knot shall not be more than 12 mm in diameter and the aggregate area of all the knots shall not exceed one half per cent of the area of the piece. It shall be close grained.

**Deodar Wood (Cedrus Deodars)**: It is the strongest of the Indian conifers. Its weight and strength is 20% per cent less than teak. It is easy to saw and works to a smooth finish. It is not, however, a suitable wood for polish or paint work as the oil in the wood and especially near knots, always seeps through such finishes and discolours them. It is used for house building, furniture and other construction work. It is also suitable for beams, floors, boards, posts, window frames and light furniture etc.

**Sal Wood (Shoera Robusta):** Sal is about 30 per cent heavier than teak, 50 per cent harder, and about 20 to 30 per cent stronger. In shock resistance it is about 45 per cent above teak. Its heart wood is a naturally durable wood, and usually remains immune to attack by white ants and fungi for a long period, While its sapwood is very perishable and should not be used. Well dried sal is not a really easy wood to saw and work. It is a rough constructional wood than a carpentry timber. No individual hard and sound knot shall exceed 25 mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece.

**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. Kiln seasoning of timber, where specified, shall be done as per IS: 1141 in a plant approved by Engineer in- Charge.

**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 preservation before jointing. Preservative treatment of timber shall be done as per IS: 401 in a plant approved by the Engineer-in-Charge

## > PANELLING MATERIAL:

**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.

**Plywood/ Plywood Boards:** Plywood boards are formed by gluing and pressing three or more layers 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 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.

**Marking:** Each plywood board shall be legibly and indelibly marked or stamped with following particulars along with such other marks as the purchaser may stipulate at the time of placing order. (a) Manufacturer's name, initials or recognized trade mark, if any.

(b) Year of manufacturing.

(c) Abbreviation indicating the species of timber used in each ply.

(d) Batch number.

## > DOOR, WINDOW AND VENTILATOR FRAMES:

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 any warp or bow. Frames shall have smooth, well-planned (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  $\pm 2$  mm shall be permitted in the specified finished dimensions of timber sections in frames.

**Joints:** 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 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.

**Fixing of Frames:** The frames shall be got approved by the Engineer-in-Charge before being painted, 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 holdfasts 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 suitably strutted and wedged in order to prevent 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.

**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. 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 up to three places of decimal.

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

## **FLUSH DOOR SHUTTERS:**

Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS: 2202 (Part I). Nominal thickness of shutters may be 25, 30, 35 or 40 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 Engineering- Charge. 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.

**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 including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 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 of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

**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.

Laminated Veneer Lumber (LVL) Door Shutters: This specification lays down requirements regarding types, sizes, material, construction, workmanship and finish, performance evaluation, sampling, measurements, rates and testing of Laminated Veneer Lumber (LVL) door shutter for use in domestic buildings, offices, schools, hospitals etc. This specification does not cover large size door shutters for industrial and special buildings such as workshops, garages, godowns etc. The material of each lot shall be supported by a certificate to that effect: Each lot of LVL materials shall be accompanied by the test reports.

**Paneling Materials:** Plain Particle Board: Plain particle boards used for panels shall be FPT-1 conforming to IS: 3087 and shall have been bonded with BWP type of synthetic resin adhesive as per IS 848. Pre-laminated Particle Board: Pre-laminated particle boards used for panels shall conform to IS: 12823.

Medium Density Fibre Board: Medium density fibre board used for panels shall conform to exterior grade as per IS 12406 made from agro-forest products or agricultural wastes or natural fibers. Pre-laminated Medium Density Fibre Board: Pre-lamination in pre-laminated medium density fiber board shall conform to the requirements such as Abrasion Resistance, Resistance to Steam, Crack Resistance, Resistance to Cigarette Burn and Resistance to Stain as specified in IS: 12823.

**Glass:** Glass for glazing shall conform to IS: 2835 or IS: 2553. The use of other types of glass, such as frosted glass, wired glass and coloured glass may also be specified by the Engineer-in-Charge.

**Wire Gauze**: Wire gauze shall generally conform to IS 1568 and shall be regularly woven with equally spaced galvanized mild steel wires of 0.63 mm nominal diameter in both warp and weft directions to form aperture of average width 1.40 mm.

**Construction and Workmanship**: Laminated Veneer Lumber (LVL) panelled, glazed and panelled and glazed shutter shall be constructed in the form of LVL framework of stiles and rails with panel inserts conforming to para above of plain or perlaminated particle board, plain or prelaminated medium density fibre board, wire gauze or glass. The panels shall be fixed by either providing grooves in stiles and rails and beading as specified. The stiles, top rails, lock rails and bottom rails shall be jointed to each other by mortice and tenon joints (Rails having width of 150 mm or more shall have plain double tenon joints. Other rails shall have single tenon joints. The

bottom lock and top rails shall be inserted 25+3 mm short of the width of stiles to form a stub mortice & tenon joint. After assembling shutter complete with panels, Bamboo pins of 6 mm dia shall be fitted on each tenon & mortise joint by drilling suitable size of holes (2 pins per joint for rail width up to 150 mm and 3 pins for rails of greater width). All the four edges of shutter shall be beaded with 12 mm thick rubber wood /plantation wood lipping. Lipping on top and bottom rails shall be of one piece and lipping on stiles may be in two pieces. All lippings shall be glued to shutter with water resisting glue (Synthetic rubber passed adhesive) at the rate of 0.15 kg/m2. All members of the shutters shall be straight, smooth and with well planed faces at right angles to each other. Any warp or bow shall not exceed 1.5 mm. The right angle for the shutters shall be checked by measuring the two diagonals from one extreme corner to the opposite one and the difference between the two diagonals shall not be more than 3 mm.

**Beading**: All the panels except glass and wire gauze shall be fixed with grooves but additional beading may be provided either on one side or on both the sides, if so specified. In so far as glass and wire gauze panels are concerned, beading shall be provided without grooves. In such a case where beading is provided without the grooves, the beading shall be only on one side, the other side being supported by rebate from stiles. The beading shall have a size not less than 15 mm x 10 mm. It can be fixed by suitable headless nailing or screwing. The beading shall be of plantation timber section, preservative chemically treated of fixed type as per IS: 401-1982. Stiles, top rails, bottom rails and lock rails of shutters shall each be made in one piece of LVL, only. Mullions and glazing bars shall be tubtenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm, whichever is less.

Two common methods for jointing of panels with stiles/rails are shown in minimum depth of grooves of stiles and rails shall be 12 mm for all types of panelling. The panels shall be framed into grooves to the full depth of groove leaving an air space of 1.5 mm and the faces shall be closely fitted to the sides of the groove. LVL Shutters shall be manufactured in factories under controlled conditions.

Acoustic Paneling: *Plain and Pre-laminated Particle Board Paneling:* The paneling shall be of 12mm thick celotax glass wool/rock wool boards stuck to 12mm thick commercial ply backing.

**Opening for Glazing:** When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m 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.

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

(a) **Mild Steel Fittings**: These shall be bright 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) Stainless Steel Fitting: These fittings shall be of stainless steel with stainless screw etc complete.

(d) **Aluminium Fittings**: These shall be anodised to natural matt finish or dyed anodic coating not less than grade AC 10 of IS: 1868. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

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-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sinking of hinges.

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 aluminum alloy butt hinges.
- (d) Stainless steel butt hinges.

**Fixing of Frames:** The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

**Measurements:** The outer length of the vertical and horizontal members of UPVC door frame shall be measured in running metres including embedded length in floor corrected up to a cm.

**Rate:** The rate includes the cost of the materials and labour involved in all the operations described above. The cost of anchor bolts or screws for joining the frame is included in the rate. Any other hardware, which may be required, shall be paid for separately.

### > UPVC DOOR FRAMES:

UPVC door frame shall be made of PVC material conforming to IS: 10151. The door frame shall be made from extruded UPVC section having overall dimensions of 48 x 40 mm or 42 x 50 mm having wall thickness of 2.0 mm + 0.2 mm. Corners of the door frame to be jointed by M.S. galvanized brackets. Joints mitred and plastic welded. The hinge side vertical outer frames shall be reinforced by galvanized M.S. Tube of size 19 x 19 mm of wall thickness 1 mm + 0.1 mm and a tie rod shall be provided at the bottom of the frame. The frame shall be fabricated in factory as per nomenclature of the item and directions of Engineer-in-Charge.

**Fixing of Frames:** The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are e to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor.

fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

**Measurements:** The outer length of the vertical and horizontal members of UPVC door frame shall be measured in running metres including embedded length in floor corrected upto a cm.

**Rate:** The rate includes the cost of the materials and labour involved in all the operations described above. The cost of anchor bolts or screws for joining the frame is included in the rate. Any other hardware, which may be required, shall be paid for separately.

## > **PVC DOOR SHUTTERS:**

The shutters shall be fabricated at factory as per nomenclature of the item and directions of Engineer-in-Charge. Shutter shall be made of PVC material conforming to IS: 10151. 24 mm thick PVC Door Shutter 30 mm Thick PVC Door Shutters

### Sampling and Criteria for Conformity:

**General Precautions:** The test specimens shall not have been exposed to a temperature below 40°C for 24 hours immediately preceding the test and shall be free from all visible moisture. The specimen shall be inspected and any specimen with visible flaws shall be discarded. If any test specimen fails because of mechanical reason, such as failure of testing equipment or improper specimen preparation, it shall be discarded and another specimen taken.

**Fixing of Shutters:** PVC door shutter shall be side hung on three bolt hinges of size 100 mm, one at the centre and the other two at 200 mm from the top and bottom of the shutter. The flat of the hinges shall be neatly counter sunk in to the recesses cut out to the ex act dimensions of the hinge flap. The door shall be drilled on the thickness to fit hinges. Screws for fixing the hinges shall be screwed in with screwdrivers and not hammered. The length of the screws should be 8 mm/30 mm. The hinges used should be of stainless steel.

**Tolerance:** The tolerance on the width and the height of the door shall be + 5 mm and the tolerance on the nominal thickness of the door shall be + 2 mm.

**Fittings:** Fittings shall be provided as per schedule of fittings decided by Engineer-in-Charge. In moisture prone areas M.S. fittings and screws should not be used. Hardware such as handles, tower bolt, stopper, buffer etc. should be directly screwed (not pre-drilled) and fitted on the door.

**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. Area is calculated to the nearest 0.01 sqm.

**Rate:** The specified rate includes the cost of the door shutter and labour involved in fixing of the shutter. Fittings & fixtures on the door shutter except hinges & screws shall be paid extra as provided.

## > PANEL PVC DOOR SHUTTER:

Panel PVC Shutters are factory made shutter and shall be brought to site fully assembled. The Solid Panel PVC Door shall be fabricated from 5 mm PVC sheet. The sheets used may be in plain colour, printed design or prelam veneer shade as approved by the Engineer-in-Charge. The shutters shall be fabricated at factory as per nomenclature of the item and directions of the Engineer-in-charge. 30 mm thick panel PVC door shutters.

# 9. STEEL & ALUMINUM WORK

## **STEEL WORK IN BUILT UP SECTION (WELDED):**

The steel work in built up sections (welded) such as in trusses, form work etc.

**Fabrication:** Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-charge. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given in the shop drawings.

**Welding:** Welding shall generally be done by electric arc process as per IS: 816 and IS: 823. The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only by resorted to using oxyacetylene flame with specific approval of the Engineer-in-charge. Gas welding shall not be permitted for structural steel work Gas welding required heating of the members to be welded along with the welding rod and is likely to create temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperature stresses. The work shall be done as shown in the shop drawings which should clearly indicate various details of the joint to be welded, type of welds, shop and site welds as well as the types of electrodes to be used.

As far as possible every effort shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc. apart from the aspect of economy. The maximum diameter of electrodes for welding work shall be as per IS: 814. Joint surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter, which adversely affect the quality of members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

**Assembly:** Before welding is commenced, the members to be welded shall first be brought together and firmly clamped or tack welded to be held in position. This temporary connection has to be strong enough to hold the parts accurately in place without any disturbance. Tack welds located in places where final welds will be made later shall conform to the final weld in quality and shall be cleaned off slag before final weld is made.

**Erection:** The work of erection may be done in suitable units as may be directed by the Engineerin charge. Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against overturning or collapse by suitable mean.

**Painting:** Before the member of the steel structures are placed in position or taken out of the workshop these shall be painted as specified.

**Measurements:** The work as fixed in place shall be measured in running meters correct to a millimeter and weights calculated on the basis of standard tables correct to the nearest kilogram. The standard weight of steel sections shall conform to IS 808 with tolerance in sizes as per IS: 1852.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

## > STAINLESS STEEL WORK IN BUILT UP SECTION (WELDED):

The steel work in built up sections (welded) such as in trusses, railing, guard rail etc.

**Fabrication:** Fabrication shall generally be done as per shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-charge.

**Welding:** Welding shall generally be done by electric arc process. The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only by resorted to using oxyacetylene flame with specific approval of the Engineer-in-charge. Precautions shall therefore be taken to avoid distortion of the members due to these temperature stresses. The work shall be done as shown in the shop drawings which should clearly indicate various details of the joint to be welded, type of welds, shop and site welds as well as the types of electrodes to be used.

**Erection:** The work of erection may be done in suitable units as may be directed by the Engineerin charge. Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against overturning or collapse by suitable mean.

**Measurements:** The work as fixed in place shall be measured in running meters correct to a millimeter and weights calculated on the basis of standard tables correct to the nearest kilogram. The standard weight of steel sections shall conform to IS 808 with tolerance in sizes as per IS: 1852.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

### **Rolling shutters:**

**General:** Rolling shutters shall be of best quality and obtained from approved make. These shall include necessary locking arrangement handles etc. These shall be suitable for fixing in position as

specified i.e. outside or below lintel or between jams of the opening. The door shall be push and pull type and also operated with chain crank as required.

**Shutters:** The shutters shall consist of MS plates of 1.25mm thick and 80mm wide as specified. The laths shall be machine rolled and straightened with effective bridge depth of 16 mm and shall be interlocked together through out there entire length and joined together at the end with locks. These shall be mounted with on specifically mounted on specifically designed pipe shaft. Each lath section shall be continuous single strip piece without any joint.

**Spring:** The springs shall be preferably of coiled type. The spring shall be manufactured from high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. & the spring pipe shall be supported on strong miled steel brackets. The guide channels shall be of mild steel deep channel section and of rolled, Pressed or built up construction. The thickness of the sheet used shall not be less than 3.15mm. The minimum depth of the guide channels shall be 60mm for clear width of shutters up to 3.5 m and 75 mm for 3.5 m and above. The gap between the two channels shall be sufficient to allow the free movement of curtain and at the same time closes enough to prevent the rattling of curtain due to wind. Each guide rail shall be provided with a minimum three fixing cleats to the wall or columns by means of bolts or screws.

**Fixing:** Brackets shall be fixed on the little or under the lintel as shown in the drawing with rawl plugs, screws, bolts etc. The shaft along with the spring shall then be fixed to the brackets.

The shutter shall be laid on the ground and the side guide channel shall be bound with it with ropes etc. The shutters then be placed in position and top fixed with pipe shaft with bolts & nuts. The side guide channels and the cover frame shall then be fixed to the walls through the plate welded to the guides. Fixing shall be done accurately in workmanlike manner so that manner so that the operation of the shutter is easy & smooth.

Grilled Curtain: Wherever specified rolling shutter shall be provided with grilled curtain.

**Finishing:** The rolling shutter together with guide channel, cover and accessories shall be supplied with two coats of approved primer and shall be painted finally with two coats of approved paint at site after installation, as specified.

**Metal Inserts' in RCC & Block Work:** Anchor bolts, rolled steel sections sleeves, pipes, inserts, etc shall be galvanized and shall be fixed or inserted as shown or directed the contractor shall supply and place in the shuttering all such inserts as may be required for sanitary, electric or work of any other trade. Work shall be done exactly as required for the purpose, to the satisfaction of engineer in charge.

**Quality of steel:** All mild steel used in this work shall be tough with even surface and shall be cleanly rolled, sound and free from flaws, cracks, crop ends and other defects. Workmanships:

All work shall be carried out as per drawing in a neat and good craftsman like manner by especially skilled men known for good quality work.

**Measurements to be checked:** The contractor shall check all measurements at site and with surroundings works as per approval of engineer in charge.

Assembly: Work carried out in sections shall be carefully assembled. All members shall be secured together or to the anchored by welding or as shown in the details. All welds shall be

ground smooth and made to match surrounding surface and finished to the satisfaction of the engineer in charge.

### > PRESSED STEEL DOOR FRAMES:

**Materials:** Steel door frames shall be manufactured from commercial mild steel sheet of specified thickness, conforming to IS: 2062 and 4351. Steel door frames may be manufactured to suit doors of either type opening inwards or outwards as directed by the Engineer-in-Charge.

**Construction:** Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold. These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified base ties shall be of pressed mild steel 1.25 mm thick adjustable to suit floor thickness of 35 or 40 mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25 mm, minimum shall be provided for external doors frames.

**Fabrication:** The pressed steel door frames shall be got fabricated in an approved workshop as approved by the Chief Engineer.

**Fixing Lugs:** There shall be three adjustable lugs with split end tail to each jamb without fan light, and four for jamb with fan light.

The head of the fixing lug shall be of one of the following lengths:

(a) 98 mm long for use with profile A

(b) 120 mm long for use with profile B

(c) 160 mm long for use with profile C

The head shall be made from flat steel strip 25 mm wide and not less than 1.60 mm thick

The tail of the lugs shall be 200mm long and shall be made of steel strip not less than 40 mm wide and not less than 1 mm thick.

**Hinges:** 20 mm mild steel butt hinges shall be used. For door frames 80 cm wide and under, three hinges shall be rigidly fixed to one jamb and for door frames above 80 cm wide, four Hinges shall rigidly fixed to one jamb, if it is single shutter, where the height of door shutter metres, one additional hinge shall be provided for every 0.5 m or part there of the additional height. In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20 cm and the distance from the bottom of the door frame to the bottom of the bottom hinge is also kept about 200 mm. The middle hinges shall be at equal distances from lower and upper hinges or as agreed to between the purchaser and the supplier. Hinges shall be made of steel 2.5 mm thick with zinc coated removable pin of 6 mm diameter. The space between the two leaves of the hinge when closed shall be 3 mm and the leaf that is not welded to the frame shall have four counter sunk holes to take No. 10 cross recessed head wood screws.

**Mortar Guards:** Mortar guards of thickness of main frame sheet shall be provided in accordance to provisions of IS 4351 and as instructed by Engineer-in-charge shall be provided. These shall be welded to the frame at the head of the frame for double shutter doors to make provision for bolts. These shall also be provided to the frame behind the hinges, mortice locks and latches, slots, aldrop and sliding /tower bolts.

**Lock** – **Strike Plate:** There shall be an adjustable lock- strike plate of steel complete with mortar guard to make provision for locks or latches complying with the relevant Indian Standards. (IS: 4351) Lock-strike plates shall be of galvanized mild steel and fixed at 95 cm from the head of the frame.

**Shock Absorbers:** For side hung door there shall not be less than three buffers or rubber or other suitable material inserted in holes in the rebate. One shall be located at the centre of the lock jamb and the other two shall be at 30 cm. from top and bottom of the frame. For double leaf shutter door, two buffers shall be provided.

**Finishing:** The surface of door frame shall be thoroughly cleaned, free of rust, mill-scale dirt oil etc. either by mechanical means, for example sand or shot blasting or by chemical means such as picking. After pretreatment of the surface one coat of approved primer i.e. red oxide zinc chrome primer conforming to IS: 2074. Two coats of paints as directed by the Engineer-in-charge shall be applied to the exposed surface.

**Fixing:** Frames shall be fixed up right in plumb and plane. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contact with frame leaving no voids behind the frame.

Three lugs shall be provided on each jamb with spacing not more than 75 cm. The temporary struts should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid when it can be removed. After pretreatment of the surface, one coat of steel primer and two coats, of paint, as directed by Engineer-in-charge shall be applied to the exposed surface.

**Measurements:** The length shall be measured in running metre correct to a cm along the centre line of the frames.

**Rate:** The rate shall include the cost of labour and material involved in all the operation described above including one coat of approved steel primer but excluding two coats of paint.

## ALUMINIUM: DOOR, WINDOW, VENTILATOR AND PARTITION FRAMES:

**Frame Work:** First of all the shop drawings for each type of doors/ windows/ ventilators etc. shall be prepared by using suitable sections based on architectural drawings, adequate to meet the requirement/ specifications and by taking into consideration varying profiles of aluminium sections being extruded by approved manufacturers. The shop drawings shall show full size sections of glazed doors, windows, ventilators etc. The shop drawings shall also show the details of fittings and joints. Before start of the work, all the shop drawings shall be got approved from the Engineer-in-Charge. Actual measurement of openings left at site for different type of door/ window etc. shall be taken. The fabrication of the individual door/ windows/ ventilators etc. shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. The frames shall be fabricated out of section which have been cut to length, mitered and jointed mechanically using appropriate machines. Mitered aluminium cleats of required length and profile. All aluminium work shall provide for replacing damaged/broken glass panes without having to remove or damage any member of exterior finishing material.

**Fixing of Frames:** The holes in concrete/masonry/wood/any other members for fixing anchor bolts/fasteners/screws shall be drilled with an appropriate electric drill. Windows/ doors/ ventilators etc. shall be placed in correct final position in the opening and fixed to Sal wood backing using stainless steel screws of star headed, counter sunk and matching size groove. of

required size at spacing not more than 250 mm c/c or dash fastener. All joints shall be sealed with approved silicone sealants.

In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units shall be checked for line, level and plumb before final fixing is done. Engineer-in-Charge in his sole discretion may allow the units to be assembled in their final location if the situation so warrants. Snap beadings and EPDM gasket shall be fixed as per the detail shown in the shop drawings. Where aluminium comes into contact with stone masonry, brick work, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electrochemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion. The contractor shall be responsible for the doors, windows etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

**Measurements:** All the aluminium sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment (weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

**Rate:** The rate shall include the cost of all the materials, labour involved in all the operations as described in nomenclature of item and particular specification.

## > DOOR, WINDOWS AND VENTILATOR SHUTTERS:

Material, fabrication and dimensions of aluminium doors, windows and ventilators manufacture extruded aluminium alloy sections of standard sizes and designs complete with fittings, ready for being fixed into the building shall be as per IS: 1948.

**Material:** Aluminium alloy extruded sections used in the manufacture of extruded window sections shall conform to IS: 733. Hollow aluminium alloy sections used shall conform to IS: 1285.

**Glass Panes:** Glass panes shall weigh at least 7.5 kg/m2 and shall be free from flaws, specks or bubbles. All panes shall have properly squared corners and straight edges.

### Fabrication:

**Frames:** Frames shall be square and flat, the corners of the frame being fabricated to a true right angle. Both the fixed and opening frames shall be constructed of sections which have been cut to length, mitered and welded at the corners. Where hollow sections are used with welded joints, argon-arc welding or flash butt welding shall be employed (gas welding or brazing not to be done).

### > **FITTINGS**:

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

**Mild Steel Fittings**: These shall be bright satin finish black stone enamelled or copper oxidised (black finish), nickel chromium plated or as specified

**Brass Fittings**: These shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified.
Aluminium Fittings: These shall be anodised to natural matt finish or dyed anodic coating not less than grade AC 10 of IS: 1868.

**Stainless Steel Friction Stay:** The stainless steel friction stays of make approved by the Engineerin-Charge shall be used. The SS friction stays shall be of grade AISI-304 and of sizes specified in nomenclature of item.

**Lockable Handles:** The lockable handle shall be of make approved by the Engineer-in-Charge and of required colour to match the colour of powder coated /anodized aluminium window sections.

**Hydraulic Floor Spring:** The hydraulic floor spring shall be heavy duty double action floor spring of make approved by the Engineer-in-Charge suitable for door leaf of weight minimum 100 kg. The top cover plate shall be of stainless steel, flushing with floor finish level. The contractor shall cut the floor properly with stone cutting machine to exact size & shape. The spindle of suitable length to accommodate the floor finish shall be used. The contractor shall give the guarantee duly supported by the company for proper functioning of floor spring at least for 10 years.

**Measurements:** All the aluminium sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment (weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

**Rate:** The rate shall include the cost of all the materials, labour involved in all the operations as described in nomenclature of item and particular specification.

**Aluminium Sheet:** Aluminium Sheets for use as panels shall be 1.25 mm thick aluminium alloy sheet conforming to IS: 737. Aluminium alloy sheet for use in general paneling work shall be of types and thickness as specified and conforming to the requirement of IS: 737. Aluminium sheets shall be of approved make and manufacturer. Aluminium panel may be prefabricated units manufactured on modular or non-modular dimension.

**Fixing:** The required size of panel, keeping sufficient margin to be inserted inside the section, shall be cut to correct size and fixed firmly in the frame with CP brass or aluminium or stainless steel screws of star headed, counter sunk and matching size groove. Joints sealed with epoxy resin or silicon sealant to make the unit water proof.

**Float Glass:** The glass shall be clear float glass and should be approved by the Engineer in Charge. It shall be clear, float transparent and free from cracks subject to allowable defects. The float glass shall conform to the IS: 14900.

# **10. ROOFING & CEILING**

# CORRUGATED GALVANISED STEEL SHEET ROOFING C.G.S. SHEETS:

These shall be of the thickness specified in the description of the item and shall conform to IS: 277. The sheets shall be of 275 grade unless otherwise specified in the description of item. The sheets shall be free from cracks, split edges, twists, surface flaws etc. They shall be clean, bright and smooth. The galvanizing shall be non-injured and in perfect condition. The sheets shall not show signs of rust or white powdery deposits on the surface. The corrugations shall be uniform in depth and pitch and parallel with the side.

**Purlins:** Purlins of the specified material or M.S. rolled sections of requisite size shall be fixed over the principal rafters. These shall not be spaced at more than the following distances given below:

Thickness of C.G.S. sheet	Maximum spacing of purlins	
1.00 mm	2.00 metre	
0.80 mm	1.80 metre	
0.63 mm	1.60 metre	

The top surfaces of the purlins shall be uniform and plane. They shall be painted before fixing on top. Embedded portions of wooden purlins shall be coal tarred with two coats.

**Slope:** Roof shall not be pitched at a flatter slope than 1 vertical to 5 horizontal. The normal pitch adopted shall usually be 1 vertical to 3 horizontal.

**Laying and Fixing:** The sheets shall be laid and fixed in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

The sheets shall be laid with a minimum lap of 15 cm at the ends and 2 ridges of corrugations at each side. The above minimum end lap of 15 cm shall apply to slopes of 1 vertical to 2 horizontal and steeper slopes. For flatter slopes the minimum permissible end lap shall be 20 cm. The minimum lap of sheets with ridge, hip and valley shall be 20 cm measured at right angles to the line of the ridge, hip and valley respectively. These sheets shall be cut to suit the dimensions or shapes of the roof, either along their length or their width or across their lines of corrugations at hips and valleys. They shall be cut carefully with a straight edge chisel to give a smooth and straight finish.

Lapping in C.G.S. sheets shall be painted with a coat of approved steel primer and two coats of painting with approved paint suitable for G.S. sheet, before the sheets are fixed in place. Sheets shall not generally be fixed into gables and parapets. They shall be bent up along their side edges close to the wall and the junction shall be protected by suitable flashing or by a projecting drip course, the later to cover the junction by at least 7.5 cm. The laying operation shall include all scaffolding work involved.

Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with galvanized J or L hook bolts and nuts, 8 mm diameter, with bitumen and G.I. limpet washers or with a limpet washer filled with white lead as directed by the Engineer-in-Charge. While J hooks are used for fixing sheets on angle iron purlins, and L hooks are used for fixing the sheet to R.S.

joists, timber or precast concrete purlins. T he length of the hook bolt shall be varied to suit the particular requirements.

The bolts shall be sufficiently long so that after fixing they project above the top of the nuts by not less than 10 mm. The grip of J or L hook bolt on the side of the purlin shall not be less than 25 mm. There shall be a minimum of three hook bolts placed at the ridges of corrugations in each sheet on every purlin and their spacing shall not exceed 30 cm. Coach screws shall not be used for fixing sheets to purlins The galvanized coating on J or L hooks, and bolts shall be continuous and free from defects such as blisters, flux stains, drops, excessive projections or other imperfections which would impair serviceability.

Where slopes of roofs are less than 21.5 degrees (1 vertical to 2.5 horizontal) sheets shall be joined together at the side laps by galvanized iron bolts and nuts  $25 \times 6$  mm size, each bolt provided with a bitumen and a G.I. limpet washer or a G.I. limpet washer filled with white lead. As the overlap at the sides extends to two corrugations, these bolts shall be placed zig -zag over the two overlapping corrugations, so that the ends of the overlapping sheets shall be drawn tightly to each other. The spacing of these seam bolts shall not exceed 60 cm along each of the staggered rows. Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the underside, while the sheet.

**Wind Tie:** Wind ties shall be of  $40 \times 6$  mm flat iron section or of other size as specified. These shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. The ties shall be paid for separately unless described in the item of roofing.

Finish: The roof when completed shall be true to lines and slopes and shall be leak proof.

**Measurements:** The length and breadth shall be measured correct to a cm. Area shall be worked out in sqm correct to two places of decimal.

The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof.

Roof with curved sheets shall be measured and paid for separately. Measurements shall be taken on the flat and not girthed.

No deduction in measurement shall be made for opening up to 0.4 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sqm in area, deduction in measurements for the full opening shall be made and in such cases the labour involved in making these openings shall be paid for separately. Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

**Rate:** The rate shall include the cost of all the materials and labour involved in all the operations described above including a coat of approved steel primer and two coats of approved steel paint on overlapping of C.G.S. sheets. This includes the cost of roof sheets, galvanized iron J or L hooks, bolts and nuts, galvanized iron seam bolts and nuts, bituminous and galvanized iron limpet washers etc.

## > RIDGES AND HIPS OF PLAIN GALVANISED STEEL SHEETS

**Ridges and Hips:** Ridges and hips of C.G.S. roof shall be covered with ridge and hip sections of plain G.S. sheet with a minimum lap of 20 cm on either side over the C.G.S. sheets. The end laps

of the ridges and hips and between ridges and hips shall also be not less than 20 cm. The ridges and hips shall be of 60 cm overall width plain G.S. sheet, 0.6 mm or 0.8 mm thick as given in the description of the item and shall be properly bent in shape.

**Fixing:** Ridges shall be fixed to the purlins below with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to the purlins. Similarly, hips shall be fixed to the roof members below such as purlins, hip and valley rafters with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to those roof members. At least one of the fixing bolts shall pass through the end laps of ridges and hips, on either side. If this is not possible extra hook bolts shall be provided.

The end laps of ridges and hips shall be joined together with C.G.S sheet by galvanised iron seam bolts 25 x 6 mm size each with a bitumen and G.I. washer or white lead as directed by the Engineer-in-Charge. There shall be at least two such bolts in each end lap. Surface of C.G.I. sheets of ridge and hip sections and the roofing sheets which overlap each other shall be painted with a coat of approved primer and two coats of approved paint suitable for painting G.S. Sheets before they are fixed in place.

**Finish:** The edges of the ridges and hips shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets.

**Measurement:** The measurements shall be taken for the finished work in length along the centre line of ridge or hip, as the case may be, correct to a cm. The laps in ridges and hips and between ridges and hips shall not be measured.

**Rate:** The rate shall include the cost of all labour and materials specified above, including painting, cost of seam bolts and any extra G.I. hook bolts, nuts and washers, required.

**Asbestos cement roofing:** Providing and fixing 6 mm asbestos roofing with GI J or L hooks, bolts and nuts 8mm Dia GI plain & bitumen washer complete including cutting to proper size, lapping finishing & providing cut outs in sheeting etc.

**Measurements:** The length and breadth shall be measured correct to a cm. Area shall be worked out in some correct to two places of decimal. The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof. Roof with curved sheets shall be measured and paid for separately. Measurements shall be taken on the flat and not girthed.

**Rate:** The rate shall include the cost of all the materials and labour involved in all the operations described.

**Polycarbonate Multiwall Sheets:** Polycarbonate Multiwall Sheet Roofing: These shall be of the thickness specified in the description of the item and as approved by engineer in charge. The sheets shall be free from cracks, split edges, twists, surface flaws etc. They shall be clean, bright and smooth. The sheets shall not show signs of rust or white powdery deposits on the surface.

Material: Polycarbonate sheet shall confirm IS: 14443: 1997.

**Laying and Fixing:** The sheets shall be laid and fixed as per the manufacturer's specification, unless otherwise shown in the working drawings or as directed by the Engineer-in-Charge.

Finish: The roof when completed shall be true to lines and slopes and shall be leak proof.

**Measurements:** The length and breadth shall be measured correct to a cm. Area shall be worked out in sqm correct to two places of decimal. The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof. Roof with curved sheets shall be measured and paid for separately. Measurements shall be taken on the flat and not girthed.

**Rate:** The rate shall include the cost of all the materials and labour involved in all the operations described.

## **CEMENT CONCRETE GOLA:**

**Gola:** A chase of 75 mm wide and 75 mm deep shall be cut in the parapet wall just above the junction of mud phuska or lime concrete with parapet wall and it shall be filled with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 10 mm and down gauge) the external face finish with a slope of 1: 0.75 and the exposed surface of the gola shall be plastered with cement mortar 1 : 3 (1 cement : 3 fine sand). Expansion joint at every 3.5 to 4.5 metres shall be provided and filled with bitumen filler. The bitumen filler shall be prepared by mixing bitumen, cement and coarse sand in the ratio of 80: 1: 0.25 (80 kg of hot bitumen: 1 kg of cement and 0.25 cum of coarse sand).

**Curing:** The finished surface shall be cured for at least 7 days.

**Measurements:** The length of the finished gola shall be measured at its junction with the wall face correct to a cm. No deduction shall be made in measurements for gaps for water outlets.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above including the cost of bitumen filler in expansion joint. The rate includes for all turnings and roundings at all the corners and risers.

**KHURRAS:** The khurras shall be constructed before the brick masonry work in parapet wall is taken up and it shall be of size 45 cm x 45 cm unless otherwise specified in the description of the item and shall be made of cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) or other mix as stipulated in the description of the item.

**Laying:** A PVC sheet of size 1 m x 1 m x 400 micron (alternatively, aluminum foil of 32 SWG) shall be laid under the khurra and then cement concrete shall be laid over it to average thickness of 50 mm with its top surface lower than the level of adjoining roof surface by not less than 50 mm.

The concrete shall be laid to a size greater than the stipulated size of the khurra in such a way that the adjoining terracing shall overlap the concrete on its three edges by not less than 7.5 cm. The concrete will slope uniformly from the edges to the outlet, the slope being as much as possible and in no case less than 20 mm cement concrete at the outlet. The concrete shall be continued at the same slope through the width of the wall into the outlet opening to ensure a water tight joint.

The khurras and the sides of the outlet shall then be rendered with 12 mm coat of cement plaster 1:3 mix (1 cement: 3 coarse sand) or other mix as stipulated in the description of the item. This shall be done when the concrete is still green and shall be finished. The sides of the khurras and sides of the outlet opening shall be well rounded. The size of the finished outlet opening shall be 10 cm wide and by 20 cm high or as directed by the Engineer-in-Charge.

Measurements: Khurras shall be counted in numbers.

**Rate:** The rate is for each completed khurra of the specified size and is inclusive of the cost of all materials and labour in forming the khurras and outlet opening as described above, except for iron gratings which shall be paid for separately.

## > PLAIN/SEMI PERFORATED PARTICLE BOARD TILES CEILING:

**Frame:** The frame work shall consist of anodized aluminium T sections for main runners /cross runners of size specified in the item with anodic coating of 15 micron and perimeter wall angle of anodized aluminium section of size specified by the Engineer-in-charge with anodic coating of 15 micron fixed to the wall with M.S. screws 50 mm long and PVC raw plugs. The frame work shall be executed in a manner so as to form a grid of 600 mm x 600 mm as specified in the item. The frame work shall be suspended from ceiling by level adjusting hangers made of 6 mm dia. M.S. rods fixed to slab by means of MS ceiling cleats. The ceiling cleats shall be fixed to the slab by means of mechanical dash fasteners 6 mm dia and 50 mm long. MS hangers and ceiling cleats shall be painted with a coat of yellow zinc chromate primer and two coats of synthetic enamel paint.

**Ceiling Tiles:** Ceiling tiles shall be of 12 mm plain/semi perforated or with design BWP type phenol formaldehyde synthetic resin bonded particle board conforming to IS 3087 of required size or Zypsum false ceiling.

**Fixing of Ceiling Tiles:** The ceiling tiles shall be placed over the aluminium frame and fixed to the frame with help of 25 mm long CP brass screws with minimum 2 screws on each side of the grid. The CP brass screws shall be counter sunk star head screws.

**Measurements:** Length & breadth of the finished ceiling shall be measured correct to a centimetre. The area shall be calculated in square metre correct to two decimal places. No deduction shall be made for making openings for electrical, air conditioning, fire fighting fixtures nor shall extra payment be made either for extra materials or labour involved in making such openings.

**Rate:** The rate shall include the cost of all the materials and labour involved in all the operation described above including scaffolding etc.

# **11. PLASTERING & POINTING**

## **CEMENT PLASTER:**

The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

**Scaffolding:** For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose.

Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not are allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

**Note:** In case of special type of brick work, scaffolding shall be got approved from Engineer-incharge in advance.

**Preparation of Surface:** The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

**Mortar:** The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in Subhead 3.0. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

**Application of Plaster:** Ceiling plaster shall be completed before commencement of wall plaster. Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about  $15 \times 15$  cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive toweling or over working, all corners, angles and junctions shall be truly vertical or horizontal as the case.

**Curing:** Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

**Finish:** The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work precedes with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

**Measurements:** Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

## > CEMENT WATER PROOFING COMPOUND:

It shall be used for cement mortar for plastering or concrete work.

**Water Proofing Compound:** Integral cement water proofing compound conforming to IS: 2645 and of approved brand and manufacture, enlisted by the Engineer-in-Charge from time to time shall be used.

The contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added.

**Measurement:** It shall be measured by weight.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

### **GYPSUM PLASTER**:

Material: Material should be as per IS: 2547 (Part I & II) or as approved by engineer in charge.

Ceiling gypsum shall be completed before commencement of wall plaster. Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled. To ensure even thickness and a true surface, the surfaces of these gauged areas shall be truly in the plane of the finished plaster surface.

**Measurements:** Length and breadth shall be measured correct to a cm and its area shall be calculated in square meters correct to two places of decimal.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

### > WASHED STONE GRIT PLASTER

**Materials:** Stone chippings obtained by crushing hard stone shall be free of dust and deleterious material. 10 mm nominal size stone chippings, where specified, shall pass 100% through 12.5 mm sieve and fully retained on 6.3 mm sieve. Stone chippings shall be thoroughly washed with water and sieved before use.

**Mortar:** Cement mortar for under coat and cement mortar to be mixed with stone chippings for top coat shall be as specified.

**Application of Plaster:** 12 mm Under Coat: Under coat of cement mortar 1:4 (1 cement: 4 coarse sand) shall be applied, after the mortar has been brought to level with the wooden straight edge, shall be done with wooden float only. The surface shall be further roughened by furrowing with a scratching tool. Furrowing shall be done diagonally both ways and shall be about 2 mm deep to

provide a key for the top coat. The scratched lines shall not be more than 10 cm apart. The surface shall be kept wet till top coat is applied.

**15 mm Top Coat:** Top coat comprising cement mortar and stone chippings shall have an overall proportion of 1:0.5:2 (1 cement: 0.5 coarse sand: 2 stone chippings 10 mm nominal size) or as specified. The top coat shall be applied a day or two after the under coat has taken the initial set. The surface of the under coat shall be cleaned and a coat of cement slurry at 2 kg of cement per sq m shall be applied before the application of coat. The top coat shall be applied in uniform thickness on the under coat after the application of slurry and sufficiently pressed with wooden float for proper bonding with the under coat. Vacant space, if any shall be filled with the specified mix.

**Finish:** The top coat of plaster shall be finished to a true and plumb surface. The surface shall be tested frequently as the work precedes with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. All the corners angles and junctions shall be truly vertical or horizontal as the case may be. Rounding or chamfering of corners junctions etc. Where required shall be true to template. Finished surface of the top coat after the mix has taken the initial set, shall be scrubbed and washed with suitable brushes and plain water. Scrubbing and washing shall continue till the stone chippings are sufficiently exposed. Stone chippings which may come out while scrubbing shall be replaced using the specified mortar mix. A sample of the washed stone grit plaster shall be got approved from the Engineer in-Charge.

# > FINISHING

**Grooves:** Grooves of size 15 mm x 15 mm or as specified shall be provided as shown on the drawing or as required by the Engineer-in-Charge. Tapered wooden battens to match the size and shape of the grooves shall be fixed on the under coat with nails before the application of the top coat and these shall be removed carefully so that the edges of the panels of top coat are not damaged. Damage, if any, shall be made good by the contractor.

**Curing:** Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve.

Measurements Length and breadth shall be measured correct to the nearest cm and the area shall be calculated in sum correct to two places of decimal.

Measurements shall be taken for the work actually done with deductions for all openings and addition for all jambs soffits and sills. However, no deduction is to be made for the grooves provided as specified. Washed stone grit plaster on circular surfaces not exceeding 6 m in radius and on external surfaces at a height greater than 10 m shall be measured separately.

**Rates:** The rates shall include the cost of all labour and materials involved in all the operations described above except for providing grooves. The length of grooves shall be measured in running meters and Paid for separately.

## **BRICK TILE CLADDING:**

**Material:** Brick tile material should be according to IS: 4101 (Part-3). Brick tile shall be of the type as specified in the item. It shall be hard, sound durable and free from cracks and weathering effect etc. Thickness of brick tile shall be as specified in item.

**Fixing:** The size & shape of the cramps shall be as per drawing and as per directions of Engineer-in-charge.

The samples of steel cramps should be approved in advance before starting the brick tile cladding work. The cramp shall be attached to top and bottom of the brick tile. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to hold support and transfer the load of brick tile unit to the supporting structured steel shall be designed by the manufacturer and approval of the same shall be obtained from the Engineer-in-Charge. Brick tile shall be secured with clamps with high quality workmanship. The walls shall be carried up truly in plumb. All the courses shall be laid truly horizontal and all the vertical joints truly vertical. The sequence of execution for cladding work shall be as specified in item & approved by the Engineer-in-Charge.

**Measurement:** The length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal.

**Rate:** The rate includes the cost of materials and labour involved in all operations described above including cost of support scaffolding staging the cost of steel cramps drilling holes etc.

# **12. FLOORING**

## **FLOORING WORK :**

#### General:

**Scope:** This section shall cover all flooring and tiling work as shown in the drawing. This section will cover all flooring work as shown in the drawing. No work under this section shall be started until specifically allowed by the engineer in charge and until all other major works .Such as plastering, embedding of conduit and pipes, channels window fixing etc, have been completed. Approved sample shall be retained up to the end of the project.

**Base Concrete:** Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slope required for the flooring. Floors in verandah, courtyard kitchens, and baths shall have slope ranging from 1: 36 to 1: 48 depending upon locations as decided by the Engineer-in-Charge. Floors in water closet portion shall have slope of 1: 30 or as decided by the Engineer-in-Charge to drain off washing water. Plinth masonry off-set shall be depressed so as to allow the base concrete to rest on it.

If the base is of lean cement concrete, the flooring shall commence within 48 hours of the laying of base, failing which, the surface of base shall be roughened with steel wire brushes without disturbing the concrete. Before laying the flooring the base shall be wetted and smeared with a coat of cement slurry at 2 kg of cement spread over an area of one sqm so as to get a good bond between sub-grade and flooring.

**Laying: Panels:** Flooring of specified thickness shall be laid in the pattern including the border as given in the drawings or as directed by the Engineer-in-Charge. The border panels shall not exceed 450 mm in width and the joints in the border shall be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sq m. The joints of borders at corners shall be mitered for provision of strips.

**Laying:** Flooring with Strips: Normally cement concrete flooring shall be laid in one operation using glass/aluminum/PVC/brass strips/stainless steel strips or any other strips as enquired as per drawing or instructions of the Engineer-in-Charge, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junction of the panels. 4 mm thick glass strips or 2 mm PVC strips or 2 mm aluminum or brass strips shall be fixed with their

tops at proper level, giving required slopes. Use of glass and metallic strips shall be avoided in areas exposed to sun. Cost of providing and fixing strips shall be paid for separately.

**Concreting:** Cement concrete shall be placed in the panels and be leveled with the help of straight edge and trowel and beaten with thapy or mason's trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge. Surface of flooring be true to required slopes. While lying concrete, care shall be taken to see that the strips are not damaged /disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry. Laying of Flooring without Strips: Laying of cement concrete flooring in alternate panels may be allowed by the Engineer-in-Charge in case strips are not to be provided.

**Shuttering:** The panels shall be bounded by angle iron or flats. The angle iron/flat shall have the same depth as the concrete flooring. These shall be fixed in position, with their top at proper level giving required slopes.

**Finishing:** The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided.

Fresh cement shall be mixed with water to form a thick slurry and spreaded @ 2 kg of cement over an area of one sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth.

**Curing:** The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached.

**Rate**: The rates shall include the cost of all material & labour involved in all the operations described above, unless otherwise specified in the description of the item.

## > TERRAZO TILE FLOORING:

**Terrazo Tiles**: Terrazo tiles shall generally conform to IS: 1237-Edition. Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of wearing layer. The size of tiles shall be as shown in the drawings or as required by the Engineer-in-Charge. Half tiles for use with the full tiles shall be such as to make two half tiles when joined together, match with the dimensions of one full tile.

**Tolerance:** Tolerances on length and breadth shall be plus or minus one millimetre, and tolerance on thickness shall be plus 5 mm. The variation of dimensions in any one delivery of tiles shall not exceed 1 mm on length and breadth and 3 mm on thickness.

The tiles shall be manufactured in a factory under pressure process subjected to hydraulic pressure of not less than 140 kg per square centimetre and shall be given the initial grinding with machine and grouting of the wearing layer before delivery to site. The wearing layer shall be free from projections, depressions, cracks, holes, cavities and other blemishes. The edges of wearing layer may be rounded. The proportion of cement to aggregate in the backing of tiles shall be not leaner than 1:3 by weight. Where colouring material is used in the wearing layer, it shall not exceed 10 per cent by weight of cement used in the mix. The finished thickness of the upper layer shall not

be less than 5 mm for size of marble chips ranging from the smallest up to 6 mm and also, not less than 5 mm for size of marble chips ranging from the smallest up to 12 mm, and not less than 6 mm for size of marble chips varying from the smallest up to 20 mm.

**Laying:** Base concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar of specified proportion and in conformity with provisions in relevant para of chapter on 'Mortar'. Cement mortar 1:4 (1 Cement: 4 coarse sand) bedding shall be used. Average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall not be less than 10 mm.

Cement mortar bedding shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. If cement mortar is laid in bedding the terrazo tiles, these shall be set immediately after laying the mortar. Over this bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 4.4 kg of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1 mm and in straight lines or to suit the required pattern. The joints shall be properly cleaned before filling with cement grout of matching colour.

The surface of the flooring during laying shall be frequently checked with a straight edge of length at least 2 metre, so as to obtain a true surface with the required slope. Where full tiles or half tiles cannot be fixed, tiles shall be cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joint. Tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster, skirting or dado. The junction between wall plaster and tile work shall be finished neatly and without waviness. After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleared off.

**Curing, Polishing and Finishing:** The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface. The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor, as ordered by the Engineer-in-Charge.

For small areas or where circumstances so require, hand grinding/polishing with hand grinder may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used:

1st grinding	— coarse grade stone (No. 60)
Second grinding	— medium grade (No. 80)
Final grinding	— fine grade (No. 120)

In all other respects, the process shall be similar as for machine polishing. After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags). The Following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean. If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with a wooden mallet.

**Measurements:** Terrazo tile flooring shall be measured as laid in square metre correct to two places of decimal. For length and breadth dimensions correct to a cm before laying skirting, dado or wall plaster shall be taken. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metres. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same room or courtyard. Terrazzo tile flooring laid in floor borders and similar band shall be measured under the item of terrazo tile flooring. Nothing extra shall be paid in respect of these and similar bands formed of half size or multiply of half size standard tiles or other uncut tiles. Treads of stairs and steps paved with tiles without nosing, shall also be measured under flooring. Moulded nosing shall be paid in running metre except where otherwise stated, returned moulded ends and angles to mouldings shall be included in the description. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above. Where cement mortar bedding is used in place of lime mortar the rate will be adjusted accordingly.

## VACCUM DEWATERED CONCRETING/TREMIX FLOORING

Preparation The surface to receive flooring shall be clean, free from dirt and free from foreign material. Any undulations or mortar remaining on the floor shall be trimmed. Base course shall be trimmed. The base shall be cleaned and watered before laying the floor. Work includes at all depths and heights. The finished surface shall be kept wet for a maximum period of one week.

#### CONCRETING

General Concreting shall have a concrete base of M25 of specified thick as per BOQ. Flooring shall have hard top on the concrete base. Flooring shall be laid in strips, the size of which is mentioned on the drawings.

Materials Cement - PPC Sand - River sand Aggregate - Max. size 10 to 20mm Water - Potable Floor hardener - @5kG/Sqm

Execution

Mix cement, sand and aggregates as per specified grade thoroughly with water to get an appropriate consistency.

Prepared concrete shall be laid immediately after mixing.

The base shall be free from water and other foreign materials, dust and dirt.

A coat of cement slurry of the consistency of thick cream shall be brushed on the surface of the base course.

The concrete shall then be spread over this base evenly and leveled carefully. Low areas shall be filled with concrete and humps removed. Devaccumisation shall be done for removing the voids. The whole concrete surface shall be leveled, compacted by ramming and trowelling. Prepared surface shall be allowed to set. Hardner screed Hard top to be prepared as per the specifications with Nitohardner and one part of dry cement. The hard top shall be provided over concrete base immediately after it is set, compacted and leveled with a

steel trowel. The surface shall be trowelled to bring the hardener coat to a leveled surface.

Excessive trowelling shall be avoided.

After the initial set, further compaction shall be done by steel trowelling.

Final brushing shall be made before the floor top becomes too hard.

#### CURING

Curing shall commence as soon as the surface is hard enough to receive the water. The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

#### Mode of measurement

Length and breadth shall be measured correct a cm before laying skirting, dado or wall plaster. The area as laid shall be calculated in sqm correct to two decimal places. The thickness of the under layer shall be measured correct to mm. The thickness of top layer shall not be less than that specified. In case of skirting the length shall be measured as finished and height shall be measured from the finish level of the floor correct to 5mm.

No deduction shall be made, nor extra paid for voids not exceeding 0.20 square metres. Deduction for ends of dissimilar materials or other articles embedded shall not be made for area not exceeding 0.10 square metres. Nothing extra shall be paid for laying the floor at different level in the same room or courtyard. Areas, where tiles of different types or decorative types are used shall be measured separately.

## > CHEQUERED TILE FLOORING:

**Chequered Tiles:** The tiles shall be of nominal sizes such as  $20 \times 20$  cm,  $25 \times 25$  cm and  $30 \times 30$  cm or of standard sizes with equal sides. The size of tiles to be used shall be as shown in drawings or as required by the Engineer-in-Charge. The centre to centre distance of chequers shall not be less than 2.5 cm and not more than 5 cm.

The overall thickness of the tiles shall not be less than 30 mm. The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be cement tiles, or terrazzo tiles as specified in the description of the item. The thickness of the upper layer, measured from the top of the chequers shall not be less than 6 mm.

**Laying:** Sub grade concrete or slab on which the tiles are to be laid shall be cleaned, wetted. The bedding of tiles is to be with 30 mm thick 1:5 cement mortar (1 cement: 5 course sand). Cement mortar shall be spread, tamped and corrected to proper level sand. Over this bedding neat gray cement slurry shall be spread. The tiles first be soaked in water and laid over the grout and tapped with wooden mallet to ensure proper level. The joints shall be kept as thin as possible not exceeding 1.5mm.

**Grouting, curing:** The joints shall be cleaned of the gray cement grout with a wire brush, the next day. Joints shall be grouted using neat cement slurry mixed with pigment to match the shade of the tiles. The floor shall be kept wet for a minimum period of 7days.

# **Cement concrete paver block & tactile flooring**: **Base concrete:** It shall be as per design & drawing.

**Laying:** The paver block & tactile tile of required size & shape made of cement concrete of M30 grade made by block making machine with strong vibratory compaction level in required pattern over and including 40 mm thick compacted bed of course sand filling joints with sand etc all complete as per direction of engineer in charge. Colour shall be guaranteed against wearing for minimum 10 years. On completion of flooring the vertical joints shall be fully filled with sand or mortar as specified in item.

**Rate**: The rates shall include the cost of all material & labour involved in all the operations described above, unless otherwise specified in the description of the item.

The rate shall not include cost of cornices which shall be measured and paid for in running meters separately.

# > MARBLE STONE FLOORING:

**Dressing of marble stone:** Every stone shall be cut to the full depth. So that a straight edge along the stone shall be fully in contact with it. So that a straight edge along the side of the stone shall be fully in contact with it. The top surface shall also be fine chisel dressed to remove all the winners. All angles and edges of the marble slab shall be true and plane.

**Laying:** Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as given in the description of the item.

# > CEMENT CONCRETE FLOORING WITH METALLIC HARDENER TOPPING:

Base Concrete: It shall be as specified.

**Under Layer:** Cement concrete flooring of specified thickness and mix (mentioned in item for under layer) shall be laid as under layer. The top surface shall be roughened with brushes while the concrete is still green and the forms/strips shall be kept projecting up 12 mm over the concrete surface, to receive the metallic hardening compound topping.

**Topping:** This shall consist of 12 mm thick layer of mix 1:2 (1 cement: 2 stone aggregate 6 mm nominal size) by volume or as otherwise specified with which metallic hardening compound is mixed in the ratio of 1:4 (1 metallic concrete hardener: 4 cement) by weight. Metallic hardener shall be dry mixed thoroughly with cement on a clean dry pacca platform. This dry mixture shall be mixed with stone aggregate 6 mm nominal size or as otherwise specified in the ratio of 1 : 2 (1 cement : 2 stone aggregate) and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete. The mixture so obtained shall be laid in 12 mm thickness, on cement concrete floor within 2 to 4 Hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

**Curing:** The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened.

**Measurement:** Length and breadth shall be measured before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

The flooring done either with strips (in one operation) or without strips (in alternate panels) shall be treated as same and measured together.

**Rate**: The rates shall include the cost of all material & labour involved in all the operations described above, unless otherwise specified in the description of the item.

## **KOTA STONE FLOORING:**

**Kota Stone Slabs:** The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge. The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

Dressing: Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane. The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of  $\pm 2$  mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of  $\pm 5$  mm for hand cut slabs and  $\pm 2$  mm for machine cut slabs shall be allowed.

**Polishing and Finishing:** Slight unevenness at the meeting edges of slabs are to be removed by chiseling care fully and then finished polished & cured in the same manner as described under terrazzo tile flooring except that (a) first polishing with coarse grade carborundum stone shall not be done, (b) cement slurry with or without pigment shall not be applied on the surface before polishing.

The finished surface shall be an even plane, level or sloped as specified clear without patches meeting the approval of the engineer in charge.

**Rate**: The rates shall include the cost of all material & labour involved in all the operations described above, unless otherwise specified in the description of the item.

## **KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO:**

Kota Stone Slabs and Dressing shall be as specified above and except that the thickness of the slabs shall be 25 mm or as specified in the description of the item. The slabs may be of uniform size if required.

**Preparation of surfaces:** In case of risers, skirting or dado, the surfaces shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly and washed with water and kept wet before skirting/riser/dado is commenced. In case of treads the surface shall be same as specified in flooring. Laying shall be as specified in except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs. Curing, Polishing and Finishing

shall be as specified above except that first polishing with coarse grade carborundum stone shall not be done.

**Measurements:** Length shall be measured along the finished face of riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread of floor to the top (the underside of tread in the case of steps). This shall be measured correct to a mm in the case of risers of steps and skirting and correct to a cm in the case of dado. The area shall be calculated in square metre correct to two places of decimal. Lining of pillars etc. shall also be measured under this item.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above.

## > PRESSED CERAMIC TILES IN SKIRTING AND DADO:

The tiles shall be of approved make and shall generally conform to IS: 15622. The tiles shall be pressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility. The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze, however, any glaze if unavoidable shall be permissible on only up to 50 per cent of the surface area of edges. The glaze shall be free from welts, chips, craze, specks, crawlings or other imperfections detracting from the appearance when viewed from a distance of one metre. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the Engineer-in-Charge. There may be more than one colour on a tile.

**Preparation of Surfaces:** The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

**Laying:** 12 mm thick plaster of cement mortar 1:3 (1 cement : 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals. The tiles should be soaked in water, washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/cut size of tile shall be adjusted at bottom to take care of slope of the flooring. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth. Skirting /dado shall not project from the finished "surface of wall" by more than the tile thickness; undulations if any shall be adjusted in wall.

**Curing and Finishing:** The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

**Measurements:** Length shall be measured correct to a cm. Height shall be measured correct to a cm in the case of dado and 5 mm in the case of riser and skirting. The area shall be calculated in

square metre, correct to two places of decimal. Length and height shall be measured along the finished face of the skirting or dado including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used the area of dado shall be measured excluding the cornices. Nothing extra will be paid for cutting (sawn) the tiles to sizes. Areas where coloured tiles or different types of decorative tiles are used will be measured separately to be paid extra over and above the normal rate for white tiles.

**Rates:** The rate shall include the cost of all material and labour involved in all the operations described above, for tiles of sizes up to 0.14 sqm. Unless otherwise specified in the description of the item. The specials such as coves, internal and external angles and beading shall be measured and paid for separately. The rate shall not include cost of cornices which shall be measured and paid for in running meters separately.

## > PRESSED CERAMIC TILE FLOORING (VITRIFIED TILE FLOORING):

Vitrified tiles shall be of approved make and shall generally conform to IS: 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS: 13630. Classification and Characteristics of pressed ceramic tiles shall be as per IS: 13712.

**Measurements:** Length shall be measured correct to a cm. Height shall be measured correct to a cm in the case of dado and 5 mm in the case of riser and skirting. The area shall be calculated in square metre, correct to two places of decimal. Length and height shall be measured along the finished face of the skirting or dado including curves where specials such as coves, internal and external angles and beads are used.

Where cornices are used the area of dado shall be measured excluding the cornices. Nothing extra will be paid for cutting (sawn) the tiles to sizes. Areas where coloured tiles or different types of decorative tiles are used will be measured separately to be paid extra over and above the normal rate for white tiles.

**Rates:** The rate shall include the cost of all material and labour involved in all the operations described above, for tiles of sizes up to 0.14 sqm. Unless otherwise specified in the description of the item. The specials such as coves, internal and external angles and beading shall be measured and paid for separately. The rate shall not include cost of cornices which shall be measured and paid for in running meters separately.

# **13. MARBLE WORK**

## > MARBLE STONE FLOORING:

**Dressing of Slabs:** Every stone shall be cut to the required size and shape, fine chisel dressed on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. The top surface shall also be fine chisel dressed to remove all waviness. In case machine cut slabs are used, fine chisel dressing of machine cut surface need not be done provided a straight edge laid anywhere along the machine cut surfaces is in contact with every point on it. The sides and top surface of slabs shall be machine rubbed or table rubbed with coarse sand before paving. All angles and edges of the marble slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slabs shall be 18, 30 or 40 mm as specified in the description of the item. Tolerance of + 3% shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of + 2% shall be allowed.

**Laying:** Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as given in the description of the item. The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm. The slabs shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible.

Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm. Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer-in-Charge.

The slabs shall be matched as shown in drawings or as instructed by the Engineer-in-Charge. Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness. Marble slabs flooring shall also be laid in combination with other stones and/or in simple regular pattern/design as described in item of work and/or drawing.

**Polishing and Finishing:** Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling and finished. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding with machine fitted with the finest grade grit block (No. 120). The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor .Cement slurry with or without pigments shall not be applied on the surface before each polishing. After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per Square meter sprinkled with water and rubbed hard with a 'namdah' block (pad of woolen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

**Measurements:** Marble stone flooring with different kind of marble shall be measured separately and in square metre correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square meters. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metres. Nothing extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs

paved with marble stone slabs shall also be measured under the item of marble Stone flooring. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm. nosing for treads shall be measured in running meter and paid for extra. The width of treads shall be measured from the outer edge of the nosing, as laid, before providing the riser.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above. However, extra shall be paid for making special type of pattern/design/flowers as per drawings. No deductions shall be made in rate even if flooring is done without any pattern/design.

## **GRANITE FLOORING:**

**Granite:** A. Granite Standard: Granite shall comply with ASTM C 615, "Standard Specification for Granite Dimension Stone" for material characteristics, physical requirements, and sampling for selection of granite.

**General:** All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling or mock-up phases will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Design Professional.

**Packing and Loading:** Finished granite shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No material which may cause staining or discoloration shall be used for blocking or packing.

**Site Storage:** Upon receipt at the building site or storage yard, the granite shall be tacked on timber or platforms at least 3" above the ground, and extreme care shall be taken to prevent staining during storage. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between any wood and finished surfaces, and shall be used also as an overall protective covering.

**Stone Installation:** Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned to tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water.

Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings

**Protection of Finished Work:** After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive.

All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

**Measurements:** Length shall be measured along the finished face of flooring, riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread of floor to the top (the underside of tread in the case of steps). This shall be measured correct to a mm in the case of risers of steps and skirting and correct to a cm in the case of dado. The area shall be calculated in

square metre correct to two places of decimal. Lining of pillars etc. shall also be measured under this item.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above.

# **14. DISTEMPERING PAINTING & FINISHING**

## > WHITE WASHING WITH LIME:

Scaffolding: Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

**Preparation of Surface:** Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings a foreign matter. In case of old work, all loose particles and scales shall be scrapped off and holes in plaster as well as patches of less than 50 cm area shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer-in-Charge, the entire surface of old white wash shall be thoroughly removed by scrapping and this shall be paid for separately. Where efflorescence is observed the deposits may be brushed clean and washed. The surface shall then be allowed to dry for at least 48 hours before white washing is done.

**Preparation of Lime Wash:** The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg of lime.

**Application:** The white wash shall be applied with brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another FINISHING from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries. Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

**Measurements:** Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

Rate: The rate shall include all material and labour involved in all the operations described above.

# **COLOUR WASHING:**

The mineral colours, not affected by lime, shall be added to white wash. Indigo (Neel) shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer-in-Charge. The colour shall be of even tint or shade over the whole surface. If it is blotchy or otherwise badly applied, it shall be redone by the contractor.

**For new work**: The priming coat shall be of white wash with lime or with whiting as specified in the description of the item. Two or more coats shall then be applied on the entire surface till it represents a smooth and uniform finish.

**For old work**: After the surface has been prepared a coat of colour wash shall be applied over the patches and repairs. Then a single coat or two or more coats of colour wash, as stipulated in the description of the item shall be applied over the entire surface. The colour washed surface shall present a uniform finish. The finished dry surface shall not be powdery and shall not readily come off on the hand when rubbed.

## > DRY DISTEMPERING

**Materials:** Dry distemper of required colour (IS: 427) and of approved brand and manufacture shall be used. The shade shall be got approved from the Engineer-in-Charge before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water using 6 deciliters (0.6 litre) of water per kg of distemper or as specified by the makers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency. Distemper shall not be mixed in larger quantity than is actually required for one day's work.

**Preparation of Surface:** New plastered surfaces shall be allowed to dry completely, before applying, distemper. In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt, etc. Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used.

The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

**Priming Coat:** A priming coat of whiting shall be applied over the prepared surface in case of new work, if so stipulated in the description of the item. No white washing coat shall be used as a priming coat for distemper.

The treated surface shall be allowed to dry before distemper coat is given.

**Application:** In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour. For old work, the surface prepared shall be applied one or more coats of distemper till the surface attains an even colour.

The application of each coat shall be as follows:

The entire surface shall be coated with the mixture uniformly, with proper distemper brushes (Ordinary white wash brushed shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform and shall show no brush marks. Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

## > OIL EMULSION (OIL BOUND) WASHABLE DISTEMPERING:

**Materials:** Oil emulsion (Oil Bound) washable distemper (IS 428) of approved brand and manufacture shall be used. The primer where used as on new work shall be cements primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-Charge.

**Preparation of the Surface:** For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

### **Application:**

**Priming Coat:** The priming coat shall be with distemper primer or cement primer, as required in the description of the item.

But if distempering is done after the wall surface is dried completely, Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming Paint conforming to IS 109 and allowed to dry for at least 48 hours before distempering is commenced.

For old work no primer coat is necessary.

**Distemper Coat:** For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat.

For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade.

**Rate:** The rate shall include the cost of all labour and materials involved in all the above operations (Including priming coat) described above.

## **CEMENT PRIMER COAT:**

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on non-asbestos cement surfaces before oil emulsion distemper Paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalis present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper Paints.

Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion Paints etc.

**Preparation of the Surface:** The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing.

The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

**Application:** The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

## **CEMENT PAINT:**

**Material:** The cement Paint shall be (conforming to IS: 5410) of approved brand and manufacture. The cement Paint shall be brought to the site of work by the contractor in its original containers is sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge.

**Preparation of Surface:** For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement Paint shall be applied over patches after wetting them thoroughly.

**Preparation of Mix:** Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of

workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

**Application:** The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade. For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

**Precaution:** Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

## **EXTERIOR PAINTING ON WALL:**

**Material:** The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

**Preparation of Surface:** For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, and fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

**Application:** Base coat of water proofing cement paint, Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be

applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

**Painting:** Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready mixed Paint (Exterior grade) as received from the manufacturer without any admixture shall be used. If for any reason, thinning is necessary in case of ready mixed Paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used. Approved Paints, oil or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

**Commencing Work:** Painting shall not be started until the Engineer-in-Charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm. Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work. The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Paint work being started.

**Preparation of Surface:** The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

**Application:** Before pouring into smaller containers for use, the Paint shall be stirred thoroughly in its containers, when applying also; the Paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with Paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is laid. No left over Paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed. No hair marks from the brush or clogging of Paint puddles in the corners of panels, angles of moldings etc. shall be left on the work. In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no Paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need not be done nor any

deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters. On painting steel work, special care shall be taken while painting over bolts, nuts, and rivets overlaps etc. The additional specifications for primer and other coats of Paints shall be as according to the detailed specifications under the respective headings.

**Brushes and Containers:** After work, the brushes shall be completely cleaned of Paint and linseed oil by rinsing with turpentine. A brush in which Paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use shall be kept closed and free from air so that Paint does not thicken and also shall be kept safe from dust. When the Paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

**Measurements:** The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except otherwise stated. Small articles not exceeding 10 sq. decimeter (0.1 sqm) of painted surfaces where not in conjunction with similar painted work shall be enumerated. Painting up to 10 cm in width or in girth and not in conjunction with similar painted work shall be given in running meters and shall include cutting to line where so required.

# > PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES:

**Primer:** The primer for wood work, iron work or plastered surface shall be as specified in the description of item.

Primer for plaster/wood work/Iron & Steel/Aluminum surfaces shall be as specified below:

S. No.	Surfaces	Primer to be used
1.	Wood work (hard and soft wood)	Pink conforming to IS: 3536
2.	Resinous wood and plywood	Aluminum primer conforming to IS: 3585
3.	(A) Aluminum and light alloys chromate	Conforming to IS: 104.
	primer	Primer conforming IS: 2074
	(B) Iron, Steel and Galvanized steel Red	
	Oxide Zinc chromate	
4.	Cement/Conc./RCC/brick work, Plastered	Cement primer conforming to IS: 109
	surfaces, non-asbestos surfaces to receive	
	Oil bound distemper or Paint finish	

The primer shall be ready mixed primer of approved brand and manufacture.

Where primer for wood work is specified to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg : 0.7 kg : 1 liter.

Where primer for steel work is specified to be mixed at site, it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg : 1 litre : 1 litre. The specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

(a) White Lead: The White lead shall be pure and free from adulterants like barium sulphate and whiting. It shall conform to IS 103.

(b) **Red Lead:** This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall conform to IS 102.

(c) **Raw Linseed Oil:** Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note: The oil shall be mellow and sweet to the taste with very little smell. The oil shall be of sufficiently matured quality. Oil turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall conform in all respects to IS 75. The oil shall be of approved brand and manufacture.

(d) **Double Boiled Linseed Oil:** This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a temperature of 30 degree C. It shall dry with a glossy surface. It shall conform in all respects to IS 77. The oil shall be of approved brand and manufacture.

**Turpentine:** Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine shall be used. It shall have no grease or other residue when allowed to evaporate. It shall conform to IS 533.

All the above materials shall be of approved manufacture and brought to site in their original packing in sealed condition.

**Preparation of Surface Wooden Surface:** The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material conforming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before Paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty.

Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

**Iron & Steel Surface:** All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

**Plastered Surface:** The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of paris and rubbed smooth.

**Application:** The primer shall be applied with brushes, worked well into the surface and spread even and smooth.

## ➢ WALL PAINTING WITH PLASTIC EMULSION PAINT:

The plastic emulsion Paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These Paints are to be used on internal surfaces except wooden and steel.

1 Plastic Emulsion Paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

#### Painting on New Surface:

**Application**: The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces. The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions. The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

#### **Precautions:**

(a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

**Painting on Old Surface:** Preparation of Surface: This shall be done, except that the surface before application of Paint shall be flattened well to get the proper flat velvety finish after painting.

## > PAINTING WITH SYNTHETIC ENAMEL PAINT:

Synthetic Enamel Paint (conforming to IS: 2933) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary Paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be us Painting on New Surface.

Application: The number of coats including the undercoat shall be as stipulated in the item.

- (a) **Under Coat:** One coat of the specified ordinary Paint of shade suited to the shade of the top coat shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of Wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.
- (b) **Top Coat:** Top coats of synthetic enamel Paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

#### Painting on Old Surface:

**Preparation of Surface**: Where the existing Paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified Paint. The surface shall again be rubbed and made smooth and uniform.

If the old paint is blistered and flaked it will be necessary to completely remove it. Such removal shall be paid for separately and the painting shall be treated as on new surface.

**Finishing**: Painting: The number of coats as stipulated in the item shall be applied with synthetic enamel Paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

## > PAINTING WITH ALUMINIUM PAINT:

Aluminum Paint shall be (conforming to IS: 2339) of approved brand and manufacture. The Paint comes in compact dual container with the paste and the medium separately.

The two shall be mixed together to proper consistency before use.

Preparation of Surface Steel Work (New Surfaces) : All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

### Steel Work or C.G.S. sheets (Old Surfaces):

**Application:** The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance. As aluminum paste is likely to settle in the container, care shall be taken to frequently stir the Paint during used. Also the Paint shall be applied and laid off quickly, as surface is otherwise not easily.

## **FRENCH SPIRIT POLISHING:**

Pure shellac conforming to IS 16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade. Readymade polish conforming to IS 348 can also be used.

### Polishing New Surface:

**Preparation of Surface:** The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

**Application:** The number of coats of polish to be applied shall be as described in the item. A pad of woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

**Measurements:** The length and breadth shall be measured correct to a cm. The area shall be calculated in sq.m. (correct to two places of decimal), except otherwise stated

**Rate:** Rates shall include cost of all labour and materials involved in all the operations described above.

**Preparation of Surface**: If the old polished surface is not much soiled it shall be cleaned of grease and dirt by rubbing with turpentine and then rubbed with fine sand paper.

If the old polished surface is much soiled then it will be necessary to remove the entire polish and such removal shall be paid for separately outside the rate of polishing. Further the polishing itself will have to do done like new work and will be paid for as such.

## **BEES WAXING OR POLISHING WITH READY MADE WAX POLISH:**

The polishing shall be done with bees waxing prepared locally or with readymade wax polish of approved brand and manufacture, as stipulated in the description of item. Where a bee waxing is to be prepared locally, the following specifications for the same shall apply. Pure bees wax free from paraffin or stearine adulterants shall be used. Its specific gravity shall be 0.965 to 0.969 and melting point shall be 63 degree C. The polish shall be prepared from a mixture of bees wax, linseed oil, turpentine and varnish in the ratio of 2: 1.5: 1: 0.5 by weight. The bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm and turpentine and varnish added to it in the required proportions and the entire mixture shall be well stirred. Waxing New Surface: Preparation of Surface: Preparation of surface shall be as described in with the exception that knotting, holes and cracks shall be stopped with a mixture of fine saw dust formed of the Wood being treated, beaten up with sufficient bees wax to give it cohesion.

**Application**: The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then rubbed continuously for half an hour. When the surface is quite dry, a second coat shall be applied in the same manner and rubbed continuously for one hour or until the surface is dry. The final coat shall then be applied and rubbed for two hours (more if necessary) until the surface has assumed a uniform gloss and is dry, showing no sign of stickiness. The final polish depends, largely on the amount of rubbing which should be continuous and with uniform pressure with frequent changes in the direction.

**Waxing Old Surfaces:** Preparation of Surface: The wood work shall be cleaned of all smoke and grease by washing with lime water. The surface shall then be washed with soap and completely dried.

**Application**: The polish shall be applied in the manner specified. In this case one or two coats shall be applied as necessary to get uniform gloss, instead of three coats in the case of new work.

# **15. MISCELLANEOUS ITEM**

## **FIRE FIGHTING DOORS:**

**General:** The doors shall be of approved proprietary make such as "NAVAIR" shall be so designed so as to provide 1 hour fire resistance when tested as per IS: 3614 and BS: 2750 and the manufacturer must produce a certificate of C.B.R.I. Roorkee to that effect.

**Frame/Panels:** The main frame, panels, head and runners etc. shall be of heavy timber of at least 100mm X 75 mm for frame and 45 mm for door panel and fire retardant plywood confirming to IS: 5509 shall be used. The doors shall be single or double leaf, as specified. When closed, there shall

be no gap between the leaves or at hinges between the frame and door panel etc. So that no smoke can pass through. The doors shall be installed strictly as per manufacturer's printed instructions.

**Fittings/Door closer:** All fittings used in the manufacturing of the door shall be heavy duty type. The door shall be fitted with heavy duty concealed type automatic door closers, of approved make.

**Seal:** A heat activated into mescent seal confirming to BS: 476 (Part-8) shall be provided on all edges of door to check the spread of smoke in case of fire.

**Paint:** The door frame and panel shall be treated with ready mixed Fire Resistant paint as per IS: 162:1950 (BS: 162:1950 (BS: 476-part I).

**Hold Fast:** Mild steel hold fasts for use with wooden doors shall be made from mild steel flats not less than 5mm thick and shall be in accordance to IS: 7196-1974. Hold fasts shall be fixed in cement concrete blocks as per drawing as directed by Engineer in Charge.

## **BISON PANEL**

Bison Panel is cement bonded particle board which represent a significant advance in building board technology. It meets all specifications and environmental regulations for standards of durability, safety and economy.

**Introduction:** Bison Panel is basically Cement bonded wood particle board. The properties of the board are determined by basic materials Wood and Cement. Cement is weather – termite and fire proof, rot and fungus resistant. Wood is comparatively light in weight, elastic and can easily be machined. Board strength is obtained by reinforcing the concrete by wood fibers or flakes. By covering wood particles with cement, they are protected. Thus, resulting in a perfect reciprocal effect of the two basic materials cement and wood viz. Strength and durability of cement and workability of wood.

**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.

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

# **16. EXTERNAL DEVELOPMENT**

## FACTORY MADE CEMENT CONCRETE INTERLOCKING PAVER BLOCK

**Base:** Interlocking paver block to be fixed on the bed 50 mm or specified otherwise thick of coarse sand of approved specification and filling the joints with the sand of approved type and quality or as specified and as directed by Engineer-in-charge.

**Interlocking Paver Block:** Factory made precast paver block of M-30 or otherwise specified grade to be used. Paver blocks to be of approved brand and manufacturer and of approved quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for

the grade specified to be tested as per method mentioned in specification of subhead cement concrete of CPWD Specification 2009 Vol. I.

**Measurement & Rates:** Area provided with paver block to be measured in sqm. Correct up to two places of decimal. The rate includes the cost of the material, labour, tools etc. required in all the operations described above.

## **KERB STONE (PRECAST)**

**Laying:** Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

The kerb stones with top 20 cm. wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. from the road edge to allow for the channel and shall project about 12.5 cm. above the latter. The channel stones with top 30 cm. wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days. The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the Engineer-in-Charge for connecting to storm water drains.

**Finishing:** Berms and road edges shall be restored and all surplus earth including rubbish etc. disposed off as directed by the Engineer-in-charge. Nothing extra shall be paid for this.

**Measurements:** It shall be measured in cubic meters with Length of the finished work (for specified width and height of stone) shall be measured in running meter along the edge of the road correct to a cm.

Rate: The rate shall include the cost of all the materials and labour involved in all the operations.

## > SUB-GRADE: PREPARATION AND CONSOLIDATION

In sub-grade composed of clay, fine sand or other soils that may be forced up into the coarse aggregate during rolling operation, an insulation layer of suitable thickness of granular materials or over size brick aggregate not less than 10 cm thick shall be provided for blanketing the sub-grade, which shall be paid for separately, unless otherwise specified. In slushy soils or in areas that are water logged, special arrangements shall be made to improve the sub-grade and the total pavement thickness shall be designed after testing the properties of the sub grade soil. Necessary provision for the special treatment required shall be made in the project and paid for separately.

**Preparation of Sub-Grade:** The surface of the formation for a width of sub-base, which shall be 15 cm more on either side of base course, shall first be cut to a depth equal to the combined depth of sub-base and surface courses below the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances. Any ruts or soft yielding patches that appear due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to the finished profile.

**Consolidation:** The sub-grade shall be consolidated with a power road roller of 8 to 12 tonnes. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves

as an elastic mass (the roller shall pass a minimum of 5 runs on the sub grade). All undulations in the surface that develop due to rolling shall be made good with material or quarry spoils as the cases may be and the sub-grade is rerolled..

**Surface Regularity:** The finished surface shall be uniform and conform to the lines, grades and typical cross section shown in the drawings, when tested with the template and straight edge, the variation shall be within the tolerances specified.

## > SUPPLYING AND STACKING OF MATERIALS:

Aggregates/Red Bajri: The item of work shall specify stone aggregate/brick aggregate/red bajri, as the case may be.

**Stacking:** Ground where stacks are proposed to be made shall be cleared, leveled or dressed to a uniform slope and all lumps, depressions etc. shall be removed. The stacked metal shall be free from vegetation and other foreign matter. Coarse aggregates stack shall be made at places as directed by the Engineer-in-Charge. All rejected stone metal shall be removed from the site.

The aggregate shall be stacked in convenient units of one metre top width, 2.2 m bottom width, 60 cm height and of length in multiples of 3 m for new roads. Where berm width is limited or for repair works. it shall be stacked in units of 40 cm top width 1.4 m bottom width, 50 cm height and length in multiples of 3 m. Template of steel shall be used for making the stacks and shall always be kept at site for check measurements. The Engineer-in-Charge may permit stacking in different sizes and height ranging between 45 to 75 cm for new roads and 40 to 60 cm for repair work, in case the site conditions so demand. In a particular reach of road as decided by the Engineer-in-Charge, the quantity of stacked material shall be comparable to the theoretical quantity required for W.B.M. to be laid in that reach.

The stacks shall be uniformly distributed along the road and shall be numbered serially. The number plate shall be planted on each stack, which shall remain in position until the stack is used in the work. A register showing daily consumption of stacks shall be maintained at site of work. The collection of stone metal shall be for completed length of one km (for each layer of W.B. macadam) or as directed by the Engineer-in-Charge in writing.

**Measurements:** Length, breadth and height shall be measured correct to a cm. The total quantity so arrived shall be reduced by 7.5% to arrive at the net quantity for payment, in cases of aggregates. No such reduction shall be made in case of fine aggregate i.e. Red Bajri & screening etc.

### **Binder:**

**Stacking:** Specified binder shall be brought to the site of work in the sealed original containers. Binder brought in damaged containers shall not be allowed. The material shall be stacked in fenced enclosures, as directed by the Engineer-in-Charge, on one side of the roadway. The material shall be purchased from reputed firms or their authorised dealer. All the drums brought to site shall be serially numbered and used in the same order. The materials shall be brought in at a time in adequate quantities to suffice for the whole work or for at least a fortnight's work.

For major bituminous road works, supply of bitumen in bulk may be taken for economical reasons, or if the contingencies of the work so require. Sufficient storage arrangement shall be made at site for at least ten days requirement. Materials shall be kept in the joint custody of the contractor and the representative of the Engineer in- Charge. The empty containers shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the

Engineer-in-Charge. A few drums may be removed before completion of work for heating bitumen and mixing aggregates etc. with the permission to the Engineer-in-Charge. Empty drums required to be returned to stores shall be in good condition. Recovery rate for non return of the empty drums or for the damaged drums shall be as decided by the Engineer-in-Charge.

**Measurements:** The materials shall be recorded as per standard weights of different type of container as intimated by manufacturers. The material shall be weighed where containers are found leaking.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above.

**Moorum/Stone Chippings/Good Earth:** The item of work shall specify moorum/stone chippings/Good Earth as the cases may be.

**Stacking:** Ground where stacks are proposed to be made shall be dressed to a uniform slope and all lumps, depressions etc. shall be removed. Sample of moorum shall be got approved from the Engineer-in-Charge, before the material in bulk is brought to site.

Moorum/Good Earth shall be stacked in convenient units of one cubic meter in between aggregate stacks in each length of 100 m as per requirement. The stacks shall be made with wooden boxes open at both ends and of  $2 \times 2 \times 0.25$  m dimensions. These shall always be kept at site for stacking and check measurement.

The stacks shall be uniformly distributed along the road. The supply of moorum shall be completed for the entire work or for a complete length of one km or as directed by the Engineer-in-Charge in writing.

**Measurements:** Length and breadth of boxes shall be measured correct to a cm. Volume shall be calculated in cubic metres, correct to two places of decimal.

**Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above.

Water Bound Macadam with Stone Aggregate: Stone aggregate of specified size is used. This is a standard sub base/base and is used where stone aggregate is available at reasonable rates. This consists of clean crushed coarse aggregate mechanically interlocked by rolling and voids there of filled with screening and binding material with the assistance of water, laid on a prepared sub grade, sub-base, base or existing pavement as the case may be. Water bound macadam may be used as a sub base, base course or surfacing course.

**Preparation of Foundation:** In the case of an existing unsurfaced road, where new materials is to be laid, the surface shall be scarified and reshaped to the required grade, camber and shape as necessary. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for W.B.M.

Where the existing surface over which the sub base of W.B.M. is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degree C to the central line of the carriageway before the W.B.M. is laid.

**Provision of Lateral Confinement of Aggregates:** Before starting with W.B.M. construction, necessary arrangements shall be made for lateral confinement of aggregates. One method is to construct side shoulders in advance to a compacted layer of the W.B.M. coarse. Inside edges may be trimmed vertical and the included area cleaned off all spilled materials there by setting the stage for spreading the coarse aggregate. The practice of laying W.B.M. after excavating a trench section in the finished formation must be completely avoided.

**Spreading Aggregate:** The coarse aggregate shall be spread uniformly and evenly upon the prepared base in required quantities with a twisting motion to avoid segregation. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed base be permitted. The aggregates shall be spread uniformly to proper profile by using templates placed across the road six metres apart. Where specified, approved mechanical devices may be used to spread the aggregates uniformly. The levels along the longitudinal direction up to which the metal shall be laid, shall be first obtained at site to the satisfaction of Engineer-in-Charge, and these shall be adhered to the surface of the aggregate spread shall be carefully trued up and all high or low spots remedied by removing or adding aggregate as may be required.

The W.B.M. sub-base shall be normally constructed in layer of 100 mm compacted thickness and W.B.M. base shall be normally constructed in layers of 75 mm compacted thicknesses. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregate shall normally not be spread in lengths exceeding three days average work ahead of the rolling and blending of the proceeding section.

**Rolling:** Immediately following at spreading of the coarse aggregate, it shall be compacted to the full width by rolling with either the three-wheel-power-roller of 8 to 10 tonnes capacity or an equivalent vibratory roller. Initially, light rolling is to be done, which shall be discontinued when the aggregate is partially compacted with sufficient void space in them to permit application of screenings. The rolling shall begin from the edges with the roller running forward and backward and adding the screenings simultaneously until the edges have been firmly compacted. The roller shall then progress gradually from the edges to the centre, parallel to the centre line of the road and overlapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. Rolling shall continue until the road metal is thoroughly keyed with no creeping of metal ahead of the roller. Only slight sprinkling of water may be done during rolling, if required. On super elevated curves, the rolling shall proceed from the lower edge and progress gradually continuing towards the upper edge of the pavement.

Rolling of sub base shall not be done when the sub-grade is soft or yielding or when the rolling causes a wave like motion in the sub-base or sub-grade. When rolling develops irregularities that exceed 12 mm when tested with a three metre straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface conforming to the desired cross-section and grade.

## > PREMIX CARPET WITH HOT BITUMEN:

This type of treatment is normally applied on roads where the motor traffic is of medium intensity, but bullock cart traffic is fairly heavy. This treatment is suitable for district roads and for internal and service road in colonies. The consolidated thickness of this type of treatment shall be 2 cm or 2.5 cm as specified. This treatment consists of applying a tack coat on the prepared base followed immediately by spreading aggregates percolated with specified binder to camber and consolidated.
Premix carpet shall not be laid during rainy weather or when the base course is damp or wet or, when the atmospheric temperature in the shade is not more than 16oC.

**Tack Coat:** The rate of application of binder for tack coat shall be as specified. The rate will be depending upon the surface on which the premix carpet is to be laid i.e. water bound macadam surface or existing black topped surface.

**Preparation of Premix:** The aggregate shall be dry and suitably heated to temperature as directed by Engineer-in-Charge before these are placed in the mixer to facilitate mixing with the binder. Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder.

The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer-in-Charge, in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by Engineer-in-Charge before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chippings shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be cleaned and be covered over in transit if so directed.

**Spreading and Rolling:** The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader, without undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 6 to 9 tonne power rollers, preferably of smooth wheel tandon type, or other approved plant. Rolling shall begin at the edges and progress towards the centre longitudinally. Except on the super elevated portions rolling shall progress from the lower to upper edge, parallel to the centre line of the pavement. The consolidated thickness shall not at any place be less than the specified thickness by more than 25%. However, the average thickness shall not be less than that specified in the item.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may get deformed thereby. The edges along and transverse of the carpet, laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it. Further, the prepared finished surface shall be protected from traffic for 24 hours or such period as may be directed by the Engineer-in-Charge.

## **SEAL COAT:**

**Scope:** This work shall consist of the application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall (camber). Seal coat shall be of either of the two types specified below:

(A) Liquid seal coat comprising of an application of all layer of bituminous binder followed by a cover of stone chips.

(B) Premixed seal coat comprising of a thin application of the aggregate premixed with bituminous binder.

#### Materials:

**Binder:** The binder and its quantity shall be penetration bitumen of a suitable grade as specified in the item or as directed by the Engineer-in-charge.

# > CEMENT CONCRETE PAVEMENT UNDER CONTROLLED CONDITIONS:

#### **Materials:**

**Cement:** Cement used on work shall be as per sub head cement concrete of CPWD specifications-2009 (Vol. -I).

**Water:** Water used on work shall conform to SH: cement concrete of CPWD, Specification 2009-Vol. I.

**Coarse Aggregate:** These shall be crushed or broken from hard stones obtained from Approved quarry. These shall be clean strong, durable of fairly cubical shape and free from soft, friable, thin elongated and laminated disintegrated pieces. These shall also be free from dirt, organic deleterious and any other foreign matter and adherent coatings and shall satisfy the physical requirements. under quality control. Fine Aggregate: This shall be coarse sand conforming to CPWD Specification 2009 Vol. I.

**Mix Design:** The mix shall be approved by Engineer-in-Charge so as to obtain the following mean strength that exceeds the minimum specified flexural strength by 1.64 times the designed standard deviation. Minimum works beam flexural strength at 28 days = 300 kg/sqm. for M-30 or specified in item Designed standard deviation = 60 kg/sqm. for M-30 or for specified grade(s) Design flexural strength at 28 days = 300+60x1.64 = 398.4 kg/sqm. (f + 1.64 s) says 400 kg.

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Water cement ratio by weight = 0.5
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Minimum slump not more than 25 mm

For the purpose of tendering the contractor shall base his rate on the assumption that the quantity of cement used for one cum. of finished concrete shall be 340 kg. or M - 30. If the actual quantity of cement required to be used as a result of the laboratory test is different from that assumed above, necessary adjustment in the cost due to short cement used shall be made on the basis of issue rate of cement including storage charges plus 2.5% for handling charges. However, under no circumstances the quantity of cement to be used shall either exceed 350 kg./cum or fall below 330 kg. per cum of finished concrete.

**Statistical Field Check:** Samples of concrete shall be taken at the mixer and works beams, made, cured and tested in accordance with IS 1199 and IS 516. When a mix is used for the first time, it is important to get a large number of results, as soon as possible, in order to establish the level of control and then suitability of the mix proportions. A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. From each sample two beams shall be made one for test at 7 days and the other for test at 28 days.

The work beam results shall be examined both individually and in consecutive (but not overlapping) sets of four, for which the average and the range of each set are calculated. The mix Proportions shall be modified to increase the strength, if in the first ten consecutive (but not overlapping) sets any of the following conditions are not satisfied.

(I) Each sample has test strength not less than the minimum specified strength i.e. 30 kg/sq. cm. (or otherwise specified in item). OR (II) (a) Not more than two individual results (Not more than one of first twenty) of the 40 beams tests shall fall below the minimum work beam strength but they shall not be less than 80% of the specified beam strength of 30 kg./sq. cm (or otherwise specified in item) or the minimum specified strength minus 1.35 times the standard deviation whichever is greater.

(b)No value of the range in any set shall exceed 3 times the designed standard deviation.

(c) The average for all samples (10 sets) shall not be less than the minimum specified strength i.e.30 kg/sq. cm (or otherwise specified in item) plus 1.64 times the designed standard deviation 60 kg./sq.cm M-30.

If either of these conditions are not satisfied, the mix shall be modified and the procedure described above shall be repeated till results satisfying the above criteria's are obtained. Subsequently samples shall be taken at the rate of one for every 30 cubic miter of concrete laid. Eight beam specimens shall constitute one sample. A set of 4 specimens shall be tested after 7 days and another set of 4 specimens shall be tested after 28 days. These test results shall be checked individually and in sets of four as the work progresses. If at any stage it is found that either of conditions, if the overall average strength minus 1.64 times the standard deviation is more than the specified beam strength (30 kg/sq.cm) (or otherwise specified in item) the concrete shall be rejected and the mix proportion shall be modified forth with for further work. The rejected work shall be replaced by the contractor immediately at his own cost and expense.

**Slump Test:** The test shall be carried out as per IS 1199. A slump test shall be carried out at each mixer at least one in fifty batches mixed or more frequently if directed by the Engineer-in-Charge. Any batch from which slump test is being made shall not be transferred to the place of lying till the slump test has been completed. Not only the batch which gives a slumps in excess of that specified shall be rejected but the concrete already laid immediately preceding the batch tested up to the nearest last transverse joint may be rejected by the Engineer-in-Charge or his subordinate, if he is satisfied that such preceding batches were substandard in this respect. The decision of the Engineer-in-Charge in this respect shall be final and binding on the contractor. Such rejected concrete shall be removed by the contractor immediately and replaced with proper slump concrete at his cost and expense.

**Steel Forms:** All side forms shall be of mild steel. The steel forms shall be of M.S. Channel sections and their depth shall be equal to the thickness of the pavement. The side forms shall have a length of at least 3.0 metres except on curves of less than 4.5 metres radius where shorter lengths may be used. When set to grade and stacked in place the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or worn out forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3.0 M length of forms. Bracing and supports must be ample to prevent the springing of forms under pressure of concrete or weight or thrust of the machinery (like screed vibrator) operating on the forms. Support to the forms shall be sufficiently rigid to hold them in position during the entire operation of laying and compacting and finishing and that they shall not at any time deviate more than 3 mm from straight edge 3 metres in length. Forms which show a variation from the required rigidity of the alignment and levels shown on the plans shall be reset or removed as directed. The length and number or pins or stakes shall be such as to maintain the forms at the correct line and grade.

The supply of forms shall be sufficient to permit their remaining in place for at least 12 hrs. after the concrete has been placed or longer, if in the opinion of the Engineer-in-Charge, it is necessary. The top line of the forms is not to vary from the correct level or alignment and the levels and alignment of the forms are to be checked and corrected as necessary immediately prior to the placing of concrete. The top edges and faces of the forms are to be carefully cleaned and maintained in clean condition. While removing the steel forms, care shall be taken to withdraw them gradually, any damage to the bull nosed edges shall be made good while the concrete is still green.

#### Setting of Forms

(a) Setting of forms shall be according to the slab plan subject to the approval of Engineer-in-Charge and concreting shall not commence until the setting of forms is approved.

(b) Forms shall be set for at least 50 metres in advance of the point where the concrete is being laid and shall not be removed until at least 12 hrs. of placing of the concrete or longer if in the opinion of Engineer-in-Charge is necessary.

(c) After setting, the working faces shall be thoroughly oiled by using approved oil before concrete is placed against them.

(d) The pavement joints of overlay layer would overlap with the joints of underlay cement concrete.

**Batching and Mixing:** As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2009.

**Placing of Concrete:** As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2009.

**Compaction of Concrete:** Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator is pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

There should be at least three needle vibrators working in any bay. A vibrating, screed consisting of a steel or timber section weighing not less than 15 kg, per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the Engineer-in-Charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted. When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slided over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained. Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints. Workmen shall

not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

**Finishing of Concrete:** During compaction, any low or high spots shall be made up by adding or removing concrete. After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished. The straight edge testing the refloating is to continue until the entire surface:

(a) is free from observable departure from the straight edge,

- (b) Conforms to the required levels and across section, and
- (c) Shall conform to the specified surface when the concrete has hardened.
- The foregoing work is to be carried out while the concrete is still plastic and workable.

**Belting:** Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transversed to the centre line of the pavement and with rapid advance parallel to the centre line.

**Booming:** After belting and as soon as the surplus water, if any, has risen to the surface, the pavement shall be given a broom finish with an approved steel or fiber broom not less than 45 cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations formed shall be uniform in character and width and not more than 1.5 mm deep. Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots; irregularities, depressions, and small pockets such as may be caused by accidental disturbing of particles of coarse aggregates embodied near the surface. The brooming shall be of uniform pattern all through.

**Edging:** After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

**Honey Combing:** The side forms shall not be removed until 12 hours or such longer period as the Engineer-in- Charge may decide after the laying of concrete. As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. Engineer-in- Charge's decision as to whether the concrete is defective or not shall be final and binding.

**Surface Accuracy:** After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface. The final surface finish is to be such

that when tested with a profilograh/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm. If the surface irregularity exceeding 3 mm still remains despite grinding as per para the concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area up to the expansion joint shall be removed to the full depth. The concrete so removed shall not be reused in the work. Fresh concrete shall be laid in the manner already described in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account. Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

**Initial Curing:** Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer-in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour. Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm. Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate. Placing burlap shall not be permitted.

**Final Curing:** Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:- All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22nd day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the Engineer-in-Charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and resaturated.

**Construction Joints:** Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 10 mm  $\times$  25 mm deep shall be neatly formed and finished.

The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with hot poured sealing compound conforming to grade B of IS 1834. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

**Dummy Joints**: The joints shall be 10 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3rd of the thickness of the slab but not less than 4 cm in any case. The joint may be formed by depressing into the soft but compacted concrete a high tensile M.S. or other approved Tee of flat bar of depth not less than required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft soap or other suitable lubricant to facilitate its removal when the steel Tee or flat is removed joints shall be neatly formed with proper tools and mortar/fine material from the slab itself. No additional cement mortar (rich or otherwise) shall be used.

# **17. HORTICULTURE AND LANDSCAPING**

# **HORTICULTURE WORK:**

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the Engineer-in-charge with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc. met with shall not be dismantled without pre-measurement and prior to the written permission of the Engineer-in-charge.

## > TRENCHING IN ORDINARY SOIL:

Trenching is done in order to loosen the soil, turn over the top layer containing weeds etc. and to bring up the lower layer of good earth to form a proper medium for grassing, regrassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer-in-charge. The depth is generally 30 cm for grassing and 60 cm for regrassing in good soil. The trenched ground shall, after rough dress, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil. Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid.

Trenching: Trenching shall consist of the following operations:

1. The whole plot shall be divided into narrow rectangular strips of about 1.5 m width or as directed by the Engineer-in-Charge.

2. These strips shall be sub-divided lengthwise into about 1 m long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it.

3. In excavating and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layer of trenched area, the dead plants so buried incidentally being formed into humus.

4. The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in back filling in the trenches with leads is practically eliminated.

**Measurements:** Length and breadth of the plot shall be taken correct to 0.1 m and depths correct to cm. Cubical contents shall be calculated in cubic meters, correct to two places of decimal. No deduction shall be made nor extra paid for removing stones, brick bats and other foreign matter met with during excavation up to initial lead of 50 m and stacking the same.

**Rate:** The rate shall include the cost of all labour and material involved in the operations described above, including cost of all precautionary measures to be taken for protections and supporting all services etc. met with during trenching. It does not include the cost of mixing of earth, sludge/manure.

## **GOOD EARTH:**

The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.

**Measurements:** Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described.

**Rate:** The rate shall include the cost of excavating the earth from areas lying at distance not exceeding one km. from the site, transporting the same at site breaking of clods and stacking at places indicated. The rate shall also include royalty if payable.

## > OIL CAKE:

**Neem/Castor:** The cake shall be free from grit and any other foreign matter. It should be under corticated and pulverized. The material shall be packed in old serviceable gunny bags of 50 kgs capacity approximately. The weight of gunny bag shall be deducted @1 kg per bag and payment shall be made for net quantity. The quality of cake should be got approved by the Engineer-in-charge before supply.

**Measurements:** The arrangement for weighing shall be made at site of work by the department. The gunny bags shall be the property of the government.

**Rate:** The rate shall include the cost of labour and material involved in all operations described above, including carriage up to site of work with all lead and lifts, weighing etc.

## > SUPPLY AND STACKING OF SLUDGE:

It shall be transported to the site in lorries with efficient arrangement to prevent spilling en route. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

**Measurements:** Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment.

**Rate:** The rate shall include the cost of labour and material involved in all operations described above, including carriage up to one km. The rate shall also include royalty if payable.

## > SUPPLY AND STACKING OF MANURE:

**Farmyard Manure:** It shall be transported to the site in Lorries with efficient arrangement to prevent spilling en route. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

**Measurements:** Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment.

**Rate:** The rate shall include the cost of labour and material involved in all operations described above, including carriage up to one km. The rate shall also include royalty if payable.

## > ROUGH DRESSING OF THE TRENCHED GROUND:

Rough dressing of the area shall include making kiaries for flooding. The trenched ground shall be levelled and rough dressed and if there are any hollows and depressions resulting from subsidence which cannot be so levelled, these shall be filled properly with earth brought from outside to bring the depressed surface to the level of the adjoining land and to remove discontinuity of slope and then rough dressed again. The supply and spreading of soil in such depressions is payable separately. In rough dressing, the soil at the surface and for 75 mm depth below shall be broken down to particle size not more than 10 mm in any direction.

**Measurements:** Length, breadth of superficial area shall be measured correct to 0.1 metre. The area shall be calculated in sqm. Correct to two places of decimal.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above.

### > UPROOTING WEEDS FROM TRENCHED AREAS:

After 10 days and within 15 days of flooding the rough dressed trenched ground with water, the weeds appearing on the ground shall be rooted out carefully and the rubbish disposed off as directed by the Engineer-in-charge.

**Measurements:** Length, breadth of superficial area shall be measured correct to 0.1 meters. Superficial area of the weeded ground shall be measured for purpose of payments.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above.

## **FINE DRESSING THE GROUND:**

Slight unevenness, ups, and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the formation levels of the adjoining land as directed by the Engineer-in-charge, and by adding suitable quantities of good earth brought from outside, if necessary.

**Measurements:** Length, breadth and depth of stacks shall be measured correct to a cm. The area shall be calculated in sqm. correct to two places of decimal.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above.

## > SPREADING GOOD EARTH:

Good earth shall be removed from stacks by head load and spread evenly over the surface to the thickness ordered by the Engineer-in-charge. It shall be spread with a twisting motion to avoid segregation and to ensure that spreading is uniform over the entire area.

**Measurements:** The quantity of good earth spread shall be determined by the difference in the volume of good earth in stacks before and after spreading duly reduced for looseness in stacking by 20% of good earth.

**Rate:** The rate shall include of all the labour and material involved in all the operations described above, but does not include the cost of the good earth which shall be paid for separately unless specifically described in the item.

## > SPREADING SLUDGE/MANURE:

Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-Charge. The mixing shall be spread as described in to the thickness ordered by the Engineer-in-Charge.

**Measurements:** The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth and sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

**Rate:** The rate shall include of all the labour and material involved in all the operations described above, but does not include the cost of good earth sludge or manure which shall be paid for separately, unless otherwise described in the item.

# > MIXING OF GOOD EARTH AND SLUDGE/MANURE:

The stacked earth shall, before mixing be broken down top particle of sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-charge.

**Measurements:** The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth, sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

**Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above, but does not include the cost of good earth sludge or manure which shall be paid for separately, unless otherwise described in the item.

## **GRASSING WITH SELECT GRASS NO. 1:**

The area from where the grass roots are to be obtained shall be specified by the Engineer-in-Charge at the time of execution of the work and no royalty shall be charged on this account from the contractor. Grass is to be arranged by contractor (**cost of grass to be paid separately**). The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm, 5 cm apart in any direction or other spacing as described in the item. Dead grass and weeded shall not be planted. The contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeded and fit for moving whichever is later. Generally planting in other direction at 15 cm, 10 cm, spacing is done in the case of large open spaces, at 7.5 cm spacing in residential lawn and at 5cm spacing for Tennis Court and sports ground lawn. Rates are including cost of labour and material (grass shall be paid separately.)

**Measurements:** Length, breadth of the lawn grassed shall be measured correct to 0.1 meter and the area shall be calculated in sqm. Correct to two places of decimal.

**Rate:** The rate shall include of all the labour and material involved in all the operations described above, excluding supply of the requisite quantity of good earth and grass so needed for properly maintaining the grassing.

# > EXCAVATION AND TRENCHING FOR PREPARATION OF BEDS FOR HEDGE AND SHRUBBERY:

Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 meters respectively. Beds for hedges and shrubbery shall be prepared in the following manner. The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm, in order to loosen the soil, in the manner. No flooding will be done at this stage but the top surface shall be rough dressed and leveled. The excavated soil from the top 60 cm depth of the bed stacked at the site shall then be thoroughly mixed with sludge over manner in the proportion 8:1 by ratio or other proportion described in the item. The mixed earth and manure shall be refilled over the trenched bed, levelled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level of 50 mm to 75 mm below the adjoining ground or as directed by the Engineer-in-Charge. Surplus earth if any, shall be disposed off as directed by the Engineer-in-charge. Any surplus earth if removed beyond initially lead shall be paid separately. Stones, bricks bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initially lead & lift, such material as is declared unserviceable by the Engineer-in-charge shall be disposed by spreading and levelling at places ordered by him. If disposed outside the initial lead & lift, then the transport for the extra leads will be paid for separately. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outsides is required to be brought in for mixing with manure and filling, the supply and stacking of such earth will be paid for separately.

**Measurements:** Length, breadth and depth of the pit excavated and trenched shall be measured correct to a cm. The cubical contents shall be calculated in cubic meter correct to two places of decimal.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above. The rate shall not include the cost of supply & stacking of the manure unless the same is specifically included in the description of the item.

## > DIGGING HOLES FOR PLANTING TREES:

In ordinary soil, including refilling earth after mixing with oil cake, manure and watering. Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and excavate soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the size as directed. Use full material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor which shall be paid for separately.

The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the Engineer-in-charge.

Measurements: Holes shall be enumerated.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above, excluding the cost of supply and stacking the requisite quantity of manure/sludge and oil cake.

## > IN SOIL OTHER THAN ORDINARY SOIL:

Where holes are dug in (a) Hard soil (b) Ordinary rock or (c) Hard rock, the above soils occurring independently over in conjunction with each other and /or ordinary soil in any hole, the different excavated soil shall be stacked separately. Excavation in hard rock shall be carried out by chiseling only.

The stack measurement of ordinary rock and hard rock shall be reduced by 50% and of soil by 20% to arrive at the excavated volume. This excavation shall be paid for as extra over the rate for holes dug in ordinary soil above, at rate appropriate to particular soil concerned. Sufficient quantity of good soil to replace the solid volume of stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth, ordinary and hard stacks shall be brought and stacked at site but the supply and stacking of such shall be paid for separately. The useless excavated stuff shall be disposed off by spreading at places as ordered by the Engineer-in-charge. If such places are outside initially leads, carriage for the extra lead shall be paid for separately. The ordinary soil excavated from the hole and the earth brought from outside shall then be mixed with manure screened through sieve of IS designation 16 mm in the proportion specified in the description of the item and filled with the pit and the same watered and finally dressed.

**Measurements:** The pit shall be enumerated. The volume of excavation in soil and other than a ordinary soil shall be determined by reducing the stack volume of the relevant soil with respective percentage for voids.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above, including mixing refilling, watering, dressing etc. but shall not include. (a) Cost of manure over sludge (b) cost of supplying and stacking of good earth for replacement and (c) The cost of carriage beyond initial lead for disposing off useless materials. The excavation other than that of ordinary soil shall be paid extra over and above the rate if excavation in ordinary soil.

## **FILLING MIXTURE OF EARTH & SLUDGE OVER MANURE:**

The separately specified earth and sludge shall be broken down to particles of size not exceeding 6 mm in any directions before mixing. Good earth shall be thoroughly mixed with sludge over manure in specified proportions as directed by Officer-in-Charge. During the process of preparing the mixture as above, trenches shall be flooded with water and levelled.

**Measurements:** Measurement shall be made in (Length, breadth and height of stacks) cubic meter. The cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above, but do not include the good earth, sludge or manure which will be paid separately.

## > **NEW PLANTATION:**

Supplying and planting of plants in the campus. The liability of the contractor for the plantation will be for the complete duration of the contract and any mortality will have to be replaced by the contractor at this cost immediately on its occurrence.

Measurements: plants shall be enumerated.

**Rate:** The rate shall include the cost of all the labour and material involved in all the operations described above, excluding the cost of supply and stacking the requisite quantity of manure/sludge and oil cake.

## (B) ELECTRICAL WORK

Detailed Specification:

#### 1. SCOPE OF WORK:

The scope of work to be carried out under this contract comprises of the supply, installation, testing and commissioning of Electrical work complete as listed out in Schedule of Quantities. The general character and scope of work to be carried out under this contract is presented in drawings and specifications. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with direction of and to the satisfaction of the Owner and Consultant/ Architect. The contractor shall furnish labour, materials, equipment, transportation and incidentals necessary for the completion of work as described in the Tender Documents.

#### 2. FEES AND PERMITS:

The Contractor shall obtain all permits/licences and pay for any and all fees required for the installation, inspection and the commissioning of the work.

#### 3. DRAWINGS :

The Drawings prepared by the consultants are indicative only of the general arrangement of the installation work. The Contractor shall follow these drawings and specifications in preparing his shop drawings and subsequent installation. He shall check the drawings of other trades to verify space for his installation.

Shop drawings shall be provided of the Main and Sub-Main Switchboards, Distribution Boards, Cable Trays, Reactive Power Compensation Panel, and any other switchboards and panels, wherever applicable and approval shall be obtained from the Consultant / Developer before commencing fabrication or procurement.

Any equipment or switchboard manufactured without the written consent of the Consultant / Developer prior to the approval drawings shall be liable for rejection.

Drawings show general run of cables, approximate locations of outlets and equipment, utility symbols and schematic diagrams of no dimensional significance. Refer to the Architectural drawings for locations and also obtain approval from the Consultant / Developer wherever dimensions are not shown, or locations cannot be determined from the drawings. Do not scale drawings to obtain locations

### 4. MEASUREMENTS OF WORK :

Payment for Conduiting, cables, earth strips and wires etc. will be made on linear measurements and will be measured upto and including the bends.

### 5. TESTING :

On completion of the installation the testing will be done in conformity with the stipulated performance specifications. Any shortcoming detected in the system/ materials/ workmanship shall be rectified by the contractor to the entire satisfaction of the consultant without any extra cost to the

owner. The installation shall be tested again after removal of the defects and shall be commissioned only after approval by the competent inspecting authority and the Consultant/Owner.

The Contractor shall notify the Consultant at least 7 working days before testing of each system. The Consultant reserves the right to be present when such tests are being made.

If the Electrical Inspectorate requires manufacturer's test reports for any equipment used in the project, the Contractor shall obtain such approvals at no extra cost to the client. Such approved reports shall be handed over to the Consultant / client.

Calibration certificates shall be obtained from the Meter and Relay Testing Department of the Electricity Board for all relays and meters used in the project at no extra cost to the client

#### 6. COMPLETION CERTIFICATE :

On completion of the installation a certificate in an approved form shall be furnished by the contractor. The contractor shall be responsible for getting the entire installation duly approved by the Electrical Inspector or other concerned authorities, if any, and shall bear all expenses in connection with the same.

#### 7. SCOPE OF WORK

The scope of work to be carried out under this contract briefly comprises of :

INTERNAL WORK :

Supply, Installation, connecting, testing and commissioning of the following :

- i) Installation of conduits Recessed/Embedded/On surface
- ii) Submains and Circuting

Lighting fixtures

Emergency conversion kits

All allied miscellaneous work related to internal lighting.

b) The contractor shall carry out and complete the work under this contract in every respect in confirming with the current rules and regulations of the local Electricity Authority, stipulations of the Indian Standard Institution, and with the directions of and to the satisfaction of the owner. The contractor shall furnish all labour, material, appliances, equipment, transportation and incidentals necessary for providing, installing, testing and commissioning of the whole electrical installation as specified herein and shown as drawings.

This also includes any materials, appliances, equipment and incidential work not specifically mentioned herein or noted on the drawings/documents as being furnished or installed but which are customary to make the installation in working order. The work shall include all incidentals and jobs connected with Electrical installation such as earthing work and cutting chases/holes and making good the same and grouting and equipment.

All Civil works in connection with the Electrical Installation including supply, laying and fixing of necessary inserts, hooks, brackets and sleeves etc

On completion of the work and before issuing of virtual completion certificate the contractor shall submit to owner "As installed drawings" showing all the details of work done by him.

The contractor shall have a valid contracting licence before starting the work and till the completion of work.

INTERNAL WIRING System of Wiring

The system of wiring shall consist of PVC insulated copper stranded conductor flexible wires in metallic / non metallic (Rigid heavy Duty ISI -marked fire retarded PVC Conduits of minimum 2mm Wall thickness and Sizes starting from 25 mm diameter conduits and shall be concealed or surface mounted above false ceiling as called for

Essential/non-essential/UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard upto final wiring for each system. As for example, conduit carrying non-essential wiring shall not have essential or UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed. General

Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.

In laying of conduits it is important that not more than two right angle bends are provided for each circuit without a pull box. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

Metal Conduits & Accessories

#### Conduits

Conduits and Accessories shall conform to latest edition of Indian Standards IS-9537 part 1 & 2. 16/14 (16 gauge upto 32mm diameter & 14 gauge above 32 mm diameter) gauge screwed GI or

MS conduits as specified on schedule of quantities shall be used. These shall be solid drawn or reamed by welding, and finished with galvanized or stove enameled surface.

No steel conduit less than 20 mm in diameter shall be used.

All conduit accessories shall be of threaded type, and under no circumstances pin grip type or clamp grip type accessories shall be used.

Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works.

Saddles for surface conduit work on wall shall not be less than 0.55 mm (24 gauges) for conduits upto 25 mm dia and not less than 0.9 mm (20 gauges) for larger diameter. The corresponding widths shall be 19 mm & 25 mm.

The minimum width and the thickness of girder clips used for fi xing conduits to steel joists, and clamps shall be as per Table indicated below

Size of Conduit	Width	Thickness
(i) 20 mm	19 mm	0.9 mm (20 SWG)
(ii) 25 mm	19 mm	0.9 mm (20 SWG)
(iii) 32 mm & above	25 mm	1.2 mm (18 SWG)

Joints between conduits and accessories shall be securely made by standard accessories, as per IS-2667, IS-3837 and IS-5133 to ensure earth continuity. All conduit accessories shall be threaded type only.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Note. : Whatever materials required to be billed by the Contractor should come on site with proper Challan Numbers and quantity mentioned in each such Challan.

Shaft which supports sheaves, Gears, coupling and other member which transmit torque shall be provided with tight fitting keys of sufficient strength and quality.

#### OUTLETS

The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes, the wall thickness shall not be less than 1.2 mm (18 gauge) for boxes upto a size of 20 cm x 30 cm, and above this size 1.6 mm (16 gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection.

Where a large number of control switches and/or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box adjacent to each other for ease of maintenance.

An earth terminal with stud and 2 metal washers and terminal block shall be provided in each MS box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.

A metal strip shall be welded/screwed, to the metal box as support if tumbler type of control switches, sockets and/or fan regulators in flush pattern.

Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

The fan regulators can also be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.

Except where otherwise stated, 3 mm thick phenolic laminated sheets shall be fixed on the front with brass screws, or aluminium alloy/ cadmium plated iron screws as approved by the Engineer-in-charge.

#### JOINTS

All jointing shall be subject to the approval of the Owner's site representative. The threads and sockets shall be free from grease and oil. End termination of conduit on GI boxes shall be by means of hexagon check nuts & spring washer on both sides of the conduit. The joints in conduits shall be free of burrs to avoid damage to insulation of conductors while pulling them through the conduits. Rubberised bushes shall be used in the conduit entry and exit from DBs, switch boxes etc ,so that wires are protected from damage to insulation of the incoming and outgoing wires

The conduit work of each circuit or section shall be completed before the cables are drawn in. Conduit pipes shall be joined by means of screwed couplers and screwed accessories only.

Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc., after they have been prepared, shall be submitted for inspection before being fixed.

No bare threaded portion of conduit pipe shall be allowed, unless such bare threaded portion is treated with anticorrosive preservative or covered with approved plastic compound.

#### RECESSED OR EXPOSED CONDUITS

All conduits shall be as per Schedule of Quantities/As per approved drawings.

Above false ceiling, in no case, open wiring shall be allowed. Wiring will be done in recessed conduit or surface steel conduit.

#### FIXING OF CONDUIT

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of the conduit system, shall be adequately protected against rust when such system is exposed to weather, by being painted with 2 coats of red oxide paint applied before they are fixed.

Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by the Engineer-in-charge.

In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.

For fixing the conduits in RCC works conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be

fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors.

Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

For conduits in RCC works Suitable inspection boxes to the minimum requirement shall be provided to permit inspection and to facilitate replacement of wires, if necessary.

These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS 2667 : 1988.

In chase the conduit pipe shall be fixed by means of staples, J- hooks, or saddles, at not more than 50cm apart. Junction boxes shall be provided at suitable locations.

In RCC, the conduit pipes shall be laid in position and fixed to the steel reinforcement bars firmly by steel binding wires before the concreting is done. Steel fish wire shall be laid in conduit if supplying & drawing of wire is not included in the scope of work. Cost of fish wire shall be paid extra.

#### FLEXIBLE CONDUITS

Flexible conduits shall be made of heavy gauge MS strip galvanized after making the spiral. Both edges of the strip to have interlocking to avoid opening up. Flexible conduit shall be heat resistant, lead coated steel, water leak, fire and rust proof. The flexible conduit shall be heat resistant on continous temperature upto 150 deg. C and intermittent temperature upto 200 deg. C. The flexible conduit shall be corrosion resistant as per IS-3480 & BS-731.

#### EARTHING REQUIREMENTS

The entire system of metallic conduit work, including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper screwed joints, or by double check nuts at terminations. The conduit shall be continuous when passing through walls or floors.

A protective (loop earthing) conductor(s) shall be laid inside the conduit between the metallic switch boxes and distribution switch boards and terminated with proper earth lugs/ terminals. Only PVC insulated copper conductor cable of specified size green in colour shall be allowed.

The protective conductors shall be terminated properly using earth studs, earth terminal block etc. as the case may be.

Gas or water pipe shall not be used as protective conductor (earth medium). PVC Conduit and Accessories

PVC Conduit

All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509 : 1973 and IS 3419 : 1989 for rigid conduits and IS 9537 (Part 5) : 2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked. and shall be heavy duty with minimum wall thickness of 2.0 mm rigid tubes which are unscrewed without coupling and with plain ends. All conduits used shall be ISI-marked and shall not be less than 25 mm diameter.

PVC shall be ISI marked, rigid "Medium class" and not less than 2mm thick. All PVC conduit accessories shall be grip type. Saddles for fixing conduits shall be heavy gauge non- metallic type with base

PVC conduit shall be used for all concealed / embedded installation.

PVC Conduit Accessories

The conduit wiring system shall be complete in all respect including accessories.

Accessories used for conduit shall be of an approved brand and type complying to relevant IS code.

All accessories used shall be of standard white or black colour, identical to conduit used.

Plain conduits shall be jointed by slip type of couplers with manufacturer's standard sealing cement.

Rigid conduit accessories shall be normally of grip type.

Flexible conduit accessories shall be of threaded type.

All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and screwed male bushes.

PVC-switch and socket boxes with round knockouts are to be used. The colours of these boxes and the conduits shall be the same.

Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.

Samples of accessories shall be submitted for approval prior to installation.

All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits. Bends in Conduit

Where necessary, bends or diversions may be achieved by means of bends and / or circular cast iron boxes with inspection cover and with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with the finished wall surface.

No bends shall have radius less than 7.5 cms or three times the outside diameter of the conduits. For metallic conduits, bends of defined radius shall be made by compactly filling fine sand inside

the conduit length, to avoid non-uniform shape, once the bend is done. Proper jigs shall be used to ensure that the Enameling /Galvanising of the Conduit is not damaged. Fixing of Conduits

All conduits, shall be installed so as to avoid exposure to steam, hot water or any other process pipes. After the conduits, junction boxes, outlet boxes and switch boxes are installed in position, their outlets shall be properly plugged or covered so that water, mortar, rodents and insects, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of heavy gauge GI saddles secured at intervals not more than 1000 mm, and on either side of couplers or bends or similar fitting saddles shall be fixed at a distance of 300 mm from centre of each fitting. For conduit fixing suitable PVC/Nylon fasteners shall be used.

Conduit pipes shall be fixed on surface of wall/ ceiling by saddles, secured to suitable approved plugs with screws at an interval of not more than 75 cm in vertical run and not more than 50cm in horizontal run. On either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of not more than 30cm from the center of such fittings.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of the conduit system, shall be adequately protected against rust when such system is exposed to weather, by being painted with 2 coats of red oxide paint applied before they are fixed.

Recessed conduiting shall be done by making chase in the masonry by chase cutter, the conduit shall be fixed in the chase by means of GI hooks not more than 600 mm apart. After fixing of conduit the chase shall be filled with cement mortar after fixing of chicken mesh and brought to the original finish level of the surface to the entire satisfaction of Owner

In chase the conduit pipe shall be fixed by means of staples, J- hooks, or saddles, at not more than 50cm apart. Junction boxes shall be provided at suitable locations.

In RCC, the conduit pipes shall be laid in position and fixed to the steel reinforcement bars firmly by steel binding wires before the concreting is done. Steel fish wire shall be laid in conduit if supplying & drawing of wire is not included in the scope of work. Switch outlets and Junction Boxes

All outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be of 1.6 mm thick mild steel sheets with HOT dipped galvanizing (or as specified in SOQ), having smooth external and internal surfaces to true finish. All outlet boxes for receiving plug sockets and switches shall be fabricated to approved sizes. All boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall generally be of 50mm depth subject to maximum depth of 65 mm.

The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 m.

PVC boxes shall comply with the requirements laid down in IS 14772 : 2000. These boxes shall be free from burrs, fins and internal roughness. Inspection Boxes

50 mm dia inspection boxes and pull boxes shall have smooth external and internal finish to facilitate removal and replacement of wires, where required. Fish Wire

To facilitate subsequent drawing of wires in the conduit, GI fish wires of 2.0 mm (14 SWG) shall be provided alongwith the laying of recessed conduit.

#### Conductors

All PVC insulated copper conductor flexible , as specified in SOQ, wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

The conductor resistance of wire/ cable used in wiring should not be more than the maximum specified value given in table below duly corrected with correction factor for the ambient temperate at the time of measurement of resistance.

Nominal Cross	Maximum Resistance of conductor at 200C				
Sectional Area	Copper		Aluminium		
	Plain	Tinned			
mm2	ohm/km	ohm/km	ohm/km		
0.5	36.0	36.7	-		
0.75	24.5	24.8	-		
1.0	18.1	18.2	-		
1.5	12.1	12.2	18.1		
2.5	7.41	7.56	12.1		
4	4.61	4.70	7.41		
6	3.08	3.11	4.61		
10	1.83	1.84	3.08		
16	1.15	1.16	1.91		
25	0.727	-	1.20		
35	0.524	-	0.868		
50	0.387	-	0.641		
70	0.268	-	0.443		
95	0.193	-	0.320		
120	0.153	-	0.253		
150	0.124	-	0.206		
185	-	-	0.164		
240	-	-	0.125		
300	-	-	0.100		

Table for Maximum permissible resistance of conductor

Table for Temperature Correction Factors For Conductor Resistance To Correct The Measured Resistance At T0 C To 200 C

Temperature of	Temperature	Temperature of	Temperature
Conductor at Time	Correction	Conductor at Time	Correction
of measurement	Factor	of measurement	Factor
t0C	k	t0C	k
5	1.064	14	1.025
6	1.059	15	1.020
7	1.055	16	1.016

1.050	17	1.012
1.046	18	1.008
1.042	19	1.004
1.037	20	1.000
1.033	21	0.996
1.029	22	0.992
0.988	37	0.936
0.984	38	0.933
0.980	39	0.929
0.977	40	0.926
0.973	41	0.923
0.969	42	0.919
0.965	43	0.916
0.962	44	0.912
0.958	45	0.909
0.954	46	0.906
0.951	47	0.903
0.947	48	0.899
0.943	49	0.896
0.940	50	0.893
	1.050         1.046         1.042         1.037         1.033         1.029         0.988         0.984         0.980         0.977         0.973         0.965         0.962         0.958         0.954         0.951         0.943	1.050 $17$ $1.046$ $18$ $1.042$ $19$ $1.037$ $20$ $1.037$ $20$ $1.033$ $21$ $1.029$ $22$ $0.988$ $37$ $0.984$ $38$ $0.980$ $39$ $0.977$ $40$ $0.973$ $41$ $0.969$ $42$ $0.965$ $43$ $0.962$ $44$ $0.958$ $45$ $0.954$ $46$ $0.951$ $47$ $0.947$ $48$ $0.943$ $49$ $0.940$ $50$

#### **Bunching of Wires**

Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shall be separate. Each Power/ Light Circuit's Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

Drawing Conductors

The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.

Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into metallic Conduits are given below :

in a	20 mn	n	25mm		32 mn	n	38 mn	n	51 mn	n
Nominal cros sectional are of conductor sq.mm	Straight	Bend								
1.5	5	4	10	8	18	12	-	-	-	-
2.5	5	3	8	6	12	10	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-

#### NRDA F-1- Schedule-D- Section III- Technical Specification of Works

Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

	16	-	-	2	2	3	3	6	5	10	7
	25	-	-	-	-	3	2	5	3	8	6
Maximum	35	-	-	-	-	-	-	3	2	6	5

permissibl

e number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below :

Size of wires Nominal Cross	Maximum size(mm)	number of	wires with	in conduit	
section Area (Sq. mm.)	20	25	32	40	50
1.5	7	12	16		
2.5	5	10	14		
4	4	8	12		
6	3	6	8		
10		4	5	6	
16		3	3	6	6
25			2	4	6
35				3	5

Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals. The terminals shall have sufficient cross sectional area to take all strands and it's connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.

Condutors having nominal cross sectional areas exceeding 10 sq.mm shall always be provided with cable sockets. At all bolted terminals brass flat washer of large area and approved steel spring washer shall be used. Brass nuts and bolts with brass washers shall be used for all connections.

Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring licence to Owner) and cable jointers shall be employed to do jointing work. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians' / Wireman's / Cable Jointer's licence to Owner.

All wires and cables shall be embossed with the manufacturer's label with ISI mark and shall be brought to site in original packing. For all internal wiring. PVC insulated wires of 1100 volts grade () shall be used.

The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust , dirt or any other obstruction. Joints

All joints shall be made at main switches, distribution boards. socket outlets, lighting outlets and switches boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to inlet.

No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/ or protective conductors in wiring shall be permitted.

If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

Termination of multistranded conductors shall be done using suitable crimping type thimbles. Mains and Sub-Mains

Mains and sub-mains cable or wires where called for shall be of the rated capacity and approved make. Every main and sub main wires shall be drawn into an independent adequate size of conduit. Earthing shall be in conformity with relevant IS codes and calculations shall be submitted for verification.

An independent earth wire of the proper rating shall be provided for every single phase sub-main. For every 3 -phase sub-main, 2 Nos. earth wires of proper rating shall be provided along with the sub-main. The earth wires shall be drawn along with circuit wires through conduit. Where mains and sub-mains cables are connected to switchgear, sufficient extra lengths of cable shall be provided to facilitate easy connections and maintenance. Where ever necessary, powder-coated 1.6 mm thick sheet steel covering (also called trunking) shall be provided to cover the group of conduits and cables entering and exiting the Wall mounted/Floor mounted Sub DBs, DBs, and FDBs ,so that the Installation looks neat .The colour of such sheet steel covering (trunking) shall be matching with the colour of the SDBs, DBs and FDBs

Sub main & Circuit Wiring

Sub main Wiring

Sub main wiring shall mean the wiring from one main/distribution switchboard to Another. linear measurement shall be made along the length of conduit from edge of Main switch to edge of DB.

(b) Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board to the 1st tapping Point inside the switch box, from where point wiring starts.

linear measurement shall be made along the length of conduit from edge of DB to edge of switched board.

Note: (a) Measurement shall be done in linear basis in metres with minimum unit as 1 cm Wire used for connection inside of DB or Meter board or switched board of length upto 0.3 metre on each end is included in the cost of submain/ Circuit wiring. If connection wire is more then 0.3 metre in length beyond edge of DB, switch board, extra length may be paid separately as supply and drawing of wires in existing conduit.

Point wiring:

Point wiring means wiring from switch box to connector or ceiling rose for light/ fan/ call bell/ exhaust fan/ twin control light/ group control light and from Distribution board to switch box for light plug point/ power plug point. The wiring system for point wiring shall be looping system. Phase/ live conductors shall be looped in the switch box, neutral wire/ earth wire shall be looped in the switch box for the 1st point and from point outlets for subsequent points. In wiring no joints will be permitted any where, except in switch box or point outlets, where jointing or wires will be allowed with use of suitable connector.

Points are categorized based on length of live conductor as under:

Table 1

S.No	Category	Length
1	Short point	Up to 3 metre
2	Medium point	Beyond 3 metre and up to 6 metre
3	Long point	Beyond 6 metre and up to 10 metre
4	Extra Long point I	Beyond 10 metre and up to 15 metre
5	Extra Long point II	Beyond 15 metre and up to 20 metre
6	Extra Long point III	Beyond 20 metre and up to 25 metre

Capacity of Circuits

Minimum size of wiring:

Light Wiring : 1.5 sq.mm. Power Wiring : 4.0 sq.mm. Power circuit rated : More than 1 KW, Size as indicated in DB schedule.

(i) Lighting circuit shall feed light/fan/ call bell points. Each circuit shall not have more than 800 Watt connected load or more than 10 points whichever is less. However, in case of CFL points where load per point may be less, number of points may be suitably increased.

(ii) Power circuit in will have only one outlet per circuit. Load Balancing

Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to. Colour Code of Conductors

Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

Colour Code of Conduits

All the exposed conduits shall be Colour coded at every 5 mtr as indicated by the Consultant for the entire wiring installations.

Red for fire/Emergency system, Blue for ELV system and , Orange for power. Measurment:

Point wiring: The length of Points shall be measured along live conductor from top of switch board to junction box in which connecter of that point is provided. Based on the length of point, it will be

put into the suitable category of points i.e. short or medium or long etc. Then points will be counted in numbers category wise.

Twin control points shall be counted as two points from point outlet to control switch board to either side.

Group control points shall be measured from switch board to first point outlet as one point and from first point outlet to next point outlet as second point and so on.

Multiple controlled call bell point shall be measured from the call bell to the nearest connector meant for connection to bell push as one point, from that connector to the next one and so on, shall be treated as separate points.

The light, fan, call bell, twin control, group control points of length more than 10 metres shall be measured as long point and in addition extra length of point wiring beyond 10 metre shall be measured in actual length and size of conduit and actual number and size of wires drawn in conduit and paid seperately. Loose wire for connection will not be measured.

The light/ power plug points of length more than 25 metres shall be measured as Extra long point III and in addition extra length of point wiring beyond 25 metre shall be measured in actual length and size of conduit and actual number and size of wires drawn in conduit and paid seperately. Loose wire for connection will not be measured.

#### Rate

Cost of all wire, conduit, junction box, switches, sockets, conductor etc. material, labour and machinery used in execution of work of point wiring/ circuit / submain wiring including cost of necessary testing included in the cost of item.

#### SWITCHES, RECEPTACLES (MODULAR), LIGHTING FIXTURES & LIGHTING CONTROL EQUIPMENT Switches

All switches shall be enclosed type flush mounted, suitable for 240 volts AC. All switches shall be fixed inside the switch boxes on adjustable flat M S strips/plates with tapped holes and brass machine screws, leaving ample space at the back and sides for accommodating wires.

Switch controlling the light point shall be connected to the phase wire of the circuit and load on each switch shall be restricted to maximum 800 watts & maximum 1500 watts per circuit. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing of the back boxes.

## Socket Outlet

Socket outlets shall be of the 6/16A three/Six pin shutter type. The switch controlling the socket outlet shall be on the phase wire of the circuit and not more than two socket outlets of 6/16 amps shall be connected on one circuit. An earth wire shall be provided alongwith the circuit wires and shall be connected to earthing screw inside the box.. All sockets shall be shuttered type.

a. Every socket outlet shall be controlled by an individual switch unless mentioned otherwise.

- b. The switch controlling the socket outlet shall be on the `Live' side of the line.
- c. socket outlet shall normally be fixed at any convenient height above the floor level as desired by the Architect. The switch for socket outlet shall be kept along with the socket outlet. However, in special case, if desired by the Architect the socket outlet can be placed at the normal switch level. 16 amps socket outlet in the kitchen of Hostel building shall be fixed at any convenient height above working platform or as specified in drawings / schedule of equipments.

In a room containing a fixed bath or shower, there shall be no socket outlet and there shall be no provision for connecting a portable appliance.

Any stationary appliance connected permanently in the bath room shall be controlled by an isolator switch or circuit breaker having outlets at such location where water / moisture does not effect.

Generally, switches and outlets shall be planned at a minimum distance of 1.5 Metre away from any water supply outlet, so that splashed water may not affect the live installation.

- d. Where socket outlets are placed at lower level, they shall be enclosed in a suitable metallic box with the system of wiring adopted or shutter type sockets shall be provided as specified.
- e. In an earthed system of supply, a socket outlet and plug shall be of three pin type, the third terminal shall be connected to earth.
- f. Conductors connecting electrical appliance with socket outlet shall be flexible twin cord with an earthing cord which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.
- g. Use of shutter type of interlocking type of socket is required for any special installation, the items should be separately and specifically listed in the Schedule of Quantities of that particular work.

#### Lighting Fixtures & Accessories

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

#### Scope :

Scope of work under this section shall include Supplying installing inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

#### Standards :

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaires :

NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur	NRDA
Part-1 Tubular flourescent lamps - IS – 1913 (Part-1)	-
Industrial lighting fittings with metal reflectors - IS - 1777	
Decorative lighting outfits - IS - 5077	
Bayonet lamp holders - IS - 1258	
Bi-pin lamp holders for tubular fluorescent lamps - IS - 3323	
Electronic Ballasts for fluorescent lamps – General & Safety requirement - IS – 13021 (Part-1)	
Electronic Ballasts for fluorescent lamps – Performance requirement - IS – 13021 (Part-2)	
Ballast for HP MV lamps - IS - 6616	
Tubular Fluorescent lamps - IS - 2418 (Part-1 to 4)	
Luminaries – General requirement - IS – 10322 (Part- 1)	
Luminaries – Constructional requirement-IS – 10322 (Part-2)	
Luminaries – Screw and Screw less termination - IS – 10322 (Part-3)	
Luminaries – Methods of Tests - IS – 10322 (Part-4)	
Particular requirement – General purpose Luminaries - IS – 10322 (Part-5/Sec-1)	
Particular requirement – Recessed Luminaries - IS – 10322 (Part-5/Sec-2)	
Particular requirement –	
Luminaries for Road and Street lighting - IS – 10322 (Part-5/Sec-3)	
Particular requirement –	
Portable General purpose	
Luminaries - IS – 10322 (Part-5/Sec-4)	
Particular requirement –	
Flood Lighting - IS – 10322 (Part-5/Sec-5)	
High pressure mercury vapour lamps - IS – 9900 (Part-1) Page <b>1</b> '	l <b>2</b> of <b>237</b>

Tungsten filament general electric lamps - IS - 418

Light Fittings-General Requirements :

Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.

Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.

All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Out door type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes. All fluorescent and CFL fittings shall be provided with electronic ballast as per schedule of quantities.

Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

All hardwares used in the fitting shall be suitably plated or anodized and passivated.

Earthing : Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

Painting/Finish : All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.

The housing shall be powder coated/stove-enamelled or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.

Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

Light Fittings – Special Requirements

Box Channel Type Industrial Fittings

Box type slim line channel must be in screwless construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a POLYESTER PRECOATED STEEL having a reflection factor of not less than 80%. SCREWLESS DESIGN & CONSTRUCTION Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type fixtures.

Page 113 of 237

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyerethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

#### 18 W / 36 W Fluorescent and 36 W CFL Low Glare Light Fittings

Recessed mounted, modular fluorescent lighting fixture made of CRCA Sheet steel powder coated (white) housing, electro chemically brightened and anodised reflector, three dimensional cross louvers with concave contours, fresnel top at louver saddle to increase efficiency. The luminance of <200 cd/M2 at 63 degree viewing angle in all directions so as to confirm Cat-2 classification of CIBSELG3

#### Highbay Industrial Fittings

Industrial Highbay luminaries shall be provided with pressure die cast housing along with all accessories, orthocyclically woundopien construction ballast, capacitor & semi parallel ignitor connected to terminal block and mounted on the gear plate. The gear shall have side entry for ease in maintenance. The spun aluminium reflector is suitable for narrows well as wide beam distribution as specified in schedule of quantities. The luminaire will be suitable for metal halide lamp HPI BU + 250 W which has 25500 lumens or similar 400W lamp and 2.5 minutes restrike time (when operate with son gear).

#### Accessories for Light Fittings - Reflectors

The reflectors shall be made of CRCA sheet steel/aluminium /Silvered glass/Chromium plated sheet copper as specified. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

#### Lamps

### TLD

Lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 5 mg. The lamp shall have minimum lumen maintenance of 85 and CRI of 85. The lamp must comply to ROSH (Restriction of Hazardous substances) and covered by WEEE. Lamp should be fully re-cyclable. The lamp should be low on maintenance with life of 40 K hours in case of electromagnetic ballast and 65 K hours in case of HF ballast upto 10% failure. The discharge glass shall be lead free.

TLD Lamps shall be minimum tri-phosphor type and have bi-pin bases. Colour spectrum of light shall be equivalent to "PHILIPS color 84 or color 86 color 82 or "OSRAM color 21 or color 11 or color 41 (as required at site)".

The fluorescent Tubes (TLD) should have cool daylight colour designation. But Architects reserve the right to prescribe either Cool Daylight or Bright White or Incandescent Colour Designations for TLD. NO extra payment will be made over the quoted rate of bidder for this. The 36 W fluorescent

tubes will have Nominal Luminous Flux of not less than 3350 lumens whether so mentioned in the Schedule of Quantities or not.

#### T 5 – High Efficiency ECO-Friendly Lamps

T-5 lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 3 mg. lamp should have lowest CO2 emission compared to any other comparable light source (40% less than a TL-D standard lamp, 26% less than TL-D / 80). T-5 lamp shall be 100% lead free. T-5 lamp shall be designed for operation with electronic gear and well suited for dimming. Maximum lumen output to be reached at approx 35oC in free burning position. T-5 lamp can be ignited from -15oC to + 50oC. Lamp should be fully recyclable and must comply to ROSH (Restriction of Hazardous substances) and shall be covered by WEEE. T-5 shall have 16 mm in diameter service life of TL-5 lamp should be 10% more than TL-D lamps. T-5 lamp shall have lumen efficacy of up to 104 Lumens / W and shall have excellent colour rendering to En 12464 (Ra 80 to 89).

Compact fluorescent lamp shall have same luminous flux and power consumption as fluorescent tubes but less than half the length and more compact than U-shaped and circulator lamps. CFL shall be suitable for use with conventional control gear & standers and for HF electronic control gear. CFL lamp shall be non integral type of OSRAM / GE / PHILIPS/ Havells Sylvania only.

#### High Frequency Electronic Ballast

High frequency electronic ballast shall be used with fluorescent / Compact Fluorescent Lamps wherever specified in the schedule of quantities. High frequency electronic ballast shall comply to the following:

IEC 927, IEC 928 for ≤10% total harmonic distortion. EMI / RFI – Confirming to FCC / VDE Class A/B. Line Transient as per IEEE C62.41. Ballast Crest Factor C1.7%. No Stroboscopic Effect Constant Wattage / Light output between 240 V ± 10%. Circuit protection for surge current and inrush current. Short circuits, open lamp protection PF > 0.99 for fluorescent / T5 lamp and 0.95 for CFL. Deactivated lamp protection Suitable for use with single and twin lamps RFI < 30 MHz EN 55015 Total Harmonic Distortion (THD)≤10% Immunity to interference EN 61547 Safetv EN 60928 / IEC 928 / IS 13021 (Part I) Performance EN 60929 / IEC 929 / IS 13021 (Part II) Vibrations & Bump tests IEC 68-2-6 FC **IEC 9001 Quality Standard** ISO 9001 Environmental Standard ISO 14001 **DC** Operation EN 60924 **Emergency Lighting Operation VDE 0108** 

At the completion of the work, the contractor shall carry out the pre-commissioning as well as commissioning checks as given below on the entire installation and records be maintained for reference of any statutory authority, Client or their representatives. Pre - Commissioning Checks

Note - Pre- Commissioning checks are to be carried out by Electrical contractor in presence of Project Management Team.

Sr. No.	Component	Points to be checked
1	Wires	Correct identification of each wire by continuity check and providing correct ferrules as per approved drawings. Correct colour coding and correct connection by proper copper lugs. Wires are dressed and bunched properly. Connections are properly tightened. Not more than two wires are connected on any one side of terminal. IR values of the circuit are measured and recorded.
2	Switch boxes & Receptacle s	<ul> <li>Wires are connected properly as per wiring diagram.</li> <li>Correct colour coding and correct connection by proper copper lugs is done.</li> <li>Wires are dressed and bunched properly.</li> <li>Connections are properly tightened.</li> <li>Not more than two wires are connected on any one side of terminal.</li> <li>Earthing connection is made properly.</li> <li>Functional check is OK</li> <li>IR values of the circuit are measured and recorded.</li> </ul>
4	Light fittings	Correct colour coding and correct connection by proper copper lugs is done. Connections are properly tightened. Not more than two wires are connected on any one side of terminal. Earthing connection is made properly. IR values of the circuit are measured and recorded.
7	Earthing	The resistance value of each earth electrode are measured and recorded. Total resistance of earthing system should be as per the design value and in any case, shall not be more than 1 Ohm as per IS-3043. Continuity test for earth continuity conductors with ELV tester.

#### NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

#### Commissioning Checks

Note –Commissioning checks are to be made in following sequence starting from Transformer / DG to main panel to last light fitting. All results of testing and observations are to be preserved for record and reference by any statutory authority.

Sr. No.	Component	Points to be checked
4	Switch boxes & Receptacles	All rectification points are attended and correctly rectified. Check the voltage with test lamp. Switch on the circuit.
6	Light fittings	All rectification points are attended and correctly rectified. Switch on the circuit.
8	Earthing	Check if all earth electrodes in earth pits for it's correct installation and connection to earth grid. Check if all protective conductors from the earth electrodes to grid and from grid up to all electrical equipment are made correctly. Remove the protective conductor / grid connection with earth electrode and measure earth electrode resistance by using earth megger. Repeat above procedure for all electrodes. Ensure that total earth resistance of the installation is less than 1 mega- ohms.

## APPENDIX - I LIST OF INDIAN STANDARDS (IS)

IS : 374	Ceiling fans and regulators (3rd revision)
IS : 694	PVC insulated Electric cable for working voltage upto and including 1100 volts.
IS : 732	Code of practice for electrical wiring and installation
IS : 1255	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
IS : 1258	Bayonet lamp holders(Third revision)
IS : 1293	Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.
IS:1554 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 1646	Electrical installation fire safety of buildings (general) Code of practice.
IS : 1885	Glossary of items for electrical cables and conductors

Page 118 of 237

NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

IS : 1913	General and safety requirements for fluorescent lamps
	luminaries Tubular.
IS : 2026 - Part I to IV )	Power Transformers/ Dry Type Transformers
IS : 2071	Methods of high voltage testing
IS : 2309	Protection of building and allied structures against
	lightning
IS : 2551-	Danger notice plate.
IS : 3043	Code of practice for earthing.
IS : 3427	AC Metal enclosed switch gear and control gear for
	rated voltages above 1 KV and upto and including 52
	KV.
IS : 3480	Flexible steel conduits for electrical wiring.
IS : 3837	Accessories for rigid steel conduit for electrical wiring.
IS: 4146	Application guide for voltage transformers
IS : 4615	Switch socket outlets.
IS : 5133 (Part -I)	Boxes for the enclosure of electrical accessories.

IS : 5216 (Part-I)	Guide for safety procedures and practices in electrical work.
IS : 5424	Rubber mats for electrical purposes.
IS : 5578 & 11353-	Marking and arrangement of bus bars
IS : 7098 - (Part - II)	Cross linked polyethylene insulated PVC sheathed cables. For working voltages from 3.3 KV upto and including 33 KV
IS: 8130 -	Conductors for insulated electric cables and flexible cords
IS:8623 - (Part - I)	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 V D C.
IS : 8623 - (Part - II)	Bus Bar trunking system
IS : 8828 -	Miniature Circuit Breakers
IS : 9537 -	Rigid Steel Conduits for electrical wiring (Second Revisions)
IS : 10810 -	Methods of test for cables.
IS : 12640 -	Earth Leakage Circuit Breakers
IS : 13947	Air Circuit Breakers
(Part-II)	
NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

IS : 13947- (Part- )	Moulded Case Circuit Breakers
IS : 13947 - (Part- )	Degree of protection provided by enclosures for LV switchgear and control gear.
IS : 13947 (Part- )	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.
IS : 15652	Insulating mats for electrical purposes.
IS : 1651 & 1652	Stationary cells and batteries lead acid type

#### APPENDIX - II ABBREVIATIONS

The following abbreviations have been used in the accompanying Specifications, drawings and Schedule of Quantities.

CU	stands for copper.
GI	stands for Galvanised Iron ( Mild Steel )
V	stands for Volts
KV	stands for Kilo Volts
HV	stands for High Voltage (3.3 KV and above)
MV	stands for Medium Voltage (110 V ,230 V ,415 V, 600 V, 110 V)
LV	stands for Low Voltage (32 V & Below)
НТ	stands for High Tension
LT	stands for Low Tension
SF6	stands for Sulphur Hexa Fluoride Gas
VCB	stands for Vacuum Circuit Breaker
PVC	stands for Polyvinyl Chloride
AMP	stands for Amperes
КШН	stands for Kilowatt Hours
KW	stands for Kilo Watts
BIS	stands for Bureau of Indian Standards

NRDA

IS	stands for Indian Standards
IEC	stands for International Electrotechnical Commision
IEE	stands for Institution of Electrical Engineers - London
IEEE	stands for Institution of Electrical & Electronics Engineers
NEC	stands for National Electrical Code
ACB	stands for Air Circuit Breaker
RCCB	stands for Residual Current Circuit Breaker
MCB	stands for Miniature Circuit Breaker
MCCB	stands for Moulded Case Circuit Breaker
SP	stands for Single Pole
DP	stands for Double Pole
TP	stands for Triple Pole
TPN	stands for Triple Pole and Neutral
4 Pole	stands for 3 phase and neutral of same capacity (size)
MDB	stands for Main Distribution Board
SDB	stands for Sub Distribution Board
FDB	stands for Final Distribution Board
MCC	stands for Motor Control Centre

#### EARTHING

#### 1. GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.

The Earthing System shall in totally comprise the following:-

- a) Earth Electrodes
- b) Earthing Leads
- c) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

#### 2. STANDARDS

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

#### 3. EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanised Steel Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.
- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

#### 4 EARTH ELECTRODES

#### • Plate Earth Electrode

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 meters below ground level.

## Earth Electrode Pit Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than  $1000 \times 500 \times 600$  mm. A precast RCC frame & cover shall be suitably embedded in the masonry enclosure.

#### Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 5 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

#### Number Of Earth Electrodes

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 as amended shall be complied with.

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

#### 5. EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

#### • Earthing Lead Sizes

Strip earthing leads shall be of copper/GI and as per specifications.

#### • Earthing Lead Installation

The length of buried strip earthing lead shall be not less than 15 metres and shall be buried in trench not less than 0.5 m deep.

If conditions necessitates use of more than one earthing lead they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

# Method Of Connecting Earthing Lead To Earth Electrode In the case of plate earth electrode the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers as required by IS 3043 : 1987.

All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe and GI plate earth electrodes or tinned brass in case of Copper plate electrode.

#### • Protection Of Earthing Lead

The earthing lead from electrode onwards shall be suitably protected from mechanical injury and corrosion by a 15 mm dia GI pipe in case of wire and 100/40 mm dia medium class GI Pipe

The portion of the G.I. pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing or pavements). The portion within the building shall be recessed in walls and floors to adequate depth.

#### 6. EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non- carrying metal parts.

#### Connection Of Earthing Conductors

- Main earthing conductors shall be taken from the earth connections at the main switch boards to all other switchboards in the network.
- Sub-mains earthing conductors shall run from the main switch board to the sub distribution boards and to the final distribution boards.
- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.
- Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing, Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. These though rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered earthed, even though the run of metallic conduit is earthed.

#### Earthing Conductor Installation

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.

Joints shall be revetted and brazed in approved manner.

Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

#### • Sizing Of Earthing Conductors

All fixtures, outlet boxes and junction boxes shall be earthed with Bare copper wires as specified.

All 3 phase switches and distribution boards upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

#### 7. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

#### 8. **RESISTANCE TO EARTH**

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers, and shall not exceed 1 ohm

#### Cable:-

#### 1. GENERAL

Technical specifications in this section covers supplying of :

- 11 kV cables
- Medium voltage cables.

#### 2. STANDARDS AND CODES

All equipment's, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended up to date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipment's certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

IS 1554 - 1988
IS 7098 - 1985
IS 1255 - 1983
IS 8130 - 1984
IS 10418 - 1982
IS 10810 - 1988
IS 3961 - 1987
IS 5891 - 1970

#### 3. CABLES

#### 3.1 11 kV Cables

11 kV cable shall be aluminium conductor with cross linked polyethylene (XLPE) insulation, galvanized steel armouring and PVC sheathing conforming to IS 7098. Conductors shall be sector shaped, made from electrical purely aluminium of 3 x 4 H or H temper conforming to IS 8130 XLPE insulation of high purity shall be extruded on the conductors with screen a layer of semi-conducting material shall be applied over the XLPE insulation to prevent partial discharge at insulation surface. This shall be followed up by metallic aluminium tape screen the cores shall be discharged tested. Built up cores shall then be laid up and filler codes added. Combined core shall be provided with extruded PVC sheathing. Galvanized steel wire of strip armouring shall then be provided protected by an overall extruded black PVC sheet. The outer sheath shall bear the manufacturer's name and trade mark at every meter length.

#### 3.2. Medium Voltage Cables

Medium cables shall be aluminium conductor XLPE insulated, XLPE sheathed armoured conforming to IS 1554/7098. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 Sq. mm. shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq. mm and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of XLPE sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of XLPE insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 1/2 /4 Core	:	Red, Yellow, Blue and Black

Current ratings shall be based on the following conditions.

Maximum conductor temperature	70 <sup>0</sup> C	
Ambient air temperature		45 <sup>0</sup> C
Ground temperature		30 <sup>0</sup> C
Depth of laying		1000 mm
	Maximum conductor temperature Ambient air temperature Ground temperature Depth of laying	Maximum conductor temperature 70° C Ambient air temperature Ground temperature Depth of laying

Short circuit rating of cables shall be as specified in IS 1554 Part-I.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

#### 4. DELIVERY, STORAGE AND HANDLING

Cable drum shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in ground causing rot and damage to the cable drum. The cable drum shall conform to IS 10418. During storage, periodical rolling of drums, in the direction of arrow marked on the drum, shall be done once in 3 month through 90o C Both ends of cables shall be properly sealed to prevent moisture ingress Drums shall be stored in well ventilated area protected from sun and rain. Drums shall always be rested on the flanges and not on flat sides. Damaged battens of drums etc. shall be replaced. Movement of drums shall always be in direction of the arrow marked on the drum. For transportation over long distance, the drums shall either be mounted on drum wheels and pulled by ropes or they shall be mounted on trailers etc. drums shall be unloaded preferably by crane otherwise they shall be rolled down carefully on suitable ramps. While transferring cable form 1 drum to another, the barrel of the new drum shall have diameter not less than the original drum. Cables with kinks or similar visible defects like defective armouring etc shall be rejected. Cables shall be supplied at site in cut pieces as per actual requirements.

#### MEDIUM VOLTAGE DISTRIBUTION BOARDS

#### 1 GENERAL

This section covers specification of DBs.

#### 2. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC circuits IS 8828: 1978 Degrees of Protection provided by enclosures for low voltage switchgear IS 2147: 1962 Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts IS 10118: 1982 General requirements for switchgear and control gear for voltages not exceeding 1000 volts IS 4237: 1982

#### 3. MINIATURE CIRCUIT BREAKERS

- The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with H.R.C. fuse/PVC cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

#### 4. FINAL DISTRIBUTION BOARDS

• Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.

- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and as per detailed specifications included in this tender document.
- The board shall be fabricated from 1.6 mm thick CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 degree of protection.
- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length.
- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.
- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.
- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.
- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.
- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Owners.
- A sample of the completed board is to be got approved by the architects/owners before commencement of supply and erection.

#### 5 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

#### 6. NAME PLATES AND LABELS

• Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

#### CABLE TRAYS

- 1. Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel/ladder design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm thick sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Cable trays shall comply with the following:
- 2. Trays shall have suitable strength and rigidity to provide proper support for all contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be power coated or approved equivalent. Cable trays shall not have sharp edges, burrs or projection that may damage the insulation jackets of the wiring. Cable trays shall have side rails or equivalent structural members.
- 3. Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following :
- 4. Cable tray mounting arrangement type to be as marked on layout drawing. Assembly of tray mounting structure shall be supplied fabricated, erected & painted by the electrical contractor. Tray mounting structures shall be welded to plate inserts or to structural beams as approved by the Owners/Architects. Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plates & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg at no extra cost. Maximum loading on a horizontal support arm to be 120 Kg. metre of cable run. Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers shown in tray layout drawings. Spacing between horizontal supports arms of vertical tray runs to be 300 mm. Cable trays will be welded to their mounting supports. Minimum clearance between the top most tray tier and structural member to be 300 mm. Cables in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angels. Clamps to be fabricated from 3 mm thick aluminium strip at site by the electrical contractor to suit cable groups. The structural steel (standard quality) shall be according to latest revision of IS : 226 & 808. Welding shall be as per latest revisions of IS : 816. All structural steel to be painted with one shop coat of red oxide and oil primer followed by a finishing coat of aluminium alkyd paint where any cuts or holes are made on finished steel work these shall be sealed against oxidation by red oxide followed by the same finishing paint. Steel sheet covers wherever indicated to be similarly painted. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Trays shall be supported adequately by means of painted MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

#### 1. GENERAL

This section covers specification of Medium Voltage Switchboards incorporating items of switchgear like Circuit Breakers, SFUs, metering and protection

#### 2 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low Voltage switchgear & controlgear	IS 13947 : 1993
Part I : General rules	
Part II : Circuit Breakers	
Part III : Switches, disconnectors, switch disconnectors and fuse combination units	
Part IV : Contactors & Motor starters	
Part V : Control circuit devices and switching elements	
Marking of Switchgear busbars	IS 11203 : 1985
Degree of Protection of Enclosures for low voltage	
switchgear.	IS 2147 : 1962
Electrical relays for power system protection	IS 3231 : 1986
Code of Practice for selection, installation and Maintenance	
of switchgear & controlgear	IS 10118 : 1982
Low voltage switchgear & controlgear assemblies	IS 8623 : 1993

#### 3. SWITCHGEAR

#### 3.1 Medium Voltage Air Circuit Breakers

#### 3.1.1 Technical Parameters

• The circuit breaker shall be of the air break type, robust and compact design suitable for indoor mounting and shall comply with the requirement of IS: 13947 : 1993. Rupturing capacity shall be 31 MVA at 415 Volts or as per schedule of quantities.

#### 3.1.2 Constructional Features

Page 131 of 237

- The Circuit Breaker shall be flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.
- The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.
- All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts.
- Self aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.
- The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

#### 3.1.3 Operating Mechanism

- The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energised.
- The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.
- The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel.

"Service" -- Both main and secondary isolating contacts closed "Test" -- Main isolating contacts open and secondary isolating contacts closed "Isolated" -- Both main and secondary isolating contacts open "Maintenance" -- Circuit Breaker fully outside the panel ready for maintenance

- The tests shall be carried out with a breaking performance during operation (lcs) and admissible short time withstand (lcw) equal to the ultimate breaking capacity (lcu). i.e. lcu = lcs = lcw for 3 Sec.
- All Air circuit breakers can be reverse fed without reduction in performance

#### 3.1.4 Circuit Breaker Interlocking

- Sequence type strain free interlocks shall be provided to ensure the following:
- It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.

- It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.
- It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.
- A safety latch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due its weight.
- Mechanical and electrical antipumping devices shall be incorporated in the ACB's as required.

#### 3.1.5 Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have minimum 6 NO/NC auxiliary contacts rated at 16 amps 415 volts 50 Hz. These contacts shall be approachable from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

#### 3. 1.6 **Protective Devices**

- The Circuit Breaker shall have protective devices as specified in the Schedule of Quantities. These will in general be:
- C.T. operated thermal overload releases with magnetic instantaneous short circuit release. The overload releases shall be such that each phase can be individually set depending on the phase unbalanced currents. The releases shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying upto 300 ms for discrimination without effecting the breaking current capacity of the ACB.
- Over voltage relay.
- Under/no voltage trip coil or Relay as required.
- Over current and earth fault IDMT relays with shunt/series trip coil operation as specified.
- The Circuit Breakers shall be suitable to accomodate one or more types of protection as specified.

#### 3. 1.7 Instrument Transformers

The Circuit Breaker shall have the required Current Transformers as specified for metering and protection mounted outside the Circuit Breaker compartment but within the free standing cubicle. The transformers shall comply to the relevant Indian Standards and the Class of Accuracy required for metering and protection. Separate sets of Current transformers shall be provided.

#### 3.1.8 Metering

The metering required to be provided for each Circuit Breaker shall be as per the Schedule of Quantities. Such metering shall not be provided on the front panel of the Circuit Breaker compartment. A separate compartment shall be provided for the metering and Protective relays as required.

Square pattern flush mounting meters complying with the requirements of the relevant Indian Standards shall only be used.

Selector switches of the three way and OFF pattern complying to the relevant Indian Standards shall be used.

#### 3. 1.9 Indicating Lamps

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the Schedule of Quantities.

#### 3. 1.10 Control Wiring

All wiring for relays and meters shall be of copper conductor PVC insulated and shall be colour coded and labelled with appropriate plastic ferrules for identification. The minimum size of control wires to be used shall be 1.5 sq mm.

All control circuits shall be provided with protective MCB. Instrument testing plugs shall be provided for testing the meters.

#### 3.1.11 Earthing

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breaker is racked into the cubicle.

#### 3. 1.12 Type Test Certificates

The Contractor shall submit type test certificates from a recognised test house for the Circuit Breakers offered.

#### 3.2. Moulded Case Circuit Breakers

Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e MCCB shall offer class– II front face.

#### 3.3. Metering, Instrumentation And Protection.

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

#### **Current Transformers**

CTs shall confirm to IS 2705 (part -I, II and III) in all respects. All CTs used for medium voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating :

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

#### **Potential Transformer**

PTs shall confirm to IS 3156 (Part-I,II and III) in all respects.

#### Measuring Instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100 C and +500C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould . Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

#### Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248

Ammeters shall normally be suitable for 5 A secondary of current transformers.

Ammeters shall be capable of carrying substential over loads during fault conditions.

#### Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection MCB.

#### Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

#### Power factor meters

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be +40.

#### Energy and reactive power meters

Trivector meters shall be two element, integrating type, KWH, KVA, KVA hour reactive meters. Meters shall confirm to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

#### Relays

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Project Manager for approval.

#### Over current relays

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % insteps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

#### Earth fault relay

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

#### Under voltage relay

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

#### 3.4. Power Factor Correction Capacitors

Power factor correction capacitors shall conform to IS 2834 in all respects. Approval of insurance association of India shall be obtain if called for. Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 5, 10, 15, 25, 25, 50 & 100 kVAR sizes as specified. Capacitor shall be usable for indoor use, permissible overloads being as below.

- Voltage overloads shall be 10% for continuous operation and 15% for six hours in a 24 hours cycle.
- Current overloads shall be 15 % for continuous operations and 50% for six hours in a 24 hours cycle.
- Over load of 30% continuously and 45% for six hours in a 24 hours cycle.

Capacitors shall be hermetically sealed in sturdy corrosion proof sheet steel containers and impregnated with non inflammable synthetic liquid. Every element of each capacitory unit shall be provided with its own built in protection. Capacitors shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants The capacitors shall withstand power frequency test voltage of 2500 volts AC for one minute. Insulation resistance between capacitors terminals and containers when a test voltage of 500 volts DC is applied shall not be less than 50 meg.ohms.

#### 4. MEDIUM VOLTAGE SWITCH BOARDS

#### 4.1 General

- All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

#### 4.2 Switch Board Configuration

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 10% spare space to accommodate possible future additional switch gear.

#### 4.3 Equipment Specifications

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

#### 4.4 Constructional Features

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as specified. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 1.6 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

#### 4.5 Switchboard Dimensional Limitations

- A base channel 100 x 50 x 6 mm thick shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

#### 4.6 Switch Board Compartmentalisation

The Switch Board shall be divided into distinct separate compartments comprising

- A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical busbars.
- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.

- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.
- For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
- A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- Adequate and proper support shall be provided in cable compartments to support cables.

#### 4.7 Switch Board Bus Bars

- The Bus Bar and interconnections shall be of electrolytic Copper/Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per sq. mm. and for Aluminium shall be 1 amp per Sq. mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities.
- The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.
- All TRIP/CLOSE/INDICATION circuit shall be compatable on 24V DC. Accordingly all relay & CTs etc shall be 24 V DC.

#### 4.8 Switch Board Interconnections

 All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.  For unit ratings upto 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

#### 4.9 Drawout Features

Air Circuit Breakers shall be provided in fully drawout cubicles. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the drawout cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

#### 4.10 Instrument Accomodation

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

#### 4.11 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

#### 4.12 Cable Terminations

- Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

#### 4.13 Space Heaters

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation.

#### 4.14 Ventilation Fans

The Switch Board shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 2500 amp and above. The fan shall be interlocked with switchgear operation.

#### 4.15 Earthing

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

#### 4.16 Sheet Steel Treatment And Painting

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

#### 4.17 Name Plates And Labels

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

#### 5. OUTDOOR TYPE DISTRIBUTION FEEDER PILLARS

The feeder pillar shall be of the floor mounting type, totally enclosed, and weather proof, conforming to ISI IP 54. The feeder pillar shall be suitable for 440 volts 3 phase 4 wires, 50 cycles AC supply.

The cubicle should be fabricated out of heavy gauge sheet steel of thickness not less than 2 mm thick with suitable side frame and stiffeners. Hinged doors of not less than 1.6 mm thick should be provided at the front and rear of the cubicle to provide access for installation, operation, tests and inspection. The rear door is provided to facilitate cable termination and the front door for inspection of breaker, to switch 'ON' and 'OFF' the switch as and when required. All doors should be fitted with dust excluding neoprene gaskets. The doors should also be fitted with suitable locking arrangement with lock to prevent unauthorized opening. The cubicle should be designed for mounting over cement concrete plinths by the roadside, and should be of substantial construction capable of withstanding the vibrations normally experienced due to vehicular traffic. The top of the feeder pillar is of slanting construction in all directions to prevent any collection of water due to rain. A gland plate is provided at the bottom of the feeder pillar (removable) for mounting the cable glands. The feeder pillar shall be fitted on an angle iron pedestal at the bottom covered with sheet metal from all the four sides which facilitates cable bending etc specially with aluminium cables. Two lifting hooks shall be provided at the top. A door switch shall be provided in the feeder pillar so as to switch 'ON' and 'OFF' the lamp fixed in the brass batten holder below the top sheet of the pillar.

The sheet steel materials used in the construction of the cubicle should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulfuric acid solution and recognised phosphating process. After metal treatment, the interior of

the cubicle should be painted with two coats of air-drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle should be painted with two coats of staving red oxide primer followed by one coats of epoxy finishing paint. One final spray of epoxy paint shall be applied at the time of handing over the installation.

All the nuts, bolts shall be cadmium plated with spring washers. A minimum spacing from cable connection to the bottom of gland plate shall be 300mm.

The bus bars should be of electrical grade copper. They should be air insulated with adequate clearances between conductors and between conductors and earth. These should be colour coded to enable immediate identification of the phases and neutral. The current density for bus bars shall not be more than 1.0 amps per square mm. All bus bar joints and tapings should be of the clamped type as far as possible thereby avoiding drilling of holes on bus bars. The bus bars should be carried on supports made out of a suitable non-inflammable and non-hygroscopic material such as Hylam, Permali or Formics. Suitable insulating phase barriers should be provided to prevent accidential short-circuits during operation.

The neutral bus bar shall be rated at 100 % of the phase bus bars. The design should allow for neutral cable sockets to be fitted directly to the bus bars. A GI earth bar of size 40x5mm together with two cable eyes shall be provided for connections to earth pits. All the cables shall be terminated at ELEMEX terminal block and therefrom wiring shall be done with PVC insulated aluminium conductor cable to breaker units. The wiring shall be neatly bunched and shall be secured to wiring cradles.

A circuit cardholder to be made inside the front door and the card duly engraved / painted on aluminium / hylam sheet, Identification ferrules shall be used for incoming and out going cables.

#### 6. TESTING AT WORKS

Copies of type test carried out at ACB/MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Project Manager reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests as per clause 7.7 of SCC

#### 7. INSTALLATION

The foundations prepared as per the manufacturers drawings shall be leveled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The able end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths.

A 15 mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000 mm. The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 mA/sq. metre.

After installation the Switch Board shall be tested as required prior to commissioning.

Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboards at site before energizing the switchboards including but not restricted to the following.

- Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.
- Physical checking and inspections of Inter panel wiring
- Checking free movement of ACBs/MCCBs/SFUs
- Checking of operation of breakers
- Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.
- Primary & secondary injection tests of relays and CTs.
- Checking of Interlocking function.

#### NS-2(TELEPHONE TAG BLOCK)

#### 1 TAG BLOCK:

1 The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be silver soldered. The cross connecting jumpers shall be insulated wires of same diameter and screw connected.

2.The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

### NS-3( TELEPHONE TAG CABLE)

1 The type of cables and the services shall be as follows:

Indoor Multi pair, PVC insulated sheathed armoured and sheathed. Inside Twin core PVC insulated with conduit twisted cores.

- 2 All multi core cables and wires shall be of tinned copper conductor of not less than 0.5 mm dia. and shall be colour coded twisted pairs with rip cord.
- 3 The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductor's not less than 50 mega ohms and the nominal capacitance of about 0.1 micro farad per kilometer.
- 4 Cables lay underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.
- 5 All armouring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.

6 All unarmoured single core cables and inner sheath of armored cables shall be provided with rip cord.

#### NS-5,6 & 11( LIGHT FIXTURE & ACCESSARIES)

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

#### 1 SCOPE

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets,

down rods and painting etc. as required.

#### 1 STANDARDS

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaires :			
Part-1 Tubular flourescent lamps		-	IS – 1913 (Part-1)
Industrial lighting fittings with metal reflectors		-	IS - 1777
Decorative lighting outfits		-	IS - 5077
Bayonet lamp holders	-	IS -	1258
Bi-pin lamp holders for tubular fluorescent lamps		-	IS - 3323
Electronic Ballasts for fluorescent lamps –			
General & Safety requirement	-	IS –	- 13021 (Part-1)
Electronic Ballasts for fluorescent lamps –			
Performance requirement		-	IS – 13021 (Part-2)
Ballast for HP MV lamps		-	IS - 6616
Tubular Fluorescent lamps		-	IS - 2418 (Part-1 to 4)
Luminaries – General requirement		-	IS – 10322 (Part-1)
Luminaries – Constructional requirement		-	IS – 10322 (Part-2)
Luminaries – Screw and Screwless termination		-	IS – 10322 (Part-3)

Page 149 of 237

Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

Luminaries – Methods of Tests - IS – 10322 (Part-4)	Luminaries – Methods of Tests	-	IS – 10322 (Part-4)
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Particular requirement – General purpose Luminaries - IS-10322 (Part-5/Sec-1)

Particular requirement – Recessed Luminaries		-	IS-10322 (Part-5/Sec-
2)			
Particular requirement – Luminaries for Road and			
Street lighting -		IS–10322 (Part-5/Sec-3)	
Particular requirement – Portable General purpose Luminaries		-	IS-10322 (Part-5/Sec-
4)			
Particular requirement – Flood Lighting	-	IS-0	)322 (Part-5/Sec-5)
High pressure mercury vapour lamps	-	IS-9900 (Part-1)	
Tungsten filament general electric lamps		-	IS - 418

#### 2 LIGHT FITTINGS GENERAL REQUIREMENTS:

- a) Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.
- b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.
- c) All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Outdoor type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.
- d) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires up to 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- e) All hardware used in the fitting shall be suitably plated or anodized and passivated.
- f) <u>Earthing</u>: Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

- g) <u>Painting/Finish</u>: All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.
- h) The housing shall be powder coated/stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia. mandrel.
- i) Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

#### NS-7(LIGHTNING PROTECTION SYSTEM (ESE TECHNOLOGY)

#### 1.1 Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system.

The design of components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The lightning protection system should complies in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advance lightning protection system shall include components as follows: ESE Air Terminal Mechanical Supports Down Conductors Lightning Strike Recorder A low impedance chemical gel earthing system

#### 2.2 Standards

(i) Complete installation shall be engineered and constructed in accordance with the latest revision of the following:

- NFC 17 102
- IEC 61024
- IEC 60-1:1989

**Test Certificates & Approvals:** 

The ESE air terminal shall be tested & certified by CPRI (Central Power Research Institute, Govt. of India) for a minimum impulse current of 45 KA (8/20 micro sec) with 5 positive & 5 negative impulse.

The ESE air terminal shall be approved from DGMS (Directorate General of Mines Safety, Govt. of India)

As per IEC 60-1:1989, the ESE air terminal should successfully withstand minimum 4 current impulse equivalent to 150 KA (8/20 micro sec waveform).

As per NF C 17 – 102, the ESE air terminal should be tested with the "Switching Impulse Voltage" of 700 KV & "Direct Voltage" of 70 KV

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

#### 2.3 Air Terminal

The ESE air terminal shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer floating four panels and an earthed central finial rod. The lightning air terminal shall be configured as a spheroid which is comprised of separate electrically isolated panels surrounding an earthed central finial. The central finial shall be elevated above the spheroid to a length of 90mm. The Insulation material used to electrically isolate the panels shall be comprised of a base polymer which provides high Ozone & UV resistance with a di-electric strength of 24-38 KV/mm tested as per NFC 17-102 & IEC 60-1:1989

The unit shall detect the lightning when it approaches and emit an electronically controlled streamer within few micro seconds. ESE air Terminals shall be manufactured as per NFC 17-102 standard. A dedicated wired ESE tester should be available for maintenance purpose. The manufacturer should be ISO 9001 certified. Performances of the air-termination should have been tested in High Voltage Laboratory (CPRI) as well as in the international laboratories as per IEC 60-1:1989.

The Air terminal should work under Early Streamer Emission (ESE) Technology and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics. The ESE air terminal shall have no moving parts, no electronic circuits and will have no dependence on external power supply or batteries. The ESE air terminal shall not have any solar panels.

The ESE air terminal should deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The ESE air terminal generates a leader that propagates rapidly to capture the Lightning stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The Materials of the air termination shall be non –corroding in normal atmosphere. The Height of the air terminal support mast should be minimum 2mts and the height will be increase as per the coverage design.

The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

Air Termination Support: The Air Termination shall be fixed at the top of a GI or FRP elevation pole so as to be at least 2 meters above the top of the structure to be protected. The elevation pole should have a minimum dia of 35mm to 50mm with a thread at the top to fix the unit. Guy wires may be used in order to ensure the stability of the installation.

#### 2.4 Down Conductor

The down conductor should be used 70 sq mm copper cable or 25x 3 mm copper strip. Two down conductors shall be used in case of the structure height is above 28mts and both should be connected with maintenance- free Grounding system.

The down conductor shall be routed as directly as possible to the ground avoiding electrical shafts and sharp bends (minimum bending radius of 0,5m). Any metallic object located less than 1 meter shall be connected to it as per IEC 62305 standards.

The main copper conductor shall be connected directly to the air termination.

The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to sharper bends.

The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

#### 2.5 Lightning Strike Recorder

The Lightning systems shall be installed complete with the lightning strike recorder. The lightning strike recorder shall contain a mechanical 6 digit display which will register all lightning discharges with a sensitivity of 1500A 8/20  $\mu$ s peak current impulse.

The lightning strike recorder shall be housed in a IP 65 rated enclosure and operate without reliance on batteries or on any other external power source. As per IEC 60-1:1989, the lightning strike recorder should withstand a maximum current impulse equivalent to 450 KA (8/20 micro sec waveform)

#### 2.6 Grounding System

The Lightning arrestor grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system.

Grounding will be done by 10 feet 5/8" mm dia copper bonded (250 microns) steel core ground rods especially designed for lightning grounding.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building to arriving services is recommended. Electrically conductive, non soluble LPI RESLO (mixture of Sulphate, Silica, Alumina, Iron Oxide, Titanium Oxide, Calcium Oxide, Potassium Oxide, Chloride, Magnesium Oxide, Sodium Oxide, Zinc Oxide, etc) Resistance Lowering Grounding Minerals. The Chemical compound RESLO shall be tested and certified by an International accredited and BIS (Bureau of Indian Standards) accredited laboratory. The testing laboratory shall be ISO 9001 & ISO 14001 certified.

#### NS-8(AUTOMATIC FIRE DETECTION & ALARM SYSTEM)

#### 1.0 <u>SCOPE</u>

This specification covers the supply, installation, testing and commissioning of the Fire Detection Systems and generally comprise

- Provision of Smoke and Heat Detectors
- Provision of Manual Call Points
- Provision of Response Indicator Units
- Provision of Audio Alarm units
- Local and Main Control Unit for the System
- Public Address System
- Wiring between Detectors and Control Units to make the complete System

#### 2.0 STANDARDS AND CODES

Specification for Smoke Detectors	BS 5445: 1984
Specification for Heat Sensitive Detectors for use in automatic fire alarm Systems	IS 2175: 1977
Code of Practice for installation of automatic Fire Alarm System using Heat sensitive type Fire Detectors	IS 2189: 1976
Code of Practice for Electrical Wiring installations (System voltage not exceeding 660 volts)	IS 732: 1963
Automatic Fire Alarm Systems in buildings	BS 3116 Part I
Control and indicating equipment	BS 3116 Part IV
British Code of practice for installation	CP 1019: 1972

Page 155 of 237
and servicing of Fire Alarm Systems

Underwriters Laboratory Specification UL 268

for Smoke Detectors

All equipment and the installation shall be as per the relevant Indian Standards Specifications. Where these Standards do not exist, the relevant British Standards or any other internationally accepted Standard shall apply.

#### 3.0 PHOTO ELECTRIC TYPE SMOKE DETECTORS

#### 3.1 <u>GENERAL</u>

The Photo-electric type Smoke Detectors shall be capable of sensing fire in the smoldering or the incipient stage. Smoke Detectors shall be sensitive to visible products of combustion in accordance with the sensitivity requirements of BS 5445 Part 7 : 1984.

### 3.2 CONSTRUCTIONAL FEATURES

### 3.2.1 DETECTOR HEAD

The Smoke Detector enclosure shall be of white plastic moulded with high impact self extinguishing polycarbonate and shall be fitted to the base by a twist and lock action. Correct alignment of the electrical contacts in the base with the terminal pins of the Detector shall be ensured. The twist and lock action shall ensure a good electrical contact with the wiping action. Apertures in the Detector housing shall allow the free ingress of smoke through a stainless steel gauze and into the fire sensing photo-optic chamber.

## 3.2.2 DETECTOR BASES

The Detector bases shall be suitable for mounting directly on a 75 mm recessed round box or as required at the site. The bases shall have terminals which shall be suitable for receiving 1.5 sq mm PVC copper conductor or 2.5 sq mm PVC aluminium conductor cables. Access to the terminals shall be available from the front of the base after removing the Detector. A plastic cover shall be provided with each base to be fixed to the rear to eliminate the ingress of dust, water and insect into the Detector

# 3.2.3 LED INDICATION LAMP

A LED lamp shall be incorporated which shall normally flicker at the rate of six flashes per minute indicating alertness and shall turn steady when a fire is sensed enabling immediate identification of the Detector.

# 3.2.4 ELECTRONICS

The Printed Circuit Board electro tinned copper tracks shall be protected from corrosion by a green epoxy solder resist coating. The tracks and solder joints shall be protected against fungus growth by an insulating varnish coating.

The sensitive electronic components shall be protected by a high resistivity silicone encapsulation compound. All electronic components shall be electrostatically screened.

The electronic design and circuit shall provide the following safety devices:

- protection against high voltage spikes on the supply line
- protection against polarity reversal
- protection of the ionization chamber monitoring circuits from high voltage static discharges
- protection against high frequency transients
- detection of alarm at the control unit even in the event of LED failure
- protection against transient spikes on long lead lines to the remote indicators

# 3.2.5 DETECTOR WIRING

The Smoke Detector shall be suitable for 2 wire monitored supply.

# 3.2.6 **OPERATIONAL PARAMETERS**

The Detectors shall be suitable for operation at a maximum ambient temperature of 60 deg C. and a minimum of 0 deg C with a maximum relative humidity of 93%.

The Detector sensitivity shall remain constant and not vary with change in the ambient temperature, humidity, pressure or voltage by more than +/- 10%.

The performance of the Detectors shall not be effected by continuous air flows upto 10 meters per second.

The Detectors shall be suitably protected against the accumulation of dust and insects.

The Smoke Detectors shall comply to the requirements of BS 5445 Part 7 : 1984 and EN 54 Part 7 : 1984 for Vibration, Impact and Shock parameters.

The Smoke Detectors shall be designed and constructed to meet the requirements of IP 43.

### 3.2.7 DETECTOR TESTING IN SITU

It shall be possible to functionally test the Detector as well as assess its actual sensitivity without having to remove the same.

### 3.2.8 DETECTOR CERTIFICATION

The Smoke Detector shall be UL Listed and tested and approved by independent Authorities for certified compliance and acceptance to the relevant Standards. The Detectors shall be approved by the Local Fire Authorities and relevant documentation shall be supplied with the tender.

#### 4.0 HEAT SENSITIVE RATE OF RISE CUM FIXED TEMPERATURE TYPE DETECTORS

# 4.1 <u>GENERAL</u>

The Heat Sensitive Detectors shall be of the rate of rise cum fixed temperature detection type and shall comply to the requirements of IS 2175 : 1977 and NFPA Standard 721. The detectors shall respond to a rate of rise in temperature of 8 deg C per minute and a fixed temperature of 57 deg C.

## 4.2 <u>CONSTRUCTIONAL FEATURES</u>

The Heat Detectors shall be of the plug-in type and shall be attached to the mounting plate by a twist and lock motion. The Detector body shall be of moulded plastic, white in colour. The electrical contacts and other moving parts of the Detector shall be enclosed in such a manner that will afford protection against moisture, dust, insects and other

foreign matter. All make and break contacts shall be of silver or any other metal or alloy of equivalent characteristics.

The body and other parts shall be made of material inherently resistant to corrosion.

Any adjustments made at the factory shall be sealed and all adjustment screws shall be provided with a reliable means of locking to avoid disturbance of the adjustments in transit. In addition, the means of adjustment shall be rendered inaccessible to prevent tampering when the Detector is being installed or during its operation.

### 4.3 MOUNTING PLATES

All Detectors shall be installed on mounting plates moulded from white self extinguishing thermoplastic. The Detector shall be attached to the mounting plate with a twist and lock motion. The mounting plate shall be suitable for installation on a 75 mm round recessed box.

### 4.4 DETECTOR OPERATION

The Detector head shall house a thermostat or a fusible alloy as a fixed temperature element. When activated the external heat collector shall drop to provide a visual confirmation that the fixed temperature element has operated.

A pneumatic element shall sense the rate of rise in temperature by expansion of air within a sealed chamber faster than it can escape through the calibrated vent. The resultant increase in pressure shall depress a diaphragm causing the electrical contacts to close a circuit and trigger an alarm. The rate of rise element shall be of the self-restoring type.

#### 4.5 DETECTORS APPROVALS

The Detectors shall meet the performance requirements as per Clause 5 of IS 2175: 1977 and/or other International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

#### 5.0 HEAT SENSITIVE FIXED TEMPERATURE TYPE DETECTORS

# 5.1 <u>GENERAL</u>

The Heat Sensitive Detectors shall be of the fixed temperature detection type and shall comply to the requirements of IS 2175 : 1977 and NFPA Standard 721. The detectors shall respond to a fixed temperature of 57 deg C. or 94 deg C as specified.

The Heat Detectors shall be of the plug-in type and shall be attached to the mounting plate by a twist and lock motion. The Detector body shall be of moulded plastic, white in colour. The electrical contacts and other moving parts of the Detector shall be enclosed in such a manner that will afford protection against moisture, dust, insects and other foreign matter. All make and break contacts shall be of silver or any other metal or alloy of equivalent characteristics.

The body and other parts shall be made of material inherently resistant to corrosion.

Any adjustments made at the factory shall be sealed and all adjustment screws shall be provided with a reliable means of locking to avoid disturbance of the adjustments in transit. In addition, the means of adjustment shall be rendered inaccessible to prevent tampering when the Detector is being installed or during its operation.

# 5.3 MOUNTING PLATES

All Detectors shall be installed on mounting plates moulded from white self extinguishing thermoplastic. The Detector shall be attached to the mounting plate with a twist and lock motion. The mounting plate shall be suitable for installation on a 75 mm round recessed box.

# 5.4 DETECTOR OPERATION

The Detector head shall house a thermostat or a fusible alloy as a fixed temperature element. When activated the external heat collector shall drop to provide a visual confirmation that the fixed temperature element has operated.

# 5.5 DETECTORS CERTIFICATION

The Detectors shall meet the performance requirements as per Clause 5 of IS 2175 : 1977 and/or other International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

# 6.0 MANUAL CALL POINTS

Manual Call Points shall consist of a push button switch housed in a dust tight sheet steel enclosure of 1.5 mm thick sheet to manually initiate audio visual alarms. The front shall be sealed with a breakable glass cover fixed in such a way that the actuating push button is kept depressed as long as the glass is intact and released automatically when the glass is broken. The front face of the Manual Call Box shall have an area not less than 5000 sq mm and the element shall have an exposed area of not less than 1600 sq mm in the shape of a square or a rectangle.

A small steel hammer shall be attached to the assembly with a steel chain to facilitate breaking of the glass front. The Manual Call Box shall be suitable for surface or recessed mounting as required. The words "IN CASE OF FIRE BREAK GLASS" 5 mm high shall be painted in red on the front face.

# 7.0 RESPONSE INDICATOR

The Response Indicator shall consist of a red LED mounted in a sheet steel enclosure of 1.5 mm thick sheet suitable for surface or recessed mounting on walls or partitions as required. These shall be connected to the Detectors in the enclosed area to indicate the status of the Detector. In normal circumstances the lamp shall flicker but in the event of the Detector inside the enclosed area sensing a fire, the lamp shall glow steadily.

# 8.0 ILLUMINATED SIGNS

The Illuminated Signs shall have the letters "FIRE EXIT" or "NO FIRE EXIT" painted in red on a white Perspex sheet as the front face of a sheet steel enclosure constructed with 1.5 mm thick sheet. The Perspex sheet shall be back lit with an integral battery back up facility so as to operate independent of the mains supply in the event of a mains failure. The preferred dimensions of the Illuminated Signs shall be 450 mm length and 225 mm height with 100 mm high lettering. They shall be suitable for surface or recessed mounting as required.

# 9.0 ALARM SIRENS

Electronic audio alarm sirens shall be suitable for operation on the DC supply of the System and will be actuated from the Main Control Panel in the event of a fire. These shall have a two tone modulated alarm signal for continuous service with an output of 100 dB at a distance of 3 metres.

# 10.0 MAIN CONTROL PANEL

#### 10.1 <u>GENERAL</u>

The Main Control Panel (MCP) shall be centrally located and shall form the nerve centre of the total System. The MCP shall continuously monitor the status of each Fire Zone.

The MCP shall be metal enclosed, sheet steel cubicle pattern, dead front, floor/wall mounting type as required and suitable for indoor mounting.

The MCP shall be dust and vermin proof. Synthetic rubber gaskets shall be provided on all covers and doors to render the joints dust and vermin proof. All doors shall be lockable.

The MCP shall be fabricated from 2.0 mm CRCA thick sheet steel and shall be folded and braced to provide a rigid support. Joints shall be seam welded.

#### 10.3 MAIN CONTROL PANEL CONFIGURATION with PA Amplifier

The MCP shall monitor the status of each Fire Zone and shall be configured to include:

- a) **Microprocessor** based semi addressable electronic panel complete with a facia to provide the following indications, controls, ON site programmable Key Pads, suitable for RS-485 communication having 40 x 2 LINE LCD display EPROM event logging. :
  - "FIRE" indication one per zone
  - "FAULT" indication one per zone
  - "FIRE TEST" push button one per zone
  - "ZONE ISOLATE" switch one per zone
  - "DETECTOR FAILURE OPEN CIRCUIT SHORT CIRCUIT" indication
  - "DETECTOR REMOVED" indication
  - "BREAK IN WIRING" indication with initiation of alarm
- b) Mother Board to control and monitor the entire System with audio/visual alarms and with a facia to provide the following controls and indications:
  - "MAINS ON" switch with indicating lamp
  - "SYSTEM ON" switch with indicating lamp
  - "MAINS FAILURE" indication
  - "BATTERY LOW" indication
  - "LAMP TEST" push button
  - "STANDBY ON" indication

- "SYSTEM RESET" push button
- "ALARM CANCEL" push button
- "TRICKLE BOOST" toggle switch
- "AUDIO ALARM" selector switches for general and/or zone wise broadcast.
- "AUTO/MANUAL" selector switch for the Illuminated Signs
- c) Power Supply for the System integral with the MCP. The power supply rating shall be adequate for the Detectors, Illuminated Signs and all other devices as required in the System.

The power supply unit integral with the Control Panel shall consist of a 230/24 volt step down transformer. The 24 volt secondary of the transformer shall be rectified through a silicon diode bridge rectifier unit and the D C output filtered to minimize ripples. The unregulated 24 volt DC supply shall be regulated for the electronic circuits and the power to the entire System.

- d) Screw type terminal blocks and cable glands for termination of all control wiring.
- e) Required potential free spare contacts/ or as called for in Bill Of Quantities.
- f) End of Line resistors as required by the System design shall be provided as a part of the Control Panel.
- g) Audio visual alarm unit with a provision to sound an alarm throughout the building from the Main Control Panel either as a general broadcast or selectively as may be required.

### 10.4 <u>ELECTRONICS</u>

The Printed Circuit Board electro tinned copper tracks shall be protected from corrosion by a green epoxy solder resist coating. The tracks and solder joints shall be protected against fungus growth by an insulating varnish coating.

The sensitive electronic components shall be protected by a high resistivity silicone encapsulation compound. All electronic components shall be electrostatically screened.

The electronic design and circuit shall provide protection against high voltage spikes on the supply line

All Printed Circuit Boards shall be mounted in the MCP such that they can be pulled out from the front without the need for disconnecting any wires and shall therefore be mounted on rails and plugged directly into connectors.

# 10.5 <u>DISPLAY</u>

The Main Control Panel shall be complete with a display showing the layout of each floor of the Building/s and each Fire Zone marked clearly thereon for ready identification with the Zone indications and controls. The Display Panel shall be integral with the MCP and shall be etched in colour on a white perspex sheet as approved by the Architects.

# 10.6 INTERNAL WIRING

All internal wiring shall be with 1.5 sq mm PVC insulated copper conductor wires colour coded and labelled with ferrules for easy identification. The wiring shall be properly bunched and harnessed. The wiring shall be done in a manner such that it is readily accessible from the front for maintenance.

# 10.7 SHEET STEEL TREATMENT AND PAINTING

Sheet steel materials used in the construction of the Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two coats of filler oxide primer before final painting.

All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

# 10.8 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels shall be provided for identification of the Fire Zones as approved by the Architects.

# 11.0 REMOTE CONTROL PANELS

Remote Control Panels shall generally comply to the Specifications of the Main Control Panels as detailed in para 5.10.3 above. These shall be located remotely and will indicate the status of each Zone and the MCP but without any controls. The indications to be provided on the Remote Control Panel shall be :

- "FIRE" indication one per zone

- "FAULT" indication one per zone
- "DETECTOR FAILURE OPEN CIRCUIT SHORT CIRCUIT" indication one per Zone
- "DETECTOR REMOVED" indication one per Zone
- "BREAK IN WIRING" indication one per zone
- "MAINS ON" indicating lamp
- "SYSTEM ON" indicating lamp
- "MAINS FAILURE" indication
- "BATTERY LOW" indication
- "STANDBY ON" indication

# 12.0 BATTERY AND BATTERY CHARGER

Adequately rated 24 volt lead acid rechargeable DC battery with 12 hour autonomy shall be provided for the System. The capacity shall be such as to feed the full load of the Fire Detection System including the Illuminated Signs in the event of a mains failure. It shall be connected to the MCP via a mains failure relay.

The battery shall be complete with a Battery trickle charger set and shall be maintained in a charged condition with the constant trickle charge. It shall be possible to boost the charging of the battery by the manual operation of the trickle/boost toggle switch when 'Battery Low' indication is observed on the Main Control Panel.

The Battery capacity shall fully meet the requirements of Clause 5.2 of IS 2189.

### 13.0 <u>WIRING</u>

The wiring for the Fire Detection System shall in general comply with the requirements of IS 2189 : 1976 and IS 732 : 1963. The Detectors in each loop shall be wired upto the

Main Control Panel with a 2 core 1.5 sq. mm. copper conductor or 2 core 2.5 sq mm aluminium conductor FRLS PVC insulated 660/1100 volt grade wires in concealed or surface conduit as required. Crimped terminations shall be used throughout the System.

### 14.0 <u>TEST CERTIFICATES</u>

Type test certificates from a recognized independent agency shall be furnished for all the equipment. The equipment shall comply to the requirements of the Indian, International Standards, Fire Insurance Authorities and all National and Local Regulations in force.

# 15.0 SENSITIVITY ADJUSTMENTS

The sensitivity of all Detectors shall be set/adjusted by the Supplier to suit the site conditions.

### 16.0 INSTALLATION, COMMISSIONING AND ACCEPTANCE TESTS

The following installation, commissioning and acceptance tests shall be conducted by the Contractor and shall be apart from the Standard/Routine tests prescribed and normally conducted by the Supplier. These tests shall be carried out as a part of the installation irrespective of whether or not these are covered by the Standard/Routine tests.

#### **INSTALLATION TESTS**

After installation of the Detector Bases and prior to installation of the Detectors, the wiring shall be tested for continuity and insulation resistance. A high voltage insulation meter 500 to 1000 volts shall be used to measure the insulation resistance between each conductor and between each conductor and earth. The value of insulation resistance shall not be less than 1 Mega ohm.

The insulation resistance of the wiring to the Response Indicators shall also be checked as above prior to the installation of the Indicators.

#### COMMISSIONING AND ACCEPTANCE TESTS

Each zone shall be tested by a test fire or by a heat source on all or any one or more of the Detector selected by the Architects. The time required for detection shall be noted and shall be within prescribed limits.

Each alarm circuit shall be energised separately and the sound level reading taken to check for conformity with the minimum standards.

Open circuit and removal of a Detector from a detection circuit shall be tested.

Short circuit operation for each detection circuit will be tested

Tests to prove satisfactory operation of the system shall be conducted simulating the conditions of

Mains Failure

Battery disconnection

Open circuit and short circuit conditions of each alarm circuit

The results of all the tests conducted shall be so recorded and approved by the Clients/Architects prior to acceptance of the System.

### NS-9(Flexible cable with electrolytic grade annealed bare copper conductor 1100 V grade.)

Wiring shall be carried out with PVC insulated (FRLS) 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

## NS-10( UPS)

Make	:	As per List of make		
Model	:			
Rating	:	As per B.O.Q.		
Technology	:	True on-line double conversion: Microprocessor based rectifier Charger, Unique Free Frequency PWM IGBT Technology for Inverter, Static & Manual bypass switch and Galvanic Isolation Transformer at inverter Output.		
Input				
Voltage Range	:	380/400/415 V <u>+</u> 15% 50 Hz + 5%		
Trequency Range	•	50 Hz. <u>-</u> 570		
Output				
Voltage Voltage transient	:	380V / 400V / 415V (site selectable) <u>+</u> 2% for load change of 0% to 100% and 100% to 0% stepload, recovery within 4 ms		
Frequency	:	50 Hz. + 0.1% in free running mode Adjustable up to + 4% in Synchronized with mains mode		
Voltage distortion	:	THDU < 2% for 100% non-linear load		
Crest Factor	:	Up to 3.5 : 1		
Overall efficiency (AC/AC)	:	93% at 100% load, 93.5% at 75% load, 93.5% at 50% load, 91% at 25% load		
Noise level	:	<u>≤</u> 60 dBA		
MTBF (Mean time between fai	lur	e) 4,75,000 hours		
Battery Monitor	:	Battery monitoring software to optimize battery life/operation provided as standard		
UPS Dimension	:	1400 (H) x 825 (D) x 715 (L) mm per KVA UPS		
Battery MCCB	:	Housed in Battery MS cabinet.		

Page 171 of 237

NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

Standards	: UPS meets the IEC 146-4 IEC 801-2/3/4 & EN 50 091-1 IEC 1000-2-2 TUV Rheinland	following standards: k IEC 1000-4-2/3/4
Battery	: Sealed mainten	ance free Global / Panasonic make
	Battery autonomy	: 30 minutes at full load

# NS-12( MCB CONTROL POINT WIRING)

### 1. Wiring for Lights

Primary Light Points : Wiring for primary light points, as defined in para 1 above, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control MCB (for MCB controlled lights). Rates for primary light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of primary light point thus defined including : .

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,
- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.
- Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required. Cost of this switch is applicable only for switch controlled points. This cost shall not be applicable for DB controlled points.
- Loop earthing with insulated copper wires.

Secondary Light points :

Secondary light points, as defined in para 1 above, shall cover the cost of interconnection wiring between group controlled light fittings and shall be deemed to be inclusive of the cost of entire materials and labour required for completion of the secondary light point thus defined including

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,
- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.

Loop earthing with insulated copper wires.

NRDA

# ( C) PUBLIC HEALTH ENGINEERING & FIRE WORKS

- 1.0 Special Conditions
- 1.1 Scope of work

1.1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.1.2 Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialised services as described hereinafter and as specified in the Bill of Quantities and/or shown on the plumbing drawings.

1.1.3 Without restricting to the generality of the foregoing, the sanitary installations shall include the following:-

Plumbing Works

- Sanitary Fixtures & C.P Brass Fittings
- Soil, Waste, Vent, Rain Water Pipes & Fittings
- Water Supply
- 1.4 Services rendered under this section shall be done without any extra charge.

#### 2 Specifications

2.1 Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

2.2 Items not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest Central Public Works Department with upto date amendments as applicable in the Contract.

2.3 Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Codes & Bureau of Indian Standards and in case of its absence as per British Standard Code of Practice.

3 Execution of work

3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

3.2 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of architectural, HVAC, electrical, structural and other specialised services drawings.

3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance

to prevent hold up of progress of the construction schedule. All supports to the civil structure shall be provided with dash fasteners as per approved make only.

On award of the work, Contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the Engineer-in-charge/Architect/ Consultant. All dates and time schedule agreed upon shall be strictly adhered to within the stipulated time of completion/ commissioning along with the specified phasing, if any.

# 4 Drawings

4.1 Contract drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

4.2 Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-charge all discrepancies or deviations noticed. Decision of the Engineer-in-charge shall be final.

4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

4.5 Any drawings issued by the Architects/Consultant for the work are the property of the Architects/ Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5 Inspection and testing of materials

5.1 Contractor shall be required, to produce manufacturers test certificate for the particular batch of materials supplied to him. Contractor may be required to get the material tested from outside approved laboratory for confirmation of material as per PM/Client instruction as and when required. The tests carried out shall be as per the relevant Bureau of Indian Standards.

5.2 For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary but not limited to the following:

Steel tapes Weighing machine Plumb bobs, sprit levels, hammer Micrometres Hydraulic

5.3 All such equipment shall be tested for calibration at approved laboratory, if required by the Engineer-in-charge. All testing equipment shall be preferably located in special room meant for the purpose.

5.4 Samples of all materials shall be got approved by Architect/ PM and Client and should be first make of the approved make list before placing order and the approved samples shall be deposited with the Engineer-in-charge.

# 6 Metric conversion

6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

# 7 Reference points

7.1 Contractor shall provide permanent bench marks, flag tops and other reference points and check that with other agencies to confirm the same reference point for all the proper execution of work and these shall be preserved till the end of the work.

7.2 All such reference points shall be in relation to the levels and locations, given in the architectural and plumbing drawings.

8 Reference drawings

8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings to be submitted by the contractor in fulfilment of the conditions of this contract.

8.3. On award of the work the contractor shall be issued four sets of consultant's working drawings stamped "good for construction" by the Engineer-in-charge. The consultant's drawings shall be the basis of contractor's shop drawings. In addition, the Engineer-in-charge shall also be issue one copy of the Interior Designer's; Electrical & HVAC approved shop drawings relevant to his work for coordination purpose.

8.4 Shop drawings are detailed working drawings which incorporate the contractor's details for execution of the work and incorporate equipment manufacturer's details and dimensions to ensure that the same can be installed in the space provided.

8.5 All shop drawings should detailed pipe routing and levels, showing location of other services at crossings etc., cable runs, route cable trays and all allied works and must be fully co-ordinated with other services and approved by the Engineer-in-charge before execution of the works. Engineer-in-charge shall arrange to issue two copies/prints of services drawings from the respective contracting agencies. All drawings will be valid only when stamped and issued by the Engineer-in-charge.

8.6 Shop drawings shall also be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.

8.7 Six sets of manufacturer's equipment drawings, roughing in and wiring diagrams shall be submitted.

8.8 Contractor shall submit shop drawings furnishing all details of MCC panels, cable routes, wiring diagrams and connection details as required.

8.9 Three copies of each set of shop drawings shall be submitted for initial scrutiny, discussion and approval.

8.10 Each submission shall be accompanied by contractor's certificate stating that the shop drawings meet all the contract requirements and that the piping and equipment can be satisfactorily installed without any obstructions in the space available.

8.11 On approval of the above the contractor shall furnish six sets of the approved shop drawings for execution of the work.

9 Completion drawings

9.1 On completion of work, Contractor shall submit one complete set of original tracings and three prints of "as built" drawings to the PM duly approved and stamped by Consultant. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.

c) Run of all water supply lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections and mechanical equipment.

All shop drawings shall be updated from time to time for the purpose of making Completion drawings.

No completion certificate shall be issued unless the above drawings are submitted.

9.2 Contractor shall provide four sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

9.3 All "warranty cards" given by the manufacturers shall be handed over to the Engineer-incharge.

10. Contractor's rates

10.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, all taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

10.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.

10.3 All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

10.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by the Engineer-in-charge. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds. All hot and cold water supply pipes crossing masonry walls and floors shall be provided with G.I. pipe sleeves. The annular space between the pipe and sleeve shall be filled up with fire proof sealant after testing. Contractor shall give the pipe sleeves to the civil contractor well in time so that the same can be fixed along with civil works. Any co-ordination gap shall be of Plumbing contractor's responsibility.

10.5 The Contractor shall furnish the Engineer-in-charge with vouchers & test certificates, to prove that the materials are as per the specification and to indicate that the rates at which the materials are purchased are in order to work out the rate analysis of non-tendered items which he may be called upon to carryout.

11 Testing

11.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

11.2 Tests shall be performed in presence of the Engineer-in-charge and test records for the tests shall be duly signed by Plumbing Consultant, Contractor and the Engineer-in-charge.

11.3 All materials and equipment found defective shall be replaced at contractor cost and whole work shall be tested to meet the requirements of the specifications.

11.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

11.5 Contractor shall provide all labour, equipment and materials for the performance of the tests at no extra cost.

12 Site clearance and cleanup

12.1 The Contractor shall, from time to time, clear away all debris and excess materials accumulated at the site. Failing of which attract penalties:

12.2 After the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discolouration leaving the same in a ready to use condition. The equipment installed shall be protected by contractor till formal handing over takes place by Client.

12.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done by the Engineer-in-charge at the Contractor's risk and cost. Cost of the cleanup shall be deducted from the contractor's bills on pro-rata basis in proportion to his contract value.

13 Licence permits and authorities

13.1 Contractor must hold a valid plumbing or any other licence as required by the municipal authority or other competent authority under whose jurisdiction the work falls.

13.2 Contractor must keep constant liaison with the local development, municipal/statutory authority and obtain approval of all drainage, water supply, fire suppression and other works carried out by him.

13.3 Contractor shall obtain, from the municipal and other authorities 'C' & 'D' forms approval of drainage and water supply works during execution and the completion certificate with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall re-imburse the fees paid to the authorities towards the connection charges a production of receipts for money paid.

13.5 Contractor shall get any materials tested from the appropriate authority if so required at no extra cost.

14 Recovery of cost for materials issued to Contractors free of cost

14.1 If any materials issued to the Contractor free of cost, are damaged or pilfered, when in his possession, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner. The cost shall include the cost paid, freight, transportation, excise duty, sales tax, octroi, import duty and other levies, plus 100% as penalty. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

14.2 Contractor has to keep full records of material issued by the owner with reference and challans etc. Contractor has to give account of all such materials to the Engineer-in-charge.

15 Cutting of Water Proofing Membrane:

No walls terraces shall be cut for making and opening after water proofing has been done without written approval. Cutting of water proofing membrane shall be done very carefully so as other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Engineer-in-charges. Actual cost of any damage to finished work by contractor shall be recovered from Plumbing Contractor.

#### 16 Cutting of structural members

No structural member shall be chased or cut without the written permission of the Engineer-in-charge. Any damage to the structure shall be on contractor's account.

#### 17 Materials supplied by employer

The Contractor shall verify that all materials supplied by the employer conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-in-charge.

# 18 Materials

18.1 Contractor to procure material as per first make from approved make list only unless otherwise specified and expressly approved in writing by the Engineer-in-charge/Client.

18.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Engineer-in-charge.

#### 1 Scope of work

- 1.1 Work under this section shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings specified hereinafter and given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:
  - a) Sanitary fixtures
  - b) Chromium plated fittings
  - c) Porcelain or stainless steel sinks
  - d) Accessories e.g. towel rods, toilet paper holders, soap dish, towel rails, coat hooks etc.
  - e) Connections to all kitchens, equipment, pump headers and other equipment requiring water and drainage connections.
- 1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.
- 1.4 All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

#### 2 General requirements

- 2.1 Sanitary fixtures and C.P. fittings in manufacturer's packing as specified in the schedule of quantities shall be supplied to the Contractors free of cost at the stores of the CLIENT.
- 2.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces, WC flexible connectors etc.
- 2.3 Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.
- 2.4 Contractor shall furnish without cost all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures & CP Fittings by the manufacturers as a part of the original and standard supply.
- 2.5 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.
- 2.6 Contractor shall seal all fixtures fixed near wall, marble and edges with an approved type of poly-sulphide sealant appropriate for its application.

#### 3 European W.C

- 3.1 European W.C. shall be wash down or syphonic type floor or wall mounted set flushed by means of porcelain/ plastic flushing cistern, which will be an integral part of the WC system. **Framework, walling and finishing will not form a part of the contractor's work.** Where applicable flush pipe/ bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.
- 3.2 Each W.C. set shall be provided with a plastic seat shall be with rubber buffers and chromium plated hinges.
- 3.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Each W.C. shall be suitable for flushing in low volume of water 3-6 litres.
- 3.4 Flushing cistern when provided shall be provided with all internal flushing mechanism, 15 mm dia ball cock with unbreakable polythene float and overflow pipe. Any frame work required for fixing cistern has to be provided by the contractor.

### 4 Indian W.C.

Indian Water closet (IWC) shall be provided with 'P' or 'S' trap outlet with a low volume cistern porcelain /plastic flushing cistern with all internal flushing mechanism.

Flush pipe/bend shall be connected to IWC by means of a suitable rubber adaptor.

#### 5 Urinals

- 5.1 Urinals shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.
- 5.2 Bowl urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers complete as directed by Project Manager.
- 5.3 Urinals shall be fixed with C.P. brass screws and shall be provided with 32 mm dia domical waste leading to urinal's trap.
- 5.4 Flush pipes shall be G.I. pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities.
- 5.5 Urinals shall be flushed by means of fully automatic no-touch flush valve with solenoid valves.
- 5.6 Waste pipes for urinals shall be G.I pipes (Medium class) to IS: 1239 or uPVC class III (6 kg/sqcm) conforming to IS: 4985 as given in schedule of quantities.

Waste pipes may be exposed on wall or concealed in chase as directed by the Project Manager. Specifications for waste pipes shall be same as given in Section II.

#### 6.Wash Basins

6.1 Wash basins shall wall mounted type or Counter top type as specified in the BOQ.

- 6.2 Each basin shall be supported on MS galvanised or CI brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- 6.3 Each basin shall be provided with 32 mm dia C.P.waste with overflow, pop-up or standard waste with rubber plug and chain, 32 mm dia C.P. brass bottle trap with CP pipe to wall and flange.
- 6.4 Each basin shall be provided with a Hot & cold CP mixer with pop up waste fittings , 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.
- 6.5 Some of the selected wash basins as identified in the BOQ shall be similar to the one described above but the supply tap shall be a Magic Eye Infrared operated automatic hot and cold mixing fittings.
- 6.6 Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Project Managers.

### 7 Sinks

- 7.1 Sinks shall be stainless steel or any other material as specified in the Schedule of Quantities.
- 7.2 Each sink shall be provided with brackets of approved and securely fixed. Counter top sinks shall be fixed with suitable brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug as given in the Schedule of Quantities. Fixing shall be done as directed by Project Manager.
- 7.3 Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the Schedule of Quantities.

#### 8 Hand Drier

- 8.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
- 8.2 The hand drier shall be fully hygienic, rated for continuous repeat use.
- 8.3 The rating of hand drier shall be such that time required to dry a pair of hands upto wrists is approximately 30 seconds.
- 8.4 The hand drier shall be wall mounting type suitable for 230 volts, single phase, 50 Hz, A.C. power supply.

### 9 Toilets for Disabled

9.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the Project Manager.

9.2 Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by the Project Manager.

## 10 Accessories

- 10.1 Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by the Project Manager.
- 10.2 All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Project Manager.
- 10.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer's drawings.

# 11 Urinal partitions

- 11.1 Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Project Manager..
- 11.2 Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. Clips as recommended by the manufacturer and directed by Project Manager.

#### 12 Measurement

- 12.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.
- 12.2 Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P Brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

#### Soil, Waste, Vent, Rainwater Pipes & Fittings

#### 1. Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the soil, waste, vent pipes system shall include the following:
  - a) Vertical and horizontal soil, waste, vent pipes, and fittings, joints, clamps, connections to fixtures.
  - b) Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.
  - c) Drainage, channels, gratings & floor drains.
  - d) Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/Khurras
  - e) Testing of all pipe lines

### 2 General requirements

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Project Manager.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.
- 2.5 Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the civil structure, false ceiling or marble cladding etc. shall be clearly reported to the DPL in the form of shop drawing so that other agencies are instructed to provide the same.

#### 3 Piping System

#### 3.1 Schedule of Pipes Use

 uPVC pipes 75,110 ,160&210 mm dia
uPVC pipes 40,50 & 63 mm dia pvc pipes
Horizontal.For Soil, Waste. Vent pipes(welded joints) 6 kg/sgcm class III

#### 4 Soil, Waste & Vent Pipes

- 4.1 The Soil & Waste Pipe System above ground has been planned as a "two pipe system" as defined in IS : 5329 having separate pipes for waste for kitchen sinks, showers, washbasins AHU's condensate drains and floor drains and is approved by Project Manager.
- 4.2 All waste water from AHU's plant and pump rooms, floor channels will be provided with a deep seal trap before connecting to the main drain or vertical stack.
- 4.3 Vertical soil & waste stacks shall be connected to a separate horizontal drain at basement ceiling generally as shown on the drawings.
- 4.4 Toilet layouts have been so arranged that the W.C. outlets shall be with "P" trap above ground.
- 4.5 All soil/waste from areas in Basement areas will be collected in sumps and after treatment in STP shall be pumped into sewer line.
- 4.6 Head (Starting point) of drains and sewage / Waste Water Sumps ( as and where applicable) having a length of greater than 4 m up to it connection to the main drain or

manhole shall be provided with a 80/ 100 mm vent pipe terminating above roof or as directed by Project Manager.

### 5 Rainwater Pipes

- a) All open terraces shall be drained by rain water down takes.
- b) Rainwater down takes are separate and independent of the soil and waste system and will discharge into the open ground Storm water Drainage system of the Complex.
- c) Rain water in open courtyards shall be collected in catch basins and connected to the storm water drain.
- d) Any dry weather flow from waste appliances e.g. AHU's pump rooms, waste water sumps shall connect to sewers after traps and not in the storm water drainage system.

### 6 Balcony/Planter drainage

Wherever required, all balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes or other type of drainage system shown on the drawings and directed by the Architect/Project Manager

# 7 uPVC Pipes & Fittings

- 7.1 Soil, Waste and Anti-siphon age pipes and fittings shall be uPVC. All pipes shall be straight and smooth conforming to IS: 13592 or as specified in Schedule of Quantities.
- 7.2 Pipes and fittings for main vertical stacks & branches 110 mm, & 75 mm dia shall be Soil, Waste & Rainwater System known in the short form as SWR drainage system with injection moulded fittings with approved type of socket & 'O' rubber ring joints.
- 7.3 Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimension for perfect joints in the system. 'O' ring fittings must have sufficient gap (approx. 10 mm) for thermal expansion of pipes.
- 7.4 uPVC pipes shall be clamped to the wall with approved type uPVC saddle clamps/U clamps and G.I. rod fixed to the angle iron support system within the shaft.
- 7.5 Use proper uPVC pipe adapters for connections between cast iron pipes, traps & uPVC pipes where necessary. Such joints shall be made of an approved type of 'Putty'.

#### 8 Clamps

- 8.1 **For UPVC pipes standard UPVC clamps shall be used. For other pipes M.S.** clamps, supports and hangers provided shall be galvanised. Factory made Pre fabricated clamps shall be preferred. Contactor may fabricate the clamps of special nature and galvanise them after fabrication but before installation. (Clamps shall be fabricated from mild steel sections) All nuts, bolts, washers and other fasteners shall be factory galvanised.
- 8.2 Clamps shall be of approved designs and fabricated from M.S. flats and other sections of thickness and sizes as per drawings or contractor's shop drawings. Clamps shall be fixed in accordance to manufacturer's details/shop drawings to be submitted by the contractors.

- 8.3 When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of galvanised expansion anchor fasteners (Dash fasteners) of approved design and size according to load.
- 8.4 Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from M.S. structural members e.g. rods, angles, channels flats as per Contractors shop drawing shall be galvanised after fabrication. All nuts, bolts and washers shall be galvanised.
- 8.5 Galvanised slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with anchor fasteners mentioned above. The spacing of support bolts on support members fixed horizontally shall not exceed 1 m.

### 9 Traps

#### 9.1 Floor traps

Floor traps where specified shall be of multi inlet uPVC traps (SWR) having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 30x30 cms of the required depth.

#### 9.2 Urinal traps

Urinal traps/horn shall be multi inlet uPVC traps with or without vent and set in cement concrete block specified for floor traps.

#### 10 Cleanout plugs

### **10.1** Floor Clean out Plug.

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Y's" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass screwed to a G.I. socket. The socket shall be lead caulked to the drain pipes.

#### 11 Waste pipe from appliances

- 11.1 Waste pipe from appliances e.g. washbasins, sinks and urinals shall be uPVC in all toilets, kitchen, pantries and service areas where so required, and as given in the Schedule of Quantities or shown on the drawings.
- 11.2 All pipes shall be fixed in gradient towards the connection to stack ,trap or drain. Pipes inside all toilets shall be in chase unless otherwise shown on drawings where so required and shown on drawings or directed by the Project Manager.

11.3 Galvanised pipes (Where specified or required at site for waste only) shall be conforming to I.S.1239 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be painted with two coats of black bitumen paint and exposed pipes with one coat of red oxide primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities.

### 12 Spun Cast iron pipes for drainage (Optional)

12.1 Spun Cast iron pipes running in shafts/internal and horizontally in ceilings shall to IS 3989.

#### 12.2 Fittings

a) Fittings e.g. bend, tees, Y, reducers used for spun C.I. drainage pipe system shall meet and match pipe system with drip seal joints.

#### 12.3 Cleanout on Drainage Pipes (CO Plugs)

- a) Cleanout plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. CO Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.
- b) Floor cleanout plugs shall be cast brass as given in Para 3.7.3 above.
- c) Cleanouts provided at ceiling level pipe shall be fixed to a uPVC adaptors/Cl flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanised sheets and angles with hinged type doors with fly nuts, gasket etc. as per drawing.

#### 12.4 Pipe Joints

- a) Joints between two pipes shall be made with pre moulded rubber joints (Tyton) supplied by the manufacturer to ensure compatibility and water tightness.
- b) Joints between pipes and fittings shall be lead caulked joints. The depth of the lead after caulking the spun yarn shall however be 45 mm deep after caulking the lead with caulking tools.

#### 13 Encasing in Cement Concrete

13.1 Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

#### uPVC soil and waste pipes under floor

Pipes laid in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and all round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m.

### Spun Cast Iron Drainage Pipes

All drainage pipes except when fixed above ground or in exposed locations shall be encased in cement concrete as specified above for soil & waste pipes. The bed and encasing thickness shall however be 150 mm in bed and all rounds as shown on the drawing.

### 14 Painting

- 14.1 Paints used shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.
- 14.2 All cast iron, soil, waste, vent, anti-siphonage, rainwater pipe sand CI (LA) Drainage pipes in exposed locations e.g. in shafts, pipe spaces and service floors or fixed at ceiling levels shall be painted with two or more coats of synthetic enamel paint to give an even shade . Spun CI Soil pipes buried under floors shall not be painted.
- 14.3 G.I. waste pipes buried in ground or fixed in chase shall be protected with 2 mm thick bitumen membrane tape with a final coat of hot or cold applied bitumen. Exposed waste pipes shall be painted with two or more coats of synthetic enamel paint.

#### 15 Cutting and making good

15.1 Contractor shall provide all holes cut outs and chases in structural members necessary and required for the pipe work as building work proceeds. Wherever cut outs , holes are left in the original construction , they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

#### 16. Sleeves/ Cut-outs.

16.1 Contractor shall utilised all cut out and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire retardant sealant. When sleeves are misplaced or inaccurately located contractor shall make the holes in the wall or structural members at his own cost but only with the prior permission of the Project Manager.

#### 17 Testing

- 17.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including spun C.I. pipes laid in ceiling.
- 17.2 Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests.

17.3. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

#### 18 Measurements

#### 18.1 General

- a) Rates quoted for all items shall be inclusive of all work and items given in the Specifications and Schedule of Quantities.
- b) Rates are applicable for the work in ground, mezzanine floors, in shafts at ceiling level area and for all depths and heights of buildings.
- 18.2 Rates are inclusive of cutting holes and chases in RCC and masonry work where no sleeves or cut outs have been provided during construction and making good the same.
- 18.3 Rates are inclusive of pre testing on site, testing of the installations, materials and commissioning of the works.
- 18.4 Pipes (unit of measurement linear meter to the nearest centimetre).
- 18.5 uPVC soil, waste, vent, anti siphon age, rain water pipes, drainage pipes shall be measured net when fixed correct to a centimetre including all fittings along its finished length.
- 18.6 G.I. pipes shall measure per running metre correct to a centimetre for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore.
- 18.7 Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centring cutting complete as described in the relevant specifications.
- 18.8 Slotted angles/channels shall be measured per linear metre of finished length and shall include support bolts and nuts embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.
- 18.9 Fittings (excluding pipe fittings) (Unit of measurement by numbers)

Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant Specifications and Schedule of Quantities.

### 18.10 Painting

Painting of pipes and fittings shall be measured per running metre.

#### Water Supply System

### 1. Scope of work

- 1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:
  - a) Distribution system from main supply headers from pump to all fixtures and appliances for cold & hot water.
  - b) Cold water supply lines from tube wells and city water connections to Fire and Under Ground Water Tanks.
  - c) Garden irrigation system
  - d) Excavation and refilling of pipes trenches.
  - e) Pipe protection and painting.
  - f) Control valves, masonry chambers and other appurtenances.
  - g) Connections to all plumbing fixtures, tanks, appliances and municipal mains
  - h) Inserts for R.C.C. tanks

#### 2 General requirements

- 2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.
- 2.4 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 2.6 Clamps, hangers and supports on RCC walls, columns & slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.
- 2.7. All pipe clamps, supports, nuts, bolts, washers shall be galvanised MS steel throughout the building. Painted MS clamps & MS nuts, bolts & washers shall not be accepted.
- 2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for

operations, maintenance and repairs.

#### 3 Water Supply System

3.1 Contractor should study the site plan and the two water supply systems one for flushing water from STP and other for domestic water supply.
## 3.1.1 Source Water supply will be acquired from Municipal Corporation water mains (as available) to a service connection and captive tube wells within the site and collected in water storage tanks located underground.

- 3.1.2 The system has been connected to a gravity feed system from overhead tanks to all parts of the building
- 3.1.3 It is proposed to provide flushing cistern for all WCs. Infra red NO-TOUCH flush valves shall be provided for Urinals. These will be fed from flushing over head tank by gravity.
- 3.1.4 Domestic water supply shall be provided with cold water system only. Hot water provisions to kitchen and all toilets connected to a local electric hot water storage geyser.

## 4 (CPVC) G.I. pipes, fittings & valves

- 4.1 All pipes inside the buildings for domestic hot and cold water supply shall be CPVC conforming to CTs SDR-13.5 at a working pressure of 320 PSI at 23 deg.C. and 80 PSI at 82 deg.C.
- 4.2 Solvent welded CPVC fittings etc. tees, elbows, couplers, unions, reducers, brushing etc. including transition fittings (connection between CPVC and metal pipes/G.I. ie. Brass adopters conforming to ASTM D-2846) shall be provided.
- 4.3 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall run above false ceiling with vertical drop in wall chases for all fixtures. No pipes to run inside sunken floor as far as possible. Pipes may run under the ceiling or floors and other areas as shown on drawings.

#### 4.4 Joining Pipes & Fittings

## a) Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut. All burrs should be removed for proper contact between pipe and fittings during jointing.

## b) Solvent Cement Application

Only CPVC solvent cement conforming to ASTM-F-493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket.

#### c) Assembly

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe <sup>1</sup>/<sub>4</sub> to <sup>1</sup>/<sub>2</sub> turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

## d) Testing

The system should be hydrostatically pressure tested at 150 psi (10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out the replaced with new one.

## 4.5 **Transition of Flow guard CPVC in metals**

When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque.

## 4.5.1 Threaded sealants

Teflon tape shall be used to make threaded connections leak proof.

## 4.5.2 Solvent Cement

Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves.

## 4.6 Hangers and supports

For Horizontal runs, support should be given at 3 feet (90 cms) intervals for diameters of one inch and below and at 4 feet (1.2 m) intervals for larger sizes.

Size of pipe	20°C	49°C	71°C	82°C
Inch	Ft.	Ft.	Ft.	Ft.
1/2"	5.5	4.5	3.0	2.5
3⁄4"	5.5	5.0	3.0	2.5
1"	6.0	5.5	3.5	3.0
1¼"	6.5	6.0	3.5	3.5
1¼"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

Supports should be as per the below mentioned table:

#### 4.7. Anchor Fasteners

4.7.1 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the DPL for any damage that may be caused by such failures.

## 4.8 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop

cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

#### 4.9 Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by the Project Manager. Connections shall be made by correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Project Manager. Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780. and C.I. butterfly valve to IS: 13095.

#### 4.10 Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia of pipe	Width of trench	Depth of trench		
15 mm to 50 mm	30 cms	75 cms		
65 mm to 150 mm	45 cms	100 cms		

#### 4.11 Sand filling

G.I. pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

#### 4.12 Painting (Painting for CPVC pipes not required)

4.12.1 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in this documents or specified by Project Manager.

#### 4.13 Pipe protection (Protection for CPVC pipes not required)

- 4.13.1 All G.I. pipes in wall chase /below floors or laid under ground shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.
- 4.13.2 G.I. waste pipes buried in ground or sunken slab shall be protected with multilayer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. Pypkote or equivalent.

#### 4.14 Valves

## 4.14.1 Ball Valves

Valves upto 40 mm dia. shall be screwed type Ball Valves with stainless steel balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm<sup>2</sup>, and accompanying couplings and steel handles.(to BS 5351)

## 4.15 Butterfly Valves

- 4.15.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.
- 4.15.2 Butterfly valve shall be of best quality conforming to IS: 13095.

## 4.16. Non Return Valve (Slim Type)

Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality.

- 4.16.1 Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanised nuts, bolts and washers of correct length.
- 4.16.2 Storage tanks Underground & Overhead Tank. (Accessories & Connections)
- 4.16.6 Storage tanks for water supply shall be in reinforced cement concrete built by the building Contractor.
- 4.16.4 Each tank shall be provided with lockable type manhole cover fabricated from M.S. sheets. Manhole covers shall be 450-500 mm dia and fully galvanised after fabrication or as approved by the Project Manager.

#### 4.17 Storage Tanks

#### 4.17.1 Underground

Underground storage tanks for water supply shall be reinforced cement concrete built by the building contractor.

Each tank shall be provided with lockable type manhole cover fabricated from M.S. sheet or standard cost iron tank covers. Manhole covers shall be 450-500 mm dia or as approved by local municipal authority.

## 4.18 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities. Further connections and accessories shall be provided under this contract.

#### 4.19 Testing

4.19.1 All pipes, fittings and valves after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg/cm<sup>2</sup> whichever is more.
Pressure shall be maintained for a period of at least thirty minutes without any drop.

A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

- 4.19.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.
- 4.19.3 After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

#### 4.20 Measurement

- a) CPVC or G.I. pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of
- b) all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.
- c) Jointing with teflon tape, white lead and insertion gasket of appropriate temperature grade.
- d) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
- e) Excavation, back filling, disposal of surplus earth and restoring the ground & floor in original condition.

#### 4.21 Pipe Supports.

Fabricated and galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structural and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

- 4.21.1 Rate quoted for supports & hangers shall be inclusive of:
  - a) Expandable anchor fastens.
  - b) Galvanising of all supports & hangers.
  - c) Cutting holes in walls, ceilings on floors and making good where permitted.
  - d) Nuts, bolts and washers for fixing and assembling.
  - e) Wooden/PVC pipe saddles for vertical or horizontal runs.

## 4.21.2 Valves

Gunmetal, cast iron, butterfly and non return valves and puddle flanges shall be measured by numbers and shall include wheels/caps, GI nuts, bolts, washers and insertion gasket.

## 4.21.3 Painting/pipe protection/insulation

Painting/pipe protection/insulation for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

NRDA

Section VII I.S. CODES AND REFERENCE STANDARDS.

A. Codes and reference standards referred to in the contract shall be understood to form a part of the contract.

B. Alternative reference standards produced by different standards authorities may be specified in a Section. Standards of any of the specified authorities may be acceptable, however, materials specified in the Section shall be incorporated in the works from only one of the specified standards authority to ensure compatibility in the performance of the materials.

C. The contractor shall be responsible for adherence to reference standard requirements by subcontractors and suppliers.

D. Where edition date is not specified, consider that reference to manufacturer's and published codes, standards and specifications are made to the latest edition (revision or amendment) approved by the issuing organization current at issue date of the Tender.

E. The specified reference standards are INDIAN STANDARD CODES and are intended to establish the quality of materials and workmanship required for the works. Reference standards published in other countries may, in the sole judgement of the owner's consultant, also be acceptable providing that the Contractor furnishes sufficient data for the Owner's Consultant to determine if the quality of materials and workmanship at least equals or exceeds all tests prescribed by the specified reference Indian Standards codes.

Such other reference standards published by the following will be considered;

BSI	:	British Standards Institute
AFNOR	:	Association Francise de Normalization
		(French Standards Institute)
DIN	:	Deutsche Industries Norman (German Standards)
ANSI	:	American National Standards Institute
ASTM	:	American Society for Testing and Materials

F. Reference standards and specifications are quoted in the specification to establish minimum standards. Works of quality or of performance characteristics that exceed these minimum standards will be considered to confirm.

Should regulatory requirements or the contract conflict with specified reference standards or specifications, the more stringent in each case shall govern.

G. Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erection, applying or other matters concerning the materials pertinent to their use in the works and their relationship to materials with which they are incorporated.

H. Obtain copies of codes applying to the Work, manufacturer's directions and reference standards referred to in the contract within 90 days of signing the contract.

I. Submit a copy of each code, reference standard and specification, and manufacturer's directions, instructions and specifications, to which reference is made in the specification to the Owner's Authorized Representative's.

# J. LIST OF CODES (INDIAN STANDARD CODES)

1.

General

Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. The materials workmanship shall be in accordance with the requirement of the appropriate CP, I.S code wherever applicable together with any building regulations or bye-laws governing the works.

The following list is included for guidance only and the omission of any CP, I.S. codes from the list does not relieve the contractor from compliance therewith:

The more important Codes, Standards and Publications applicable to this section are listed hereinafter:

SP : 6 (1)	Structural Steel Sections
IS : 27	Pig Lead
IS : 325	Three Phase Induction Motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
IS : 779	Specification for water meters (domestic type).
IS : 782	Specification for caulking load.
IS : 800	Code of practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
IS : 1172	Code of Basic requirements for water supply drainage and sanitation.
IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1100 V.
IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV upto and including 11 KV.

Page 199 of 237

NRDA F-1- Schedule-D- Section Construction of Office Campus including	III- Technical Specification of Works Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur	NRDA
IS : 1726	Specification for cast iron manhole covers and frames.	
IS : 1742	Code of practice for building drainage.	
IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.	
IS : 2065	Code of practice for water supply in buildings.	
IS : 2104	Specification for water meter for boxes (domestic type)	
IS : 2373	Specification for eater meter (bulk type)	
IS : 2379	Colour code for identification of pipe lines.	
IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.	
IS : 3114	Code of practice for laying of cast iron pipes	
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.	
IS : 4127 IS : 4853	Code of practice for laying glazed stoneware pipes. Recommended practice for radiographic inspection of fusion welded b joints in steel pipes.	utt
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.	
IS : 5455	Cast iron steps for manholes.	
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.	
IS : 7558	Code of practice for domestic hot water installations.	
IS : 8321	Glossary of terms applicable to plumbing work.	
IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration medium s and gravel.	and
IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2 under drainage sys	stem.
IS : 9668	Code of practice for provision and maintenance of water supplies and fighting.	fire
IS : 9842	Preformed fibrous pipe insulation.	
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron steel pipe lines.	on and
IS : 10221	Code of practice for coating and wrapping of underground mild steel	

Page 200 of 237

pipelines.

2.

IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets
IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
IS : 12251	Code of practice for drainage of building basements.
IS : 5572	Code of practice for sanitary pipe work.
BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
BS : 8301	Code of practice for building drainage.
BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.
Pipes and Fittings	
IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salt glazed stone ware pipes and fittings.
IS : 1239 (Part 1)	Mild steel, tubes, tubular and other wrought steel fittings : Part 1 Mild Steel tubes.
IS : 1239 (Part 2)	Mild Steel tubes, tubular and other wrought steel fittings: Part 2 Mild Steel tubular and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1537 IS : 1538	Vertically cast iron pressure pipes for water, gas and sewage. Cast Iron fittings for pressure pipes for water, gas and sewage.
IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings.
IS : 1978	Line pipe
IS : 1979	High test line pipe.
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and Page <b>201</b> of <b>237</b>

dimensions.

3.

IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
IS : 3468	Pipe nuts.
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.
Valves	
IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves.
IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
IS : 13095	Butterfly valves for general purposes.

4.

Sanitary Fittings	
IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
IS : 781	Specification for cast copper alloy screw down bib taps and stops valves for water services.
IS : 1700	Specification for drinking fountains.
IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets: Part 1 Thermo set seats and covers.
IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.
IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets.
IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans.
IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china): part 4 specific requirements of wash basins.
IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china): part 6 Specific requirements of urinals, section 2 half stall urinals.
IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china): Part 6 specific requirements of urinals, section 4 partition slabs.
IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings.
IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china) : Part 7 Specific requirements of half round channels.
IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of siphoning wash down water closets.
IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose.

NRDA

IS : 2556 (Part 12)	Specification for vitreous sanitary appliances (vitreous china): Part 12 Specific requirements of floor traps.
IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china): Part 15 Specific requirements of universal water closets.
IS : 2692	Specification for ferrule for water services
IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
IS : 2963	Specifications for waste plug and its accessories for sinks and wash basins.
IS : 3311	Specification for waste plug and its accessories for sinks and wash basins.
IS : 5961	Specification for cast iron gratings for drainage purposes.
IS : 6249	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
IS : 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubes.
IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
IS : 9758	Specification for flush valves and fitting for water closets and urinals.
Pumps & Vessels	
IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers.
IS : 2825	Code for unfired pressure vessels.
IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
IS : 5600	Specification for sewage and drainage pumps
IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
IS : 8418	Specification for horizontal centrifugal Self priming pumps.

5.

# TECHNICAL SPECIFICATIONS FOR PLUMBING WORKS

# Fire Hydrant System and Sprinkler System

# 1 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install wet riser fire hydrant and sprinkler system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the work shall include but not limited to the following:
  - a) Piping for wet riser hydrant systems and for yard hydrants.
  - a) Landing valves, canvas hose pipes, hose reels, hose cabinets & connections to mains.
  - b) Fully automatic sprinkler system
  - d) Isolation valves, non-return valves, installation valves, flow control switches and accessories.

#### 2. General

- 2.1 All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Project Manager.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4 Pipes shall be securely fixed to walls, and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.
- 2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.
- 2.6 The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation certificate from the Local Development / Fire Authority.
- 2.7 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.
- 2.8 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.
- 3 Pipes

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. pipes confirming to IS : 1239 Heavy Class

## 4 Pipe Fittings

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. and all such connecting devices that are needed to complete the piping work in its totality.

Screwed fittings shall be approved type malleable or cast iron with reinforced ring on all edges of the fittings suitable for screwed joints.

Forged steel fittings of approved type with "V" groove for welded joints.

Fabricated fittings shall be not being permitted for pipe diameters 50 mm and below. When used, they shall be fabricated, welded and inspected in workshops whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler System under the supervision of Project Manager. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

## 5 Jointing

#### 5.1 Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

#### 5.2 Welded (65 mm dia and above)

Joints between M.S. and pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

## 5.3 Flanged

- a) Flanged joints shall be provided on:
- b) Straight runs not exceeding 30 m on pipe lines 80 mm dia and above.
- c) Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia or larger diameter.
- d) For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as per good engineering practice.
- e) Flanges shall be as per I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

#### 5.4 Unions

Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges.

## 6 Excavation

- 6.1 Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1.2 meter or as shown on drawings.
- 6.2 Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.
- 6.3 On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.
- 6.4 Contractor shall dispose off all surplus earth within a lead of 200 m or as directed by Project Manager.

## 4 Anchor Thrust Blocks

- a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.
- b) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Project Manager.
- c) Exact location, design, size and mix of the concrete block shall be approved by the Project Manager prior to execution of work.

## 7 Valves

#### 7.1 Gunmetal Valves

- 8.1.1 Valves 65 mm dia & below shall be heavy gunmetal full way valves or globe valves conforming to I.S. 778-1971 class II with female screwed ends. Valves shall be carry I.S. certifications mark.
- 7.1.2 All valves shall be approved by the Project Manager before they are allowed to be used on work.

#### 7.2 C.I. Iron Butterfly Valves/Sluice Valves

- 7.2.1 All valves 80 mm dia and above shall be C.I. double flanged butterfly valves. Each sluice valve shall be provided with wheel for valves in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with cap tops.
- 7.2.2 Butterfly valves shall be of best quality conforming to I.S.13095 of class specified and sluice valves shall conform to IS: 780.

## 7.3 Non-return valves (Check Valves)

Non-return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS: 5312.

## 7.4 Air valves

25 mm dia screwed inlet cast iron single acting air valve shall be provided on all high points in the system or as shown on drawings.

## 7.5 Orifice Flanges

Orifice flanges fabricated from 6 mm thick stainless steel plate shall be provided to reduce pressure on individual hydrants to restrict the operating pressure to 3.5 kg/cm<sup>2</sup> and allow a discharge of 560 lpm. The contractor shall submit design of the orifice flanges for approval before installation.

## 7.6 Drain Valve

50 mm dia black steel pipe to IS: 1239 (heavy class) with 50 mm gunmetal fullway valve shall be provided for draining any water in the system in low pockets.

## 7.7 **Pressure Gauge**

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be 100 mm dia gunmetal Bourden type with gunmetal isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

#### 8 Hydrant/valve chambers

- 8.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.
- 8.2 Valve chambers shall be of following size:-

for depths 100 cms and beyond 120x120 cms.

## 9 Fire brigade connections

As shown on drawings separate gunmetal 2-3 way collecting head Fire brigade connection each with two or three 63 mm instantaneous type inlets with built in check valves and 150 mm dia inlet/outlet connected to the fire and sprinkler main as given in BOQ shall be provided. Both shall be installed on a stand post and provided with horizontal C.I. reflux valve and location to be approved by Project Manager. Etched gunmetal label plates with 80 mm high letters shall be fixed along with necessary enclose cabinet. The plates should be firmly fixed to the FB connection and any support system.

#### 10 Fire hydrants

#### 10.1 External hydrants

- 10.1.1 Contractor shall provide stand post type external hydrants. The hydrants shall be controlled by a cast iron sluice valve installed in underground lockable chambers. Hydrants shall have instantaneous type 63 mm dia outlets. The hydrants valve shall be single outlet conform to I.S.5290 with C.I duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.
- 10.1.2 Contractor shall provide for each external fire hydrant two numbers of 63 mm dia. 15 m long controlled percolation type hose pipes with gunmetal male and female instantaneous type couplings machine wound with G.I. wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with M.S. certification), gunmetal branch pipe with nozzle to I.S. 903.

#### 10.2 Internal hydrants

- 10.2.1 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal oblique landing valves with 63 mm dia outlet mounted on a common 80 mm inlet conforming to I.S.5290-1969. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.
- 10.2.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses.
- 10.2.3 Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric linen hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I. wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with I.S. Certification), fire hose reel conforming to IS:884, gunmetal branch pipe with nozzle I.S. 2871 and Fire man's axe conforming to IS: 926.
- 10.2.4 Each hose box shall be conspicuously painted with the letters "FIRE HOSE".

#### 11 Fire hose reels

Contractor shall provide standard fire hose reels with 20 mm dia high pressure Dunlop or equivalent rubber hose 36.5 m long with gunmetal nozzle and control valve, shut off valve, all mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall be connected directly to the wet riser. Hose reel shall conform to IS: 884-1969 and rubber hose to IS: 5132.

#### 12 Hose Cabinets

12.2 All internal fire hydrants shall be enclosed in M.S. glazed cabinet. Hose cabinets shall be fabricated from 16 gauge M.S. sheet of fully welded construction with hinged double front door partially glazed with locking arrangement stove enameled fire red paint with "FIRE HOSE" written on it prominently. (Sizes are as given in the Bill of Quantities).

#### 13 Pipe protection

a) All pipes above ground and in exposed locations shall be painted with one coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

b) Pipes in chase or buried underground shall be painted with two coats of zinc chromate primer and wrapped with one layer of 4 mm thick PYPKOAT mutilayer sheet as per standard manufacturer's specifications.

## 14 Pipe Supports

2.16.1 All pipe clamps and supports shall be galvanised steel. When fabricated from M.S. steel sections, the supports shall be factory galvanised before use at site. Welding of galvanised clamps and supports will not be permitted.

2.16.2 Pipes shall be hung by means of expandable anchor fastner of approved make and design (Dash Fastners or equivalent). The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastner and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encounted.

		<		Pipe co	ommercial	dia			→
S.No.	Pipes & Position	15/20	20/25	32/40	50	75/80	100/110	150/160	200
1	Vertical								
1.1	GI /MS	2.4	2.4	3	3.6	4.5	4.5	5.4	5.4
1.2	CI Pipes IS 1729/3989	x	х	<		3 m			>
1.3	CI Heavy Duty IS 1536	х	х	<		3.6 m			→
1.4	uPVC SWR Systems	х	х	0.5	0.7	0.9	0.9	1.0	
1.5	uPVC Water Supply								
1.6	Polybutylene	< As	per manu <sup>.</sup> I	facturer's	Reccome	endations			→
1	Horizontal								
1.1	GI /MS	2.0	2.0	2.4	3.0	3.6	4.0	4.5	4.5
1.2	CI Pipes IS 1729/3989			<	3 m		>		
1.3	CI Heavy Duty IS 1536					3.0	3.6	3.6	4.5
1.4	uPVC SWR Systems				1.2	1.8	1.8	1.8	
1.5	uPVC Water Supply								
1.6	Polybutylene	<-As per	manufact	urer's rec	ommenda	tions>			

# **Pipe Spacing Table**

#### 15 Installation Valve

- 15.1 Installation valves shall be installed on the sprinkler circuits as shown on the drawings.
- 15.2 Contractor shall submit his detailed shop drawings showing the exact location, details of installation of the valve and alarm in all its respects.
- 15.3 Installation valve shall comprise of a cast iron sluice valve with gunmetal trim, pressure

gauge, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

## 16 Sprinkler Heads

- 16.1 Sprinkler heads shall be quartzoid bulb type with gunmetal body fully approved and having current certification of the fire laboratory of the C.B.R.I. Roorkee, Underwriter's laboratory (UL) and under the approved certified list of the Fire Office Committee (FOC) of U.K. or NFPA of USA. Any one of the certification as acceptable to the local fire authorities obtained prior to the procurement and approved and accepted by the Project Manager.
- 16.2 Sprinkler heads shall be installed in conformity with approved shop drawings and in co-ordination with electrical fixtures, ventilation ducts, cable galleries and other services along the ceiling.
- 16.3 Following type of sprinklers shall be used:

S.No.	Type of Sprinkler	Temp rating
a)	Pendent /Upright type	68°C
b)	Sidewall	68°C

16.4.1 Spacing and coverage of sprinkler shall be in accordance with risk classification of area in which they are installed, design density and TAC regulation.

## 17 Spare Sprinklers

17.1 Provide a lockable enamel painted steel cabinet including following type of spare sprinklers

a)	Pendent /Upright type	20
b)	Sidewall	10

- 17.2 The cabinet should also contain one pair of wrenches (of each size of the same are different) for the sprinklers.
- 17.3 Spare sprinklers shall be of the same specifications as that of the original sprinklers specified.

## 18 Testing

- 18.1 All piping in the system shall be tested to a hydrostatic pressure of 1.5 times the working pressure or 14 kg/sq.cm( whichever is more) without drop in pressure for at-least 2 hours.
- 18.2 Rectify all leakages, make adjustments and retest as required and directed.

#### 18.3 drill.

## 19 Annunciation Panel

- a) Provide one solid state electronic annunciation panel, fully wired with visual display unit to indicate:
- b) Flow condition in any flow indicating valve
- c) The panel should give a visual and audible alarm for any of the above conditions.
- d) The panel should be standard manufacturer's factory made. All details shall be submitted with the tender.

## 20 Cables

- 20.1 Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.
- 20.2 All control cables shall be copper conductor PVC insulated armoured and PVC sheethed 1100 volt grade.
- 20.3 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.
- 20.3 All cable joints shall be made in an approved manner as per standard practice.
- 20.4 Cable Trays
- 20.5 All cables shall be routed in approved locations in coordination with all other services in a proper manner.

Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fastners drilled into the slabs and walls by an electric

#### 21 Cable Trays

- 21.1 All cables shall be routed in approved locations in coordination with all other services in a proper manner.
- 21.2 Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.

#### 22 Measurement

22.1 Mild steel pipes shall be measured in linear metres of the finished length correct upto one cm.and shall include all fittings, flanges, welding, jointing, clamps for fixing to walls or hangers, anchor fasteners, painting and testing complete in all respects.

- 22.2 Sluice and fullway valves, check valves, installation valves, air valves & flow switches shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications and bill of quantities.
- 22.3 Fire hydrants, hose reels, fire brigade connections, orifice flanges shall be measured by number and include all items given in the specifications and bill of quantities.
- 22.4 Fire hose and boxes specified shall be measured by number and include all items given in specifications and Bill of Quantities.
- 22.5 Cables and cable trays shall be measured in linear metre correct upto cm shall include clamps, hangers, anchor fasteners complete in all respects.

## Hand Appliances

#### 1 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.
- 1.2 Without restricting to the generality of the foregoing the work shall consist of the following:-

Installation of fully charged and tested fire extinguishing hand appliances  $CO_2$  foam, dry chemical powder type as required by these specifications and/drawings.

## 2 General requirements

- 2.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended up to date :-
- 2.2 Fire extinguishers shall be installed as per Indian Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances" I.S.2190-1962.
- 2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.
- 2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.
- 2.5 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

#### 3 Measurement

Fire extinguishers shall be measured by numbers and include installation and all items necessary and required and given in the specifications.

#### TECHNICAL SPECIFICATIONS:

## SYSTEM DESIGN DATA:

#### 1.0 General:

The system design, basis of design, estimated requirements and other relevant data are outlined in this section. The detailed specifications and specific requirements are outlined in the subsequent sections.

#### 2.0 Location

2.1 The Proposed building is to be located at SECTOR 24 AT NAYA RAIPUR.

#### 3.0 Scope of Work

3.1 The work proposed under this tender includes providing Ventilation System.

#### 4.0 Standards & Codes

## 4.1 CODES AND REGULATIONS

The following codes and standards have been used in the design:

- National Building Codes : Building Services 2005
- The American Society for Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards:

Ventilation for acceptable indoor air quality 62.1-

2007. Energy standards for buildings 90.1-2007.

ASHRAE handbooks:

2006 ASHRAE Handbook. ASHRAE Refrigeration. 2007 Handbook, Applications. 2008 ASHRAE Handbook, Systems and 2009 ASHRAE applications. Handbook, Fundamentals.

- Air Conditioning, Heating and Refrigeration Institute (AHRI).
- Sheet Metal and Air conditioning Contractors National Association (SMACNA): HVAC duct construction standards, metal and flexible, 1995.
- Energy Conservation Building Code (ECBC 2008)
- ASHRAE 52.1-1992, 52.2-2007.
- IMD Weather Data.

- The following IS codes shall be applicable:

S. No. Material/item of Work		Standard/Code	
1.	Ducting Fabrication	IS : 655 (Latest Rev.)/ SMACNA	
2.	Galvanised Sheets/Wires	IS : 277-1977	

	3.	Aluminium Sheets/Wires	IS : 737	
	4.	Horizontal Centrifugal Pumps	IS : 1620	
	5.	Mild Steel, ERW Pipes	IS : 1239, IS : 3589	
	6.	Pipe Fittings	IS : 1239	
	7.	Steel Pipe Flanges	IS : 6392	
	S. No.	Material/item of Work	Standard/Code	
	8. b) iro c) d)	Gate, Globe and Check Valves Upto 40 mm gun metal Butterfly valves of 50 mm and above (cast n) Balancing Valves Non Return Valves	IS : 778 IS : 780, IS : 2906 IS : 778 IS : 5312	
	9.	Colour Code for Identifications of pipes	IS : 2379-1963	
	10.	3 Phase induction motors	IS : 325	
	11.	Burden type pressure gauges	IS : 3624	
	12.	PVC insulated electric cables	IS : 1554	
	13.	HRC cartridge fuse links	IS : 2208	
	14.	Starters sheets/wires	IS : 8555	
15.	15.	Specific requirements for	IS · 4064 (Part	
		direct switching of motors	II) IS : 732 (Part	
	16.	Inspection and testing of Installation		
	17.	Glossary of terms used in refrigeration and air-conditioning	IS : 3615 IS : 4736-	
	18.	Hot die zinc coated steel pipes	1968	
	19.	Expanded polystyrene	IS : 4671	
	20.	Glass wool	IS : 8183	
	21.	Resin bonded glass wool	IS : 8183	
	Safety codes			

## 5.0 VENTILATION

5.1 The following spaces shall be provided with mechanical ventilation:

#### NRDA F-1- Schedule-D- Section III- Technical Specification of Works Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

Toilets (common)	Independent exhaust	Centrifugal Axial fans to be provided for mechanical exhaust.
Pump Rooms	Supply & Exhaust	Centrifugal/axial fans to be provided for

Space/Room	Type of System	Remarks
		exhaust and supply.
Public Spaces	Fresh air mixed with return air of AHUs	
Basement	Natural/forced intake and forced exhaust Normal @ 12 ACPH Fire @ 30 ACPH	Fresh air intake shall be natural intake throug ramps/openin h g for Basement B1, while centrifugal DIDW/axial fans with ducting, grills, louvers to be provided for exhaust.

## 5.2 Toilets:

A central ducted mechanical ventilation system shall be provided to serve all toilets There shall be an enthalpy recovery device before exhaust to recover cooling enthalpy from exhaust air.

## 6.0 Pump Room:

Pump rooms shall be provided with mechanical ventilation.

Mechanical supply and extract air ventilation shall be provided to the boiler room and other plant rooms. Cooling shall be provided for plant rooms specific areas eg. Chief Engineer's Room/BMS/Control room etc.

# 7.0 SMOKE CONTROL:

#### 8.0 Internal Staircases and Lift Lobbies:

Internal staircases and lift lobbies shall be provided with pressurization systems, so as to maintain 6mm WG positive pressure in case of fire. Pressurization fans shall be located at roof level.

Basements shall be ventilated @ 12 ACPH during normal operations and 30 ACPH incase of fire.

## VENTILATION FANS:

#### 1.0 SCOPE:

Scope of this section comprises of supplying, erection, testing and commissioning of following type of fans.

The fans shall be as indicated on drawings and mentioned in schedule of quantities.

## 2.0 EXHAUST FANS:

- 2.1 The exhaust fans shall be propeller type with steel hub and blades, mounted directly on the shaft of a totally enclosed motor.
- 2.2 The fan blades shall be of pressed steel of aerofoil design for high efficiency and static pressure.
- 2.3 The mounting frame shall be of cast /sheet steel brackets to connect the frame, with the fan/motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.
- 2.4 The fan motor shall be totally enclosed squirrel cage type.
- 2.5 All wall mounted exhaust fans shall be provided with gravity back draft louvers.

#### 3.0 CENTRIFUGAL FANS:

#### 3.1 Scroll:

Casing shall be welded construction fabricated with 14 gauge M.S. Sheet with spray galvanization. Minimum zinc deposition shall conform to class 375 of relevant latest IS code.

The minimum thickness of casing shall not be less than 3 mm. The fan scroll shall be attached to the side plate by means of continuous lock seam.

18 gauge galvanized wire mesh inlet screens of 50 mm sieves shall be provided on both inlets. Housing shall be provided with standard clean out and door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

#### 3.2 Impeller:

The impeller shall have die-formed, forward/backward curved blades, welded to the rim and back plates to have a non-over loading characteristic of the fan. Rim shall be spun to have a smooth contour if required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished wherever required. The impeller, pulley and housing shall be statically and dynamically balanced. Fan velocity shall not exceed 2200 FPM.

## 3.3 Shaft:

Shaft shall be constructed of SAE 1040 steel turned, ground and polished. Shaft sizes shall be carefully calculated and designed such that the maximum operating speed (RPM) shall not exceed 75% of the first critical speed.

#### 3.4 Bearings:

The bearing shall be self-aligning, heavy duty ball, roller or sleeve bearings. Bearing shall

be selected for quiet operation and shall be grease pack, pillow block type. Bearings shall be maintenance free with permanently lubricated sealed ball bearing type.

## 3.5 Inlet Guard:

Inlet guard shall be spun to have a smooth contour. Inlet screen if provided shall be of galvanized wire mesh of 25 mm square.

#### 3.6 Base Plate:

Base plate shall be provided for each fan. Base for both fans and motor shall be built as an integral part and shall be mounted on a concrete foundation through cushy foot mountings for vibration isolation. The concrete foundation shall be at least 150 mm above the finished floor level and shall be further isolated from structural floor through 50 mm thick layers of sand all around, topped with bitumen.

## 3.7 Motor:

Fan motor shall be of squirrel cage type totally enclosed fan cooled motor, suitable for 415  $\pm$  10% volts, 50 Hz, 3 phase. Horse power indicated on the name plate of motor shall be more than brake horse power by at least 10% and shall have sufficient torque available for starting and continuous operation. Motor R.P.M. Shall not exceed 1450 R.P.M. The fan motor combination selected for the particular requirement shall be of the most efficient type (i.e smallest horse power) so that power consumption and noise level may be minimized. The motor shall have 'F' class insulation and four pole.

#### 3.8 Drive:

These fan shall be provided with V-belts. All belt shall be selected for 150% rated HP. All V-belt shall be supplied with removable belt guards that do not impede the air flow to the fan inlet. There shall be a minimum of two belts per drive.

#### 3.9 Vibration Isolation:

Fan with motor shall be mounted on a concrete foundation through spring type of spring isolators vibration.

## 4.0 AXIAL FLOW FANS:

Axial flow fan shall be of vane axial type and shall be suitable for mounting in duct or floor/slab as required/indicated on the tender drawings.

#### 4.1 Impellers:

Single piece cast aluminium or steel impeller shall be with blades of aerofoile design to give maximum efficiency and shall vary in twist and width from hub to top to effect equal air distribution along the blade length. Single piece fan and hub shall be statically and dynamically balanced. Maximum clearance between blade tip and the fan housing at the specified speed shall be 5 mm. Impellers blades shall be whirl tested to a speed 25% above the design operating speed. Extended grease leads for external lubrication shall be provided. The fan blade shall be adjustable type so that actual air flow can be achieved at site as per indicated in Drawings & BOQ.

#### 4.2 Casing:

Casing shall be constructed of 14 gauge sheet steel, properly reinforced for rigidity. Fan casing, motor mount and straightening vanes shall be of welded steel construction motor mounting plate shall be minimum 20 mm thick and machined to receive motor flanges.

Casing shall be provided with two nos. wide, hinged doors which open easily. Inspection doors with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspensions shall be welded to casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bondorized, primed and finish coated with enamel paint.

#### 4.3 Motor:

Motor shall be squirrel cage, totally enclosed, fan cooled, constant speed, suitable for 415  $\pm$  10% volts, 50 Hz, 3 phase power supply, motor nameplate horsepower shall be more than brake horse power by a minimum of 10%. Motor speed shall not exceed 1450 R.P.M (4 pole). The fan and motor combination selected for particular requirement shall be of the most efficient type so that sound level and energy consumption is minimum. Motor conduit box shall be mounted on exterior of the casing. Wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit. The motor shall have 'E' class insulation.

#### 4.4 Drive:

#### For Duct/Wall Mounted Fan:

For duct/wall mounted fans the impeller shall be mounted directly on the motor. Drive unit and impeller shall be totally enclosed inside the duct.

#### For Floor/Ceiling Mounted Fan:

The fan shall be provided with belt drive and adjustable motor sheave, standard sheet steel belt guard with vented front for heat dissipation. Belt shall be of the oil resistant type.

#### Vibration Isolation:

Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through spring type of vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.

## 6.0 TECHNICAL DATA:

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment and Bill of Quantities.

#### 1.0) FANS:

S.No.	Description	Unit	Condition of Services
1.1	S. No.		
1.2	Туре		
1.3	Manufacturer		
1.4	CFM		
1.5	Static Pressure MM WG		

Page 221 of 237

- 1.6 Motor H.P.
- 1.7 Insulation Class
- 1.8 Outlet Vel. FPM
- 1.9 R.P.M
- 1.10 Type of Drive
- 1.11 Noise Level DB

#### DUCT WORK AND OUTLETS:

1. This section deals with supply, erection, testing & balancing of GI sheet metal duct work and air registers conforming to specifications as given below:

#### 2. MATERIAL FOR DUCTING

All the ducts shall of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates. Galvanizing shall be 120gms/sq.m. (total coating on both sides).

In addition, if deemed necessary, sample of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only, irrespective of cross-section dimensions.

#### **Governing Standards**

Unless otherwise specified here, the construction, erections, testing and performance of the ducting system shall conform to the SMACNA standards and Addendum of SMACNA

## **Duct connectors and Accessories**

All the transverse duct connectors (Flanges\Cleats) and accessories related hardware such as support system shall be zinc coated (galvanized).

#### **Fabrication standards**

All the ductwork including straight sections, tapers, elbows, branches, shoe pieces, collars, terminal boxes and other transformation pieces shall be factory-fabricated. Equivalency will require fabrication by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply.

Coil lines to ensure location of longitudinal seams at corners\folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any side of the ducts.

All ducts, transformation pieces and fittings shall be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.

All edges shall be machines treated using lock-formers and rollers for furning up edges.

## Selection of G.I. and Transverse Connectors

Duct construction shall be in compliance with 1" (250 Pa) w.g. static norms as per

SMACNA. All transverse connectors shall be 4-bolt system.

To avoid any leakage additional sealant shall be used.

The specified class of transverse connectors and duct guage for a given duct dimensions shall be 1"( 250 Pa) pressure class.

Non-toxic, AC -application grade P.E. or PVC gasketing shall be provided between all mating flanged joints. Gasket sizes shall conform to flange manufacturer's specification.

#### **Duct construction**

The fabricated duct dimensions shall be as per approved drawings and all connecting sections shall be dimensionally matched to avoid any gaps.

Dimensional Tolerances: All fabricated dimensions shall be within  $\pm$  1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerance shall be  $\pm$ 1.0mm per meters.

Each duct pieces hall be identified by coded sticker, which shall indicate specific part number, job name, drawing number, duct sizes and gauge.

Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners, which shall be either Pittsburgh or snap button punch as per SMACNA practice, to ensure air tightness.

Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7) turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

Plenum shall be factory fabricated panel type and assembled at site.

Factory fabricated ducts shall have the thickness of the sheet as follows and length of the piece not more than 1200mm and should have beading at every 300mm.

Recommended SMACNA standard at 4 feet Transverse Joint Reinforcement

#### Note:

SMACNA- sheet Metal & Air Conditioning Contractor National Association Inc. "HVAC Duct construction standard metal & flexible"- Third Edition 2005 USA. In 1" static pressure i.e. comfort cooling application optional " C&S and C&SS cleats joints can be used Upto 450mm duct size use C&SS cleats.

Over 750 mm duct size use TDF/TDC flanges with respective gauges as mentioned above.

Alphabets B,C,D,E,F,G,H,I and j per SMACNA 2005, transverse joint reinforcement table 1-12m (T-25b flanged) and TDC addendum.

R means reinforcement with Zeebar Stiffener / Joint Tie Rod /Mid Tie Rod.

The gauges, joints and bracing for sheet metal ductwork shall further conform to the provisions as shown on the drawings.

Ducts larger than 600 mm shall be cross broken, duct sections up to 1200 mm length may be used with bracing angles omitted

Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All the branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-in-charge.

# For Duct Pieces for shoot or Pieces make at set shall be as ISI specification given below.

MAXIMUM SIDE	THICKNESS OF GI SHEET	TYPE OF TRANSVERSE JOINT CONNECTIONS	BRACING
(1) mm Up to 300	(2) mm 0.63	(3) S-drive, pocket or bar	(4) None
301 to 600 601 to 750	0.63	Slips, on 2.5m centers S-drive, pocket or bar slips, on 2.5m centres S-drive, 25mm pocket or 25 mm bar slips on 2.5m centers.	None 25 x 25 x 3 mm angles, 1.2m from joint
751 to 1000 0	).80	Drive, 25-mm pocket or 25mm bar slips, on 2.5 m centres 40 x 40 mm angle connections, or 40-mm bar slips, with	25 x 25 x 3 mm angles, 1.2 m from joint
		35 x 3 mm bar reinforcing on 2.5 m centres.	40 x 40 x 3 mm angles, 1.2 m from joints
1501 to 2250	1.00	40 x 40 mm angle conn- ections, or 40-mm bar diagnol slips, 1 m maximum centres with 35 x 3 mm angle bar reinforcing.	40 x 40 x 3 mm angles, or 40 x 40 x 3 mm 60 cm from joint.
2250 to above connec-	* 1.25	50 x 50 mm angle tions, or 40 mm pocket or 40 mm bar slips, 1 m max. centres with 35 x 3 mm bar reinforcing.	40 x 40 x 4 mm diagnol angles, or 40 x 40 x 3 mm angles, 60 cm From joint.

\* Ducts 2250 mm and larger require special field study for hanging and supporting methods.

In addition to above the following points should be also taken into account while fabrication of ducts.

- a) All ducts of size larger than 450mm shall be cross broken.
- b) All ducts shall be supported from the ceiling / slab by means of MS rods of dia 9mm with MS angle of size 40 x 40 x 5 mm at the bottom with neoprene pad in between the duct & MS angle. The ducts shall be suspended from the ceiling with the help of dash fasteners. Provision for necessary ancillary materials required for hanging the ducts shall be arranged by the contractor.
- c) The vanes shall be provided wherever required and shall be securely fastened to prevent noise & vibration.
- d) The rubber gasket shall be installed between duct flanges in all connections and joints.
- e) All flanges and supports should be primer coated.
- f) The flexible joints shall be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300 mm between faces.
- g) The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.

## h) Box Type Dampers & Splitters

These dampers shall be provided in the ducting work for proper control and balancing of air distribution. All dampers shall be louver type robust construction. These dampers shall be fitted with easily accessable operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct. All dampers, splitters shall be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers shall be installed in duct at all required locations. No extra payment shall be made separately since these form part of Air Circulation System.

**NOTE**: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

#### 3.0 THE SUPPLY AND RETURN AIR GRILLS AND CEILING DIFFUSERS

The supply and return air grills and ceiling diffusers shall be made of powder coated extruded aluminum sections. The supply air grills / diffusers shall be provided with screw operated opposed blade volume control device made of extruded aluminum in black anodised finish.

All grills / diffusers shall have soft continuous rubber / foam gasket between the periphery of the grills / diffusers and surface on which it has to be mounted. The colour of grills / diffuser shall be as per the approval of the Engineer in Charge.

## 4.0 LINEAR SUPPLY AND RETURN GRILLS

The linear continuous supply / return air grills shall be made of powder coated extruded aluminum construction with fixed horizontal bars. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the grills shall mechanically crimped from the back to hold them.

The colour of grills shall be as per the approval of the Engineer in Charge. The volume control device made of extruded aluminum construction in black anodised finish shall be provided in supply air duct collars only.

## 5.0 FRONT FIXED BAR REAR ADJUSTABLE LOUVERED GRILLS.

The grills shall be made of powder coated extruded aluminum construction with front fixed horizontal bar at 0 degree inclination with one way or two way deflection with rear vertical individually adjustable louvers in black shade mounted on Nylon bushes to hold deflection setting under all conditions of velocity and pressure.

The colour of grills shall be as per the approval of the Engineer in Charge. The volume control device of extruded aluminum construction in black anodised finish shall be provided in supply air duct collars.

#### 6.0 SQUARE / RECTANGULAR CEILING DIFFUSERS.

The square / rectangular ceiling diffusers shall be made of powder coated extruded aluminum construction with flush fixed pattern. The diffusers shall have Anti-Smudge ring and spring loaded removable central core in various pattern for air flow direction. The diffusers shall be mounted by concealed screw fixing arrangement. The volume control device of extruded aluminum construction in black anodised finish shall be provided in supply air diffusers. The colour of diffuser shall be as per the approval of the Engineer in Charge.

#### 7.0 VOLUME CONTROL DEVICE

The opposed blade volume control device shall be made of Powder Coated extruded aluminum construction in black anodised finish. Opposed blades shall be pivoted to extruded aluminum frame with Nylon bushes. Specially designed blade shall have an overlapping lip which shall ensure a tight closure.

#### 8.0 MOTORIZED FIRE DAMPERS:

8.1 Fire Dampers shall be installed in the openings/passage fromed by supply and return air ducts when they pass through AHU room walls as well as when passing through all floors as shown in the drawing.

Fire dampers shall be motor operated with atleast 90 minutes fire rating as per UL 555-1995 as tested CBRI Roorkee, India.

Fire dampers shall be multi leaf type. The blades and outer frame shall be made of 16G galvanized steel sheet. Fire damper assembly shall be factory fitted in a sleeve made of 18G galvanized steel sheet of minimum 400mm long. The blades shall be pivoted on both sides using chrome plated spindles in self lubricated bronze bushes. Metallic compression seal shall be provided on both ends to prevent smoke leakage. Stop seal shall be provided on top & bottom. Dual side linkage shall be provided for better structural stability. The construction of the fire damper shall allow maximum free area to reduce pressure drop and noise in the air passage.
Fore wall mounted fire dampers retaining angles shall be supplied and installed by HVAC contractor as per established installation procedure. Whereas the fire damper is also to be used for smoke management (smoke and fire damper) the same shall be as per UL 555S – ClassII.

Every motorized fire damper/smoke and fire damper shall be tested for in the factory and will be certified by the manufacturer in form of the test certificate.

Fire damper shall also be supplied with spring locked fusible link reted for 72<sup>°</sup>C (UL stamped) to close fire damper in event of rise in duct temperature.

For fire dampers/smoke fire dampers of size higher than one approved by certifying agency the damper shall be supplied in multiple units of size not exceeding the tested damper by CBRI.All the multiple units shall be housed in a common factory fitted sleeve.

#### 8.2 Actuators

The actuator used shall be maintenance free direct coupled spring return type suitable to work on 24V electric supply. The torque rating of the actuator shall exceed at least by 15% over torque required to open/close the damper. The selection of actuator size shall be the responsibility of the manufactuere of the fire damper. Spring return time shall be 20 seconds or less at ambient temperature. The tamper proof housing with IP-54 protection rating.

8.3 The control panel shall have atleast following features:

Power on indicating lamps with 230V/24V Transformer. Damper close & open indication. Rset push button Push button for manual running of actuator for periodic inspection. Auxiliary contacts 24V & 230V Contact points to receive signal from smoke defector/fire alarm

panel. Access door will be provided in the duct before each fire

damper.

## 9.0 FRESH AIR INTAKE LOUVERS WITH BIRD SCREEN

The fresh air intake louvers at least 50mm deep will be made of powder coated extruded aluminum construction. Bird / insect screen will be provided with the intake louvers. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted.

The intake louvers shall be provided with factory fitted aluminum construction volume control dampers in black anodised finish.

#### 10.0 PAINTING

All ducts collar / shoot behind the grills / diffuser shall be given at least two coats oil black enamel paints.

#### 11.0 TESTING

The complete duct system shall be tested for air leakage & complete air distribution system shall be balanced in accordance with air quantities indicated on the approved drawing.

#### 12.0 TECHNICAL DATA:

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment and Bill of Quantities.

#### 13.0 TECHNICAL DATA:

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment and Bill of Quantities.

#### GRILLES/DIFFUSERS/DAMPERS:

Make, Materials and Gauge

- 1.1 Fire Dampers UL Listed
- 1.2 Grilles
- 1.3 Louvers
- 1.4 Diffusers Duct Dampers

#### 2.0 INSULATION ON SHEET METAL DUCTING

- 2.1 The air handling ducts shall be insulated with resin bonded glass wool slabs.
- 2.2 Duct insulation thickness shall be as follows:

a)	Duct in Conditioned Space	- 25 mm
b)	Duct in Unconditioned	thick
	Space	- 50 mm
C)	Exposed Duct	thick
		- 50mm
		thick

#### 2.3 Installation

- a) Clean the surface with a wire brush and make it free from rust and oil.
- b) Apply one coat of cold setting compound .
- c) Wrap the duct with insulation blankets of the thickness mentioned in BOQ and covered with 38 G.A aluminium foil using 50 mm wide aluminium adhesive tape.
- d) Alternatively, the duct insulation can be of pre-laminated glass wool of above specifications. Pre-lamination should be of minimum thickness as above with vapour barrier.
- e) The ducts in areas exposed to the weather shall be additionally covered with one layer of tar felt B.H. The tar felt shall be stuck with bitumen R 85/40 or 80/25.

#### 4.0 ACOUSTIC LINING:

4.1 The acoustic lining shall consist of 25 mm resin bonded glass wool of density 32 kg/m<sup>3</sup> (min) then it shall be covered by 0.5 mm perforated aluminium sheets having 3 mm perforation at 6 mm centres.

#### 4.2 Installation:

- a) The duct surface shall first be cleaned from inside.
- b) The insulation boards shall be wrapped in RP Tissue paper with the end stitched.
- c) Then the boards shall be fixed inside the duct.
- d) The insulation shall then be covered with 0.5 mm perforated aluminium sheets.
- e) The sheet and the insulation shall be secured to the duct by means of cadmium plated bolts, nuts and washers. The ends should be completely sealed off, so that no insulation material is exposed.

#### 6.0 TECHNICAL DATA:

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment and Bill of Quantities.

S.No. Description Unit Condition of Services

#### 1.0 INSULATIONS:

- 1.1 Manufacturer
- 1.2 Duct Acoustic Lining Materials
- 1.3 Duct Insulation Material
- 1.4 Thermal Conductivity
- 1.5 Duct Insulation

#### TEST AT SITE:

#### 5.0 DUCT WORK:

- 5.1 All branches and outlets shall be tested for air quantity, and the total of the air quantities shall be within plus five percent (5%) of fan capacity.
- 5.2 Fire Dampers, Volume Dampers and Splitter Dampers shall be tested for proper operation.
- 5.3 All ducting shall be smoke tested for any leakages.

#### 6.0 BALANCING AND ADJUSTMENT:

All air handling ventilation equipment, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities indicated, at each inlet and outlet, on the drawings. if these air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horse power, the architect shall be notified before proceeding with the balancing of air distribution system.

#### 7.0 ELECTRICAL EQUIPMENT:

- 7.1 All electrical equipment shall be cleaned and adjusted on site before application of power.
- 7.2 The following tests shall be carried out: Wire and cable continuity tests.
- 7.3 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 volt meggar. The meggar reading shall be not less than one megaohms.
- 7.5 Earth resistance between conduit system and earth must not exceed half (1/2) chm.Phasing out and phase rotation tests.
- 7.6 Operating tests on all protective relays to prove their correct operation before energising the main equipment.
- 7.7 Operating tests on all starters, circuit breakers, etc

#### 8.0 PERFORMANCE TESTS:

- 8.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the Architects.
- 8.1.1 Air volume passing through each unit, duct, grilles, apertures.
- 8.1.2 Differential pressure readings across each filter, fan and coil, and through each pump.
- 8.1.3 Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.
- 8.1.4 Continuous recording over a specified period, of ambient wet and dry bulb temperatures under varying degrees of Internal Heat Loads and use and occupation, in each zone of each part of the building.
- 8.2 Daily records should be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of Wet and Dry Bulb Temperatures, upstream

"ON-COIL" of each cooling coil. Also suction temperatures and pressures for each Refrigerating Unit. The current and voltage drawn by each machine.

- 8.3 Any other readings shall be taken which may subsequently be specified by the Architect.
- 8.4 Drawings marked with all grill outlets with CFM.

#### 9.0 MISCELLANEOUS:

- 9.1 The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of Contract and Specification.
- 9.2 The date of commencement of all tests listed above shall be subject to the approval of the Architect, and in accordance with the requirements of this specification.
- 9.3 The contractor shall supply the Commissioning Engineer and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the architect requests such a test for determining specified or guaranteed data as given in the Specification or on the Drawings.
- 9.4 Any damage resulting from the tests shall be repaired and/or damaged material replaced to the satisfaction of the architect.
- 9.5 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.
- 9.6 The Contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.
- 9.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the Architect.
- 9.8 The Contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the Architect, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

#### 10.0 ERECTION AND COMMISSIONING:

The contractor shall carry out the complete erection and commissioning. All work shall commence on previously prepared foundation. All the materials shall be moved from their place of storage into the plant by the Contractor. The contractor shall make his own arrangement to OFF load equipment/material received at respective Rail/Road Transport Terminal Points, dispatched to site and to store all material received at site. The purchaser shall provide clear storage and erection space only. All erection tools and tackles as and when required to suit the erection program shall be provided by the Contractor.

All consumables required for erections such as cotton waste, kerosene, oil, emery paper, coil string, bamboo's and planks for scaffolding etc as well as necessary welding rods, gases etc shall be provided by the contractor. Protective and finish painting shall be carried out by the contractor. Carbon steel surface shall be thoroughly cleaned before painting. The contractor shall indicate the water and electricity requirements during erection. The contractor shall remove all the waste material or rubbish from and about the work site and leave the job thoroughly cleaned up and ready for use.

#### 1.0 General:

Perform following testing and commissioning to approval:

Air balancing of each system (each supply air system, fans, cooling tower blower, air handling units, and VAC boxes.

Hydronic tests (testing and balancing) including water flow balancing and thermal capacity testing of chilled water system, circulating pumps and chiller.

Excessive noise & vibration testing.

#### 2.0 Criteria:

systems shall be balanced and adjusted to give design/operating conditions under following criteria:

	Tolerance of air flow quantities : 3%
S.A. Ducts, 5% other ducts	
: 5%	Tolerance of water flow quantities
35 in occupied spaces.	Maximum noise level reading : NC-
: 100% of nameplate capacity	motor Maximum current load on s

#### 3.1 Reports:

- 3.2 On completion, supply at least six copies of balancing and test report, suitably bound, 8 ½" x 11" size for checking and review. submit completed reports within three weeks of testing and balancing.
- 3.3 Reports shall include all design data together with recorded data of all tests for comparison and schematic of each system and components.
- 3.4 report all temperatures in Degree Celsius. For convenience, reports may also show temperature in Fahrenheit but only as secondary data.
- 3.5 Reports should show schematic of each system. Location of each traverse should be mark and each outlet should have corresponding number.
- 3.6 Keep a record of all tests and have these signed by General Contractor's superintendent and where applicable, equipment Manufacturer's Representative. Show in an approved schedule form, record of systems or parts of systems tested or intended to test, date of test, circumstances such as pressure, temperature, duration of test and any special remarks pertaining to events during test.

#### 3.7 Final Report Shall Include:

3.8 Specified and achieved total air quantities per system.

3.9

- 3.10 Specified and achieved individual air quantities for each VAV box complete with sp.
- 3.11
- 3.12 Specified and achieved individual air quantities per outlet with supporting schematic diagrams.
- 3.13 Specified and actual fan total SP with breakdown showing inlet and discharge pressure. Sheaves and belt sizes and quantities per unit.
- 3.14 Each pump suction pressure, head pressure, amps and voltage, nameplate amperage and voltage.
- 3.15
- 3.16 Specified and achieved total water flow per system.
- 3.17
- 3.18 Specified and achieved individual water flow, and pressure drop though Cooling Tower and Chiller.

#### 4.0 Testing:

- 4.1 carry out all tests specified. Test equipment to requirement of and where necessary, in presence of equipment manufacturer.
- 4.2 Tests for balancing shall proceed only after system installation has been completed and system has been put into continuous operation.

#### 5.0 Sanitary Exhaust & Miscellaneous Exhaust Systems:

5.1 test each system as herein described. Pre-set system as

follows: Set exhaust (backdraft) dampers to fully open

position.

Close doors for those rooms being

exhausted. Start related supply air system.

- 5.2 Check fan speed, motor amperage and voltage. Compare to shop drawing data. Adjust fan speeds (except for direct drive fans) to within 5% of shop drawings figure.
- 5.3 Make pitot tube traverse, velocity and static pressure readings in ducts wherever needed as specified for test.
- 5.4 When airflow capacity is within 5% of design, test and balance individual inlets starting with those closets to fan.
- 5.5 Adjust system to normal operating audition and record all data.

#### MODE OF MEASUREMENTS:

#### 1.0 UNIT PRICES IN THE SCHEDULE OF QUANTITIES:

1.1 The item description in the Schedule of Quantities is in the form of a condensed resume. The unit price shall be held to include everything necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.

#### **1.2** The Unit Price of the Various Items shall include the following:

- 1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the Design Consultant may request in addition to the tests generally required to prove quality and performance of equipment.
- 1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.
- 1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.
- 1.2.4 All the necessary measures to prevent the transmission of vibration.
- 1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.
- 1.2.6 Storage and insurance of all equipment apparatus and materials.
- 1.3 The Contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

#### 2.0 MEASUREMENTS OF SHEET METAL DUCTS, GRILLES/DIFFUSERS ETC.

#### 2.1 Sheet Metal Ducts:

- a) All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars, vanes & other fittings. Gaskets, nuts, bolts, vibration isolation pads are included in the basic duct items of the BOQ.
- b) The unit of measurements shall be the finished sheet metal surface area in meters squares. No extra shall be allowed for lapse and wastage.
- c) All the guide vanes, deflectors in duct elbows, branches, grille collars quadrant dampers etc. shall be measured for actual sheet metal surface and paid for at the same rate as duct of same thickness.
- d) The unit duct price shall include all the duct hangers and supports and making, exposing of concrete reinforcement for supports and good of the same as well as any materials and labour required to complete the duct frame.

#### 2.2 Grilles/Diffusers

All grilles/diffusers are as per tender requirements shall be tested as a lump sum item. Where extra grilles diffusers are ordered upto award of work, they should be measured as Page **235** of **237**  follows:

a) All measurements of grilles/diffusers shall be the actual outlet size excluding the outer flanges.

- b) The square or rectangular grilles/diffusers shall be measured in plain m<sup>2</sup>.
- c) All round diffusers shall be measured by their diameters in cm.
- d) All linear diffusers shall be measured as per actual length in metres.

#### 4.2.1 Duct:

Measurements for insulation of ducts shall be made in actual net square metres of bare uninsulated duct surface through all dampers, flanges and fittings. In case of bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measurements for the dampers, flanges, fittings shall be for the surface dimension for the connecting duct, nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

#### 4.4 Acoustic Duct Lining

- 4.4.1 In case of acoustic lining of air ducts, measurements of the bare inside duct surface in square metres, shall be final for billing purposes.
- 4.4.2 The insulation/acoustic panels shall include cost of battens, supports, adhesives, vapour proofing, finished tiles/boards/sheets as well as additional labour and materials required for completing the work.

# SCHEDULE- D Section-IV Special Conditions of Contract

Signature of NRDA.....

## **Special Conditions of Contract**

## 1. GENERAL

The Special Conditions of Contract are to be read in conjunction with General Conditions of Contract. If there are any variations or discrepancies or conflicting provisions, the provisions in Special Conditions shall take precedence over the provisions in the General Conditions of Contract.

All additional facilities/equipment/ office etc to be provided by the contractor, as mentioned in the tender, document outside the BOQ shall not be paid separately, and shall be deemed to have been included in the rates quoted by the contractor.

## 2. ACCESS

The Contractors are to verify the work site details including:-

- a) Access,
- b) Availability of water supply and electrical energy,
- c) Space for dumping stores and materials and
- d) Space for erection of site office,

The Contractors are deemed to have catered for all contingencies connected with the site, access, water & electricity.

## 3. SUPPLY OF WATER

Water will not be supplied by NRDA and the Contractor shall make his own arrangements. NRDA will give recommendatory letter to the concerned authority if so requested by the Contractor. However, NRDA shall be in no way responsible for obtaining permission and no claim on account of this will be entertained.

## 4. ELECTRIC SUPPLY

- (a) Electric power both for construction and lighting shall not be made available to contractor. Contractor shall arrange at his own cost power with necessary switch boards, energy meter etc. and shall be responsible for their maintenance.
- (b) Further distribution by the Contractor at his cost shall be done as per approved layout. He shall provide required clearances for overhead lines to facilitate easy movement of heavy machinery such as cranes etc. These shall be shifted and rerouted at Contractors cost during execution of work if the same are found to obstruct any other work of any agency working at site or requires shifting due to unforeseen reasons.
- (c) On completion of the work the Contractor shall remove all wiring installed by him and make good to the satisfaction of Engineer if any disturbance or damage is done.
- (d) The Contractor shall employ an Electrical Agency as approved by the Engineer for carrying out this work.
- (e) The Contractor has to keep alternative arrangement ready at his own cost for any failure/ interruption of electric power that takes place and under no circumstances can this be deemed to be reason for any consequential delay in the works.
- (f) Any disputes in sharing of power obtained directly/ indirectly from CSEB with other agencies shall be resolved by the contractor at his risk and cost. NRDA shall not be responsible or a party for such disputes.

## 5. DEFECT LIABILITY

The Contractor shall be responsible for rectification of defects, during the defect liability period as per clause 17 of GCC after the certified date of completion by the NRDA. This period shall be known as Defects Liability period as defined in CL. No. 17 of the General Conditions of Contract. Subsequent to the taking over of the works and after it has been in use, its removal/correction of defects would be the responsibility of the Contractor. Any defects or failures during this period shall be rectified by Contractor within one week of intimation in writing. If the same is not carried out in the stipulated time, NRDA shall have the right to get it repaired departmentally or through any other agency, entirely at the risk and costs of the Contractor as detailed in the GCC clause. No. 17.

## 6. SAMPLES

## 6.1 Material

(a) The Contractor shall furnish to Engineer for approval, with reasonable promptness and with reasonable time for consideration, adequate numbers of samples of all the materials to be used in the work, irrespective of whether material/product is from approved list given in tender. He shall permit and account for all costs in his quotation toward supply, testing, examination at site or at any approved place by the Engineer. The choice of approval of materials rests with NRDA unless otherwise specified.

(b) All material samples shall be delivered to the Engineer's office at the Contractor's cost. Each sample shall be in duplicate and properly labelled as under-

- Name of Project
- Name of Contractor
- Name of Product
- Name of Manufacturer
- Item reference of BOQ
- Date of Submission

(c) Samples shall be accompanied with technical specifications/ catalogues/ test results of manufacturer.

(d) In case the Contractor intends to keep an approved sample in his possession, he shall submit additional set of samples for Engineer's approval.

## 6.2 **Standards of Acceptability**

(a) In order to establish the standards of acceptability for materials and finishes, the Contractor shall finish in all respect a mock up for each pro-type room. The material used in this shall be as approved and special attention shall be paid to establish the workmanship and finishing standards to be achieved for the project. Works such as form finished concrete & finishing items such as joinery, floor finishes, false ceiling, wall finishes, toilets including sanitary fittings and fixtures, electric fitting and fixtures etc. shall be provided as per drawings and specifications. All mock-ups, except for exposed concrete finish to be made within the building blocks. For exposed concrete finish a maximum of 3 (three) mock-ups (approx. 36 (thirty six) SqM each), independent of the main building block shall be prepared for approval jointly by C E & Architect. (b) The Contractor shall give notice in writing in this respect and shall obtain approval through Engineer in Charge from the CE NRDA. Approval should be taken well in advance so as not to delay execution of work.

## 6.3 Submission of Invoice:

On request of engineer in charge the contractor shall be bound to supply of invoice as a proof of source of material being procured.

## 7. TESTING OF MATERIALS IN OTHER LABORATORY

As a valedictory measure, in addition to establishing testing a full fledged site laboratory, 10 % (ten percent) of the samples shall be sent every month for testing in one of the following laboratory:-

- i) Chief Engineer (PWD) Laboratory, Raipur
- ii) National Institute of Technology, Raipur
- iii) Govt. Engineering College, Raipur
- iv) B.I.T., Durg
- v) Sriram Test House N. Delhi
- vi) National Test House N. Delhi

**7.1** In case, certain testing facility for typical/ special materials are not available in Chhattisgarh, then it can be tested at a recognized laboratory anywhere in India.

**7.2** All testing charges for the above shall be borne by the Contractor. In case, the testing charges demanded by the testing authorities is not paid by the Contractor within 15 (fifteen) days, then the same will be paid by NRDA with due recovery from the Contractor's bill for the project.

#### 8. CRECHE FACILITIES FOR THE CHILDREN OF CONSTRUCTION LABOURER

Contractor undertakes to provide creche facilities for the children of construction labour through a volunteer agency **within one month from start of work**. The facility is open to children of construction labourers employed by the Contractor. In case the Contractor fails to provide this facility within stipulated time, following charge shall be levied on the Contractor.

Range of Contract Amount	Amount of Creche fund	
Upto Rs. 50 lacs	Nil	
Above Rs. 50 lacs to Rs. 5 Crores	Rs. 50000/-	
Above Rs. 5 Crores	Rs. 5 lacs.	

- 8.1 The amount shall be recovered if such facility is not provided by the Contractor from running account bills in one or more instalments but not exceeding 6 (six) instalment.
- 8.2 If the facility is provide after 3 month, 50% of the amount shall be refunded to the contractor, after 6 month 25% will refunded.

Signature of Contractor.....

Signature of NRDA.....

## 9. SUBMISSION OF DETAILED BAR/ PERT CHART OF COMPLETION

The Contractor shall, within the stipulated time in Tender, submit to the Engineer for his approval a detailed programme covering-

- a) Descriptive note explaining sequence of various activities.
- b) Network (PERT/ CPM), bar chart.
- c) Quarterly programme of supply of materials by the Employer.
- d) Quarterly cash flow indicating money to be earmarked by the Employer for the purpose of the contract.
- e) Programme for supply of working drawing.

f) Phased requirements of plant and equipment to be deployed by the Contractor.

### 10. Method of Working

After Contract award and before starting Work at the site, Contractor, NRDA's representative/ Engineer, and Architect shall together make a thorough survey of the grounds where Work under this Contract will occur and areas to be used as access ways to the Work areas. Contractor shall list, and photograph, if Contractor desires, existing conditions not requiring alterations, shall note discrepancies between Drawings and existing conditions, and shall designate areas of storage and routes of access agreed upon by NRDA.

The Contractor shall, within the stipulated time in Tender, submit to the Engineer for his approval the following information,

a) A general tentative lay-out plan of construction plant and equipment for the execution of work within time period stipulated in schedule.

b) Drawings or prints showing the location of major plants and other facilities which he propose to put up at the site, including any changes in the general layout, at least 15 (fifteen) days prior to the commencement of the respective work.

c) Layout and details of temporary works that the Contractor wants to carry out to fulfil his obligation under the contract.

d) Indication of shuttering system to be followed.

## 11. Project Monitoring

11.1 Within 7 (seven) days the Engineer shall give their approval to proceed with the work, with or without modification. However acceptance of programme and method of working as submitted by the Contractor or with any modification

there to in the opinion of the Engineer, shall not relieve the Contractor of any of his contractual obligation.

- 11.2 All these programmes and plans submitted by the Contractor and approved by the Engineer shall become part of the contract.
- 11.3 The acceptance of programmes as submitted by the Contractor or with any modification thereto in the opinion of the Engineer, shall not relieve the Contractor of any extension of time unless delay, if any, is expressly sanctioned by the Engineer.

## 11.4 Construction Photographs-

A General: Contractor will provide construction photographs taken, developed, printed, and mounted by a recognized commercial photographic studio or reputable photographer acceptable to Owner, in the number and type and at construction stages enumerated below:-

- (i) Before Starting Work: Have photographs taken at site from different points of view sufficient in number to show site (and conditions at existing structures) but not fewer than 30 photographs.
- (ii) During Progress of the Work: Have not fewer than 15 photographs taken at least once a week from points of view (both inside and outside), as necessary to show progress of construction and site development for each part of the Work. Co-ordinate taking photographs with utility Work and back filling. Photograph each buried utility line before back filling. During later stages of the Work, have photographs taken from suitable locations inside the building showing the progress of various stages of the Work, such as piling, centering, reinforcement, water proofing, concreting, etc. Size of photographs will be 125 mm X 250mm. Photographs shall be supplied with negatives/ CD to the Engineer. Each photograph shall be attached with date of photograph and location of work. These photographs shall be from location as fixed by the Engineer at start of work

## 12. QUARRY RELATED DEDUCTIONS

The royalty for Minor minerals used in the work like murrum, stone metals, sand, rubble etc. will be levied as per prevailing practice in PWD of Chhattisgarh and shall be recovered suitably through R.A./ Final bill and will be kept in deposit. The above royalty charges kept under deposit shall be refunded as soon as the Contractor submits relevant NOC from Collector, Raipur, Chhattisgarh.

## 13. CONTRACTORS ALL RISK POLICY (C.A.R. POLICY)

The successful Contractor shall take out a C.A.R. policy from any approved company by IRDA India. Chhattisgarh Govt., administered by Directorate of Insurance. The policy so obtained shall cover the entire period of construction (including all extensions) and also shall cover the defects liability period. The policy shall be for the total contract amount including cost of free supply material by NRDA, if any. All amounts/ charges towards premium etc. on this account shall be borne by the Contractor.

## 14. INDEMNITY BOND

The Contractor shall require to execute an Indemnity Bond for satisfactory performance of the entire project on stamp paper of Rs.100/- (Rupees Hundred only) in the format approved by the NRDA Ltd. This Indemnity Bond shall remain in force for the Defect Liability period after completion of the project to be furnished in contract form E of GCC.

## 15. ACCIDENTS

Should any accidents, fatal or otherwise occur, a detailed report about the same shall be made promptly by the Contractor to the Engineer. The Contractor should at all times during execution of work keep the NRDA fully indemnified against all risks, claims, litigations and financial burdens arising out of all incidental operations on work and accidents.

## 16. TRAFFIC

The Contractor shall have to make all necessary arrangements for regulating traffic day and night during the period of construction and to the entire satisfaction of the Engineer. This includes the construction and maintenance of diversion, if necessary, at no extra cost to the NRDA. The Contractor shall provide necessary caution boards, barricades, flags and lights, watchmen etc. so as to comply with the latest Motor Vehicle Rules and Regulations and for traffic safety. The Contractor shall be responsible for all claims for the accidents which may arise due to his negligence whether in regulating traffic, in stacking materials on the road or by any other reason. The contractor must comply with the following:-

A. General: Plan and control use of site and access to site in co-operation with Owner and other contractors working at site to minimise disruption of use of other facilities; portions of buildings and site areas affected by this Contract and to remain in use; and the work of other contractors.

B. Temporary Access Drives: Construct on the premises as necessary, and maintain in good usable condition; remove when no longer needed. Until permanent improvements have been completed, when necessary to prevent excessive dust, periodically water temporary unpaved access roads.

C. Construction Site Access: Use most direct route from public streets as agreed to by Owner. Construction traffic elsewhere on Owner's property is prohibited.

D. Driveways Between and Around Combustible Storage Piles: Maintain at least 15 feet wide and free of accumulation of rubbish, equipment, and materials.

F. Access for Fire-Fighting Equipment: Maintain.

G. Access: Refer to other sections for requirements to keep access to site and buildings open to Owner, other contractors, and fire-fighting equipment.

H. Use of Streets and Sidewalks on Public Property: Make arrangements with authorities having jurisdiction for use. Restrictions shall be those of the Municipal Authorities. Be solely responsible for adherence.

J. Roadways, Driveways, and Walkways: Where outside indicated Contract limit on Owner's property and on public property, keep open to pedestrian and vehicular traffic at all times. When temporary closing of a roadway, driveway, or walkway is absolutely unavoidable, provide alternative access routes. Such temporary closings shall be approved by Owner in each case and shall be for the shortest possible time. Strictly adhere to requirements of governmental authorities having jurisdiction.

K Parking: Owner will issue temporary parking permits for use by construction personnel and will make available, at the location shown. Construction personnel shall not park in any other location on Owner's property, even when bearing permits. Access to allocated parking spaces shall be by most direct route from public streets. Construction personnel shall not drive vehicles elsewhere on Owner's property and shall take the most direct pedestrian way along walks and roadways (not on lawns) from parking lot to construction site.

L Barricades and Signs: Should barricades or directional signs for traffic control be necessary, prepare and install such signs and barricades of approved size, colour, and lettering or

other markings. Remove signs when no longer needed, or at Substantial Completion, whichever is latest.

M. Restricted Use of Premises: Enforce Contract requirements, local ordinances and Owner's instructions pertaining to signs, fires, smoking, trucking, parking, and other use of premises.

N. On-Site Storage:-

1. General: Extent of Work and site area available limits amount of on-site material and equipment storage. Do not unnecessarily encumber job site with excess materials or equipment and means of delivery of materials, equipment, and supplies, removal of rubbish, and, hours during which deliveries may be made. Determine, and take into account in the Work, limitations on storage space and of times, rates, and means of deliveries to and removals from the job site whether such limitations are imposed by laws, rules, ordinances, or physical conditions. Owner will not pay extra amounts due to such limitations. Co-ordinate arrangements for delivery and storage of materials.

2. Paved Areas: Do not use paved areas on Owner's property to stockpile excavated materials or to store construction materials except where shown. Use of paved areas on public property is subject to requirements of authorities having jurisdiction, and arrangements for such use are solely Contractor's responsibility.

3. Protection and Repair: Protect roadways, walks, and other permanent site improvements, and access ways subject to damage. Satisfactorily repair improvements and surfaces damaged during construction operations, or remove damaged improvements or surfaces and provide new acceptable improvements or surfaces. Except where new Work is required, return areas used for temporary access to original condition.

### 17. ALIGNMENT AND BENCH MARKS

The alignment of the work to be carried out under the contract shall be marked on the ground as per the drawing and as per the instructions of the Engineer. For the purpose of facilitating the work, the series of temporary bench marks on masonry pillars will have to be established. These pillars will be constructed along with the alignment and such other locations as may be initiated by the Engineer. The temporary bench-marks shall be established for the work line-out and its connections to other proposed roads in Naya Raipur using the DGPS instrument and Total Station software. All expenses involved in the process of marking alignment on ground, checking the alignment, constructing masonry pillars in establishing bench marks thereon, shall be borne by the Contractor. It will be responsibility of the Contractor to ensure that the masonry pillars so constructed are not damaged during the period of work in progress.

#### **18. PREVENTION OF MOSQUITO BREEDING AT CONSTRUCTION SITE**

The Contractor shall on the respective construction site install mosquito proof and accessible water storage tanks or to cover/protect the present water storage tanks properly. The Contractor shall periodically give larvaecidal treatment to water storage tanks, sites of water stagnation, water collection.

Any expenditure that may be incurred by NRDA to ensure that the above conditions are fulfilled by the Contractor will be debitable to Contractor's account and will be recovered from the bills of the Contractor from time to time.

## **19.** INSPECTION OF SITE AND SUFFICIENCY OF THE TENDER

If the NRDA is not in a position to deliver to the Contractors the site of the Contract work for any reason whatsoever at the agreed time, delaying the commencement of the contract work, or part

thereof not beyond 50 % (fifty percent) of contract period for completion, such omissions of the NRDA shall not be breach of any its obligations under the contractor and the Contractor shall not be entitled to claim from the NRDA for loss or damage, if any, caused thereby, but shall be entitled to a reasonable extension of the period agreed for the completion of contract work. If the contractor shall be obstructed in the execution of the work by any person other than an agent or servant of the NRDA, the Contractor shall exclusively deal with such set by the due process of law but shall not be entitled to attribute thereby the beach of any obligation under the contract to the NRDA compensation for damage or loss, if any, thereby suffered but shall be entitled to an appropriate extension of period agreed for the completion of the contract work, provided that the contractor has reported to the NRDA every such act of obstruction with particular soon after its occurrence and the NRDA has after enquiry found the same to be substantially true and has determined the duration of such obstruction.

## 20. PROGRESS OF WORK

The Contractor shall carry out the work as per the programme approved by the Department from time to time. He will also not be allowed to proceed with the work in a scattered manner.

### 21. FIELD LABORATORY

The Contractor shall establish a field laboratory for the various field tests for items like concrete cubes, cement, aggregates, sand, blocks for masonry, tiles, wood and for similar items as directed by the Engineer. A Site Laboratory of approximately **12.0m x 5.0 m.** area with platform, display boards, storages, IS Codes, etc. shall be constructed for items similar as directed by the Engineer.

In addition to the general measuring and checking instruments such as plumb bob, setsquare, measuring tapes, screw drivers, hammers, total station, spirit level etc. the Laboratory must have the following equipments;

Slump Cone	2 nos. as per ISI
Cube moulds for concrete	54 nos.
Cube moulds for cement mortar	12 nos.
Cement testing equipment soundness accelerated	1 set
(Initial and final setting, fineness, compressive test equipment, etc.)	
Oven	1 no.
Universal Testing Machine (Electro mechanically operated)	1 no
Weighing Balance (Digital)	2 nos.
IS Sieves for sand& metals	2 sets for each
Glass-measuring Cylinders	12 nos.
Micro Meter	2 no.
Vernier callipers	2 no.
Rebound Hammer	1 Set

In addition to above if any other equipment are required for the testing and quality control during construction, the same shall be procured by the contractor at his cost.

Construction of Laboratory building well-equipped with equipments as listed above is incidental to the work and no separate payment will be made for this.

The Contractor shall carry out other various tests for various items and materials at National Institute of Technology or any other approved laboratory as directed by the Engineer at Contractor's own cost. At the end of each month for each category of the work, e.g. RCC work, masonry work, etc. the Contractor shall give statistical analysis of all the test results in the format prescribed by the Engineer and take corrective action in the work in accordance with these results.

The Contractor shall keep all relevant IS/ BIS/ special publications at site lab for various items of works covered in the present Contract.

### 22. ENGINEER

**22.1** Engineer for this project shall be the Engineer or the person nominated or appointed by NRDA from time to time and shall include any person duly authorised by them.

**22.2** Engineer shall be responsible for the execution of the project with regards to management and supervision. Instructions issued by the Engineer to the Contractor shall be deemed to be the Employer's instructions in respect of-

- 1. Day to day supervision including material testing using ISO formats proforma of which should be got approved from Engineer.
- 2. Approval of material and workmanship using ISO formats proforma of which should be got approved from Engineer.
- 3. Matter of urgency involving safety or protection of person or property.
- 4. Monitoring progress of work using System Application of Projects (SAP). (Refer 3.5 hereunder).
- 5. Interpretation of drawings
- 6. Interpretation of specifications
- 7. Issue of additional drawings
- 8. Certification of measurements and bills and issue of certificates accordingly for interim and final bills.

22.3 Engineer shall hold fortnightly progress meetings at site for evaluation and execution of works. The Contractor shall assist in providing revised programmes, cash flow charts in the format required by Engineer/ NRDA.

22.4 The Engineer shall coordinate works at site of all agencies appointed by the Employer.

#### 23. EXCAVATED OBJECTS

All the materials obtained during the process of excavation shall remain the property of the NRDA and shall be disposed off as instructed by the Engineer. The Contractor is supposed to use the selected materials for filling in plinth, pipe bedding, and providing embankment where required, filling the trenches and also filling low lying areas. All operations including loading, unloading, transportation of materials where required with all leads and lifts and handling them and levelling at disposal site etc., shall be included in the quoted cost and no extra payment whatsoever shall be made to the Contractor on the account.

## 24. AS BUILT DRAWINGS

The Contractor shall during the course of execution, prepare and keep updated a complete set of 'as- built' drawings recording all works on the blue prints, which shall be corrected daily, if necessary, to show each and every change from the Contract Drawings as a approved working drawings, shop drawings and the exact 'as-built' location, sizes and kinds of work etc. This set of drawings shall be kept on the site and shall be used for record purposes. Changes recorded shall be countersigned by the Engineer and the Contractor. Copies of 'as-built' drawings shall be supplied to the CE), NRDA/ and the Engineer on request.

The Contractor shall submit complete 'as-built' drawings on reproducible tracings and ammonia prints 10 (ten) sets in form of hard copies and Compact Discs 2 nos. for building work and all services as directed by the Engineer within 30 (thirty) days of the completion of entire work by using AutoCAD facility. Maintenance manuals and original warranties shall be submitted at the time of submitting the As-built drawings. In case the Contractor fails to submit complete 'as-built' drawings as aforesaid [in form of hard copies [10 (ten) sets] and Compact Discs [2 (two) nos.], he shall be liable to pay a sum equivalent to 0.1 percent of the value of work subject to maximum of Rs.10 lakhs (Rupees ten lac only) or as may be fixed by NRDA and this decision shall be final and binding. Pre-final & Final Bill shall not be released until all the as-built drawings are submitted & approved.

### **25.** ENGINEER'S SITE OFFICE

The Contractor shall construct and provide temporary site office for the Engineer's use of area measuring minimum 400 (Four hundred) Sq.mt. carpet area with Air Conditioners & ceiling insulation for entire office premises including Conference hall (Upto 25 person) as per the detailed drawings approved for the site office and shall be removed on completion of work. Toilet facilities shall be provided exclusive for Engineer-in-charge and PMC usages.

Broad details about construction of office and other facilities to be provided at the minimum shall be as follows:-

(a) This shall include individual cabins, Conference hall and Computer rooms approved by Engineer in Charge.

(b) The above office shall be fully furnished including furniture, fittings, fixtures etc. such as Lockers, Chairs, Sofas for waiting, Cabinets for storage of drawings/ tracings, Cabinets for storage of books, Cupboards for storage of box files & flat presentations, Soft boards – 4nos for display of CPM charts, White board - 4nos, 1 no. Refrigerator, RO Filter (Aquaguard /Kent) and water Cooler (Blue star) of 2 nos. of induction & Gas arrangement, Office stationary incl. papers, CDs, envelopes, pen holders etc. Minimum equipments required for providing tea/ coffee/ snacks etc shall be arranged by the contractor. The items shall be approved by EIC.

The Contractor shall arrange to maintain this office by daily sweeping the floor and keeping the premises clean. The Contractor shall also arrange to deploy 3 (Three) office boys for the pantry and for NRDA's Engineer's office. The Contractor is also required to provide three computer operators with computers for NRDA's Engineer's office. The provisions shall be approved by EIC.

Cost of all this shall be deemed to have been included in the tender as incidentals and no separate payment shall be made for providing these facilities.

If the facilities are not provided by the contractor, the same will be got executed by EIC at the cost of the contractor and will be recovered from their RA bills.

## 26. TRANSPORTATION

#### The Contractor shall provide one number new vehicles.

1(one) number of Mahindra Bolero 8 seated all new vehicles latest top model (airconditioned) with chauffeur and fuel at the disposal of the Engineer for the use by NRDA and its representatives in connection with the project during the period of the execution of the Project. The Contractor will bear all expenses, connected with the operation and maintenance of this vehicle including driver's wages, overtime and other benefits, cost of the fuel, lubricant, repairs and maintenance, insurance, etc. to the satisfaction of NRDA. The Contractor shall be required to bear the fuel expenses towards 4000kilometers of cumulative distance travelled by each vehicle per month. Vehicle shall be subject to an average maximum mileage of 50,000 kilometers per annum per vehicle. The vehicle shall be replaced with new vehicle after maximum run of 1, 00,000 kilometres. In case of break down or nonavailability of vehicle the NRDA will hire the vehicle at the risk and cost of the contractor. The vehicle may be withdrawn after 3 (three) months of completion of work including O& M Period. The vehicle should be under name of his firm/contractor and will remain fully dedicated to NRDA. The vehicle should be provided within 15 days after issuing the work order.

If the facilities are not provided by the contractor, the same will be got executed at the cost of the contractor and will be recovered from their RA bills.

### 27. PROVIDING COMPUTER & OTHER EQUIPMENTS AT SITE OFFICE

The contractor shall install the required configured computers and other equipments and operators for the office of Engineer including necessary stationery and furniture as under:-

a) 2 (Three) SONY/DELL/ LENOVO Desktop with Intel I-7 Processor, 4GB Ram, 1 GB Graphics Card, Hard drive 500GB, 17" TFT LCD Color Monitor and 3 years warranty. (Latest Model)

- b) 2(Three) I-PAD 4 (APPLE)/Galaxy Note 3 (Samsung), 3 years warranty. (Latest Model)
- c) LICENSED SOFTWARE LICENSED SOFTWARE: (Latest versions, where available),
  - i. Window -8 (2 Sets),
  - ii. AutoCad 2013 (2 Sets),
  - iii. Microsoft Office 2013 (2 Sets),
  - iv. Microsoft Project 2012 (1 Sets) and
  - v. Antivirus (4 License for 3 years)

d) PRINTERS AND OTHER PERIPHRALS including tonner, cartridges + backup till end of Defect liability period, (Latest Model with warranty)

i.	HP Laser Jet: A3 Latest Model color Printer	1 Nos
ii.	HP LaserJet: A4 Latest Model (All-in-one Printer)	1 Nos
iii.	Digital camera (18mega pixel)	1 Nos
iv.	Latest Model Laser distance measuring instrument (Bosch/Sokkia/Hilti)	1 Nos

v. UPS for all equipments

All computers at site and head office shall be interconnected by LAN connection as well as with a 24 hour broadband / WI FI internet connection **till completion of Defect liability Period** having a minimum bandwidth of 4MBPS.

e) Safety Helmets

100Nos

All the above equipments and softwares shall be retained with NRDA after completion of Defect liability Period. The Running and maintenance of the above equipments and softwares shall be born by the contractor till completion of Defect liability Period. If the facilities are not provided by the contractor, the same will be got executed by Engineer in Charge, NRDA including penalty for non-compliance of the same at the cost of the contractor and will be recovered from their RA bills.

## 28. TELEPHONE CONNECTION

The Contractor shall provide 02 (Two) nos. of Mobile phones (Nokia, Sony Erickson, Samsung) for use of NRDA staff including instrument with prepaid card of minimum value Rs.1,000 (Rupees one thousand only) per instrument per month. This arrangement may be withdrawn after 3 (three) months of completion of the work. If the facilities are not provided by the contractor, the same will be got executed at the cost of the contractor and will be recovered from their RA bills.

### 29. TIME SCHEDULE FOR COMPLIANCES

The tenderers should please note the following time schedule for various compliances and follow the same:

a) The Initial Security Deposit shall be paid within 15 (fifteen) days of receipt of Letter of Acceptance.

The Contractor should construct the site office within 1 (one) month of date of work order. The site office should be as per relevant clause in the tender document.

The CAR policy and Labour license shall be taken by the Contractor within 1 (one) month from the date of work order.

d) The M.S. Project formatted programme (Physical and Financial Programme) shall be submitted by the Contractor within 10 (ten) days of the date of work order and detailed breakup of quantities. The successful tenderer has to furnish Quality Assurance Manual along with programme within 15 (fifteen) days from the date of paying Initial Security Deposit.

#### **30.** APPROVAL OF ENGINEER

The foundation strata as well as steel reinforcement provided in all RCC members shall be got approved from the NRDA/ Engineer or his authorised representative. At every stage of work, approval of the Engineer shall be taken by the Contractor. Before starting any work like concreting, block masonry, water proofing, concrete, etc. detailed information of the work in the prescribed proforma shall be given to the Engineer and his approval shall be taken by the Contractor. It is the responsibility of the Contractor to get all the hidden measurements like foundation work, reinforcement, etc. recorded before covering the same. All the measurements shall be taken jointly by NRDA's representative and the Contractor's authorized representative and then only the measurements will be forwarded by the Engineer, who will forward it for payment to Chief Executive Officer, NRDA through Chief Engineer, NRDA and directions on any matter whether mentioned explicitly or otherwise.

## 31. PERMISSION FOR CONSTRUCTION OF SITE OFFICE/ GODOWN/ LABOUR HUTS:

The Contractor shall be permitted to construct temporary structures such as site office, godown, labour huts, Engineer site office, etc. on the land of NRDA within 1 Km radius of site.

The Contractor will have to submit requirement of land for Godown/ Labour Camp/ Batching Plant etc. with logistic layout in Technical Bid. The land shall be provided to the Contractor on Lump sum lease rent of Rs. 100/- (Rupees Hundred only) per year with Lease Agreement as per prevailing NRDA format. However the Contractor shall require permission of NRDA for erecting site office, labour huts. In the event the Contractor fail to remove site office/ godown and labour huts from the land immediately after construction is over, NRDA will charge rent as per the rules prevalent at the time. No final bill payment shall be made, unless the site is cleared by the contractor in all respects.

The Contractor shall number the structures and display name of the Company, period for which permission is granted, etc. at such approved sites.

No final bill payment shall be made unless the site is cleared in all respects by the Contractor.

### **32.** CONDITIONAL TENDER

The Tenderer shall note that the clarifications shall be obtained in the pretender meeting and the tender should be submitted without any conditions, whatsoever. Clarifications given to the various tenderers in the pre-tender meeting would be summarized by NRDA and would be issued to every tenderer as "Minutes of Pre-Tender Meeting". The same will be binding on all the tenderers irrespective of whether they have attended the pre-tender meeting or not. The Minutes of the Pre-Tender Meeting would form part of the Contract Agreement and the Tenderers should submit the Financial Offer taking into consideration the same. The Tender submitted with conditions would be summarily rejected.

### 33. SITE ORDER BOOK & OTHER BOOKS REQUIRED

The Engineer will maintain Site Order Book at the site of work. The Contractor or his authorized representative shall sign all the instructions received therein, in token of having received the same and shall comply with them forthwith.

All other books of record at site shall have to be maintained as required in the CPA Code of works.

#### 34. POURCARD SYSTEM

Pour card system/RFI system to be introduced for approval of individual activity. Format to be got approved from engineer before start of work.

#### 35. CLEANING OF SITE

- a) All water which may accumulate on the site during the progress of the works or in trenches and excavation shall be removed from the site to the satisfaction of the Engineer at the Contractor's cost. Site shall be maintained free from rubbish. Proper stacking of scaffolding material, shuttering material bricks/ brickbats, steel pieces, etc. needed for work on day to day basis shall be organized in proper stacks. Heaps of material lying around in unplanned manner and disorderly fashion shall not be permitted. Engineer's decision in this matter shall be final.
- b) The Contractor shall not, at any time, do cause or permit any nuisance on the site or do anything which shall cause unnecessary disturbance or inconvenience to Employer, tenants or occupiers of other properties near the site and to the public in general. The Contractor shall install mosquito proof and accessible water storage tanks for construction and drinking water.

- c) The Contractor shall periodically give largasidal treatment to water storage tanks, sites of water stagnation, water collection.
- d) Prior to handing over the contractor shall appoint Professional Cleaning Agency to clean the building works prior to handing over. The Agency shall have minimum 5 (five) years prior experience in the hospitality industry and shall be appointed with the prior approval by the Engineer.
- e) Any expenditure that may be incurred by NRDA to ensure that the above conditions are fulfilled by the Contractor will be debitable to Contractor's account and will be recovered from the running bills of the Contractor from time to time.
- f) Cleaning: Remove staining or reactive materials from new surfaces immediately during course of the Work.
- g) Debris: Remove hazardous accumulations of debris promptly, at least daily.
- h) Dust: Confine dust producing operations during painting and finishing .Vacuum immediately after completion.
- i) TRASH DISPOSAL
- j) General: Keep new buildings and site free from accumulations of waste materials.
- k) Removal: Remove cartons, crates, wrappings, lunch trash, and other trash from each room daily. Provide trash receptacles on each floor of each building and in convenient locations on the site.
- 1) Burning: Do not burn trash or other materials on Owner's property.
- m) EXCESS MATERIAL; General: Remove excess materials, including demolished materials, excess earth, and excess building materials from Owner's property and dispose of legally.
- n) Clean: Keep paved drives on Owner's property and public streets and alleys clean, by cleaning daily, or more often if necessary, of earth and debris spillage from trucking involved in construction operations.

#### 36. FENCING

During the construction, care shall be taken so that, areas around are not polluted and where required Hessian cloth shall be tied around, while work is in progress.

Further, it is obligatory on the part of the Contractor to fence the area allotted and earmarked by NRDA for labour camp, batching plant of the Contractor within a month of issuance of work order. The temporary fencing shall be provided in the area as directed by Engineer using vertical blinds using corrugated GI sheets about 3m high with necessary metal frame work and staging to cordon off the view of the premises. The Contractor shall maintain the fencing properly throughout the construction period.

## 37. WATCH AND WARD

The Contractor shall make necessary watch and ward arrangement for a period of three months from the date of total completion of work. No claim shall be paid to the Contractor towards the watch and ward during this period.

Protection General Requirements:

a) **Laws:** Comply with applicable laws, ordinances, rules, regulations, and orders of authorities having jurisdiction for safety of people and protection of property from damage, injury, or loss.

- b) **Responsibility:** Be solely responsible for initiating, maintaining, and supervising safety precautions and programs concerning Project security, but obtain Owner's approval of methods to be used and location of safeguards. Submit to NRDA, through Engineer, drawings and written description of methods and devices Contractor intends to use and do not begin Work at the site until such means and methods are mutually agreed on by Owner and Contractor.
- c) **On Public Property:** In addition to other means used in the interest of safety or security, comply with the requirements of governmental agencies having jurisdiction
- d) **Safeguards:** Erect and maintain, as required by conditions and progress of the Work, necessary safeguards, for safety and protection, including temporary fences, guards, railings, barricades, canopies, lighting, shoring, directional and danger signs, signals, and other warnings against hazards.
- e) **Security:** Protect and secure the site, new materials and equipment from theft and damage by whatever reasonable means are effective. Use methods such as the following, singly or together: locks, fences, signs, patrols, radio, alarms, locked storage on-site, and off-site warehousing.
- f) Wall Closures: Unless other acceptable means are provided, provide temporary closures for openings in walls along adjoining to make the building and site secure. Secure temporary closures when Work is not in progress using suitable means such as dead bolts inaccessible from the public side or locks or padlocks construction master keyed in accordance with Section, "Finish Hardware."
- g) **Entrances:** Do not block entrances to premises to remain in use or in any way inhibit access to them.
- h) **Design Live Loads:** Do not permit placing materials or equipment on new to exceed design load of structure or endanger structure or people.
- i) **Trenches:** Do not permit trenches to remain open for prolonged periods without adequate board covering or fencing.
- j) **Broken Glass:** Be responsible for glass broken during construction period; at completion, replace broken glass.
- k) Weather Protection: During construction, provide protection against weather (rain, wind, storms, frost, or heat), and maintain work, materials, apparatus, and fixtures free from damage. At end of each workday, cover new work likely to be damaged.
- 1) **Dust:** Take precautions necessary to keep Work under this Contract and adjoining property reasonably free of dust.
- m) **Protection of Construction Materials:** Refer to other specification sections for specific requirements.
- n) Materials Hoist: Do not permit transporting of people on materials hoisting facilities.
- o) **Removals:** Except for fences, remove temporary construction and protection specified in this section promptly when no longer needed and when removal is approved.
- p) Maintain temporary fences until date of Substantial Completion, unless approval is obtained for earlier removal; then remove the temporary fence.
- q) Damaged Site Improvements: Repair and restore to condition at beginning of construction, or better, existing site improvements, such as pavements, curbs, buildings, fences, lawns, plantings, and lighting which are not to be removed under this Contract but are damaged or defaced by Contractor's operations, except where new Work is required by the Contract.
- r) First Aid Equipment: Provide at the site. Also provide continually available trained and

qualified personnel to render first aid when needed.

s) **Emergency Signs:** Provide signs posted at telephones listing telephone numbers of emergency medical services, physicians, ambulance services, and hospitals.

### 38. MOBILISATION PERIOD

This clause shall be read in continuation of Clause No 10 (B) (ii) of GCC. The mobilization advance shall be limited up to 5% of value of work order. The mode of release of mobilization advance shall be as follows:-

- (i) 1% shall be released after issue of work order.
- (ii) 2% shall be released after completion of activities listed below.
- (iii) 2% shall be released after successful installation of Batching Plant.

Mobilization period for the Contractor shall be fifteen days from date of letter of intent. Contractor is obliged to adhere to these timings.

This shall be of 15 (fifteen) days and the Contractor shall carry out following:

- Compound/ Fencing to Site where required as per directives of Engineer.
- Contractor's Site Office (part). Engineer's Site Office.
- Construction of temporary hutment of labour.
- Arrangement for water supply.
- Arrangement for electric supply.

• Submission of Bar Chart programme for approval by Engineer with details of temporary works, plants, equipment and machinery list.

- Establishing full site godown for cement and steel yard.
- Establishing internal water supply for construction activities. Establishing internal electric network for construction activities.
- Submitting for approval a list & appointment of specialized sub contractors intended to be engaged at site with detailed credentials/ profile of the contractors.
- Appointment of Anti-termite sub-contractor.
- Establishing laboratory with testing equipments.
- Submitting proposal for concrete mixes and casting trial cubes.

• Approval of Bar Chart programme by Engineer with details of temporary works, plants, equipment and machinery list.

• Arrival of centering & shuttering material.

• Line out including establishing of grid lines for project and its approval by Architect through Engineer. Line-out shall include the establishing of the critical Capitol Complex line-out and its connections to other proposed roads in Naya Raipur.

#### **39.** METHOD OF CARRYING OUT THE WORKS

The Contractor shall, within 15 (fifteen) days of receipt of the Employer's order to commence work under respective clause of General Conditions of Contract submit for his approval a detailed programme and statement with drawings and diagrams showing how he proposes to carry out the works based on the tender programme. The statement shall describe the methods to be employed in carrying out the works, the Constructional Plant and temporary works which the Contractor intends to supply or use and shall include a list, classified into trades of labour force envisaged. The programme shall give the estimated

dates on which the various sections of the works will commence together with the estimated date of completion and estimated output so that the whole of the works may be completed within the Contract Period.

- a) In addition, the Contractor shall submit to the Engineer drawings and full particulars of Temporary Works he intends to construct at least 8 (eights) days before he intends to commence such works. The Engineer may require modifications to be made if he considers the proposals to be insufficient and the Contractor shall give effect to such modifications at his own cost but shall not be relieved of his responsibility for the sufficiency thereof.
- b) The Contractor shall prepare a detailed survey of existing services on the site which he shall clearly mark up on a drawing for the approval by the relevant service authorities prior to commencement of the works.
- c) The Contractor is to progress the works thoroughly and to take such action as is necessary in order to ensure that the approved programme is strictly adhered to in all its stages. The Contractor shall submit detailed programmes of the various sections of the works as and when required by the Engineer, the Contractor shall take all precautions and cover all contingencies to ensure that adequate spare equipment and materials are available at all times to ensure completion of this work in accordance with the agreed programme.
- d) The acceptance of programmes as submitted by the Contractor or with any modification thereto, in the opinion of Engineer, shall not relieve the Contractor of his responsibility to complete the work within period specified in as per Annexure 'A' unless extension of time limit is expressly sanctioned under respective clause of standard General Conditions of Contract or Special Conditions of Contract.
- e) The Contractor shall prepare the CPM programme on computer and the same to be monitored by proper installation of PC and printer facilities at the site.
- f) The bills shall be on computer and the programme will incorporate the deductions of Mobilisation Advance and other items.

## 40. CONTRACTOR RESPONSIBLE FOR SUFFICIENCY OF MEANS EMPLOYED

The Contractor shall take upon himself the full and entire responsibility for the sufficiency of plant, centering, scaffolding, timbering, machinery, tools or implements and generally for all means used for the fulfilment of the Contract. In the event of any of these means proving insufficient, the Contractor is still fully and entirely responsible for the sufficiency of these means notwithstanding any previous approval or recommendation that may have been given by the Engineer.

#### 41. DRAWINGS

The Contractor will receive from the Engineer, 2 (two) prints of the tender drawings listed hereof, together or thereafter with any further drawings issued for Road, Water Supply Net Work, Sanitation Electrical, Landscaping Works, etc. Working drawings shall be progressively issued as per the approved construction schedule submitted by the contractor & approved by NRDA.

#### 42. STANDARDS

In various places throughout this specification and the bills of quantities, reference is made to the standards, specifications and byelaws issued by the Indian Standard Institutions and other similar organizations. These references shall in every case be deemed to include the latest edition or issue of such standards, specifications and byelaws including all revisions, amendments and addendum

subsequently issued. Where materials are not specified and standard exists in respect of such materials, then the materials shall in all respects comply with relevant and current I.S.I. In such cases where I.S.I. do not exist, the best manufacturers' specification shall be followed; in absence of all these, Engineer's instruction shall be followed.

### 43. SUPERVISORY STAFF (As per clause 36 (i) of schedule F of the tender)

The Contractor shall engage on the work a qualified and experienced Engineers, Supervisor, capable of managing and guiding the work properly as detailed in Cl36(i) of schedule F of the tender Form F-1. This supervisor shall be authorized by the Contractor in writing to receive the orders issued by the Engineer from time to time. The Contractor shall be responsible for carrying out these orders promptly.

#### 44. FIRE PRECAUTIONS

The Contractor shall comply with fire regulations of the controlling authority in force at the site of the works relating to the precautions to be taken against fire hazards.

#### 45. USE OF SITE

The Contractor shall not use any portion of the site for purpose not connected with the works without the prior written approval of the Engineer. He shall maintain permanent and site access roads free of spillage and shall not interfere with the flow of traffic. Also same shall apply to terraces and other developed areas. This clause shall be read in conjunction with clause no. 15 of the Special Conditions of Contract.

### 46. SAFETY ENGINEER

The Contractor shall employ and depute at site on full time basis a fully qualified Safety Engineer(s) who shall be responsible to ensure observance of safety precautions and measure required to be taken at site. Further he shall make sure stipulations laid down in safety code as provided in GCC.

#### 47. QUALITY ASSURANCE MANUAL AND SAFETY MANUAL

Successful tenderers will be required to submit Quality Assurance Manual and Safety manual made as per applicable specification for various items of work and get the same approved from Engineer before start of work and the adhere the same during actual execution of work.

## i. Quality Assurance Manual (QAM)-

A quality assurance manual constituting a base document outlining quality policy of the agency, procedures, name of action, compliance, acceptance criteria and documentation etc. Shall be prepared by the successful tenderer and submitted to the Engineer for approval within 15 (fifteen) days from the date of receipt of work order. The QAM shall be prepared in such a way that it follows all the applicable specifications. The document shall generally cover aspects listed below, but not limited to the same.

Scope of work

- a) Planning for items to be executed including method statement and resource deployment both physical and financial.
- b) Identification of all parties involved in QA and their inter-relationship.
- c) Execution plan of Quality System giving reference standard frequency and acceptance criteria.
- d) Levels of cross checking/ verification in case of multiple verifications/ controls, including systems of inspection and audit, wherever applicable.

Signature of NRDA.....

- e) Organization of personnel, responsibilities and lines reporting for QA purpose.
- f) Testing and statistical analysis.
- g) Inspection reports at the end and during defect liability period/ maintenance period.
- $h) \quad \mbox{Items to be covered for maintenance manual,} \\$
- i) Check list viz. Forms and formats.

## ii. Inspection of Works at Factory/ Workshop

For any visits that maybe necessary for the purpose of performance of testing, inspection of factory made goods/ equipments, at a location other than the site or Raipur, the actual cost of travel (to & fro airfare/ train A/c 1st class), boarding & lodging, local transport & per diem (per person per day) costs at the rate of Rs. 3000 (Rupees three thousand only) for any visit made by officials from NRDA/ PMC/ Architect/ Consultant (maximum 3 (three) persons per instance), shall be borne by the Contractor. Such visits may be necessary for the inspection of chillers, panels, elevators, transformers, DG sets, fabricated doors, etc. that require inspection prior to shipping from the place of its manufacture. Any other item which is required to be tested before being processed/ fabricated in the factory, such visits shall require the prior written approval from the NRDA.

### 48. QUALITY ASSURANCE SYSTEM

A quality assurance procedure covering all aspects of the work shall be adopted for this work to ensure the desired quality. Details of the procedure shall be decided by mutual consultation between the Engineer and the contractor at the start of the works.

- a) The contractor shall submit within the time stipulated by the Engineer in writing, the details of actual methods that would be adopted by the contractor for the execution of any item as required by the Engineer at each of the locations, supported by necessary detailed drawings and sketches including those of the equipment and machinery that would be used, their locations, arrangements for conveying and handling materials etc., and obtain prior approval of Engineer well in advance of starting of such item of work.
- b) The Engineer reserves the right to suggest modifications or make complete changes in the methods proposed by the contractor, whether accepted previously or not, at any stage of work, to obtain the desired accuracy, quality safety and progress of work which shall be binding on the contractor and no claim on account of such change in method of execution will be entertained by the Employer so long as Specifications of the items remains unaltered.
- c) The Contractor shall furnish within the period of 15 (fifteen) days a detailed programmed schedule using PERT/ CPM technique in quadruplicate including the date of actual start, the monthly progress expected to be achieved and the anticipated completion date of each major item of work to be done by him, also indicating, plant and machinery and material procurement schedule.
- d) The schedule is to be such as is practicable of achievement towards the completion of the whole work in the time limit and of the particular items, if any, on the due date specified in the contract and shall have the approval of the Engineer. No revised schedule shall be operative without such acceptance in wiring. The Engineer is further empowered to ask for more detailed schedule or schedules say weekly for any item or items, in any case of urgency of work as will be directed by him and the contractor shall supply the same as and when asked for.

- e) The contractor shall furnish sufficient plant, equipment and labour as may be necessary to maintain the progress schedule. The working and shift hours for operations to be done under.
- f) Further, the contactor shall submit the progress of work in forms and statements etc. at periodical intervals in the form of progress charts, forms, statements and/ or reports as may be approved by the Engineer.
- g) The contractor shall maintain proforma, charts, details regarding machinery, equipment, labour, materials, periodical returns thereof as may be specified by the Engineer.

#### 49. EQUIPMENT MAINTENANCE MANUAL

The Contractor shall mention the list of machinery procured at site for the work in this manual. This manual shall also reflect the name of the manufacturer, age of machinery and the agency entrusted with the maintenance work of the machinery listed in the manual.

### 50. MINIMUM PLANTS, EQUIPMENTS AND SHUTTERING

Sr. No.	Particulars	Quantity (Minimum)
1	RMC concrete shall be used for all design mix concrete work	For all design mix
1	Computerised and Fully Automatic Concrete batching plant of minimum 30Cum /hr capacity	1 No. minimum or as required
	Cement Silos for 2 (two) days capacity with direct feeding and batching facility	
	Hoopers for fine and course aggregate	
	Approved Plasticizer dozing facility	
	Software programme compatible to make corrections to batching /mix design.	
	Concrete Pump of required capacity	2 Nos.
	Transit Mixer of 6 Cum capacity	4Nos.
	MS concrete Piping system for pumping	3 sets per Pump set
2	Steel lifting Electric winch	1 No.
3	JCB	1 No.
4	Proclain with Rocker Breaker	1 No.
5	Vibrators	
а	Electric with low noise	8Nos.
b	Petrol (Stand by)	4Nos.
С	Needle Vibrator - 20	6 Nos.
d	Needle Vibrator - 40	6 Nos.
е	Needle Vibrator - 65	4 No.
6	Bar Bending Machine up to 40mm dia.	2 No.
7	Bar cutting Machine up to 40mm dia.	2 No.
8	Material Hoist	4 Nos.
9	Curing Pumps	6 Nos.
10	Double legged tubular scaffolding System	As per requirement
11	Pan mixer of not less than 0.5 Cum	2 Nos.
12	Plate Vibrators of 1 ton capacity	2 Nos.

Sr.	No.	Particulars	Quantity (Minimum)
13		Minimum shuttering material to be provided by the contractor (Good quality steel plate's inc steel propos etc.)	As per requirement

Note: The details referred to herein above are only for the purpose of quantitative assessment. The specifications & qualitative aspects of the shuttering material shall be in accordance with the BOQ & Technical specifications. The details are to be provided with in 30days after award of contract.

### 51. SUBMITTALS

Unless otherwise specified or directed by NRDA, the Contractor shall submit to NRDA for his review and approval all Co-ordinated services drawings, shop drawings, samples, materials lists, equipment date, instruction manuals, record documents, manufacturers' equipment manuals, design calculations for proprietary items of work, technical submittals, and other information required by the Contract Documents. Submittals and their contents including deviation shall be properly prepared, identified, and transmitted as provided herein or as the Owner may otherwise direct. Except for record documents and instruction manuals for operation and maintenance, submittals including deviation shall be approved before the material or equipment covered by the submittal is delivered to the site. The contractor shall furnish an authority if required from material suppliers.

### 52. PLANT, MACHINERY AND SHUTTERING

The contractor is required to submit details of plants and machineries to be deployed by him in a proformas indicating all details such as make, year of manufacture, registration etc be submitted. The details are to be provided with in 30days after award of contract.

## 53. SUB-CONTRACTORS

All specialised works will be carried out by licensed (where applicable) sub contractors approved by NRDA.

- i. It may be noted that the contractors will have to submit credential of the selected contractors to NRDA for approval.
- ii. It may further be noted that even if the contractor has in house licensed subcontractors for these works, they will have to select and engage contractors with prior approval of NRDA.
- All specialists, merchants, tradesmen and other agency executing any work or supplying iii. goods which and fixing items have been included any in the Schedule of Quantities and/ or Specifications or for Extra/ Substituted items of works, who may be nominated or selected by the Engineer/ Contractor are hereby declared to be Sub-contractors employed by the Contractors. No nominated Sub-contractor shall be employed on or in connection with the works against whom the contractor shall make reasonable objection or (save where the Engineer and contractor shall otherwise agree) who will not enter into a contract provided:
  - 1. That the nominated sub-contractor shall indemnify the Contractor against the same obligations in respect of the sub-contractor as the contractor is under in respect of this contract.
  - 2. That the nominated sub-contractor shall indemnify the Contractor against claims in respect of any negligence by the Sub-contractor, his servants or agents or any misuse by him or them or any scaffolding or other plant, the property of the Contractor or under any Workmen's Compensation Act in force.

- 3. That the nominated sub-contractor shall submit his bills to the Contractor.
- 4. That the Contractor shall make payment to the nominated Sub-Contractor within 3 (three) days of the Contractor's receipt of the payment from NRDA against the Engineer certificates of payment providing that before any Certificate is issued, the Contractor shall upon request, furnish to the Engineer proof that the nominated sub-contractor's accounts included in previous certificates have been duly discharged in default whereof NRDA may pay the nominated Sub-contractors upon a certificate of the Engineer and deduct the amount thereof from any sums due to the Contractor. The exercise of this power shall not create privity of contract as between NRDA and Sub-Contractors.
- 5. The Engineer in his absolute discretion may recommend payment to the nominated Sub-Contractor directly by NRDA and deduct the amount thereof from any sums due or which may become due to the Contractor or recover the same amounts from the Contractor.
- 6. No Labour contracts shall be permitted.
- 7. Prior approval of the Sub-contractor by the NRDA is mandatory.
- 8. Required 2 No. of contractors as choice would be of NRDA
- 9. Further sub-contracting/ sub-letting of the work shall not be permitted.
- 10. NRDA shall not permit under any circumstances Assigning, Transferring or Subletting of entire work or substantial part of work to be executed under this contract. If the Contractor attempts or assigns, transfers and sublets the entire or substantial work, the contract shall be terminated by the NRDA without prejudice to any right or remedy which shall have accrued or shall accrue thereafter to the NRDA.
- 11. The Contractor shall not be permitted to give power of attorney for executing the work to any other agency or person on their behalf. The power of attorney for executing the work shall only be given to regular employee of the agency with prior approval of NRDA.

#### iv. Works to be Sub-Contracted & Prequalification criteria:-

The details of work to be subcontracted and PQ criteria shall be governed as mentioned in detailed  $\ensuremath{\mathsf{NIT}}$ 

#### v. ESSENTIAL CONDITIONS FOR ELETRICAL WORKS:-

1. The Sub-contractor for carrying out the electrical works under the contract should strictly be in accordance with the above criteria.

2. All above referred works will have to be carried out under the supervision of Engineer.

3. Power supply distribution scheme given in tender document is only for guideline purpose. However, successful agency will be responsible for obtaining necessary sanctions to over all power supply distribution scheme, from CSEB/ applicable local authority and Engineer before starting execution of work. No extra charges will be paid for obtaining necessary approvals/ sanctions to power supply distribution scheme sanctioned by concerned power supply authority CSEB/ applicable local authority, successful agency will have to take up and complete the work accordingly.

4. Successful agency will have to obtain the required approvals to the total electrical works such as, HT/ LT distribution, Sub-station, Meter rooms, DG sets, etc from CSEB/ applicable local authority/ concerned power supply authority, Electrical Inspector, authority or any other statutory body at their own cost before starting execution of the work and the original sanctions obtained should be submitted to NRDA's concerned Electrical Division before execution of the work. Any statutory cost for obtaining the approval will be reimbursed on production of original receipts.

5. It will be the responsibility of the agency to get the energy meters of the DG sets approved/ tested/ sealed from the necessary authorities.

6. The electrical works under the scheme should be carried out strictly in Coordination with the concern CSEB/ applicable local authority and necessary approvals should be obtained from time to time.

7. Activity Bar Chart and the makes of material should be submitted for electrical works for necessary approvals from the competent authority from NRDA before execution of the work and work should be started only after the approvals.

8. It will be the agency's responsibility to obtain the following listed documents from CSEB/ applicable local authority. Electrical Inspector authority and other concerned Statutory Body towards completion of the work at their own cost, without which work will not be treated as completed.

a) Sanction papers for the total external electrification works along with BOQ of material, demand note for supervision charges, if any.

b) Charging permission of the installation.

c) Inspection report of the various equipments & material supplied under the electrification work certified by CSEB / applicable local authority and NRDA authorities.

d) Manufacturers test certificates and guarantee certificates in original for all the equipments and material supplied for execution of electrification work under the scheme.

e) As Built drawings as stated Volume I for substation, HT/LT network, meter room, etc. showing all the details and certified by CSEB, Electrical Inspector authority (along with soft copy).

f) As Built Drawings as stated Volume I for internal electrification work, area lighting work, water pumps, etc. (along with soft copy)

g) Earth test report for the total installation.

h) Work completion report from CSEB/ applicable local authority for the total electrification work including substation, HT/LT distribution, Meter Room etc. should be submitted.

i) Handing over of the total electrification work under the scheme, such as substations, including equipments, HT/LT distribution, meter room with energy meters to CSEB/ applicable local authority. The letter in writing for taking over of the installation as above addressed to Engineer should be obtained from CSEB and should be submitted along with details of scheme.

j) Separate guarantee, from the electrical agency should be submitted to NRDA against the electrical works carried out under the scheme, for a period of 18 (eighteen) months including defects liability period in order to avoid any inconvenience in connection with releasing and common services under the scheme and also to attend any defects in installation during this period.

Required electrician/ Helpers are to be deployed round the clock for Operation & Comprehensive Maintenance of total Utility works & installations for a period of 18 (Eighteen) months from the date of completion OR taking over of the installation whichever is later.

9. All material & equipments to be supplied under this contract shall be offered for

inspection at the manufacturing place. No material shall be supplied by the agency without the clearance from the Engineer.

10. The total electrification work under the scheme will have to be carried out as per the terms & conditions mentioned in various sections of the Tender Document.

11. Electrical works under the contract will not be treated as completed unless and until above listed activities are completed by successful agency.

**54.** Subject work is strictly to be completed within stipulated work completion Period and in accordance with the activities listed below completely as per the directives from Engineer. The charges and the expenses for completing the following listed activities should be included in the quoted offer and no separate payments against this will be made.

1. Successful agency will have to obtain and submit the Contractor All Risk Insurance Policy (CAR) in original within 1 (one) week from date of work order from Director of Insurance, Government Insurance Fund, Raipur, Chhattisgarh. The Contractors All Risk (CAR) Policy as said above shall be inclusive of insurance coverage under workman's compensation insurance policy for all workmen employed by contractor to complete the works covered under present contract. Further the contractors All Risk Policy period completely as stated in the tender. In case of time period extension (If any), it is essential that, premium of CAR policies should be timely paid by agency in order to ensure the continuity of CAR policy without any break in the same, suitable action will be taken against defaulters as per General Conditions of Contract unless and until the Contractors All Risk Policy as stated in above manner is submitted to the office of Engineer no payments will be released against any work executed.

2. Obtaining necessary scheme sanctions in detail towards execution and completion of subject work in all respect, from concerned CSEB/ applicable local authority. This activity includes required co-ordination and follow-up with concerned CSEB/ applicable local authority for obtaining necessary scheme sanctions. The scheme sanction should be inclusive of specifications and required layout and other drawings etc. completely as per the requirement.

The payment towards the supervision charges of CSEB/ applicable local authority shall be paid directly to CSEB/ applicable local authority on behalf and in the name of NRDA by the agency.

The original scheme sanctions along with original certified drawings, specification details, quotations, payment receipt against supervision charges etc. should be submitted to the Engineer.

The supervision charges paid in the name of NRDA as mentioned above shall be reimbursed on submission of original payment receipts.

3. If required, preparation and submission of execution drawing in co ordination with concerned planning authority of NRDA by engaging Govt. approved Surveyor for confirmation and marking of proposed cable routes, location of control pillar, existing services along the proposed route under the present contract as per the sanctioned scheme obtained from CSEB Reports and marked computerized plans duly certified by surveyor in 3 sets of should be submitted after carrying out the details survey as mentioned above.

4 Obtaining necessary road/ soil/ footpath etc. cutting permission for cable trenching from concern authorities like NRDA/ CSEB/applicable local authority/ RMNN/

PWD etc. as applicable along the approved route and submit the approval in original along with the drawings and permission to Engineer.

The charges required for obtaining the approvals and permission as mentioned above should be directly paid on behalf and in the name of NRDA by the agency.

The charges paid in the name of NRDA as mentioned above shall be reimbursed on submission of original payment receipt to the Engineer

5. Preparation and submission of shop/ execution drawing to Engineer for approvals. Submitting list of Makes of various items and material to be used under present contract for approvals.

6. The Contractor or his qualified engineer having updated technical knowledge for execution of the subject work should invariably remain present and co-ordinate during every inspection and testing programme at manufacturers works, similarly during every joint site visits and when required.

7. After supply of material at site, all the documents such as delivery challan, excise gate pass, material test report (in original), etc. should be submitted to Engineer for obtaining installation clearance.\*

8. The complete work under the present contract shall be carried out with required supervision, stage-wise inspection from concerned authority of CSEB/ applicable local authority & Electrical Inspector authority in co-ordination with Engineer complete with required power shutdowns. The record of all inspection and shutdowns shall be submitted to Engineer.

9. The execution work of cable trenching/ foundation for poles/ foundation of feeder pillar/excavation and trenching in all types of surfaces rocks, soils etc. shall be carried out as per approved route plan by using appropriate tools and machines in close co-ordination with concerned authorities from NRDA, CSEB/ applicable local authority, etc. completely as per the requirement so as to avoid the damages to the existing services.

8. Obtaining clearance certificate from concern authority of NRDA, RNN, PWD, CSEB/ applicable local authority, etc. As applicable, towards completion of re-surfacing work of cable trenches, excavated surfaces and removal of debris and submission of this clearance certificate in this regard obtained from concerned authorities to Engineer.

\* In absence of activity No. 1 & 15 above, the payment towards cable trenches erection and installation will not be released.

10. Arranging and carrying out pre & post testing and commissioning of the completed installation in presence of Engineer, his representative and the representative of any other statutory authorities like CSEB/ applicable local authority & Electrical Inspector etc. as required.

11. Excess saving statement as per final execution of work, item wise measurement break up in detail and escalation claim as applicable along with detail calculations and copies of confirmed indices etc. to be submitted to Engineer.

It is mandatory to complete all the activities listed above from Sr. No. 1 to 11 for releasing the final payment.

**55.** Following conditions are the essential conditions of contract for carrying out and completing the subject work in all respect within stipulated time period. The successful agency will be responsible for completing the same as per the directives of Engineer. The charges and
expenditure if any required for completing the same should be including in the quoted offer, and no separate payments against this will be made.

1. The contractor shall visit the site to access the actual quantum of work and period required for completing the same before quoting the offer.

2. Scheme specifications and quantity of the material to be used for the subject work under the contract and specified in the tender document is only for guideline purpose. However it will be the responsibility of the successful agency to obtain the measurements and specifications in detail of each and every item before starting the execution of work and complete the work in accordance with the approvals, clearances obtained for the same. All cost required for completion of work as per statutory approval, shall deemed to have included in the offer quoted.

3. The foundation and excavation for feeder pillar and control pillar, grouting of frames in wall/ ground etc, are require to be carried out by the agency, and cost for the same shall be include in the offer quoted.

4. It will be Agency's responsibility to obtain necessary sanctions and permissions by paying necessary charges towards;

a) Obtaining necessary scheme sanctions and permissions for completing the subject work in all respect from any concerned statutory authority.

5. The successful agency will be completely responsible for accidents occurred if any during the execution of work as well as during 24 (twenty four) months defect liability period under this contract. It will also be the responsibility of agency, for making police complaints against any thefts and accidents etc. under intimation to NRDA.

6. Charges against following listed activates should be included in the quoted offer itself and no separate payments will be made against same.

a) Arranging and carrying out the material inspecting at respective manufactures unit as stated in Annexure - I.

b) Arrangements for performing site visits and other connected activities as and when required by Engineer or his representative.

c) Carrying out necessary co-ordination and follow up with concern authorities for obtaining necessary sanctions and permissions as required towards completion of work in all respects.

d) Appointing Govt. Approved surveyor for carrying out site survey and preparation of computerized shop drawing, Execution drawing, As built drawing etc. with soft copy.

e) Any other incidental charges required towards completion of work in all respect.

7. Bills submitted against the executed and completed works at site, will be processed further by Engineer, after necessary scrutiny and verification.

**56.** The services/ tasks/ works as referred to under clauses shall be suitably applicable to all Utility services executed by the contractor, whether specifically mentioned herein above or no.

### 57. Safety, Security and Protection of the Environment

Signature of Contractor.....

The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:

(a) Have full regard for the safety of all persons entitled to be upon the Site and keep the Site (so far as the same is under his control) and the Works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons,

(b) provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and

(c) take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

#### 58. HANDING OVER PROCESS:-

The handing over process shall be based on a performance comprising individual activities. The process shall be approved by the Engineer.

### 59. EROSION AND SEDIMENTATION CONTROL

- i. **General:** Prevent pollution of land, air, and water; control erosion, washout, and surface runoff of earth and stockpiled materials. Preclude sedimentation in general and especially in existing on-site and public storm-water system and public right of way.
- ii. **Procedures:** Perform erosion, sedimentation and temporary storm-water control. Follow procedures stipulated in local laws and regulations and as shown on Site work drawings.
- iii. **Maintenance:** Maintain controls in place until permanent controls are functioning. Remove when no longer needed.

### 60. NOISE AND VIBRATION CONTROL

Noise and Existing Building Structure Vibration Generated by Construction Procedures, Equipment, Tools, and Operations: Keep to minimum practicable during demolition and removal from building and site, including loading and removing storage containers. Equipment generated noise levels shall not exceed the following in decibels:-

- 1. Concrete mixer: 85
- 2. Concrete pump: 82
- 3. Crane: 83
- 4. Materials elevator: 85
- 5. Pumps: 76
- 6. Generators: 78
- 7. Compressors: 81
- 8. Pneumatic tools: 86
- 9. Saws: 78
- 10. Vibrators: 76
- 11. Other tools: 85

- i. Operation of Air Hammers, Compressors, and Reciprocating Equipment: Not permitted inside existing buildings unless specifically approved in writing by Owner.
- ii. Laws: Comply with applicable noise control laws, ordinances, and regulations.
- iii. Acoustical Enclosures: Stationary equipment may be enclosed to produce required sound attenuation subject to continued maintenance of such enclosures to ensure that specified sound levels are not exceeded.
- iv. Violations: Where field sound measurements reveal sound levels exceeding those specified, cease operating such equipment and repair or replace it with equipment that complies with the sound levels specified.
- v. Cutting and Drilling Concrete: Use only rotary or core drilling for holes through concrete. Do not use impact tools to cut or otherwise remove concrete or to install inserts.
- vi. Power-Activated Tools: Not permitted in or immediately adjacent to existing buildings, except with Owner's written approval in each specific case, except where such use is specifically specified.

### 61. EXISTING CONDITIONS

i. Contractors Examination of Site:-

1. By executing Contracts, Contractor and subcontractors represent that they have:

a. Visited the site and made due allowances for difficulties and contingencies;

b. Compared Contract documents with existing conditions and informed themselves of conditions to be encountered, including work by others, if any, being performed; and

c. Notified Architect of ambiguities, inconsistencies, and errors they have discovered within Contract documents or between Contract documents and existing conditions.

2. Failure to visit the site and become familiar with conditions shall not relieve Contractor or a subcontractor from furnishing materials or equipment or completing the Work in accordance with Contract documents at no additional cost.

3. Contractor or subcontractors will not be given extra payment for Work related to conditions they can determine by examining the site and Contract Documents.

4. Contractor or subcontractors will not be given extra payment for work related to ambiguities, inconsistencies, or errors within Contract documents, or between Contract documents and existing conditions, when such ambiguities, inconsistencies, or errors are known to Contractor or subcontractor before Contract execution unless Contractor or subcontractor has notified Architect in writing of such condition before execution of Agreement Between Owner and Contractor.

- ii. Make use of public property and make arrangements for that use. No extra compensation will be paid due to costs associated with using public property.
- iii. Access by Contractor to portions of Owner's property beyond the actual area of Work under this contract is denied, except where necessary to perform the Work, and then only with specific written approval in each case. Refer to other

sections for additional requirements.

- iv. Contractor shall accept the site in the condition in which they exist at the time Contractor is given access to begin the Work.
- v. Damage caused by Contractor to existing structures, grounds plants, pavements, utilities, work by others, fixtures, or furnishings, shall be repaired by Contractor and left in as good condition as existed before the damaging, unless such existing work is shown to be removed or replaced by new Work.
- vi. Immediately upon entering the site for purposes of beginning Work, locate general reference points and take such action as is necessary to prevent their destruction; lay out Work and be responsible for lines, elevations, and measurements, and Work executed under this Contract. Exercise proper precautions to verify figures shown on Drawings before laying out Work. See Section "Field Engineering" for additional requirements.
- vii. Contractor and each subcontractor, before starting work, shall verify governing dimensions at the premises, including floor elevations, floor-to-floor heights, and column locations and shall examine adjoining Work on which Contractor's or subcontractor's Work is in any way dependent. No "Extra" or additional compensation will be allowed on account of differences between actual measurements and dimensions shown. Submit differences discovered during the Work to Architect for interpretation before proceeding with associated Work.
- viii. Employment of local labour shall be given priority wherever possible. However,
- ix. This shall not in any way affect/ dilute the Contractors obligations listed within the Tender document.

### LAMINATION OF DRAWINGS

All drawings issued to site shall be kept in lamination condition.

### 1. Maintainance of installed equipments, macheneries and fixtures:

The Contractor, at the time of bidding, will be responsible to ensure the completeness and adequacy of his Bid Price to fulfill the entire responsibilities for Maintaining the installation of all installed equipments, machineries and fixtures minimum for a period of 1 year from the date of commissioning and imparting training to the workers/ staff as asked for maintaining the installations as per IS requirement and exercising.

### 2. Handing Over:

At the time of handing over after completion of work, all the equipment, spare including standby equipment etc. must be in good working order as were taken over before commencement of defect liability period.

# **3.** Penalties for failure to achieve the functional guarantees during Defect liability Period:

In case of failure to deliver the required quality of work, liquidated damages shall be imposed for such failure to meet the performance criteria, as described below. The Employer will be entitled to recover any such damages from the security deposits of the contractor or any other sun due to him. However, the contractor shall be allowed to take up routine/ periodical maintenance as per IS guidelines, with prior permission of the Authority. i. For each breakdown of any equipment/machinery for more than 12 hour: Penalty @ Rs. 6000.00 each time

ii. Non redressel of any complaint within 48 hours: Penalty @ Rs. 12000.00 for each such complaint.

iii. Penalties for absence of Supervisory / Operating staff shall be as follows:

SI. No.	Staff Category	No. of Staffs	Penalty for absence
1	Electrician	1	Rs. 500.00 per day
2	Mechanic cum Fitter	1	Rs. 500.00 per day
3 Watchman 4 Rs. 350.00 per day / person			
Note: However contractor can depute substitute staff with permission of the Authority in			

case leave of any staff member. In such case this penalty shall not be levied.

### 62. ORDER OF PRECEDENCE

In case of any discrepancy between the items mentioned in the BoQs/Specifications/Drawing, the Order of precedence should be as follows:

- i. Item details as mentioned in the BoQs, read along with the specification shall prevail. However in case of conflict specification shall hold good.
- ii. Drawings.

### **PAYMENT**

- 1. The Contractor, at the time of bidding, will be responsible to ensure the completeness and adequacy of his Bid Price to fulfill the entire responsibilities as described above.
- II. On completion of work i.e. after **Defect liability Period**, the contractor shall handover all the machineries, equipments & fixtures such as bore well, pump, motor, sprinklers fountain accessories etc. in good working condition to NRDA, including plant/hedges/tree/lawn etc.

Signature of Tenderer Date :

For

Chief Executive Officer, NRDA, Utility block, Capitol Complex, Sector- 19, Naya Raipur- 492 002, Chhattisgarh Tel No: + 91 771 2511500; Fax No.: +91 771 2511400.

Date :

# SCHEDULE – D Section-V List of Approved Makes

Signature of Contractor.....

For the items missing in the list/ the relevant IS Code and specification should be binding on the contractor. The contractor should take approval wrt the approved vendor list prior to any procurement from the Engineer-in-charge.

Sr. No.	Item	Approved Make	
1	AAC Blocks	BILT or Equivalent as approved by NRDA	
2	Acoustical Ceiling tiles	Armstrong / Anutone/ Hunter Douglas	
3	Adhesive For Wood Work	Fevicol/Vamicol/Dunlop	
4	Aluminium Accessories	Classic/Argen/Oxford/Nulite/Crown/EBCO	
5	Aluminium composite panel	ALUCOBOND/ALSTONE/Eurobond	
6	Aluminium Sections	Hindalco/Jindal	
7	Anti-Termite Treatment	Pest Control India Ltd/Pest Control Service of	
		India/Pest India Corporation/ Godrej	
8	Bricks and Brick tiles	Best quality available conforming to class 75	
9	Calcium Silicate Boards	HILUX by RAMCO/Gypsum India/Lafarge	
10	Cement PPC/OPC	Ultratech/Lafarge/Ambuja/ACC/Birla/Century India Cement.Cement from mini cement plants shall not be allowed.	
11	Cement Based Paint	Super Snowcem (Killick Nixon Ltd.)/Duracem/ Berger	
12	Cement Board	Everest/Bison/Hyderabad Industries	
13	Ceramic Tiles Adhesive	CICO/Bell/Pidilite/Weber (Saint Gobain)/MYK/	
		Latricrete/Bal-Endura	
14	Clear Glass	Saint Gobain/Asahi India Safety/Modiguard/	
		Pilkington	
15	Concrete Additive	Sika /STP/CICO / Fosroc/Roffe/ Pidilite	
16	Compressed Chequered Tiles	Eurocon/Unitile/Ultra Tiles& EquivalentApproved by NRDA	
17	Curtain Rod	Vista Levolor/Mac Décor/Aerolux/Luxelon/ Hunter Douglas	
18	Dash Fasteners	Hilti/Fisher	
19	Extruded Polystyrene Board	Supreme Industries/ Owens Corning/SIKA	
20	Fire Doors	Shakti Met-Dor Limited/Navair/Signum	
21	Flush Door	Kitply, Merino, CENTURY. Green Ply Industries/Sarda Plywood Industries Ltd (Duro Door)/Archid	
22	Fly-ash Bricks	Brick Shall be as per IS 12894	
23	Glass Doors (Motorised)	Autodoor Industries/DORMA/Manusa/Enox	
24	Glass Fibre Acoustical Tiles	ECOPHON/Armstrong/Anutone	
25	Glass mosaic tiles	Italia/Bissazza	
26	Grab Bars and Disabled Hardware	DLine/ Commander/Jaguwar/Hindrance	
27	GRC Screens/Louvers	Unistone/Grasim	
28	Gypsum Ceiling	Lafarge/ Saint Gobain/Gypsum India	
29	Heat Reflective Glass/ thermal glass	Saint Gobain/Asahi India Safety/Pilkington/ Armstrong	
30	Interlocking Paving Blocks / Grass Pavers	Ultra Spectra/ Eurocon/ Duracrete	
31	MDF Bords	Panelmax (Greenlam) /Anchor/Duro/Archid/Merino	

### A. APPROVED MAKE LIST FOR CIVIL WORKS

Signature of Contractor.....

Sr.	Item	Approved Make
No.		
32	Metal Ceilings	Armstrong / Hunter Douglas (Luxalon)
33	Mineral Fibre Grid Ceilings	Armstrong / DAIKEN/ Hunter Douglas
34	Mirrors	Modiguard/Saint Gobain/Asahi India Safety
35	Modular Toilet Partitions	BESCO by Merino/Sturdo by Greenlam
36	Night Latch	Godrej/Dorma/Heffelle/Hettich
37	Oil Bound Distemper & Dry	Berger Paints/Nerolac Paints/Asian Paints/Jenson &
	Distemper	Nicholson Paints./AkzoNobel (Dulux)
38	Panic Exit Device	Dorma/DLine/ Heffelle/Hettich
39	Ply/ Commerical board/ Block boards/ Particle Boards	ARCHID/Century/Bhutanboad/Duro/National/Kitply
40	Polyurethane insulation and waterproofing	BASF/ BAYER/Huntsman (ICI)/Lloyd Insulations
41	Polycarbonate Sheets	Lexan from Sabic/G.E./Wilson/Sunpal/Bayer
42	Polymeric APP felt	Shalimar Tar Products (STP)/ Texsa India Ltd.
43	Polysulphide Sealant	STP/CICO/Pidilite
44	Pre-Laminated Particle Board	Anchor/Merinolam/Archid/Novopan/Greenply/Kitla
		m
45	PVC Flooring	Tarkett Floors/LG Floors/Armstrong
46	Resin Based Cement	Killick Nixon/Berger/Nerolac/ICI/Pidilite.
47	Rolling Shutters	Shakti Met-Dor Limited/Rama Rolling Shutters&Equivalent
48	Silicone Sealant	WackerChemie/Pidilite/Dow Corning
49	Spider Fittings/ WCP profiles /Patch	Dorma/ Dline/Heifele/Hettich
	Fittings	
50	Stainless Steel Friction Stay	Securistyle/ EBCO
51	Stainless Steel Screws	Kundan/Puja/Atul/Northfold
52	Steel: Main Producers only	SAIL/RashtriyaIspat Nigam Ltd./IISCO/ TISCO/TATA/IINDAL/ESSAR
53	Structure Steel & Hallow Seation	Tata/Jindal/Sail/Bhushan
54	Synthetic Enamel Paints	AkzoNobel (Dulux)/ Kansai Nerolac Paints
51	Synthetic Entanier Faints	(Nerolac)/ Asian Paints (Apcolite)/ Lewis Berger
		Paints (Luxol)
55	Tensile Fabric Roofing	ENCON/Structureflex
56	Texture Paints (Exterior)	Heritage/ AkzoNobel (Dulux)/Asian Paints
57	Texture Paints(Interior)	Heritage/Asian Paints/Dulux
58	UPVC Rain Water Pipe	Prince/Supreme/Finolex/Oriplast
59	Veneered Particle Board	Kitply/Anchor/Archid/Century/Duro/Bhutan/
		Greenply Particle Board.
60	Veneers and Laminates	Greenlam / Century/Merino/Euro/Archid
61	Vitrified Tiles/Ceramic Tiles	NITCO/ ASIAN/
		KAJARIA/RAK/JOHNSON/Orient Bell
62	Wall putty	Birla / JK
63	Water Proofing Materials	Shalimar Tar Products (STP)/ SIKA/IWL (India)
	_	Ltd./Lloyd Insulations India Ltd./Chemisol Adhesive
		Pvt. Ltd. Mumbai Chemistik) /CICO /Choksey
		/Fosrock /Dr. Fixit, BASF
64	White Cement	JK/Birla
65	Wooden Finish Ceilings	Armstrong / Anutone
66	Precast concrete tiles	Ultra/Eurocon/Duracrete

### **B. APPROVED MAKE LIST FOR PLUMBING WORKS**

Sr. No.	Item	Approved Make
1	Automatic variable temperature control/ fixed temperature control faucets	Parry/Jaguar/Kohlar/Hindware
2	Ball Valves /Globe valves	ITAP (Italy)/TBS Engineers Ltd./Zoloto/RB (Italy)/Leader/Surya/ DRP -M
3	Battery operated Autosensor Urinal flushing system	Parry/UTech Systems/AOS Systems/Jaguar/Kohlar/Hindware
4	Brass stop & Bib Cock	L&K/ Jaquar/Hindware/Kohler
5	Ball valve with floats	Zoloto/ Leader/ Sant/ Jayco
6	C.I. Spun Pipe (IS 8329)	Electro Steel/Kesoram/IISCO/Lanco
7	Centrifugally Cast CI Soil Waste Pipe And Vent Pipes (IS 3989)	Neco/Anand/HAPPO/Ashutosh Casting
8	CPVC Valves up to 50 mm Dia	ASTRAL/Ashirvad/Supreme/Finolex
9	CPVC Pipes & Fittings above 50 mm dia	ASTRAL/Ashirvad/Supreme/Finolex
10	CPVC Pipes & Fittings up to 50 mm dia	ASTRAL/Ashirvad/Supreme/Finolex
11	Chlorinator	Ion Exchange/Thermax Limited.
12	C.I. Rainwater inlet fitting/Bronze gratings etc.	Sage Metals/GMGR
13	Copper Fittings (Capillary)	Yorkshire Imperial/ U.K./Rajco Metal Works/ Mumbai/IBP Conex Ltd.
14	Copper Pipes	Rajco Metal Works/ Mumbai/IBP Conex Ltd.
15	C.I. Sluice Valve (Fully Way Checked And Globe Valve)	Leader/Kirloskar/Upadhyay
16	C.P. Fitting And Accessories	Kingston/Jaquar/Marc/Parry/GEM/Hohlar/Hindwar e
17	Cockroach Trap	Chilly/Player/Jayna
18	Centrifugal Pump	Crompton/Kirloskar/KSB
19	C.I. Fitting	R/Ks/Avr/Unik/Neco/Hepco
20	C.I. Sluice Valve& Non- Return Valve	Kirloskar/IVC/Leader/Electrostal
21	C.I. Spun Pipe (IS 8329)	Electro Steel/Kesoram/IISCO/Lanco/Neco/Hepco
22	Centrifugally Cast CI Soil Waste Pipe And Vent Pipes (IS 3989)	Neco/Anand/Hepro/Ashutosh Casting
23	D.I. Pipe Fitting	Electro Steel Casting Limited/Lanco Industries Ltd./Jindal
24	Ductile Iron(DI) pipe	Electro steel casting ltd./Jindal saw ltd.
25	FRP/GRP	EVERLAST/TECHNOCRATS/THERMOSET/BA JAJ
26	Flush Valves	Gem/Jaquar/Kohlar/Hindware
27	Filtration Plant / Softening Plant	Thermax Limited./Ion Exchange

Sr. No.	Item	Approved Make
28	G.I. Pipe With Anti Corrosive Coating	Jindal/Zenith/Hissar/Tata
29	G.I. Fitting	R Brand/Zoloto/Unik/Surya/KC
30	Gun Metal Valves (Fully Checked And Globe Valve)	Zoloto/Leader/Surya Gold
31	G.I. Pipes	Jindal-Hissar/ Tata/Zenith
32	G.I. Fittings	Unik/ K.C./ Zoloto/Leader/Surya
33	Gunmetal Valves	Zoloto/ Leader/ Sant/ Kilburn
34	Hand Drier	Kopal/UTech Systems , world Dryer corp Blue Circle (India) Pvt. Ltd./Kohler
35	Hydro Pneumatic System	HBDGM/ Grundfoss /Salmson /Nocchi
36	HDPE pipe	Duraline/ Jain/Time Tech/KML/Supreme
37	Liquid Soap Container	UTech Systems/Blue Circle (India) Pvt. Ltd. Kimberly Clark/Jaguar/Hindware
38	Level Controller	21st Century/Advance Auto/Sridhan International
39	Motor	Crompton/Kirloskar/Siemens/Jyoti
40	Manhole Covers & Frame SFRC	K.K/ PERGITY/Neco/SRIF/Pratibha/Bajaj
41	Non Clog Centrifugal Pump	Crompton/Kirloskar/KSB
42	PVC Flushing Cistern	Commander/Johnson Pedder/Parryware/Hindware
43	Plastic Seat And Cover (Solid Heavy	Commander /Hindware/Johnson/Pedder/ Parryware
	Duty)	/ Juquar / Kohler
44	Waste & Vent Pipes and Fittings/ Type B PVC Casing & Screen Pipes	Supreme/Prince/Finolex/Oriplast
45	Polyethylene Water Storage Tank	Sintex /Rotex /Fusion /Storex/Plasto/Rotoplast
46	PVC Insulated Tank 3-layer	Frontier/Euro/Diplast
47	P.T.M.T. Fitting	Prince/India /Symet
48	PP-R pipes ( PN - 16)	Amitex polymers Pvt. Ltd./Prince/Supreme
49	PVC Flushing Cistern	Commander/Johnson Pedder/Parryware
50	Plastic Seat And Cover (Solid Heavy Duty)	Commander/Hindware/Johnson/Pedder/Parryae
51	RCC Hume Pipe	Indian Hume Pipe/Pragati Concrete Udyog/Equivalent/(ISI Mark) /Jain Spun /Dewan spun
52	R.O. System	Ion Exchange/Sterling India Ltd/Pentair Water
53	Stainless Steel Sinks	Jayna/Neelkanth/Nirali/Franke
54	SFRC Manhole Cover And Frame, Gully Trap covers & SFRC Casings	K.K. Manhole/Pratibha/Everlast
55	Submersible Water Pump	Raindrop/KSB/Grundfos/Kirloskar
56	Submersible Drainage Pump	Mody/Grundfos/HBDGM/Zenit
57	Stone Ware Pipes And Gully Traps (ISI Marked)	Perfect/Burn/R.K.&Equivalent, approved as per Engineer Incharge /pragati
58	Self-Closing Taps/Pillar cocks	Gem/Tower Stop – Italy/Kohlar/Hindware/Jaguar
59	Self-Closing Mixers	Gem/Tower Stop – Italy/Kohlar/Hindware/Jaguar
60	Solar Hot Water System	Tata BP Solar/EPL INDIA LIMITED/Solahart (India)

Sr.	Item	Approved Make
No.		
61	Specification for EPDM Gasket	AnandReddiplex/ Enviro Seals
62	S.S. Sink	Franke / Cobra/ Jayna / Nirali
63	Turbine Pump	Jyoti/Kirloskar/KSB/Crompton
64	Thermal insulation	K-flex/Vidoflex
65	Vitreous China Sanitary Ware	Parryware/Neycer/Cera/Hindware/Kohlar/Jaguar
66	Water level controller	Elegant controls/Active Controls
67	WC connections	Multi KWik (U.K) / Prince/Supreme
68	uPVC Pipes and fittings	Prince/Supreme / jain
69	Pipe clamp and support	Chill / euro clamping / Hi-tech

# C. APPROVED MAKE LIST FOR FIRE FIGHTING WORKS

Sr. No.	Item	Approved Make
1	Air Release Valve / Pressure release Valve	Sukan/Leader/ZOLOTTO/TBS/Arco
2	Anti Vibration Pads	Kanwal/Dunlop/Kiloskar
3	Air Curtains.	Almonard / Becon / Technomech / Russel /
-		Aerodynamics
4	Balancing Valve	Advance / Sant / Castle / HBD/Esseti
5	Ball Valve (Gunmetal/White Metal)	Leader/Zoloto
6	Battery	Exide / Amco-yuasa/AMAR RAJA
7		Jayshree/ Newage/ Crc /Exflame/Safeguard/ Life
	Canvas Rrl Fire Hose	Guard
8	C.I. Butterfly valves	Audco/ Zoloto/ KSB Conforming To IS-13095/
		Kirlosker
9		Kirloskar/ Indian Valve Company Conforming To
	C.I. Double flanged sluice valve	IS-780 / Exflame/Safeguard/ Life Guard
10		Kirloskar/ Indian Valve Company Conforming To
	C.I. Double flanged non-return valves	IS-5312
11		Kirloskar Oil/ Cummins/Ashoka Leyland /
	Diesel Engine	Greever/Loel
12	Dual Plat types non-return valves	Audco/ C & R/ KSB
13	Fire Hydrant Landing Valves/ Fire	Minimax / Safex / Newage / Vijay / Safe Guard /
	Brigade Connection (Isi Marked).	Exflame/ Life Guard
14	Filters	Dyna / Kirloskar / Puromatic / Purafill / Aitech
		/Thermodyne / Aerosol / Smil / Pure Air
15	Fire Damper Motors	Balemo /Juvanto / Siemens
16	Fire Alarm	Honeywell/Ias Morley/Notifier
17	Forged Steel Fitting	Vs/Sant / Jk forging/Jainson industries
18	Fire Hydrant Valves And Branch Pipe	Minimax/ Newage/ Safex Conforming To Is-5290
19		Minimax/ Newage/ Safex Conforming To Is-884/
• •	First Aid Hose Reels Drum	Exflame
20	Fire Pumps	Mather & Platt/ Kirloskar/ Crompton Greaves
21		Minimax/ Newage/ Nitin / Exflame/Safeguard/
	Fire Extinguishers	Crease Fire.
22	Flow Switch	System Sensor/ Potter / Johnson control / Potter
23	Factory Mutual (F.M) U.S.A.	Clab
24	Approved	Globe
24	Grilles /Diffusers.	Carryaire / Airmaster / Vinayaga / Matasys
25		Corporation / Ajanta / Ravi Star
25	CI Ettimory (Mellershie Cost Incos)	R' / Zoloto/ Unik. Conforming 10 Is-18/9(Part 1 10
26	U.I. Fillings (Malleable Cast Iron)	A) Costooh/Sofocord
20	In the second se	Deenacii/Salegard
21	/Humidistats Strip Heaters.	Penn / Honey wen / Indioss / Escorts / Dasspass.
28	Hp /Lp /Off Switch Thermostats	Penn / Honey Well / Indfoss / Escorts / Dasspass.
	/Humidistats Strip Heaters.	
29	Insulation Material.	Fgp / Up Twiga / Pilkington / Beardsell / Lloyds /

Signature of Contractor.....

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Sr.	Item	Approved Make
No.		17.
20	<b>x 1 1 1 1</b>	Kimmco
30	Indicating lamps/ push buttons	Siemens/ L&t/ Ge power
31	Installation valve	HD/ Spraysafe/ Mather & Platt / Tyco/ Viking
32	Loss Prevention (F.O.C) Council	
	Approved	Globe
33	Mechanical Seal	Dunlop /Duramat / seald
34	Modulating Motor	Honey Well / Johnson / Stefa Control / Rapid Cool.
35	Modulating Valve/ Solenoid Valve For	Rapid Cool / Honeywell / Johnson
	AHU	
36	Mixing Valve With Motor	Siemens / Johnson Control / Honeywell / Rapid
		Cool
37	Motors	Kirloskar/ Siemens/ Crompton Greaves
38	Pressure Guage.	Japsin / Fiebig / Guru / Dwyer /
39	Proportional Thermostate	Honey Well / Johnsons / Landis & Steaefa
40	Pressure Switch	Indfoss/ Switzer/ Resistoflex/ Kanwal /Potter
41	Protective tape	IWL (Pypkote)/ Rustech Products (Coatek)
42	Rubber Tube For Hose Reel	Jyoti/Newage/
43	Refrigerant Valve	Brasmatic / Sant
44	Rubber Hose(20mm)	Deep Jyoti/ Maruti Conforming To Is-5132
45	Sprinklers	Spray Safe / Hd/Newage.
46	Sluice Valve	Kirloskar/Ivc
		Siemens/ L&T/ Ge Power/ABB
47	Selector switch	Kaycee/ Salzer
48	Sprinklers	Tyco / Viking / HD
49	Standpost hydrant	Minimax/ Safex/ Newage Conforming To IS-908
50	Terminal Block	Elmex/ Wago/ Fiebeg/ H. Guru
51	Under Writers Laboratories (U.L)	
	U.S.A Approved	Globe
52	VVVF Drive For AHU/ Cooling	Danfoss / Alan Bradley./ Siemens /Abb
	Tower Motor	
53	Welding rods	Adani/ Oerlikon/ ESAB/Superweld/Modi/DNH
54	Y-Stainer	Leader/ Zoloto / Aip valve /Audco / Advance

# **D. Approved Make for Electrical Works**

Sr. No	Items	Approved Makes
1	Distribution Transformer	EMCO/VIJAY/VOLT AMP/KIRLOSKAR/APPROVED VENDER OF CSPDCL
2	HT PANEL	SCHNEIDER/L&T/SIEMENS/ABB/CG
3	Timers	L&T/SCHNEIDER/LEGRAND/SIEMENS
4	ACB	L&T/SCHNEIDER/SIEMENS/ABB/C&S
5	CHANGE OVER SWITCH	
i	ON LOAD	GE/L&T/C&S/ABB
II	OFF LOAD	STANDARD/C&S/ABB/L&T
6	VOLT METER,AMPERE METER	
Ι	ANALOG TYPE	MECON/ESSVEE/AE
II	DIGITAL TYPE	MECON/ESSVEE/AE/C&S
7	CURRENT TRANSFORMER	C&S/AE/KAPPA
8	SELECTOR SWITCH	GE/L&T/C&S/ABB/SIEMENS
	STATIC WATT HOUR	
9	METER	L&T/SEMS/GENIUS/APPROVED VENDOR OF CSPDCL
10	STARTER/CONTACTORS	GE/L&T/SCHNIEDER
11	RELAY	SIEMENS/ABB/SCHNEIDER
12	МССВ	L&T/ABB/SCHNEIDER/LEGRAND/C&S
13	CONNECTORS	ELMEX/CONNECTWELL/RAYCHEM/
14	MCB/RCCB/DBs	L&T/ABB/SCHNEIDER/LEGRAND/C&S
15	METAL CLAD INDUSTRIES PLUG & TOP	
i	PIN & SLEEVE TYPE	HAVELLS/LEGRAND/SCHNEIDER/ABB
II	BUTT TYPE	BCH/MILLBORN
	SELF EXTINGUISHABLE	
III	POLYMER TYPE	HAVELLS/LEGRAND/SCHNEIDER/ABB
16	CAPACITOR	EPCOS/DUCATI/SCHNEIDER/UNISTAR
17	POWER SWITCH (UPTO 32A)	L&T/SCHNEIDER/SIEMENS/ABB/HAVELLS
18	EXHAUST FAN	GE/CROMPTON/BAJAJ/ORIENT/USHA/HAVEELLS
19	CEILLING FAN/WALL FAN	GE/CROMPTON/BAJAJ/ORIENT/USHA/HAVEELLS
20	SWITCH & SOCKET	NORTHWEST/LEGRAND(MYRUS)/CRABTREE(ATHEN A)
21	LIGHT FITTING (OUTDOOR)	PHILIPS/WIPRO/BAJAJ/SCHREDER/GE
22	LIGHT FITTING (INDOOR)	PHILIPS/WIPRO/BAJAJ/CG/GE
23	LAMPS	PHILIPS/OSRAM/GE
24	LED	PHILIPS/OSRAM/CREE/NISHIA
25	STORAGE WATER HEATER AND ACCESSORIES	BAJAJ/CG/RACOLD/JAGUAR
26	SOLAR HEATING SYSTEM	TATA/BP/BHEL
27	AIR CONDITIONER	LG/VOLTAS/SAMSUNG/O- GENERAL/HITACHI/DIAKIN

Sr. No	Items	Approved Makes	
28	WIRES	FINOLEX/POLYCAB/RR KABEL/GLOS	STER/HAVELLS
		FINOLEX/POLYCAB/GLOSTER/HAVE	LLS/RAVIN/CCI/
29	LT CABLES	UNIVERSAL	
30	BRASS GLAND	COMET/METAL CRAFT INDUSTRIES/	RAYCHAM
31	ALUMINIUM LUG	DOWELLS/METAL CRAFT INDUSTRI	ES/RAYCHAM
32	TELEPHONE CABLE	DELTON/FINOLEX/ NATIONAL/HAVI	ELLS
33	HT CABLES	UNIVERSAL/GLOSTER/CCI/POLYCAI	B/RAVIN
34	CABLE JOINTS	DENSON/RAYCHEM/3-M	
		VENUS/PASCO/DOLPHIN/METALEM/	ASIAN
35	MS CABLE TRAY	ANCILLARIES	
26	COPPER BUS TRUNKING		
30	ARRANGEMENT	DECISION/DEC DLAST/EL	
37	PVC PIPES	PRECISION/BEC PLAS1/Thermoplast	
38	33/11 KV	CROMPTON/BHEL/EMCO/VIIAI/VOL	ΓΑΜΡ
39	RING MAIN UNIT 11&33 KV	CROMPTON/SIEMENS/ABB/SCHNEID	ER
40	OCTAGONAL POLES	BAJAJ/TRANSRAIL/VALMONT	
41	TUBULAR POLES	AS PER IS CODE & SPECIFICATION	
		JACKSON/ CUMMINS/ CATERPILL	AR/STERLING
42	DG SET	WILLSON/KIRLOSKA	R
43	LIFT	OTIS/JHONSON/THYSSEN KRUPP/KO	NE
44	PACKAGE SUBSTATION	SCHNEIDER/ABB/SIEMENS/CROMPT	ON
	BATTERY&BATTERY		
45	CHARGER	AMARRAJA/EXIDE/TEJA	
46	UPS	EMERSON/SUKAM/APC/HIREN	
47	DWC PIPES	TIRUPATI/C-REX/RELIANCE	
48	RACE WAY	LEGRAND/M&K/UNITECH	
49	LT Panel	SCHNEIDER/L&T/SIEMENS/ABB/CG/	C&S
		SIEMENS/ABB/CG/BHARAT	
50	ELECTRICAL MOTOR	BIJLEE/KIRLOSKAR/ALSTOM	
51	SOFT STADTED	SCHINIEDEK/L&I/SIEMENS/ABB/T	
51	SOLISIAKIEK	ELEMIECHANQUE	

## E. APPROVED MAKE LIST FOR HVAC WORKS

Sr. No	Item	Approved Make
110.		
1	Accessories	
А	Automatic Air Vent	Rapid Control/Spirotech /Emerald
В	Flow Switch	Rapid Control/Anergy
С	Pressure Gauge	H.Guru/Fiebig/ Emerald
D	Pot Strainer	Vaishno/ Flowell/ Emerald
E	Suction Guide	Anergy/ Rapid Control/ Emerald
F	Thermometer	Emerald/ Fiebig/Japsin/Guru/H.Guru//Bestobell
G	Y-strainer	Flowell/ Emerald
2	Air Filters	
A	Filters	Airtech/ Purolator/ Mechmark
3	Air Handling Units	
А	Air Handling Units (High Static)	VTS/Crystal/EdgeTech/Zeco/Waves/FeddersLlyod
В	Air Handling Units (Sectional	VTS/ Crystal / EdgeTech /Zeco/ Waves/
D	/Unitary)	FeddersLlyod
C	Air washer/Scrubber	Crystal /EdgeTech /Zeco/ Airflow/Roots
C		Air/Humidin
Д	Fan Coil Units	VTS/ Crystal / EdgeTech /Zeco/ Waves/
D		FeddersLlyod
E	Ozone	RUKS / Trimed
F	Second Stage Air washer	Ambassador/Roots
4	Air Ozone	RUKS/ Trimed
5	Axial Flow Fans	
A	Axial Flow Fans	Kruger/Cometri/Airflow/Humidin
B	Centrifugal Blowers	Kruger/Cometri/Airflow/Humidin
6	Building Automation System	
A	Airflow Switch (Air & water)	Johnson Control/Anergy/ Honeywell/Stemens
B	DDC Controllers	Johnson Control/Anergy/Honeywell/Siemens
	Sensors(Pressure/Temperature)	Johnson Control/Anergy/ Honeywell/Stemens
		Johnson Control/Anergy Honeywell/Stemens
1	Cables	
A	Control Cables	Ford/Glostor/Finolex
B	Power Cables	Gloster Finolex/ Cap cab/ KEI
8	Controls	
A	2/3-Way motorized valve for AHU	Honeywell/Belimo
B	2/3-Way motorized valve for FCU	Honeywell/Belimo
C	Thermostats	Belimo/ Honeywell/ Siemens
9	Ducting & Grilles	
A	Factory Fabricated	Ductofab/Zeco
В		
-	Fire Dampers motors	Belimo/Seimens/Conaire
C	Fire Dampers motors   G.I. Sheet Metal Duct   G.I. Sheet Metal Duct	Belimo/Seimens/Conaire Jindal/National/ Tata
C D	Fire Dampers motors   G.I. Sheet Metal Duct   Grilles/Fire Dampers/Diffusers	Belimo/Seimens/Conaire   Jindal/National/ Tata   Airflow/Tristar/ Dynamic/Conaire/Caryaire
C D E	Fire Dampers motors G.I. Sheet Metal Duct Grilles/Fire Dampers/Diffusers G.I. Sheets	Belimo/Seimens/Conaire   Jindal/National/ Tata   Airflow/Tristar/ Dynamic/Conaire/Caryaire   Jindal/ SAIL/ Nippon
C D E F	Fire Dampers motors G.I. Sheet Metal Duct Grilles/Fire Dampers/Diffusers G.I. Sheets PUF/PIR Board or Panel	Belimo/Seimens/Conaire Jindal/National/ Tata Airflow/Tristar/ Dynamic/Conaire/Caryaire Jindal/ SAIL/ Nippon PAL / P3

Sr.	Item	Approved Make	
HU.	Stick Pins	Prima Seal/Air flow	
10	Flectrical Equipment		
10	Auxiliary Relays/Contactors	Siemens/Cutler Hammer	
B	Change Over Switch	Siemens/Cutter Hammer	
D	Flectric Panel Board	System Power Control/ Electra Power /FAP/Nitva	
С	Electric Tailer Dourd	Electrical Controls/EPC	
D	Electric Motors	ABB/Siemens/Crompton/Kirloskar/Alstom/Jvothi	
E	Earthing	JMV or as per IS Code.	
Б	Indicating lamps	Siemens/L&T/Cutler Hammer/Covered	
Г		modular/Vaishno	
G	Line Type Fuse	GEC Alsthom/Siemens	
Н	MCB	Siemens/MDS Lexic Schneider MG L&T	
Ι	MCCB/ACB	Siemens/L&T/EE Schneider	
J	Push button starter	Siemens/Cutler Hammer/ L&T	
K	Selector Switches	Siemens/L&T/Kaycee/GE	
L	Starters/Switchgear	Cutler Hammer/Siemens/English Electric/ L&T	
М	Timer	Siemens/Cutler Hammer/ GEC Alsthom	
Ν	Terminal Block	Elmex/ Comex/ HMI	
0	Voltmeter/Ammeter	Siemens/AE/KAPPA/Rishabh (L&T) Automatic	
0		Electric	
11	High Side Equipment		
Α	Cooling Towers	Paharpur/Coron/Flowtech/Mihir	
В	Electric hot water generator	Rapid cool/ KEPL/Emerald	
С	Pumps Coupled	Kirloskar/Maxflow/ Beacon/Mather & Platt./	
D	Pumps Monoblock	Virlockar/Beacon/Siemens/Gundfoss	
	Pumps Coupled with VED	ITT/Pall & Coset/ Cundfoss	
E F	VED with controls	ABB/Danfoss	
1	Water Cooled Screw Chilling Units	Carrier/Trane/Vork/BlueBoy/Clivet /Dan hum hush	
G	water cooled serew chining chits	/Daikin Mcqway	
12	Insulation		
А	Aluminium Tape	Johnson/Birla 3M/Garware	
В	Crossed linked Polyethylene Foam	Trocellene / Paramount/Supreme	
С	Closed Cell Elastomeric Insulation	K-flex /Vedoflex	
D	Expanded Polystyrene	Thermolloyd/ R.P. Packaging	
Е	Glass Wool	Owens Corning /U.P. Twiga	
F	Non woven fibre material	Mikron/ Du pont	
G	Polyurethene Foam	Malanpur /Superurethane	
н	Premoulded PUF section for pipe &	Malanpur/ Lloyd	
11	pipe supports		
13	Microprocessor based systems	Siemens/Johnson Controls/Honeywell/ Belimo	
14	Miscellaneous		
Α	Anchor fastners	Cannon/ Hilti/Fisher	
В	Vibration isolator	Resistoflex/Dunlup/Kanwal	
15	On-line non-chemical water treatment	Scale Guard of Aqua Treat Pvt. Ltd./ Crystallo of	
	system	D- Borne Engineers/ Scaloid of TBI System	
16	Paints		
Α	Bituminus	Shalimar/ICI / Dulux	

Sr.	Item	Approved Make
No.		
В	Enamel	AkzoNobel/ Asian/ Nerolac/ Berger/ICI
C	Plant Audit & Certification Works	Energy Management Consultants
П	Tarfelt ( for underground chilled water	Shalimar
D	pipe insulation)	
17	Valves	
٨	Butterfly Valves	Audco/Advance/Castle/Honeywell /C & R/AIP
A		Valve
В	Balancing Valves	Advance/Audco/ Honeywell/ C & R
C	Gate/Globe Valves	Sant/ Zoloto/Emerald
D	Non Return Valve	Advance /Audco/ Castle/Honeywell/AIP Valve

# SCHEDULE– D Section – VI Drawings

Signature of Contractor.....

Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

### NRDA

# LIST OF DRAWINGS

Sr No.	Drawing Title	Drawing Number
1	Site plan	NRDA-TD/ARCH/SP-01
2	Upper Ground Floor Plan - Plot 7 & 8	NRDA-TD/ARCH/LGF-02
3	Lower Ground Floor Plan - Plot 7 & 8	NRDA-TD/ARCH/UGF-03
4	First Floor plan - Plot 7 & 8	NRDA-TD/ARCH/1F-04
5	Second floor plan - Plot 7 & 8	NRDA-TD/ARCH/2F-05
6	Third floor plan - Plot 7 & 8	NRDA-TD/ARCH/3F-06
7	Fourth floor plan - Plot 7 & 8	NRDA-TD/ARCH/4F-07
8	Terrace plan - Plot 7 & 8	NRDA-TD/ARCH/TR-08
9	Plot 7-Upper Ground Floor plan	NRDA-TD/ARCH/UGF-09
10	Plot 7-LowerGround Floor Plan	NRDA-TD/ARCH/LGF-10
11	Plot 7-First Floor plan	NRDA-TD/ARCH/1F-11
12	Plot 7-Second floor plan NRDA-TD/ARCH/2F-12	
13	Plot 7-Third floor plan	NRDA-TD/ARCH/3F-13
14	Plot 7-Fourth floor plan NRDA-TD/ARCH/4F-14	
15	Plot 7-Terrace plan	NRDA-TD/ARCH/TR-15
16	Elevation - North and South - Plot 7 & 8	NRDA-TD/ARCH/EL-16
17	Elevation - North and South - Plot 7	NRDA-TD/ARCH/EL-17
18	Elevation - North and South - Plot 8	NRDA-TD/ARCH/EL-18
19	Elevation - East & West	NRDA-TD/ARCH/EL-19
20	Sections - AA, BB & CC	NRDA-TD/ARCH/SC-20
21	Sections - DD & EE	NRDA-TD/ARCH/SC-21
22	Door Elevation Details	NRDA-TD/ARCH/DW-22
23	Guard Room detail	NRDA-TD/ARCH/GR-23
24	Road Section	NRDA-TD/ARCH/RS-24
25	Boundary Wall and Gate detail	NRDA-TD/ARCH/BW-25

# **SCHEDULE-E**

# **Reference to General Conditions of contract.**

Signature of Contractor.....

Signature of NRDA.....

Page 1 of 2

# SCHEDULE-E

### **Reference to General Conditions of contract**

Name of Work: "Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur".

Estimated cost of work : Rs. 59 Crores

(i) Earnest Money : Rs. 59 Lacs

- (ii) Performance : 5% of tendered value Guarantee
- (iii) Security Deposit : 5% of tendered value

Signature of Contractor.....

Signature of NRDA.....

Page 2 of  $\mathbf{2}$ 

# **SCHEDULE-F**

# **General Rules & Directions**

Signature of Contractor.....

Signature of NRDA.....

Page 1 of 6

### SCHEDULE-F

### GENERAL RULES & DIRECTIONS: Officer inviting tender

Maxim	um per	centage for quantity of items of		
work to	be exe	ecuted beyond which rates are to		
be dete	rminec	I in accordance with Clauses 12.2		
& 12.3:			See below	
Definit	ions:			
2(v)	Eng	ineer-in-Charge	Executive Engineer (EE C-III), NRD Appointed by CEO, NRDA	A or Any Officer
2(viii)	Acce	epting Authority	Chief Executive Officer, NRDA	
2(x)	Perc	centage on cost of materials and		
	Labo	our to cover all overheads and		
	profi	ts:	15 %	
2(xi)	Star	ndard Schedule of Rates	CG SoR with Updated Amendments	
2(xii)	Dep	artment	Naya Raipur Development Authority	
Clause	e 1			
	(i)	Time allowed for submission of I date of issue of letter of accepta	Performance Guarantee from the nce	7 days
	(ii)	Maximum allowable extension b above	eyond the period provided in (i)	7 days
Clause	2			
Authori under c	ty for fi lause 2	xing compensation	CEO, NRDA	
Clause	e 2A			
Whethe	er Clau	se 2A shall be applicable	Applicable	
Clause	<del>9</del> 5			
Numbe	r of da	ys from the date of issue of letter	15 days	
of acce	ptance	for reckoning date of start		
Signatur	e of Con	tractor	Signature of NI	RDA

Mile stone(s) as per table given below:-

#### To be submitted by the tendered on award of work

SI. No.	Description of Milestone (Physical)	Time allowed in days(from date of start)	Amount to be with-held in case of non achievement of mile stone
1.		NA	
2.		NA	
3.		NA	
4.		NA	
5.		NA	

Time allowed for execution of work

24 months including Rainy Season

Authority to decide:

 Extension of time <u>CEO, NRDA</u> (Engineer in Charge or Engineer in Charge of Major Component in case of Composite Contracts, as the case may be)

6A

(ii) Rescheduling of mile stones Chief Engineer (Engineering)

### Clause 6, 6A

Clause applicable - (6 or 6A)

Signature of Contractor.....

#### Clause 7

Gross work to be done together with net **Rs 150 Lakhs** payment /adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment

Clause 10A All the materials as per contract and as per details specified in Clause 21 F1, Schedule D – Section IV Special conditions of contract.

1	2	
4	5	6

Signature of NRDA.....

Page 3 of 6

### Clause 10B(ii)

Whether Clause 10B (ii) shall be applicable

Applicable subjected to Clause as per Special conditions of contract

### Clause 10C

Component of labour expressed as percent of 35% (Buvalue of work

35% (Building work)

Clause 10CA		Applicable	
SI. No.	Material covered under this clause	Nearest Materials (other than cement, reinforcement bars and the structural steel) for which All India Wholesale Price Index to be followed	Base Price of all Materials covered under clause 10 CA*
1.	Nill		
2.	Nill		

\* Base price of all the materials covered under clause 10 CA is to be mentioned at the time of approval of NIT. **Clause 11** 

Specifications to be followed for execution of	Tender specification attached with Tender document,
work	CPWD, MORTH, CPHEEO and relevant IS
	Specifications.

### Clause 12

12.2. & 12.3	Deviation Limit beyond which clauses 12.2 & 12.3	
	shall apply for building and allied infrastructure work	<b>25%</b>
12.5	Deviation Limit beyond which clauses 12.2 & 12.3 shall apply for foundation	
	work	25%

### Clause 16

Competent Authority for deciding reduced rates. Chief Engineer (Engineering), NRDA

### Clause 18

List of mandatory machinery, tools & plants to be deployed by the contractor at site:-

As per relevant Clause of Special Conditions of Contract

Clause 36 (i): Minimum Technical Representative(s) and recovery Rate

Signature of Contractor.....

Signature of NRDA.....

Page 4 of  ${\bf 6}$ 

NRDA F-1- Schedule-F
Construction of Office Campus including Buildings and Services on Plot No. 7 & 8 of Phase 1, Sector-24 at Naya Raipur

### NRDA

SI. No.	Designation (Principal Technical/ Technical Representative)	Number	Educational and Relevant Experience	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 36(i)
1	Project Manager	1	Graduate in Civil Engg. With Minimum 20 yrs of experience in the construction management, and supervision of Building project with minimum 8 years experience in the capacity of project manager.	6000/day/head
2	Senior Engineer	2	Graduate in Civil Engg. With Minimum 15 yrs of experience in the construction management, and supervision of Building project with minimum 5 years experience in the similar capacity.	4000/day/head
3	Quality Control Engineer	1	Graduate in Civil Engg. With Minimum 10yrs of experience and specific experience of 5 years in Quality control of Building projects.	3000/day/head
4	Electrical Engineer	1	Graduate in Electrical Engg. With Minimum 10 yrs of experience in the errection and commissioning electrification works of Building projects.	4000/day/head
5	Plumbing Engineer	1	Graduate in Civil Engg with Minimum 10 yrs of experience in the design, errection and commissioning of Plumbing works of Building projects.	4000/day/head
6	Health Safety Environment Engineer	1	Graduate Engg with dip in fire and safety with Minimum 10 yrs of experience and a minimum of 5 years in the similar position in high rise structures.	4000/day/head
7	Site Engineer (Civil Engg)	3	Graduate in Civil Engg. With Experience of at least 5years/ Dip. In Civil Engg. With 8 years of experience in site supervision of construction projects.	1200/day/head
8	Site Engineer (Electrical Engg.)	1	Graduate in Electrical Engg. With Experience of at least 5years/ Dip. In Electrical Engg. With 8 years of experience in site supervision of construction projects.	1200/day/head
9#	Computer Operator	1	Experience of at least 5 years in Auto CAD and MS Office	600/day/head
10#	Office Attendant	2	HSC Certificate	350/day/person

# 1 no. Computer Operators and 2 nos of Office Attendants should be placed with Engineer in Charge of NRDA in his office within ten days from the signing of agreement and up to 30 days beyond the date of completion of work. He shall assist the Engineer in charge in day to day activities. The above Technical Representative shall be got approved from Engineer in Charge prior to deployment. The monthly attendance of Technical Representative shall be monitored by EIC and any recovery shall be levied in the none fulfilling the designated technical manpower.

Clause 42

(i)	(a)	Schedule/statement for determining theoretical
		quantity of cement & bitumen on the basis of
		C.G.S.O.R

(ii) Variations permissible on theoretical quantities:

(a) Cement

For works with estimated cost put to tender not more than Rs. 5 lakh.

Signature of Contractor.....

Signature of NRDA.....

Not Applicable

3% plus/minus.

Page 5 of 6

For works with estimated cost put to tender more than Rs.5 lakh.

	Rs.5 lakh.	2% plus/minus.	
(b)	Bitumen All Works	2.5% plus & only & nil on minus side.	
(C)	Steel Reinforcement and structural steel sections for		
	each diameter, section and category	2% plus/minus	
(d)	All other materials.	Nil	

# RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION

SI.	Description of Item	Rates in figures and words at which recovery shall be made from the Contractor		
No.	P	Excess beyond permissible variation	Less use beyond permissible variation	
1.	Cement	NA	NA	
2.	Steel Reinforcement	NA	NA	
3.	Structural Sections	NA	NA	
4.	Bitumen issued free	NA	NA	
5.	Bitumen issued at stipulated fixed price	NA	NA	

Signature of NRDA.....

Page **6** of **6**