



DIU SMART CITY LIMITED

CIN: U74999DD2018PLC009814
C/o Diu Municipal Council,
Fort Road, Diu 362520
Contact: +91 2875 252126
Email: Diudscl@gmail.com

E – Tender (Online Tender)

TENDER NOTICE NO. 25/2020–21/DSCL-Diu

DMC/DIU/CONST/SMARTCITY/2020-21/ 1527

Date: 14/01/2021

The Chief Executive Officer, DSCL, Diu, invites, on behalf of the President of India, the online item rate tenders from the experienced, eligible and reputed Contractors, registered, under CPWD, State PWD's or MES, railways, and also, invariably, with VAT / GST Department of U.T. of Daman & Diu (Lowest bidder must obtain local VAT/GST Registration within 15 days) for the below mentioned works.

Sr. No	Name of work and location	Estimated cost	EMD	Tender Fee	Time Limit
1.	Beautification and Landscaping of Diu Fort, Diu (3 rd Call).	Rs. 11,33,40,380/-	Rs. 21,33,500/-	Rs. 10,000/- (Non-refundable)	18 Months

Details of each works i.e. name of work, estimate cost, amount of EMD, tender fees, time limit etc. is available on	https://ddtenders.gov.in
* Closing date for Online downloading of tender documents	02 / 02 / 2021, 11:00 hrs.
* Closing date & time for Receipt of Bid/Uploading Bid	02 / 02 / 2021, 17:00 hrs.
* Last date & time for Receipt of Physical Bid	05 / 02 / 2021, 17:00 hrs.
* Pre bid Meeting	21/ 01 / 2021 15:30 hours at Office of DSCL, C/o 2 nd Floor, Diu Municipal Council, Fort Road, Diu or via Video Conference (VC)
* Online Opening of Technical Bid	05 / 02 / 2021 up to 17:30 hrs.
* Online Opening of Price Bid	On 12/ 02 / 2021, 15:30 hrs. (If Possible)
Bidders have to submit price bid in electronic format only on (https://ddtenders.gov.in website till the last date and time for submission. Price Bid in physical shall not be accepted in any case.	

- All the agencies are hereby directed to scan their tender fees and EMD online only. It is mandatory to submit tender fees and EMD online failing which the price bid of that agency will not be opened online and Physical submission of such scanned documents shall reach to office of the Executive Engineer within 3 (three) working days after closing of online bidding.
- Should have satisfactorily completed the works as mentioned below during the last Seven years ending previous day of last date of submission of tender.

Three similar completed works costing not less than the amount equal to 40% of the Estimated Project Cost (Amount INR 4,53,36,152/-).

Or

Two similar completed works, costing not less than the amount equal to 60% of the Estimated Project Cost (Amount INR 6,80,04,228/-).

Or

One similar completed work of aggregate cost not less than the amount equal to 80% of the Estimated Project Cost (Amount INR 9,06,72,304/-).

with Archaeological Survey of India/ Central Government Department / State Government Department / Central Autonomous Body / Central Public Sector undertaking / State Autonomous Body / State Public Sector undertaking / City Development authority / Municipal Corporation of city formed under any act by central / state Government and published in Central / State Gazette / Smart City Mission

Definition of Similar Nature of work: The Bidder(s) should have required experience in executing Landscape, Beautification and Outdoor Illumination works within Heritage structure premise or Monuments. Similar nature Projects consist of works in Traditional natural stone cobble flooring, pointing works and civil works, Outdoor Façade illumination works in a heritage/monuments with world class/International brand lighting and Horticulture-Irrigation works.

Note:

TDS (Tax deducted at Source) certificate for Private works shall be enclosed other than Govt. works for above mentioned criteria.

The value of executed work shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to last date of receipt of application for tender.

The Tender Inviting Authority reserves the right to accept or reject any or all the tender to be received without assigning any reasons thereof.


Bidder shall have to post their queries on E-mail Address: - diudscl@gmail.com on or before dated **20/01/2021**

All the Contractors are directed to submit the scanned documents of the following: -

- 1) VAT/GST Registration.
- 2) Latest Solvency Certificate 40% of Estimate cost within one year from the last date of tender Uploading.
- 3) PAN Card.
- 4) Tender EMD in form of FDR (Jointly) valid for 6 months i.e. (180 days) from the last date of Tender uploading.
- 5) Tender Fee in form of Demand Draft. (Non-Refundable)
- 6) Experience certificate.
- 7) Registration Certificate.
- 8) Labour License Registration.
- 9) The documents prescribed in the NIT to be submitted along with bid.
- 10) For Electrical works Electrical license is mandatory.
- 11) Bid document is not submitted with duly signed by contractor, shall not allowed for the bid selection.
- 12) The bidder should own construction equipment as per list required for the proper and timely execution of the work and submit the list of firms from whom he proposes to hire.
- 13.) The bidders should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder should submit a list of these employees.

If the scanned copies of the above documents are not visible during opening of the tender, the tender shall not be downloaded.

Dated: 14/01/2021


CTO, DSCL, Diu
Email: diudscl@gmail.com
Phone:- 02875 - 252126

DIU SMART CITY LIMITED

(SMART CITY MISSION)

TENDER

FOR

Beautification and Landscaping of Diu Fort, Diu with Defect and Maintenance Liability Period for Five Years Under "SMART CITY MISSION" at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India (3rd Call).

Estimated Cost : INR 11,33,40,380/-

Earnest Money : INR 21,33,500/-

Tender Fees : INR 10,000/- (Non-refundable)

Period of Completion:

Construction : 18 Months (1.5 Year) including monsoon

Defect and Maintenance Liability Period : 60 Months (5 years)

NIT No. : 25/2020-21/DSCL-Diu

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INFORMATION AND INSTRUCTIONS FOR BIDDERS FOR E-TENDERING FORMING PART OF BID DOCUMENT AND TO BE POSTED ON WEBSITE

Chief Executive Officer, Smart City Limited. (DSCL), Diu, on behalf of the President of India invites **online** the Item rate bid from **firms/contractors** of repute in **two bid system** for the following work:

1	Tender Notice No.	
2	Organizational Name	Diu Smart City Limited (DSCL)
3	Name of Work & Location	Beautification and Landscaping of Diu Fort, Diu with Defect and Maintenance Liability Period for Five Years Under "SMART CITY MISSION" at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India (3rd Call).
4	Tender Type	Item Rate
5	Estimated Cost put to bid (in INR.)	1. INR. 11,33,40,380/- (Inclusive of GST and all other taxes).
6	Earnest Money (in INR.)	INR. 21,33,500/-
7	Tender Fees Money (in INR.)	INR. 10,000/- (Non-refundable)
7	Period of Completion of Construction	18 Months (1.5 Year) including monsoon
8	Defect and Maintenance Liability Period	60 Months (05 years) from completion of construction works.
9	Pre Bid Conference	21/01/ 2021 15:30 hours at Office of DSCL, C/o 2nd Floor, Diu Municipal Council, Fort Road, Diu or via Video Conference (VC)
10	Last date and time of Online submission of bid, EMD, e-tender processing fee and other documents as specified in the press notice	02 / 02 / 2021, 17:00 hrs.
11	Last date and time of submission of Hard Copies of EMD, E-Tender Processing Fee and other Documents	05 / 02 / 2021, 17:00 hrs.
12	Time & date of opening of Technical bid	05/ 02 / 2021 up to 17:30 hrs.

1. Firms/contractors who fulfill the following requirements shall be eligible to apply. **Joint**

ventures are not accepted. Following are initial criteria for eligibility.

(a) Should have satisfactorily completed the works as mentioned below during the last Seven years ending previous day of last date of submission of tender.

Three similar completed works costing not less than the amount equal to 40% of the Estimated Project Cost (Amount INR 4,53,36,152/-).

or

Two similar completed works, costing not less than the amount equal to 60% of the Estimated Project Cost (Amount INR 6,80,04,228/-).

or

One similar completed work of aggregate cost not less than the amount equal to 80% of the Estimated Project Cost (Amount INR 9,06,72,304/-).

with Archaeological Survey of India/ Central Government Department / State Government Department / Central Autonomous Body / Central Public Sector undertaking / State Autonomous Body / State Public Sector undertaking / City Development authority / Municipal Corporation of city formed under any act by central / state Government and published in Central / State Gazette / Smart City Mission

The value of executed work shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to last date of receipt of application for tender.

Definition of Similar Nature of work: The Bidder(s) should have required experience in executing Landscape, Beautification and Outdoor Illumination works within Heritage structure premise or Monuments. Similar nature Projects consist of works in Traditional natural stone cobble flooring, pointing works and civil works, Outdoor Façade illumination works in a heritage/monuments with world class/International brand lighting and Horticulture-Irrigation works.

The bidder shall have domain experience in Civil & Horticulture/Landscape works in similar nature of works. The bidder shall have executed Electrical/Illumination works of outdoor lighting as per following in the last 7 years:

Single Project worth min. INR 4 cr.

or

Two projects worth min. INR 3 cr.

or

Three projects worth min. INR 2 cr.

(Note- The bidder shall have to submit the Agreement, entire BoQ / Certificate signed & certified by the Client / Authority by an officer not below the rank of Executive Engineer or equivalent.)

In case the bidder does not have experience in electrical/illumination works of that quantum as mentioned above, a MoU may be done by the bidder with other agency having

experience in electrical/illumination works for the similar nature of works as per above mentioned condition.

Note: TDS (Tax deducted at Source) certificate for Private works shall be enclosed other than Govt. works for above mentioned criteria.

Physical Requirements

Execution of similar items of work executed within completed projects in the last 7 financial years.

Table for Physical Requirement (To be filled by the bidder along with the technical bid as part of Form-D)

S. No	Particulars	Actual Quantity Executed in last 7 years. (To be filled in by the contractor)		
		Project Name	Ref. Boq/Certificate	Amount
1	Traditional Cobble/local stone flooring, pointing and Stone street furniture and signage works, civil works worth 3 Cr.			
2	Horticulture, plumbing and Irrigation works- Min. 3cr work			

Note: The bidder has to submit the details of the each above works with reference to the specific project (duly certified by the Executive Engineer or equivalent), mentioning the name of the project, Agreement no., Cost of the project, date of completion etc. / and the certified copy of the relevant BOQ / certificate of Executive Engineer regarding the execution of the specific work under the relevant agreement.

1. The bidder should have had Average **Annual Financial Turnover of 50%** of estimated project cost on Civil and Electrical construction works during the last three consecutive years. Balance sheets duly audited by Chartered Accountant shall be submitted. Year in which no turnover is shown would also be considered for working out the average.
2. Should not have **incurred any loss** in more than two years during the last five years ending 31st March 2020. **(Scanned copy of certificate from CA to be uploaded).**
3. The bidder should have a **solvency of amount equal to 40%** of the Estimated Project Cost certified by his Bankers.
4. The bidder should not have been blacklisted by any Central Government/State Government Offices/PSUs etc. and self-certificate is to be scanned and uploaded.
5. The intending bidder must read the terms and conditions prescribed in Form **CPWD-6** carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.
6. Information and Instructions for bidders posted on website shall form part of bid document.

7. The bid document consisting of indicative drawings specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from **website** <https://ddtenders.gov.in> , www.diu.gov.in.
8. But the bid can only be submitted **after filling the details of EMD** in favor **Chief Executive Officer, DSCL, Diu, (UT) and other documents as specified. e-Tender Processing Fee - Rs. 10000/- (Non-refundable) shall be payable to inform of DD in favor of Chief Executive Officer, DSCL, Diu,(UT).**
9. Those contractors not registered on the website mentioned above, are required to get registered beforehand. If needed they can be imparted training on online bidding process as per details available on the website.
10. The intending bidder must have valid **Class-III** digital signature to submit the bid.
11. **Certificate of Financial Turnover:** Average annual financial turnover on construction works should be at least 50% of the estimated cost put to tender during the immediate last three consecutive financial years at the time of submission of Bid.

Contractor shall upload Affidavit/ Certificate from CA mentioning Financial Turnover of last 3 years or for the period as specified in the bid document and further details if required may be asked from the contractor after opening of technical bids. There is no need to upload entire voluminous balance sheet.
12. Contractor must ensure to quote rate of each item specified in **Schedule of Quantity**, Considering the Defect and Maintenance Liability Period of 5 Years.
13. The rates quoted by the Contractor shall be deemed to be inclusive of the GST, commercial tax and other levies, duties, cess, toll, taxes of Central and State Governments, local bodies and authorities.
14. Contractor must ensure to quote rate of each item. The column meant for quoting rate in figures appears in pink colour and the moment rate is entered, it turns sky blue.

In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as "0". Therefore, if any cell is left blank and no rate is quoted by the bidder, rate of such item shall be treated as "0" (ZERO).

However, If a tenderer quotes nil rates against each item in item rate tender or does not quote any percentage above/below on the total amount of the tender or any section / sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.
15. **Contractors, who are executing ongoing mandates from DSCL of similar nature, must propose a separate team of key staff while bidding for this project.**
16. **For line items of similar nature in the BOQ's, the Contractor shall not enter separate rates in the BOQ's.**

17. In case different rates filled by the bidder for similar nature of items and then lowest quoted rate shall be considered.

15. The technical bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the technical bid shall be communicated to them at a later date.
16. Pre Bid conference shall be held at 21/ 01 / 2021 15:30 hours at Office of DSCL, C/o 2nd Floor, Diu Municipal Council, Fort Road, Diu or via Video Conference (VC), this conference shall be secured by a password to join, and interested bidders may write to DSCL at diudscl@gmail.com , to obtain the meeting ID and password to clear the doubts of intending bidders, if any.
17. The rates quoted by the Contractor shall be deemed to be inclusive of the GST, commercial tax and other levies, duties, cess, toll, taxes of Central and State Governments, local bodies and authorities.
18. The department reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.
19. The bidder has to furnish three affidavits as follows.
 - a) I/We S/o R/o Undertake and confirm that eligible similar works has /have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/We shall be debarred from tendering in Diu Smart City Limited in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.
 - b) I/We..... S/o.....R/o..... hereby declare that:-
 - i) I have submitted the requisite EMD amount, scanned copy uploaded
 - ii) In case of my tender is not accepted as per terms & condition of NIT and for any refund is made to me, the refund may please be made to my account as per details given below:-
 - A. Name of agency: -
 - B. Bank, Branch code, Place details etc.:-.....
 - C. Account No.:-
 - D. IFSC code No.:-.....
 - E. UTR/RTGS No.:-.....

Chief Executive Officer, DSCL, Diu, shall not be responsible in any way for none crediting of EMD/amount in the account of Chief Executive Officer, DSCL, Diu, by due date and time as mentioned in NIT.

c) I/We S/o..... resident of Hereby solemnly affirm and declare as under:-

i) That I am sole proprietor/Partner of M/s..... , R/o.....

20. **List of documents to be scanned and uploaded within the period of bid submission.**

i) Copy of FDR/ Bank Demand Draft/ bank guarantee if any towards EMD to CEO,DSCL

ii) Copy of Demand Draft towards tender Processing Fee in favor of Chief Executive Officer, DSCL, Diu,(UT)

iii) Certificates of Work Experience and other details as per Forms A to E.

iv) Copy of Pan Card.

v) Copy of GST Registration Certificate

GST Registration Certificate of the State in which the work is to be taken up, if already obtained by the bidder.

If the bidder has not obtained GST registration in the State in which the work is to be taken up, or as required by GST authorities then in such a case the bidder shall scan and upload following undertaking along with other bid documents.

"If work is awarded to me, I/we shall obtain GST registration Certificate of the State, in which work is to be taken up within one month from the date of receipt of award letter or before release of any payment by the Employer, whichever is earlier, failing which I/We shall be responsible for any delay in payments which will be due towards me/us on a/c of the work executed and/or for any action taken by the Employer or GST department in this regard.

vi) Forms/Agreements and Schedules as per **Section 4** of NIT

vii) An Affidavit regarding work not executed through another agency.

viii) Any other Document as specified in the NIT

21. It is mandatory to submit tender processing fees and EMD online failing which the bid of that agency will not be opened.

22. The Bidder may modify, substitute or withdraw its e- BID after submission prior to the BID Due Date. No BID shall be modified, substituted or withdrawn by the Bidder on or after the BID Due Date & Time.

23. For withdrawal of bid, the bidder has to click on withdrawal icon at e-tendering portal and

can withdraw its e-bid.

24. On opening date, the contractor can login and see the bid opening process. After opening of bids he will receive the competitor bid sheets.
25. It is mandatory to fill details / upload scanned copies of all the documents including GST registration as stipulated in the bid document. If such document is not uploaded his bid will become invalid & processing fee shall not be refunded.
26. If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically by the contractor the bid shall become invalid and processing fee shall not be refunded.
27. Financial bid document shall be submitted only Online, Hard copies will not be acceptable in any case.

Section 1 Brief Particulars of the Work

1.1 Salient Details of the Work

Salient details of the work for which bids are invited are as under:

S. No	Name of Work	Estimated Cost	Period of Completion
1.	Beautification and Landscaping of Diu Fort, Diu with Defect and Maintenance Liability Period for Five Years Under "SMART CITY MISSION" at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India (3rd Call)	INR- 11,33,40,380/-	18 Months (1.5 Year) including monsoon Defect and Maintenance Liability Period 60 Months (05 years) from completion of construction works.

1.2 Work Location

The work is situated at: **Diu**

1.3 Important Instruction for contractors

Diu Fort is a national importance Archeological site of Archeological Survey of India and a significant heritage structure in Diu and the agencies involved in the construction processes will have to exercise tremendous sensitivity in handling the work on this building premise and will strictly follow the Engineer-in-charge's instructions on drawings and specifications for the works.

Heritage buildings and their entire premises are significant assets and they are proud possessions of the city and country. Since the time of their buildings, and the journey through its evolution patterns, they have undergone several changes in use patterns and have thus been altered to certain extents and the principal fabric would indicate such changes in various formats. And yet the assets retain their essential heritage character and display their cultural significance at various levels of integrity.

The process of works, shall thus be carried out in all manners of sincerity towards beautification and illumination and will become a highly specialized operation. The aim of the works would be to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documentation prior to the commencement of the works, while the operations are being carried out and prepare a documented record of the works carried out. This shall be augmented with a management plan report for posterity to have a sufficient base for future programmes of maintenance and protection.

1.3.1 Instructions:

The agencies will require especially skilled work force in different trades involved which vary from traditional flooring cobble stone flooring, flooring pointing works, horticulture works, lighting and illumination works etc, using like-to-like materials and minimum interventions to the historic fabric, in order to restore the building elements, which have suffered degradation due to ageing and change of use patterns.

The entire work shall have to be carried out strictly under the instructions of the Engineer-in-charge, and at no point the work shall proceed without sufficient details and mock-ups required to carry out the details on actual site.

Any new work as per the details and specifications on the existing building will have to be properly inserted with least interference to the original structure and it has to be carefully achieved as per the instructions of the Engineer-in-charge such that it is reversible and does not damage the existing structure in any case.

Any extra work, which is indispensable, must be distinct from the architectural composition and where traditional techniques prove inadequate, the consolidation can be achieved by use of modern technique, the efficacy of which has been shown by scientific data and proved by experience and as approved by the Engineer-in-charge.

Appropriate laboratory test and sampling shall be carried out while using new materials to match them with the existing materials to avoid mismatch and material incongruity. The agencies will have to undertake these investigations as directed by the Engineer-in-charge,

The agency will maintain appropriate record of supervision and a log kept of any new evidence and additional decision during the process of executing. The agency must appoint a well-qualified Supervisor, trained in dealing with historic buildings for the period of execution of works. The Engineer-in-charge, shall approve this appointment.

No action of the agency should amount to removal of parts of the building from its original location at any cost. If this has become necessary for the reasons of safety of the building, the Engineer-in-charge's instructions will be communicated with a procedure to deal with such a situation and his instructions will be considered final in the matter.

Agency must take all the precaution to safeguard the historic property while the restoration work is in progress by proper cordons and boundary limits.

The entire affected portion where the work is being carried out shall be temporarily secured and supported as the case may be. The scaffolds and such temporary work shall be independent and shall not be physically or attached to the existing building in any manner.

1.4 General Description



Diu Fort is one of the most prominent Portuguese Fort in India with a total site area of around 5.5 Ha and is located within the island area of Diu Town at the end of the Fort Road. Diu Fort is one of the most predominant tourist destinations with lakhs of tourist footfall. The design intervention is within the Diu Fort precinct site consisting of 24704 sqm of intervention area. The site falls under Archaeological Survey of India's ownership and presently lacks proper public or tourist amenities and quality public realm development. As it is a historically important site, the scope of work is only limited to developing landscape, illumination and beautification works. Conservations, Restoration and Preservation of Historical structures, fort walls, elements and artefacts will be under the scope of the specialist apart from pointing works in existing flooring works.

The intent of the project is primarily to create a continuous public realm experience for locals and tourist whilst giving importance to the existing monuments. The material palette like use of local stone, the use of size and proportions of patterns are carefully chosen to create reflection in the past experience with minimum interventions. One of the vision for Lighting and Illumination was to

create high end world class Illumination. Street furniture like Dustbins, Seating's, Signages and Illumination are carefully integrated to create a holistic day and night experience for the tourist.

1.5 Scope of Work

1.5.1 Key features to carried out for Beautification and Landscaping of Diu Fort, Diu

Sr no.	Location	Design features
1	Pathways	<ul style="list-style-type: none"> • Proposed new Primary Pathway of Rajula Cobble stone including redesign of the carriage width with pavements and uniform public realm experience (avg. 4 mtr. wide) of 2850 sq.mt., • Proposed missing link pathway (secondary) in Rajula cobble stone flooring avg. 2.5 mtr. wide of 2150 sq.mt • Providing Rajula kerb stone both side along the pathway, • Pointing works with lime mortar in all pathway flooring work, • Universal access with addition of ramp and tactile tiles of rajula and SS strips and studs accordingly, • Define edge conditions of pathways, • Restoration of existing stone flooring pathway with Pointing works, • Replacing damaged flooring with pointing works or new works on similar material and pattern,
2	Plazas 6350 sq.mt.	<ul style="list-style-type: none"> • Providing pavements at Fort main entrance area, • Providing pavement Plaza 01 at Entrance area, • Replacing existing flooring with rajula stone flooring at Plaza 02 near Jetty area, • Jetty area: proposed new flooring in local dhanghdhra stone slabs with pointing works in lime mortar, • Providing flooring at Plaza 03 near morgue room, • Plaza 04: Jail plaza (Jail plaza designed while retaining open green space with seating, placing existing Bell with Cross and statue of Nuno da Cunha on separate plinths) • Providing flooring & landscape spaces at Plaza 05 Couraca Light House, • Providing Flooring and Sitting spaces at Plaza 06 near Chapel/ Artillery room, • Providing Flooring at Plaza 07 Cavallario Bastion,

Sr no.	Location	Design features
		<ul style="list-style-type: none"> • Central green area pocket points with sitting spaces, • Toilet and drinking water facility for the users, • Provision of trees and Landscape accordingly at all plazas, • Street furniture like benches, dustbins, signages etc. to enhance pedestrian experience,
3	Demolition Works	<ul style="list-style-type: none"> • Raking out joints in lime or cement mortar. • Dismantling and disposal of unserviceable materials with all leads and lift of unreinforced cement concrete / RCC / WBM/ rubble soling surface layers in road works / Pavements / rubble works. • Dismantling of Brick and Stone Masonry works and removal of old deteriorated plaster works. • Dismantling tiles of stone floors laid in lime/cement mortar including paver blocks, cobble stone floor, China mosaic floor, tile dado, etc. • Dismantling steel works, doors, windows, ventilators etc. with other attachment of roofing works with A.C sheet, Mangalore tiles, G.I. sheet, etc. • Felling of trees, Removal of Telephone/ Electrical poles, Junction boxes and cables, RCC manhole, RCC manhole cover, etc.
4	Street Furniture and signages Works	<ul style="list-style-type: none"> • Providing and fixing machine cut Dhangadhra Sand Stone Bench as per specifications, • Providing and fixing hand cut Hard Stone Bench as per specification, • Providing and fixing Stone Litter Bin as per drawing and specification, • Providing and fixing informational and directional signage made from local stone machine cut with natural rock cut edge on sides as per design and specification, • Providing and laying Large Stone Boulders in Landscape and plazas,
5	Horticulture Works	<ul style="list-style-type: none"> • Cleaning of earth and back filling with garden soil of farmyard manure works including Supplying, stacking and spreading of sludge / well decayed farm yard manure works. • Providing and planting trees and shrubs as per specification with required stacking and maintaining it for 3 year for trees works. • Clearing and grubbing of thorny jungle area, • Plantation of trees and Shrubs with Introduction of local horticulture species with dedicated Lawn areas, • Fine landscape works including trees, shrubs and lawn areas of 5320

Sr no.	Location	Design features
		<p>sq.mt.</p> <ul style="list-style-type: none"> • Restoring existing central area with wild plantation landscaping in central green space with natural trails of 6990sq.mt. • Central upper plinth area for wild plantation of 5355 sq.mt.
6	Miscellaneous Work	<ul style="list-style-type: none"> • Providing information wall with engraved polished granite stone Machine engraving/etching of alphabets/ map /diagram placed on wall vertically at jail plaza, • Providing battery operated electric golf cart vehicle, • Providing and fixing expansion hold fasteners and S.S. cramps for anchoring wall wherever required, • Providing Stainless steel (Grade 316) railing wherever required,
7	Plumbing, sewage and Irrigation Works	<ul style="list-style-type: none"> • Providing water supply and sewage as per specification and the plumbing drawings, • Providing Irrigation, Sprinklers arrangements as per specification and the plumbing drawings, • Providing Septic tank and Sock pit arrangements as per specification and the plumbing drawings, • Providing Filtration unit, Pumping unit and Automation equipment arrangements as per specification and the drawings,
8	Illumination Works	<ul style="list-style-type: none"> • Providing Electrical arrangements and illumination as per specification and the electrical drawings.

1.5.2 The detail scope of works to carried out Beautification and Landscaping of Diu Fort, Diu

Sr.	Components	Details for Scope of Works
1.	Survey	<ul style="list-style-type: none"> • The contractors are advised to inspect and examine the site and its surroundings and satisfy himself with the nature and extent of site and work, the hydrological and climatic conditions the means of access to the site, the constraints of space for stacking material/machinery, labour etc. he requires, if any, weather conditions at site, general ground/subsoil conditions etc. or any other circumstances which may affect or influence their bid. No claim, whatsoever, shall be entertained from the bidder, on the plea that the information supplied by the Owner is insufficient or is at variance to the actual site conditions. • The contractor should carry out detail Total station survey with Differential Global Positioning Systems (DGPS) TBM and marking of all spot levels, trees with trunk diameters, utility services like Manhole locations, Electric boxes, poles, all buildings, compound wall and civil works before commence of the construction activity.
2.	Cleaning of site	<ul style="list-style-type: none"> • All working areas under construction should be cleaned of unnecessary vegetation, malba, grass and any other items. • Clearing and grubbing road land in area of thorny jungle including removal of Vegetation such as grass, shrubs and Trees by manual/mechanical means.
3.	Dismantling and Demolition	<ul style="list-style-type: none"> • Raking out joints in lime or cement mortar and preparing the surface for repointing or replastering, including disposal of rubbish to the dumping ground. • Dismantling and disposal of unserviceable materials with all leads and lift of unreinforced cement concrete / RCC / WBM/ rubble soling surface layers in road works / Pavements / rubble works. • Dismantling of Brick and Stone Masonry works and removal of old deteriorated plaster works also for dismantling of bella stone masonry. • Dismantling tiles of stone floors laid in lime/cement mortar including paver blocks, cobble stone floor, China mosaic floor, tile dado, etc. • Dismantling steel work including distempering and stacking the materials with all lead and lift steel works. • Dismantling doors, windows, ventilators etc. (wood or steel) shutters including chowkhats architraves, holdfasts and other attachment etc. • Dismantling and disposal of roofing works with A.C sheet, Mangalore tiles, G.I. sheet, etc. • Felling of trees, Removal of Telephone/ Electrical poles, Junction boxes and cables, RCC manhole, RCC manhole cover, etc.
4.	Excavation works	<ul style="list-style-type: none"> • Excavation works upto 3.0m depth in all kinds of soil. • Filling excavated earth, Rubbles, Murrum and Coarse sand under floors and plinths including disposal of unused excavated earth, malba, etc.

		<ul style="list-style-type: none"> • Providing cement, sand and grit mixture as cement concrete for leveling purpose. • Layers with power roller including filling in depressions of 200mm.
5.	PCC and RCC works	<ul style="list-style-type: none"> • PCC works as per structural specification and requirement wherever mentioned. • Nominal reinforcement is provided to arrest temperature changes in PCC. • Providing and laying RCC of M25 grade in batch mix machine for foundation, footing, columns, pillars, walls, fins, slabs, landing, lintels, beams, cantilever, staircase, etc. including fair/ expose RCC finish as per specification and approved by structure engineer with latest IS 456 for all work. • Supplying, laying and spreading of graded stone aggregate of Crushed stone aggregate for Hard Quality up to 63 mm size and spreading of screened cleaned pea gravel of 12mm nominal size. • Supplying, laying and spreading of hard murrum 50mm to 150mm size.
6.	Steel works	<ul style="list-style-type: none"> • TMT Bar Fe 500D reinforcement for R.C.C. work as per specification with IS standard approved for all work. • Anticorrosive treatments to all HYSD/ Fe 500D bars with Fusion Bonded Epoxy Coating (FBEC) at approved plant. • All kind of steel/ Structural steel works including fabricating, assembling, hoisting/ erecting and fixing in all position using MS Rolled Steel Sections, ISMB, ISMC, UC, H-Section, Hollow sections, Tubular Sections, MS Plates, Chequered Plates, MS Pipes, Perforated Sheet, Flats, Bars, Angles, MS Sheet, Girder, Beam, cattle trap, deep threaded MS bolts with anchor bolts and washer plates all complete, confirming to relevant IS codes. • Steel works samples to be approved before execution as specified. • Providing and Stainless steel railing (Grade 316) as per mentioned and specified as per drawing. • Providing and fixing expansion hold fasteners and S.S. cramps for anchoring wall wherever required.
7.	Stone and Masonry work	<ul style="list-style-type: none"> • Providing Coursed rubble masonry with hard stone of approved quality in foundations, plinth and above plinth in lime/ cement mortar wherever required and specified. • Providing coursed White Stone Bela masonry with stone of approved quality in foundation, superstructure and partition walls. • Carrying out Plinth treatment to post construction / existing structure by spraying chemical solution for termite control as specified.
8.	Door window and opening works	<ul style="list-style-type: none"> • Providing and fixing 35mm flush door / FRP frames and shutter works. • Providing & fixing Louvers of Anodized Aluminium sections works, Samples should be approved before execution. • Providing and fixing Locks and door closers hydraulic wherever required. • Providing and fixing 6mm thick Lexan Polycarbonate multi

		wall Roofing sheet as per specification.
9.	Flooring works	<ul style="list-style-type: none"> • Providing and laying Stone works Polished Kota stone, Granite gang saw cut stone, Flame finish/ machine cut natural finish Rajula stone, etc. works as per given specification. • Providing Edge moulding to Kota/Granite/ other stones as per specification. • Providing and laying broken China mosaic flooring for terrace as per specification. • Providing and laying five courses water proofing treatment conforming to IS: 2645 for treatment of roofs, balconies, terraces, etc. works. • Providing and laying glazed tile and antiskid Vitrified tile in floor works as per specification. • Pointing on stone work of existing/proposed pathways with lime Mortar 1:1:1 (1 Slaked lime:1 surkhi:1 course sand) Flushed/ Ruled Pointing Including curing, finishing, making grooves, etc. • Providing and fixing Rajula Kerb stone min. 100mm thick with pointing of lime mortar 1:1:1 (1 lime :1surkhi:1 coarse sand) all complete. • Providing and laying of rajula cobble stone 10x10, 14x14, 20x14 cm in size, rajula and dhanghdhra stone slabs min. 80 mm thick with pointing works of lime mortar and epoxy grouting works as per given specification. • Providing Engraved Polished Granite stone of 20-22 mm thk with Machine engraving/etching of alphabets/ map /diagram in flooring/wall. • Providing and laying of Rajula stone flooring with Tactile floor pattern and SS tactile strips and studs as per given specification.
10.	Lime/ cement Plaster, Jikki Plaster, Painting and Finishing works	<ul style="list-style-type: none"> • Providing lime mortar in floors and walls. • Sand faced lime plaster with Lime plaster 1:1:1 (1 lime putty : 1 surkhi: 1 fine sand) including the fresh plaster in two layers. • Jikki Plaster with Mortar in lime, surkhi (50% red and 50% light yellow) and marble dust (1:1.5:0.5). • Providing and applying 15mm thick cement plaster works with acrylic Lapy-putty as mentioned in paint specification. • Providing and applying wall painting with plastic emulsion paint and weather proof exterior emulsion paint as per mentioned specification. • Providing and applying hot dip galvanized coating and epoxy based paint for all the metal works as per specification.
11.	Ruled/ Flush Pointing of flooring and masonry surface	<ul style="list-style-type: none"> • Application of ruled/flush pointing to the masonry and flooring joints for in the required depth, size & true shape.
12.	Street furniture and signage works	<ul style="list-style-type: none"> • Providing battery operated electric golf cart vehicle. • Providing and fixing machine cut Dhangadhra Sand Stone Bench as per specifications. • Providing and fixing hand cut Hard Stone Bench as per specification. • Providing and fixing Stone Litter Bin as per drawing and

		<p>specification.</p> <ul style="list-style-type: none"> • Providing and fixing informational and directional signage made from local stone machine cut with natural rock cut edge on sides as per design and specification. • Providing and laying Large Stone Boulders in Landscape and plazas.
13.	Landscape and Horticulture works	<ul style="list-style-type: none"> • Cleaning of earth and back filling with 150mm of garden soil with 25 mm of farmyard manure works including Supplying, stacking and spreading of sludge / well decayed farm yard manure works. • Providing and planting with including cost of the trees as per specification, excavation of 0.6x0.6x0.6 m pit, back filling with garden soil and farmyard manure (3:1 ratio), application of required pesticides for anti-termite treatment. Planting of 2 m height and min. 20 cm girth healthy saplings with required stacking and maintaining it for 3 year for trees works. • Providing and planting with including cost of the shrubs as per specification, excavation of 0.3x0.3x0.3/0.5x0.5x0.5 m pit, back filling with garden soil and farmyard manure (3:1 ratio), application of required pesticides for anti-termite treatment. Planting of 0.6 m height healthy saplings with required stacking and maintaining it for 3 year for shrub works.
14.	Sanitary Fixture, fittings	<ul style="list-style-type: none"> • Providing and fixing sanitary fixture and C.P. Fittings as per specified in technical specification and the plumbing drawing.
15.	Water supply	<ul style="list-style-type: none"> • Providing and fixing water supply CPVC (SDR 13.5) pipe as per specification and the plumbing drawings. • Providing, fixing ball valves for water supply system as per specified in technical specification and the plumbing drawing. • Providing, fixing butterfly valves for water supply system as per specified in technical specification and the plumbing drawing. • Providing, fixing Ball float valves for water supply system as per specified in technical specification and the plumbing drawing. • Providing, fixing PVC double coated overhead tank (Sintex) for water supply system as per specified in technical specification and the plumbing drawing.
16.	Drainage System	<ul style="list-style-type: none"> • Providing, laying and fixing UPVC (Type B) drainage pipes as per specified in technical specification and the plumbing drawing. • Providing and fixing PVC Nahni trap and Multi floor trap for internal drainage as per specified in technical specification and the plumbing drawing. • Excavation up to 1.5m to 5.0m depth including sorting out and stacking of useful materials and disposing off the excavated stuff with all lead and lift for all kinds of soil. • Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers, in depth

		<p>consolidating each deposited layer by ramming and watering.</p> <ul style="list-style-type: none"> • Providing, lowering, laying and jointing of DWC pipe for external drainage as per specified in technical specification and the plumbing drawing. • Providing and fixing Gully trap for drainage system as per specified in technical specification and the plumbing drawing. • Providing and fixing Sewer Trap (Intercepting trap) for drainage system as per specified in technical specification and the plumbing drawing. • Constructing masonry valve chamber and manhole as per specified in technical specification and the plumbing drawing.
17.	Storm water drain	<ul style="list-style-type: none"> • Providing and fixing UPVC (Type A) Storm water internal drain pipes as per specified in technical specification and the plumbing drawing. • Providing and fixing Khurras for storm water internal drain as per specified in technical specification and the plumbing drawing. • Providing and fixing PVC cowl for storm water internal drain as per specified in technical specification and the plumbing drawing.
18.	Storage tanks and septic tanks	<ul style="list-style-type: none"> • Providing and erecting underground water storage tanks as per specified in technical specification and the plumbing drawing. • Providing and erecting underground Septic tank for sewage collection as per specified in technical specification and the plumbing drawing.
19.	Pumping unit,	<ul style="list-style-type: none"> • Providing and fixing water supply and landscaping pumping unit as per specified in technical specification and the plumbing drawing. • Providing and fixing underground tank accessories likewise flanges and water level indicator as per specified in technical specification and the plumbing drawing.
20.	Landscape, Irrigation work,	<ul style="list-style-type: none"> • Providing, laying and fixing UPVC 6kg/cm² agriculture pipe for landscape work as per specified in technical specification and the plumbing drawing. • Providing and fixing Pop up sprinkler with saddle services and swing joint assembly as per specified in technical specification and the plumbing drawing. • Providing and fixing drip irrigation system with Plain drip pipe, micro tubing with dripper as per specified in technical specification and the plumbing drawing. • Providing and fixing Pop up sprinkler with saddle services and swing joint assembly as per specified in technical specification and the plumbing drawing. • Providing and fixing ball valve, isolation valve and quick coupling valve with required size valve box as per specified in technical specification and the plumbing drawing. • Providing and fixing air release valve with required size valve

		<p>box as per specified in technical specification and the plumbing drawing.</p> <ul style="list-style-type: none"> • Providing and fixing water filtration system for sprinkler system as per specified in technical specification and the plumbing drawing. • Providing and fixing pumping system with all related accessories for sprinkler system as per specified in technical specification and the plumbing drawing. • Providing, fixing Garden hydrant as per specified in technical specification and the plumbing drawing. • Providing and fixing automation system for landscape sprinkler system as per specified in technical specification and the plumbing drawing. • Providing and fixing water cooler and reverse osmosis for drinking water as per specified in technical specification and the plumbing drawing.
21.	Electrical and illumination works	<ul style="list-style-type: none"> • Providing international brand façade and area illumination for the entire fort with all the latest IP patents, • Providing custom designed footlights along the pathway, • Lighting along the fort wall and fort premise, • Lighting along pathways and other plaza areas, • Refer detail specification in the document, • All lighting work should be undertaken without any damage or change in heritage importance of the monument. • Providing Electrical arrangements as per specification and the electrical drawings.

1.5.3 Views from the Jail Plaza



1.5.4 View from the internal Pathway



1.5.5 View from the Entrance area Pathway



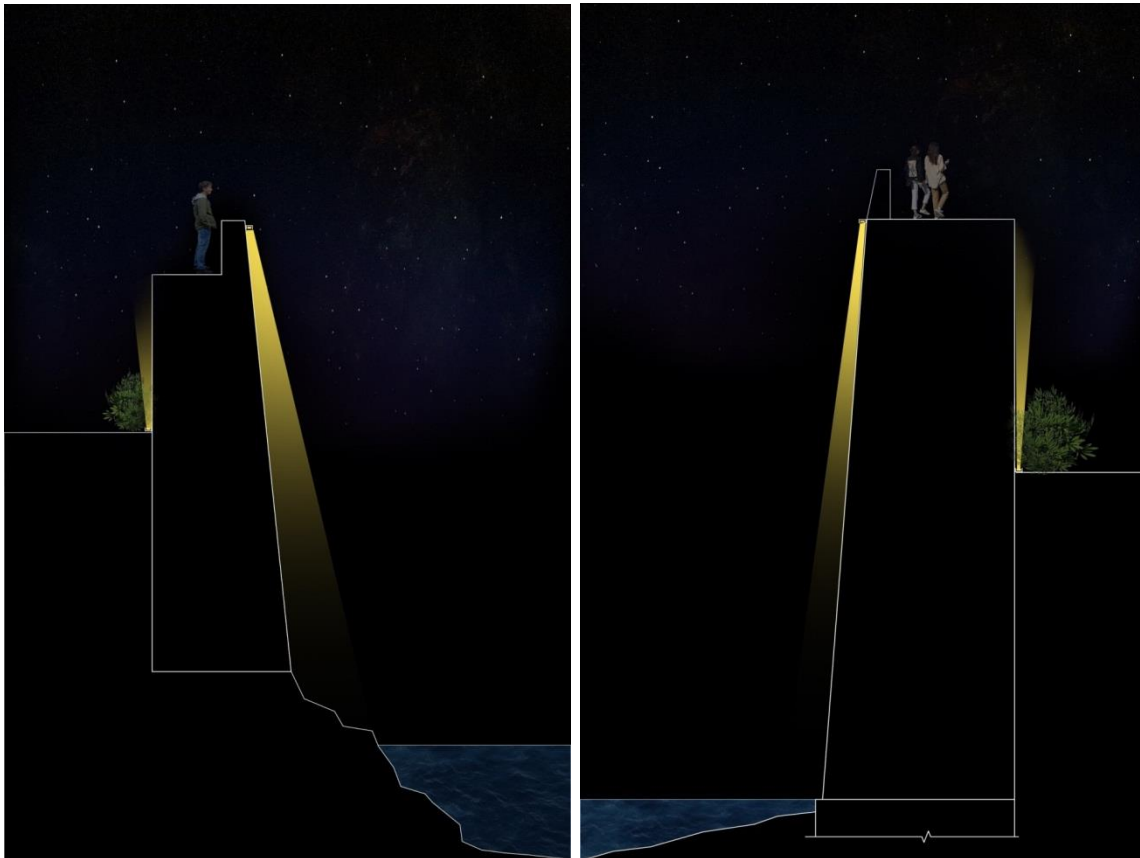
1.5.6 Illumination and Lighting Aerial View of Fort



1.5.7 Night view of Entrance area



1.5.8 External Façade Fort wall Illumination



1.6 General Conditions of Contract

General Conditions of Contract of Central P.W.D. Works 2020 shall be conditions of the Contract for executing of construction works under the “Beautification and Landscaping of Diu Fort, Diu”.

1.7 Defect and Maintenance Liability

The Defect and Maintenance Liability Period for the Work shall be of the Five year (5) years from the date of completion of construction. The above mentioned period shall supersede the defect liability period provided in the Clause 17 of General condition of Contract (GCC) and shall be applicable for the Work with reference to the provisions of clause 17 of GCC and Article 6 of the Integrity Agreement as per the GCC and also shall ensure the following.

- I. Correction of all defects noticed during the defect liability period such as Flooring works, Pointing works, Rectification of Defects / Leakages / Cracks, Replacement of defective materials such as Lime Plaster, Anti Termite Treatment, water proofing, Flooring, Plumbing & Sanitary works, Illumination and electrical items/Fixtures. All works carried out under Scope of Work discussed in section 1.5 shall be covered under the defect and maintenance works.
- II. The Contractor shall promptly rectify all defects pointed out by the Engineer-In-Charge well before the end of the Defect Liability Period. The Defect Liability Period shall automatically stand extended until the defect is rectified.

- III. The Contractor shall maintain landscape area on day to day basis and replacement of any damaged or under grown species, watering, trimming and maintenance of species, manuring every year.
- IV. All street furniture including benches, dustbins, signage's to be cleaned, dusted and maintained by the contractor on daily basis.
- V. If the Contractor has not corrected a Defect pertaining to the Defect Liability Period to the satisfaction of the Engineer-In Charge, within the time specified by the Engineer-in-charge, the Engineer-in-charge will assess the cost of having the Defect corrected, and the cost of correction of the Defect shall be recovered from the Performance Security or any amount due or that may become due to the Contractor and other available securities.
- VI. The maintenance for all Electrical and illumination components will be comprehensive in nature and it will be contractor's responsibility to replace them as and when required (whether under guarantee period or not) during the whole defect & maintenance liability Period including the defects caused by the Public / Tourists.
- VII. Preparation of Maintenance manual
- VIII. Provide required manpower, tools and spares required for day to day maintenance works
- IX. Daily cleaning and maintenance of Diu Fort premises
- X. Cleaning and maintaining of public toilets on twice a day basis.
- XI. Make arrangement for collection and disposal of solid waste
- XII. Maintenance of all the illumination components.
- XIII. Maintain operating logs and records on daily basis
- XIV. Submission of Monthly Progress Report
- XV. Provide Training on Maintenance to personnel nominated by the Employer for a period of two months prior to the Employer issuing Taking over certificate.

1.8 Supplementary Information

1.8.1 Site Visit

Intending Bidder shall visit the site and make himself thoroughly acquainted with the local site condition, nature and requirements of the works, facilities of transport condition, effective labour and materials, access and storage for materials and removal of rubbish. The Bidder shall provide in their tender for cost of carriage, freight and other charges as also for any special difficulties and including police restriction for transport etc. for proper execution of work as indicated in the drawings. The successful Bidder will not be entitled to any claim of compensation for difficulties faced or losses incurred on account of any site condition which existed before the commencement of the work or which in the opinion of the Engineer-in-charge, might be deemed to have reasonably been inferred to be so existing before commencement of work.

1.8.2 Provisions by the Contractor to provide everything necessary.

The contractor shall provide everything necessary for the proper execution of the work according to the intent and meaning of the drawings, schedule of quantities and specifications taken together whether the same may or may not be particularly shown or described therein provided that the same can reasonably be inferred there from and if the contractor finds any discrepancies therein, he shall immediately and in writing, refer the same to the Engineer-in-charge, whose decision shall be final and binding. The contractor shall provide himself for ground & fresh water for carrying out of the works at his cost. The Employer shall on no account be responsible for the expenses incurred by the contractor for hired ground or water obtained from elsewhere. The rate quoted against individual items will be inclusive of everything necessary to complete the said items of work within the contemplation of the contract, and beyond the unit price no extra payment will be allowed for incidental or contingent work, labour and/or materials inclusive of all taxes and duties whatsoever except for specific items, if any, stipulated in the tender documents.

1.8.3 Construction Program and Progress of Works

Construction Program

Contractor shall prepare Construction Program showing the sequences, dependencies, durations and dates for execution of all major items including sectional completion following the subdivisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract. It shall be supported by:

- a) Data of the construction methods
- b) Equipment Utilization Schedule
- c) Manpower Utilization Schedule
- d) Subcontracting Schedule
- e) Mobilization/Demobilization Schedule

Progress Reports

The Contractor shall furnish 5 copies of Progress Reports at regular monthly intervals in a form determined by the Engineer-In-Charge, containing the following information:

- Physical progress for the report month and estimated progress for the next month;
- Updated **S-curves** for physical progress at different sections of the Works
- Any report which may be specifically requested by the Employer and/or the Engineer-in-charge.

The monthly progress reports shall be submitted not later than 7 days after the end of the report month.

1.8.4 Preconstruction Survey and Setting out

The contractor shall set out the works and shall be responsible for the true and perfect setting out of the work and for the correctness of the positions, levels, dimensions and alignment of all parts thereof. If at any time, any error shall appear during the progress of any part of the work, the Contractor shall at his own expense rectify such error, if called upon to the satisfaction of the Employer. The contractor shall further set out the works to the alternative positions at the site until one is finally approved and the rates quoted in his tender should include for this and no extra on this account will be entertained

The Contractor shall verify all measurements and be responsible for their correctness. Any differences which may be found between actual measurements and the dimensions given in the Contract Documents shall be submitted to the Engineer-In-Charge, in writing, for consideration and directives before proceeding with the Works.

The contractor is to construct and maintain proper benches of all the main walls, in order that the lines and levels may be accurately checked at all times. These benches will consist of salwood post of adequate length and minimum diameter 75 mm to be drive in the ground at suitable distance as directed and encased with brickwork. The wire nails will be driven on the top of salwood post on the center lines of columns, walls, inside and outside faces of foundation trenches, in order that lines may be stretched between the benches and accurate intersection of excavation. Center line of walls, columns etc., may be clearly indicated and checked at any time, if it is so required.

Site bench marks shall be accurately and safely established, maintained and removed upon completion of the Works, all to the satisfaction of the Engineer-In-Charge. The Contractor shall prepare a plan detailing the location of the bench marks and keep this up to date throughout the period of the Contract.

The Engineer-in-charge reserves the right to order levels, considered necessary for the full and proper supervision and measurement of the works, to be taken at any time.

Before the Works, or any part thereof, are commenced, the Contractor make a complete survey and take levels, of the site and agree on the dimensions and elevations upon which setting out of the Works shall be eased.

These levels shall be related to the bench marks and shall be plotted and drawn up by the Contractor. After agreement of the drawings, which shall be signed by the Engineer-In-Charge and the Contractor, these levels shall form the basis of setting out of the Works.

The Contractor shall be responsible for the true and proper setting out of the Works in relation to reference data given on the Drawings and shall accurately set out the positions, levels and dimensions of all parts of the Works. Any delay or loss resulting from errors in the setting out of the Works shall be the responsibility of the Contractor

Setting out shall be reviewed by the Engineer-In-Charge before commencing the Works, but any approval shall, in no way, relieve the Contractor of his responsibility for the correct execution of the Work.

1.8.5 As Built Drawings

The Contractor shall Submit 1 (one) reproducible copy and 3 (three) prints of all As-Built drawings clearly named as such to the Engineer-in-charge for approval before applying for the Taking-Over Certificate. After approval of the As Built Drawing the Contractor shall supply an electronic copy of the drawing in together with a licensed copy of the drafting software. During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

Section 2 Information & Instructions for Bidders

2.1 General

- 2.1 1 Letter of transmittal and forms for deciding eligibility are given in **Section 3**.
- 2.1 2 All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a "nil" or "no such case" entry should be made in that column. If any particulars / queries are not applicable in case of the bidder, it should be stated as "not applicable". The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the PQ application being summarily disqualified. Application made by telegram or telex and those received late will not be entertained.
- 2.1 3 Overwriting should be avoided. Correction, if any, should be made by neatly crossing out, initialing, dating and rewriting. Pages of the eligibility criteria document are numbered. Additional sheets, if any added by the contractor, should also be numbered by him. They should be submitted as a package with signed letter of transmittal.
- 2.1 4 References, information and certificates from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer, or equivalent.
- 2.1 5 After opening of the Technical bids, Chief Executive Officer, DSCL shall prepare a list of deficiencies noticed in the bids of each bidder vis-a-vis requirements as per NIT and the respective bidders will be communicated by email with a request to furnish required documents within one week of receipt, failing which it will be presumed that they do not have any further documents to furnish and decision on bids will be taken accordingly.
- 2.1 6 The bidder may furnish any additional information, which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after submission of eligibility criteria document unless it is called for by the employer.
- 2.1 7 Any information furnished by the bidder & found to be incorrect either immediately or at a later date, would render him liable to be debarred from tendering / taking up of work in DSCL and PWD Diu. Such bidder will be debarred from tendering DSCL, Diu and entire amount of EMD shall be forfeited.
- 2.1 8 The contractor shall carry out performance tests of entire installation as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the tests.
- 2.1 9 The contractor shall be responsible to arrange at his own cost all necessary Tools and Plants (T&P) required for the execution of work.
- 2.1 10 The contractor(s) shall make his/their own arrangements for water required for the work at

their own expenses and nothing extra will be paid for the same. This will be subject to the following conditions as per Clause 30 of CPWD GCC 2020

(i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

(ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water are in the opinion of the Engineer-in-Charge, unsatisfactory.

2.1 11 The contractor shall be deemed to have fully acquainted himself with the nature and extent of the work and working conditions at site before submitting the tender. The work shall be executed as per preference of items approved by Engineer-in-charge. If the drawing, designs etc. are not available due to any conditions, the work programme of the contractors shall be modified accordingly and no compensations/damages shall be payable.

2.1 12 Contractor shall be required to provide necessary safety arrangements throughout execution, completion, maintenance and defect liability period to avoid any accidents or damage to adjacent buildings, roads and service lines.

2.1 13 Safety of the works

i. The contractor shall be fully responsible for safety of labour, working staff etc. Proper safety equipment's like helmets, safety belts, gumboots, barricading etc. as per requirement of site shall be provided by the agency and agency shall be fully responsible for any accident and consequent claims etc. if any and Employer shall not be responsible in any more.

ii. All temporary warning/ caution boards display such as "Construction Work in progress", "keep away", "No parking", "Diversion ahead" etc. shall be provided and displayed during day as well as night time by the contractor, wherever required and as directed by the Engineer-in Charge.

iii. Whenever any work is required to be carried out at night in the interest of structural safety or any other reason with authorized to supervise, adequate lighting and other arrangement shall be made in advance by the contractor for proper execution and supervision of such work. The contractor shall not be however entitled to any extra payments for night work. The responsibilities of all kind shall be of contractor

2.1 14 If the work(s) be delayed by:- (i) force majeure, or (ii) abnormally bad weather, or (iii) serious loss or damage by fire, or (iv) civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or (v) delay on the part of other contractors or tradesmen engaged by Engineer-in- Charge in executing work not forming part of the Contract, or (vi) epidemic/pandemic situations, or (vii) any other cause like above which, in the reasoned opinion of the Engineer-in-Charge is beyond the Contractor's control, then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer-in-Charge but

shall nevertheless use constantly his best endeavors to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Charge to proceed with the works. The contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s if any for events listed in this clause(ref: 5.2 of CPWD GCC 2020)

2.1 15 The rates of all items of work shall, unless clearly specified otherwise are including cost of all labor, material and other inputs involved in the execution of the item.

2.1 16 The Mandatory tests required for materials shall be got done from the NABL certified labs & all the testing charges shall be borne by the contractor, cost of sample and its carriage shall also be borne by the contractor.

2.1 17 The time of completion shall be essence of the contract and to be strictly adhered to by the contractor. He shall provide a work schedule showing all the activity for timely completion of the project.

2.1 18 The Contractor shall be responsible for:

- i) The accurate setting out of the Works in relation to original lines, levels and points of reference given by the Engineer -in-Charge in writing.
- ii) The correctness of all positions, levels, dimensions and alignment of all parts of the Works, and
- iii) The provision of all necessary instruments, appliances and labour in connection with the foregoing responsibilities.

2.1 19 Any defect, error, omission, fault shall be immediately brought to the notice of the Engineer- in-Charge before or during the execution of the works.

2.1 20 Tenders with any conditions including that of conditional rebate shall be rejected forthwith.

2.1 21 The contractor should make necessary arrangement for working except National holidays & the planning should be done accordingly.

2.1 22 The Contractor shall make necessary arrangements for medical aid / first aid to all his workers including availability of first aid box all the time at the site of work

2.1 23 Deleted

2.1 24 Even BIS marked material may be subjected to the quality test at the discretion of the Engineer-in-charge. Whenever BIS marked materials are brought to the site of work the contractor shall, if required by the engineer-in-charge, furnish manufacturers test certificate or test certificates confirming to the relevant IS Codes.

2.1 25 Contractor is required to fulfill the provisions of PF (under EPF Scheme) and other labor laws as applicable time to time. The ESI & EPF contribution on the part of employer in respect of this contract shall be paid by the contractor.

2.1 26 Labour Laws to be Complied by the Contractor

- i) The contractor shall obtain a valid license under the Contract Labour (R&A) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, before the commencement of the work, and continue to have a valid license until the completion of the work.
- ii) The contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.
- iii) The contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986.
- iv) The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

2.1 27 Employer. Any deduction/ compensation proposed by Employer, in regard to defective work or work not confirming to specifications, loss of time, amount shall be deducted from running bills. No claim of the contractor whatsoever shall be entertained on this account.

2.1 28 The department will be responsible only to the contractor and his authorized representative and none else, with whom contractor may be in liaison or associated in any manner.

2.1 29 The contractor shall also make necessary agreement at his own cost for diesel generator sets required for the work, so that the same can be used by him during failure/none availability of electricity. Necessary permission etc. if required shall be taken by him from the concerned authorities. Nothing extra shall be paid on this account

2.1 30 Nothing extra, what so ever shall be payable to the contractor for executing the work as per general specifications and special conditions in all the above paras.

2.1 31 The quality assurance of the work shall be got done through the PMC, DSCL appointed by the Employer, and the payment of work done shall be released to contractor after certification of PMC for its quality etc

2.2 Definitions

In these documents, detail list of definitions is been attached as per Appendix II and the the following words and expression have the meaning here by assigned to them.

2.2.1. **Employer:** means the Chief Executive Officer, DSCL, Diu on behalf of the President of India; Engineer-in-Charge represents the Employer.

2.2.2. **Board of Directors or Board:** means the collective body of directors of the company;

2.2.3. **Bidder:** means the Individual, proprietary firm, partnership firm, limited company private or Public Corporation.

- 2.2.4. **“Engineer-in-charge”** shall mean the “Chief Operating Officer (COO)/ Chief Technical Officer (CTO) / Executive Engineer (EE) / Engineer-in-charge /Project Manager/ Construction Manager” / the person designated as such by the Employer from time to time and shall include those who are expressly authorized by the Employer to act for and on its behalf for all functions pertaining to the execution and operation of this Contract. The Contractor will be given a copy of the Employer's authorization designating the Engineer-in-charge by name and delegating him his authority, at the time when Contract is signed. It is however, to be distinctly understood that, no delegation of powers shall be made to such assistants or sub-ordinates, except in respect of supervision to ensure compliance of the Contract conditions.
- 2.2.5. **“Project Management Consultant” or “PMC”**: To assist in due discharge of its obligation, the Employer has appointed a Project Management Consultant or PMC. The PMC, as Employer’s/ Engineer-in-Charge’s Authorized Representative, will be responsible for overall construction supervision and project management of works to be executed under this tender. Such activities will include but will not be limited to Contract Management, Scope Management, Cost Management, Quality Management, Time Management and Safety, Health and Environment (SHE) compliances for the tendered works. In addition to the above, the PMC shall also be responsible for Certification of Contractors bill of quantities and all the roles and responsibilities assigned to it as part of Project Implementation and Supervision activities specified in Contract Agreement between DSCL and PMC
- 2.2.6. **Year** means “Financial Year” unless stated otherwise.

2.3 Method of Application

- 2.3.1. If the bidder is an individual, the application shall be signed by him above his full type written name and current address.
- 2.3.2. If the bidder is a proprietary firm, the application shall be signed by the proprietor above his full type written name and the full name of his firm with its current address.
- 2.3.3. If the bidder is a firm in partnership, the application shall be signed by all the partners of the firm above their full typewritten names and current addresses, or, alternatively, by a partner holding power of attorney for the firm. In the later case a certified copy of the power of attorney should accompany the application. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.
- 2.3.4. **If the bidder is a limited company or a corporation, the application shall be signed by** a duly authorized person holding power of attorney for signing the application accompanied by a copy of the power of attorney. The bidder should also furnish a copy of the Memorandum of Articles of Association duly attested by a Public Notary.

2.4 Final Decision Making Authority

The employer reserves the right to accept or reject any bid and to annul the process and reject all bids at any time, without assigning any reason or incurring any liability to the bidders.

2.5 Particulars Provisional

Deleted.

2.6 Site Visit

Bidders are encouraged to submit their respective BIDs after visiting the Project site and ascertaining for themselves the site conditions, location, surroundings, availability of power, water and other utilities for construction, access to site, handling and storage of materials, , applicable laws and regulations, and any other matter considered relevant by them.

2.7 Criteria for Eligibility

2.7.1. Should have satisfactorily completed the works as mentioned below during the last Seven years ending previous day of last date of submission of tender.

Three similar completed works costing not less than the amount equal to 40% of the Estimated Project Cost (Amount INR 4,53,36,152/-).

or

Two similar completed works, costing not less than the amount equal to 60% of the Estimated Project Cost (Amount INR 6, 80, 04, 228/-).

or

One similar completed work of aggregate cost not less than the amount equal to 80% of the Estimated Project Cost (Amount INR 9,06,72,304/-).

with Archaeological Survey of India/ Central Government Department / State Government Department / Central Autonomous Body / Central Public Sector undertaking / State Autonomous Body / State Public Sector undertaking / City Development authority / Municipal Corporation of city formed under any act by central / state Government and published in Central / State Gezzete / Smart City Mission.

Definition of Similar Nature of work: The Bidder(s) should have required experience in executing Landscape, Beautification and Outdoor Illumination works within Heritage structure premise or Monuments. Similar nature Projects consist of works in Traditional natural stone cobble flooring, pointing works and civil works, Outdoor Façade illumination works in a heritage/monuments with world class/International brand lighting and Horticulture-Irrigation works.

The bidder shall have domain experience in Civil & Horticulture/Landscape works in similar nature of works. The bidder shall have executed Electrical/Illumination works of outdoor lighting as per following in the last 7 years:

Single Project worth min. INR 4 cr.

or

Two projects worth min. INR 3 cr.

or

Three projects worth min. INR 2 cr.

(Note- The bidder shall have to submit the Agreement, entire BoQ / Certificate signed & certified by the Client / Authority by an officer not below the rank of Executive Engineer or equivalent.)

In case the bidder does not have experience in electrical/illumination works of that quantum as mentioned above, a MoU may be done by the bidder with other agency having experience in electrical/illumination works for the similar nature of works as per above mentioned condition.

Note: TDS (Tax deducted at Source) certificate for Private works shall be enclosed other than Govt. works for above mentioned criteria.

Physical Requirements

Execution of similar items of work executed within completed projects in the last 7 financial years.

Table for Physical Requirement (To be filled by the bidder along with the technical bid as part of Form-D)

S. No	Particulars	Actual Quantity Executed in last 7 years. (To be filled in by the contractor)		
		Project Name	Ref. Boq/Certificate	Amount
1	Traditional Cobble/local stone flooring, pointing and Stone street furniture and signage works, civil works worth 3 Cr.			
2	Horticulture, plumbing and Irrigation works- Min. 3cr work			

Note: The bidder has to submit the details of the each above works with reference to the specific project (duly certified by the Executive Engineer or equivalent), mentioning the name of the project, Agreement no., Cost of the project, date of completion etc. / and the certified copy of the relevant BOQ / certificate of Executive Engineer regarding the execution of the specific work under the relevant agreement.

The value of executed work shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to last date of receipt of application for tender.

2.7.2. The bidder should have had Average Annual Financial Turnover of 50% of estimated project cost on Civil/Electrical construction works during the last three consecutive years. Balance sheets duly audited by Chartered Accountant shall be submitted. Year in which no turnover is shown would also be considered for working out the average.

- 2.7.3. **Contractors, who are executing ongoing mandates from DSCL of similar nature, must propose a separate team of key staff while bidding for this project.**
- 2.7.4. **For line items of similar nature in the BOQ's, the Contractor shall not enter separate rates in the BOQ's.**
- 2.7.5. **In case different rates filled by the bidder for similar nature of items and then lowest quoted rate shall be considered.**
- 2.7.6. **If a MoU is being signed between main agency and subletting agency for electrical works then same shall be submitted by the contractor during uploading of bid documents and as well as in Physical submission.**
- 2.7.7. Experience gained as nominated sub-contractor shall be considered provided following conditions are met:
- a) If the contract signed between the employer and main contractor has provision for sub-contracting and a signed copy of such contract or its relevant part is submitted
 - b) Work completion certificate from the Main Contractor is provided
- 2.7.8. Firm must be registered as Class A with for any state Government, R&B Division of State Government or central Government or CPWD Class II Contractors as well specialized firms having experience in executing similar nature of work with ASI/ / State government/ INTACH/ similar other reputed organizations.
- 2.7.9. Bidder should not have incurred any loss in more than two years during the last five years ending 31st March 2020. (Scanned copy of certificate from CA to be uploaded).
- 2.7.10. The bidder should have a Solvency of the amount equal to 40% of the Estimated Project Cost certified by his Banker
- 2.7.11. Experience of similar works shall only be considered of the Main firm with valid documents
- 2.7.12. The bidder should not have been blacklisted by any Central Government/State Govt. Offices/PSUs and self-certificate is to be scanned and uploaded.
- 2.7.13. The bidder should own construction equipment as per list required for the proper and timely execution of the work. Else, he should certify that he would be able to manage the equipment by hiring etc., and submit the list of firms from whom he proposes to hire.
- 2.7.14. The bidders should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder should submit a list of these employees stating clearly how these would be involved in this work within 15 days of award of work.
- 2.7.15. The bidder's performance for each work completed in the last seven years and in hand should be certified by an officer not below the rank of Executive Engineer

2.8 Evaluation Criteria

2.8.1. The details submitted by the bidder will be evaluated for eligibility by the Employers Competent Authority or a Committee constituted by him. The details submitted by the bidders will be generally evaluated in the following manner:

2.8.2.1. The criteria prescribed under Clause 2.7 above in respect of experience of similar nature of works completed, bidding capacity and financial turn over etc. will first be scrutinized and the bidder's eligibility for the work shall be determined.

2.8.2.2. The bidders qualifying the criteria as set out in Clause 2.7 above will be evaluated for following criteria by scoring method on the basis of details furnished by them:

S. No	Details	Marks (Maximum)
1.	Financial strength (Form 'A' & 'B')	20
2.	Experience in similar nature of work during last seven years (Form 'C')	20
3.	Performance on works (Form 'D ') – Time over run	20
4.	Performance on works (Form 'D ') – Quality	40
	Total	100

To become eligible for short listing, the bidder must secure at least **fifty** percent marks in each (Section 1, 2, 3 & 4) and **sixty** percent marks in aggregate.

The Employer, however, reserves the right to restrict the list of such qualified contractors to any number deemed suitable by it.

Note: The average value of performance of works for time overrun and quality shall be taken on the basis of performance report and eligible similar works

2.8.2. Even though any bidder may satisfy the above requirements, he would be liable to disqualification if he has:

2.8.2.1. **Made misleading or false representation or deliberately suppressed the information** in the forms, statements and enclosures required in the eligibility criteria document,

2.8.2.2. Record of poor performance such as abandoning work, not properly completing the contract, or financial failures / weaknesses etc.

2.9 Financial Information

Bidder should furnish the following financial information:

Annual financial statement for the last five year in (**Form "A"**) and solvency certificate in (**Form "B"**)

2.10 Security Deposit

2.10.1 Security Deposit shall be deducted from each running bill at the rate as specified in **Schedule E** of NIT. The total amount of Security Deposit so deducted shall not exceed the percentage of Contract Price specified in the **Schedule E**.

2.10.2 The security deposit may be replaced by equivalent amount of bank guarantee or fixed deposit receipt assigned to the Employer, with validity up to 3 (three) months beyond the completion of Defect Liability Period/ extended Delectability Period.

2.10.3 The Security Deposit shall be refunded on completion of Defect Liability Period.

2.11 Experience in works Highlighting Experience in Similar Works

2.15.1 Bidder should furnish

The List of eligible similar nature of works successfully completed during the last seven years in **(Form "C")**.

Bidder should furnish the Particulars of completed works (CIVIL/ELETRICAL) etc., and performance of the bidder duly authenticated/certified by an officer not below the rank of Executive Engineer or equivalent should be furnished separately for each work completed or in progress in **(Form "D")**

2.12 Organization information

Bidder is required to submit the information in respect of his organization in **Form "E"**

2.13 Letter of Transmittal

The bidder should submit the letter of transmittal attached with the document.

2.14 Opening of Price Bid

After evaluation of applications, a list of short listed Contractors will be prepared. Thereafter the financial bids of only the qualified and technically acceptable bidders shall be opened at the notified time, date and place in the presence of the qualified bidders or their representatives. The bids shall remain valid for 120 days (as prescribed in **CPWD-6** for e-tendering) from the opening of technical bid.

2.15 Award Criteria

2.15.1 The Employer shall award the work to the eligible bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the lowest Evaluated Price Bid.

2.15.2 The employer reserves the right, without being liable for any damages or obligation to inform the bidder, to:

2.15.2.1. Amend the scope and value of contract to the bidder.

2.15.2.2. Reject any or all the applications without assigning any reason.

2.15.3 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

2.16 Criteria for Evaluation of the Performance of Contractors for Pre-Eligibility

Attributes		Evaluation					
(a)	Financial strength	(20 marks)					
	(i) Average annual turnover 16 marks (ii) Solvency Certificate 4 marks	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro-rata basis.					
(b)	Experience	(20 marks)					
	Experience in similar class of works	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro-rata basis.					
(c)	Performance on works (time over run)	(20 marks)					
	Parameter	Calculation for points	Score		Marks		
	(i) Without levy of compensation.	If TOR=	1.00	2.00	3.00	>3.50	20
	(ii) With levy of compensation.		20	15	10	10	
	(iii) Levy of compensation not decided		20	5	0	-5	
			20	10	0	0	
<p>TOR = AT/ ST, where AT = Actual time; ST = Stipulated Time.</p> <p>Note: Marks for value in between the stages indicated above is to be determined by straight line variation basis</p>							
(d)	Performance of works (Quality)	(40 marks)					

	Attributes	Evaluation
	(i) Outstanding	40
	(ii) Very Good	30
	(iii) Good	20
	(iv) Poor	0

2.17 Corrupt Practices

The Employer requires that bidders observe the highest standard of ethics during the procurement and execution of contracts. In pursuance of this policy, the employer.

- 2.17.1. May reject the bid for award if it determines that the bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract; and
- 2.17.2. May debar the bidder declaring ineligible, either indefinitely or for a stated period of time, to participate in bids, if it at any time determines that the bidder has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for, or in executing, a contract.

Section 3 Information Regarding Eligibility

3.1 Letter of Transmittal

From:

To

Chief Executive Officer,

Diu Smart City Limited,

Fort Road, Diu 362520 (UT)

Subject: Submission of Bid for the work **Beautification and Landscaping of Diu Fort with Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India**” (3rd Call).

Having examined the details given in press notice and bid document for the above work, I/we hereby submit the relevant information.

1. I / we hereby certify that the statement made and information supplied in the enclosed Forms A to E and accompanying statement is true and correct.
2. I / we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I / we submit the requisite certified solvency certificate and authorize **Chief Executive Officer, DSCL, Diu, (UT)** to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I / we also authorize **Chief Executive Officer, DSCL, Diu,** to approach individuals, employers, firms and corporation to verify our competence and general reputation.
4. I / we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following works:

Name of work:	Certificate from
---------------	------------------

Certificate: It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I / We shall be liable to be debarred, disqualified / cancellation of enlistment in case any information furnished by me / us is found to be incorrect.

Enclosures:

Seal of bidder

Date of submission:

Signature(s) of Bidder(s)

3.2 Form 'A' - Financial Information

FORM 'A'

FINANCIAL INFORMATION

- I. Financial Analysis: - Details to be furnished duly supported by figures in balance sheet / profit & loss account for the **last five years** duly certified by the Chartered Accountant, as submitted by the bidder to the Income Tax Department (Copies to be attached).

Year	Gross Annual turnover on construction works	Profit / Loss
2015-16		
2016-17		
2017-18		
2018-19		
2019-20		

- II. Financial arrangements for carrying out the proposed work.
- III. Solvency Certificate from Bankers of the bidder in the prescribed Form 'B'.

Signature of Chartered Accountant with seal

Signature of Bidder(s).

3.3 Form 'B' - Form Of Bankers' Certificate From A Scheduled Bank

FORM 'B'

FORM OF BANKERS' CERTIFICATE FROM A SCHEDULED BANK

This is to certify that to the best of our knowledge and information that M/s..... having marginally noted address, a customer of our bank are / is respectable and can be treated as good for any engagement up to a limit of Rs..... (Rupees only).

This certificate is issued without any guarantee or responsibility on the Bank or any of the officers.

(Signature)

For the Bank

Note:-

1. Bankers certificates should be on letter head of the Bank, sealed in cover addressed to tendering authority.
2. In case of partnership firm, certificate should include names of all partners as recorded with the Bank.

3.4 Form 'C' - Details Of All Works Of Similar Class Completed During The Last Seven Years

FORM 'C'

DETAILS OF WORKS OF SIMILAR NATURE COMPLETED DURING THE LAST SEVEN YEARS ENDING PREVIOUS DAY OF THE LAST DATE SUBMISSION OF TENDERS

S. No.	Name of work/project and location	Owner or sponsoring organization	Cost of work in crores of rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation/ arbitration cases pending/ in progress with details*	Name and address/ telephone number of officer to whom reference may be made	Whether the work was done on back to back basis Yes/ No
1	2	3	4	5	6	7	8	9	10

* Indicate gross amount claimed and amount awarded by the Arbitrator.

Signature of Bidder(s)

3.5 Form 'D' Performance Report of Works Referred To In Forms 'C'

Form 'D'

PERFORMANCE REPORT OF WORKS REFERRED TO IN FORMS 'C'

1.	Name of work / project & location	:	
2.	Agreement No.	:	
3.	Estimated cost	:	
4.	Tendered cost	:	
5.	Date of start	:	
6.	Date of completion (i) Stipulated date of completion (ii) Actual date of completion	: : :	
7.	Amount of compensation levied for delayed completion, if any	:	Yes/No
	(a) Whether case of levy of compensation For delay has been decided or not		
	(b) If decided, amount of compensation levied for delayed completion if any	:	
8.	Performance report: 1) Quality of work	:	Outstanding/Very Good / Good / Fair / Poor
	2) Financial soundness	:	Outstanding/Very Good / Good / Fair / Poor
	3) Technical Proficiency	:	Outstanding/Very Good / Good / Fair / Poor
	4) Resourcefulness	:	Outstanding/Very Good / Good / Fair / Poor
	5) General Behavior	:	Outstanding/Very Good / Good / Fair / Poor

Dated:

Executive Engineer, or Equivalent

Table for Physical Requirement (To be filled by the bidder along with the technical bid)

S. No	Particulars	Actual Quantity Executed in last 7 years. (To be filled in by the contractor)		
		Project Name	Ref. Boq/Certificate	Amount
1	Traditional Cobble/local stone flooring, pointing and Stone street furniture and signage works, civil works worth 3 Cr.			
2	Horticulture, plumbing and Irrigation works- Min. 3cr work			

Note: The bidder has to submit the details of the each above works with reference to the specific project (duly certified by the Executive Engineer or equivalent), mentioning the name of the project, Agreement no., Cost of the project, date of completion etc. / and the certified copy of the relevant BOQ / certificate of Executive Engineer regarding the execution of the specific work under the relevant agreement.

3.6 Form 'E' Structure & Organization

FORM ' E'

STRUCTURE & ORGANISATION

1. Name & address of the bidder
2. Telephone no. / Telex no. / Fax no.
3. Legal status of the bidder (attach copies of original document defining the legal status)
 - (a) An Individual
 - (b) A proprietary firm
 - (c) A firm in partnership
 - (d) A limited company or Corporation
4. Particulars of registration with various Government Bodies (attach attested photocopy)

Organization / Place of Registration	Registration No.
1.	
2.	

5. Names and titles of Directors and Officers with designation to be concerned with this work.
6. Designation of individuals authorized to act for the organization.
7. Has the bidder or any constituent partner in case of partnership firm/Limited company/Joint Venture, ever been convicted by the court of law? If so give details.
8. In which field of Civil Engineering construction the bidder has specialization and interest?
9. Any other information considered necessary but not included above.

Signature of Bidder(s)

FORM CPWD-6

FOR e-Tendering

1. Item rate bids are invited by Chief Executive Officer, DSCL on behalf of President of India, from approved and eligible firms/ contractors of repute in Two bid system for the work of: **“Beautification and Landscaping of Diu Fort” with Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India”(3rd Call)**

The enlistment of the contractors should be valid on the last date of submission of bids. In case the last date of submission of bid is extended, the enlistment of contractor should be valid on the original date of submission of bids.

- 1.1 The work is estimated to cost Estimated Cost:- Estimated Cost:- INR: 113,340,380/-

This estimate, however, is given merely as a rough guide.

- 1.2 Intending tenderer is eligible to submit the bid provided he has definite proof from the appropriate authority, which shall be to the satisfaction of the competent authority, of having satisfactorily completed similar works of magnitude specified below.

1.2.1 Criteria for Eligibility for the Registered Contractor in last 7 years ending previous day of last date of submission of bids

Three similar completed works costing not less than the amount equal to 40% of the Estimated Project Cost (Amount INR 4,53,36,152/-).

or

Two similar completed works, costing not less than the amount equal to 60% of the Estimated Project Cost (Amount INR 6,80,04,228/-).

or

One similar completed work of aggregate cost not less than the amount equal to 80% of the Estimated Project Cost (Amount INR 9,06,72,304/-).

With Archaeological Survey of India/ Central Government Department / State Government Department / Central Autonomous Body / Central Public Sector undertaking / State Autonomous Body / State Public Sector undertaking / City Development authority / Municipal Corporation of city formed under any act by central / state Government and published in Central / State Gazette / Smart City Mission

Definition of Similar Nature of work: The Bidder(s) should have required experience in executing Landscape, Beautification and Outdoor Illumination works within Heritage structure premise or Monuments. Similar nature Projects consist of works in Traditional natural stone cobble flooring, pointing works and civil works, Outdoor Façade illumination works in a heritage/monuments with world class/International brand lighting and Horticulture-Irrigation works.

The bidder shall have domain experience in Civil & Horticulture/Landscape works in similar nature of works. The bidder shall have executed Electrical/Illumination works of outdoor lighting as per following in the last 7 years:

Single Project worth min. INR 4 cr.

or

Two projects worth min. INR 3 cr.

or

Three projects worth min. INR 2 cr.

(Note- The bidder shall have to submit the Agreement, entire BoQ / Certificate signed & certified by the Client / Authority by an officer not below the rank of Executive Engineer or equivalent.)

In case the bidder does not have experience in electrical/illumination works of that quantum as mentioned above, a MoU may be done by the bidder with other agency having experience in electrical/illumination works for the similar nature of works as per above mentioned condition.

Note: TDS (Tax deducted at Source) certificate for Private works shall be enclosed other than Govt. works for above mentioned criteria.

The value of executed work shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to last date of receipt of application for tender.

Physical Requirements

Execution of similar items of work executed within completed projects in the last 7 financial years.

Table for Physical Requirement (To be filled by the bidder along with the technical bid as part of Form-D)

S. No	Particulars	Actual Quantity Executed in last 7 years. (To be filled in by the contractor)		
		Project Name	Ref. Boq/Certificate	Amount
1	Traditional Cobble/local stone flooring, pointing and Stone street furniture and signage works, civil works worth 3 Cr.			
2	Horticulture, plumbing and Irrigation works- Min. 3cr work			

Note: The bidder has to submit the details of the each above works with reference to the specific project (duly certified by the Executive Engineer or equivalent), mentioning the name of the project, Agreement no., Cost of the project, date of completion etc. / and the certified copy of the relevant BOQ / certificate of Executive Engineer regarding the execution of the specific work under the relevant agreement.

1.2.2. To become eligible for issue of bid, the bidders shall have to furnish an affidavit as under:-

1. I/We undertake and confirm that eligible similar works(s) has/have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding in DSCL, Diu in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee. (Scanned **copy to be uploaded at the time of submission of bid**).
2. Agreement shall be drawn with the successful bidders on prescribed **Form No. CPWD-8** which is available as a Govt. of India Publication and also available on website <https://ddtenders.gov.in>, www.diu.gov.in Bidders shall quote his rates as per various terms and conditions of the said form which will form part of the agreement.
3. The time allowed for carrying out the work will be 15 Days from the date of start as defined in **Schedule 'F'** or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the bid documents.
4. (i) The site for the work is available.

or

- (ii) The Architectural and Structural Drawings with specifications for various components for the work are attached as **Appendix 1** with NIT.
5. The bid document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions of Contract Form can be seen on website <https://ddtenders.gov.in> , www.diu.gov.in on free of cost.
6. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified
7. The Earnest Money of **INR 21,33,500/-** Drawn in favor of Chief Executive Officer, DIU SMART CITY LTD, Diu, in the shape of Fixed Deposit Receipt (FDR)/Demand Draft/Bank Guarantee shall be scanned and uploaded to the e-Tendering website within the period of bid submission. The FDR/BG shall be valid for a period of 120 days from the last date of receipt of bids. It is mandatory to submit tender fees (non-refundable) and EMD online failing which the price bid of that agency will not be opened online and Physical submission of such scanned documents shall reach to office of the Chief Executive Officer, DIU SMART CITY LTD, within 3 (three) working days after closing of online bidding.
8. The bid submitted shall become invalid if: (i) The bidders are found ineligible. (ii) The bidders do not upload all the documents (GST registration) as stipulated in the bid document. (iii) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically in the office of tender opening authority.
9. The contractor whose bid is accepted will be required to furnish **performance guarantee of 5% (Five Percent) of the bid amount** within the period specified in **Schedule F**. 50% of said Performance Guarantee Amount or 20 Lakhs whichever is less shall have to deposit in the

shape of Fixed Deposit Receipt (FDR) and the remaining amount shall be submitted in the form of an irrevocable bank guarantee bond of any scheduled bank or the State Bank of India in the prescribed form given in this document. In case the contractor fails to deposit the said performance guarantee within the period as indicated in Schedule 'F', including the extended period if any, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor. The Earnest money deposited along with tender shall be returned after receiving the aforesaid performance.

10. Intending Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground, the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The bidder shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder 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 of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.
11. The competent authority on behalf of the President of India does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidder shall be summarily rejected.
12. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable for rejection.
13. The competent authority on behalf of President of India reserves to himself the right of accepting the whole or any part of the bid and the bidder shall be bound to perform the same at the rate quoted.
14. The contractor shall not be permitted to bid for works in DSCL, PWD, DMC, District Panchayat, Diu and other govt. similar agency in which his near relative is posted as a Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted officer, DSCL, Diu. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.
15. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or

engagement in the contractor's service.

16. The tender for the works shall remain open for acceptance for a period of One Twenty (120) days from the date of opening of technical bid. If any tenderer withdraws his tender before the said period or issues of letter of acceptance, whichever is earlier, or makes any modification in the terms and conditions of the tender which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the tenderer shall not be allowed to participate in the retendering process of the work
17. This notice inviting Bid shall form a part of the contract document. The successful bidders/contractor, on acceptance of his bid by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of:-
 - a) The Notice Inviting Bid, all the documents including additional conditions, specifications and drawings, BOQ's forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.
 - b) **Standard CPWD Form-8 and Rules and directions provided in the General Contract Conditions 2020 published by CPWD.**

Chief Executive Officer, DSCL, Diu,(UT).

Section 4 Forms, Agreements and Schedules

4.1 Form Integrity Pact

INTEGRITY PACT

To,

.....,

.....,

.....

Sub: NIT No. for the work **“Beautification and Landscaping of Diu Fort” with Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India”** (3rd Call).

Dear Sir,

It is here by declared that Chief Executive Officer, DSCL, Diu, is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer/bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the President of India.

Yours faithfully

Chief Executive Officer, DSCL, Diu,

4.2 Form Acknowledgement By Bidder For Acceptance Of Principal Of Integrity

ACKNOWLEDGEMENT BY BIDDER FOR ACCEPTANCE OF PRINCIPAL OF INTEGRITY

To,

Chief Executive Officer,

Diu Smart City Limited,

Fort Road, Diu -362520 (UT).

Sub: Submission of Tender for the work “**Beautification and Landscaping of Diu Fort**” with **Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India**” (3rd Call).

Dear Sir,

I/We acknowledge that Chief Executive Officer, DSCL,, Diu is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by Chief Executive Officer, DSCL, Diu. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, Chief Executive Officer, DSCL, Diu, shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid in accordance with terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder)

4.3 Form Integrity Agreement

To be signed by the bidder and same signatory competent / authorized to sign the relevant contract on behalf of the Employer.

INTEGRITY AGREEMENT

This Integrity Agreement is made at on this..... day of 2021

BETWEEN

President of India represented through **Chief Executive Officer, DSCL, Diu,(UT)** (Hereinafter referred as the “Employer/Principal/Owner” which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

.....

(Name and Address of the Individual/firm/Company)

through.....

..... (Details of duly authorized signatory).....
(Hereinafter referred to as the “**Bidder/Contractor**” and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender (NIT No.) (Hereinafter referred to as “**Tender/Bid**”) and intends to award, under laid down organizational procedure, contract for

(Name of work)

Hereinafter referred to as the “**Contract**”.

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as “**Integrity Pact**” or “**Pact**”), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Principal/Owner

- 1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

- (a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - (b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.
 - (c) The Principal/Owner shall endeavor to exclude from the Tender process any person, whose conduct in the past has been of biased nature.
- 2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

- 1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / Department all suspected acts of **fraud or corruption or Coercion or Collusion** of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.
- 2) The Bidder(s)/Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:
 - a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.
 - b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.
 - c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/Contractor(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
 - d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality

shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

- e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose (with each tender as per proforma enclosed) any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.
- 3) The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 4) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice **means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.**
- 5) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

- 1) If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days' notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. Such exclusion may be forever or for a limited period as decided by the Principal/Owner.
- 2) **Forfeiture of EMD/Performance Guarantee/Security Deposit:** If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

- 3) **Criminal Liability:** If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of Indian Penal code (IPC)/Prevention of Corruption Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

All the agencies / executing agencies & Consultants will be held criminally liable and will be subjected to prosecution, in case of substandard material supply, usage, substandard work execution, substandard or faulty design etc. as per **circular No. JS/PWD/DMN/CIRCULAR/2020/89 Dated 23/09/2020.**

Article 4: Previous Transgression

- 1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.
- 2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.
- 3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

- 1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Subcontractors/ sub-vendors.
- 2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.
- 3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor **after** the completion of work under the contract or till the continuation of defect and maintenance liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, Chief Executive Officer, DSCL,, Diu.

Article 7- Other Provisions

- 1) This Pact is subject to Indian Law, place of performance and jurisdiction is the Headquarters of the Division of the Principal/Owner, who has floated the Tender.
- 2) Changes and supplements need to be made in writing. Side agreements have not been made.
- 3) If the Contractor is a partnership firm, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partnership firm members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.
- 4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this **Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.**

Article 8- Legal and Prior Rights

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contract documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

.....
(For and on behalf of Principal/Owner)

.....
(For and on behalf of Bidder/Contractor)

WITNESSES:
.....
(Signature, name and address)

.....
(Signature, name and address)

Place:

Dated:

4.4 Form CPWD - 8 Contract For Works

FORM CPWD - 8

ITEM RATE TENDER & CONTRACT FOR WORKS

(A) Tender for the work of: - **“Beautification and Landscaping of Diu Fort” with Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India”.(3rd Call)**

- (i) To be Uploaded online by 02/02 / 2021 at 17:00 Hrs.
- (ii) Pre Bid conference 21 / 01 / 2021 at 15:30 Hrs.
- (iii) Technical Bid to be opened online on 05/02/ 2021 at 17:30 Hrs.
- (iv) Financial Bid to be opened online on 12 /02/ 2021 at 15.30 Hrs. **(If Possible)**

(After approval of technical bid by the competent authority)

TENDER

I/We have read and examined the notice inviting tender, schedule, A, D ,E & F. Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rate & other documents and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified for the Chief Executive Officer, DSCL, Diu, within the time specified in Schedule ‘F’, viz., schedule of quantities and in accordance in all respects with the specifications, designs, drawings and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract (CPWD GCC 2020) and with such materials as are provided for, by, and in respects in accordance with, such conditions so far as applicable.

I/We agree to keep the tender open for acceptance for the period of One Twenty (120) days from the date of opening of technical bid and not to make any modifications in its terms & conditions.

A sum of **INR 21,33,500/-** is hereby forwarded in cash/receipt treasury challan/deposit at call receipt of a scheduled bank/fixed deposit receipt of scheduled bank/demand draft of a scheduled bank/bank guarantee issued by a scheduled bank as earnest money.

A copy of earnest money in receipt treasury challan/deposit at call receipt of a scheduled bank/fixed deposit receipt of scheduled bank/demand draft of a scheduled bank/bank guarantee issued by a scheduled bank is scanned and uploaded (strike out as the case may be). If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the said President of India or his successors (CEO, DSCL), in office shall

without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely. Further, if I/We fail to commence work as specified, I/ We agree that President of India or the successors (CEO, DSCL), in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the CPWD GCC 2020.

Further, I/We agree that in case of forfeiture of Earnest Money or both Earnest Money and performance guarantee as aforesaid, I / We shall be debarred for participation in the re-tendering process of the work.

I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for tendering in DSCL, Diu in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest money Deposit/Performance Guarantee.

I/We hereby declare that I/We shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information / derived therefrom to any person other than a person to whom I/We, am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the state.

Dated

Signature of the Contractor

Postal Address -----

Telephone No.-----

FAX -----

E-MAIL -----

Witness:-----

Address:-----

Occupation:-----

ACCEPTANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf President of India for a sum of Rs. * _ _ _ _ _
(Rupees * _ _ _ _ _
_ _ _ _ _)

The letters referred to below shall form part of this contract Agreement:-

(a) -----*

(b) -----*

(c) -----*

For & on behalf of the President
of India

Chief Executive Officer, DSCL,,
Diu

Signature.....

Dated

Designation.....

4.5 Schedules A Schedule Of Quantities

SCHEDULE 'A' (Attached as part of Boq)

Name of Work: "Beautification and Landscaping of Diu Fort" with Defect and Maintenance Liability Period for Five Years Under "SMART CITY MISSION" at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India (3rd Call).

Note:

- 2. Contractor must ensure to quote rate of each item specified in Schedule of Quantity considering Five Year Defect and Maintenance Liability period.**
- 3. For line items of similar nature in the BOQ's, the Contractor shall not enter separate rates in the BOQ's.**
- 4. In case different rates filled by the bidder for similar nature of items then lowest quoted rate shall be considered.**
- 5. The financial evaluation will be based on the lowest combined price bids .**
- 6. The rates quoted by the Contractor shall be deemed to be inclusive of the GST, commercial tax and other levies, duties, cess, toll, taxes of Central and State Governments, local bodies and authorities.**

4.6 Schedule 'D' Extra Schedule for Specific Requirements

SCHEDULE 'D'

Extra schedule for specific requirements / documents for the work, if any - **NIL**

4.7 Schedule 'E' Reference to General Conditions Of Contract

SCHEDULE 'E'

Reference to General Conditions of Contract: As per the Form no. CPWD-8 and General Contract Conditions – 2020 Published by CPWD which is available on CPWD website at https://cpwd.gov.in/Publication/GCC_Constructions_works_2020.pdf and https://cpwd.gov.in/Publication/GCC_Maintenance_Works_2020.pdf and with amendments issued time to time & terms by UT Administration and CPWD conditions, specifications, etc enclosed.

Name of work: - “Beautification and Landscaping of Diu Fort” with Defect and Maintenance Liability Period for Five Years Under “SMART CITY MISSION” at Diu, U.T. Administration of Dadra and Nagar Haveli and Daman & Diu, Government of India”(3rd Call).

- | | | |
|----------------------------------|---|---|
| (i) Estimated cost of work | : | INR. 11,33,40,380/- |
| (ii) Earnest money | : | INR. 21,33,500/- to be returned after receipt of Performance Guarantee |
| (iii) Performance Guarantee (PG) | : | 5% of Contract Value |
| (iv) Security deposit | : | 2.5 % of tendered value |

Or

2.5 % of tendered value plus 50% of PG for contracts involving maintenance of the building and services/ other work after construction of same building and services/ other work

4.8 Schedule 'F' General Rules and Directions

SCHEDULE 'F'

General Rules & Directions: -

Officer inviting tender:		Chief Executive Officer, DSCL,, Diu
Definitions:		
2 (v)	Engineer-in-Charge	Chief Operating Officer (COO)/ Chief Technical Officer (CTO) / Executive Engineer (EE) / Engineer-in-charge /Project Manager/ Construction Manager
2 (viii)	Accepting Authority	CEO,DSCL
2 (x)	Percentage on cost of materials and labor to cover all overheads and profits.	15%
2 (xi)	Standard schedule of Rates	SOR of R & B 2015-16 of Junagadh, GWSSB 2019-20, GOG Electrical SOR for the year 2014-15 DSR- CPWD and Rate Analysis based on S.O.R/ Market Rate.
2 (xii)	Department	Diu Smart City Limited
9 (ii)	Standard CPWD contract form	CPWD Form 8 and General Contract Conditions 2020 published by CPWD & Corrected up to the date of bidding.

Clause 1:

(i) Time allowed for submission of Performance Guarantee, programme chart (Time and progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW welfare board or proof of applying thereof from the date of issue of letter of Acceptance.	15 days
(ii) Maximum allowable extension with late fee @ 0.1% per day of the Performance Guarantee beyond the period provided in (i) above.	15 days

Clause 2:

Authority for fixing compensation under clause 2.	Chief Technical Officer (CTO), DSCL with the prior approval of COO,DSCL
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Clause 2A:

Whether Clause 2A shall be applicable	No
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Clause 5:

Number of days from the date of issue of letter of acceptance for reckoning date of start Mile stone(s) as per table given below	15 days
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Table of Mile Stones

S. No.	Description of Milestone (Physical)	Time Allowed in days (from date of start)	Amount to be with-held in case of non-achievement of
1.	1/8 of the whole work	1/4 of the whole work	In the event of non-achieving the necessary progress as assessed from the running payments, 1% of tendered value of work will be withheld for failure of each mile stone.
2.	3/8 of the whole work	1/2 of the whole work	
3.	3/4 of the whole work	3/4 of the whole work	
4.	Full	Full	

Time allowed for execution of work:

- Period of Completion of Construction : 18 Months (1.5 Year) including monsoon
- Defect and Maintenance Liability Period : 60 Months (05 years)

Authority to decide:	
1. Extension of time 2. Rescheduling of mile stones 3. Shifting of date of start in-case of delay in handing over of the site	Engineer-in-Charge

PROFORMA OF SCHEDULES Clause 5 Schedule of handing over of site

Part	Portion of site	Description	Time Period for handing over reckoned from date of issue of letter of intent.
Part A	Portion without any hindrance	Site is Free from hindrance and work can be started immediately abiding to ASI rules and regulations.	
Part B	Portions with encumbrances		

Part C	Portions dependent on work of other agencies	
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Clause 7:

Gross work to be done together with net payment / adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment.	INR 40 Lakhs of Contract Price To be decided by Engineer- in- Charge.
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Clause 7 A:

Whether clause 7A shall be applicable	Yes
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Clause 10A:

List of testing equipment to be provided by the contractor at site lab.	<p>As per CPWD Specification-2019 Volume-I & II and relevant IS Codes.</p> <p>Testing equipment's required at site</p> <ol style="list-style-type: none"> 1. Cube Testing Machine 2. Set of Cube Molds for Concrete 3. Slump Testing Cone 4. Weighing Balance (Scientific & Conventional) 5. Set of Sieves 6. Vernier Calipers 7. Auto Level 8. Calibrated Glass Jars 9. Automatic Ovens 10.Lime testing equipment's
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Clause 10 – B(ii):

Whether clause 10-B(ii) shall be applicable	Not Applicable
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Clause 10C:

Component of labor expressed as percent of value of work	Not Applicable
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Clause 10 CA: - Not applicable

S.No.	Materials covered under this clause	Nearest Materials (other than cement*, reinforcement bars, the structural steel and POL) for which All India Wholesale Price Index to be followed:	Base price and its corresponding period of all the materials covered under clause 10CA **
1	Not Applicable		

Clause 10CC: Not Applicable

Clause 10 CC to be applicable in contracts with stipulated period of completion exceeding the period shown in next column..... months Schedule of component of other Materials, Labour, POL etc. for price escalation	-	If the time limit is more than 18 Months
Component of civil (Except materials covered under clause 10 CA)/ Electrical construction % value of work	Xm	
Component of labour expressed as percent of total value of work.	Y	
Component of POL expressed as percent of total value of work. Note: Xm.....% should be equal to (100)- (materials covered under clause 10CA i.e. Cement, Steel and other material specified in clause 10CA + Component of Labour + Component of P.O.L)	Z = NIL	
Note : Xm % should be equal to 100) - (materials covered under clause 10CA i.e. Cement, Steel, POL and other material specified in clause 10CA + Component of Labour)		

Clause 11:

Specifications to be followed	CPWD Specification for works-2019 Vol I &II with up to date
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for execution of work.	correction slips till last date of submission of tender and as detailed in nomenclature of items and its amendments, additional specifications, terms and conditions as applicable
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Clause 12:

<u>Clause 12: Authority to decide deviation upto 1.5 times of tendered amount and as per provision of CPWD</u>	Chief Technical Officer (CTO), DSCL with the prior approval of COO,DSCL
<u>Clause 12.2 &12.3:</u> Deviation Limit beyond which clauses12.2 & 12.3 shall apply for building work	As per 12.5
<u>Clause 12.5:</u> (i) Deviation Limit beyond which clauses 12.2 & 12.3 shall apply for Superstructure & foundation work (except items mentioned in earth work subhead in SoR and related items) (ii) Deviation Limit for items mentioned in earth work subhead of SoR and related items	30% 100%

Clause 16:

Competent Authority for deciding reduced rates.	Chief Technical Officer (CTO), DSCL with the prior approval of COO,DSCL
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Clause 18:

List of mandatory machinery, tools & plants to be deployed by the contractor at site.		
1	Concrete Mixer	2
2.	Concrete breaker	1
3.	Tractor	2
5.	Site Laboratory with all equipment	1
6.	Steel cutting and bending machine	1
7.	Electric weight scale	2
8.	DG Set	2
9.	Traditional Chakki with heavy stone	2

	wheel	
10	Water Tanker (5000 Ltr)	2
11	Pressure Grouting Machine	2
12	High pressure water jet machine	2
13	Zigsaw Machine	As per requirement
14	Planner Machine	As per requirement
15	Router Machine	As per requirement
16	Winch machine/ material lift	As per requirement
17	CNC/ wood carving machines / land	As per requirement
18	Equipment for decorative wood work & other tools	As per requirement
20	Transportation Vehicles	2
21	Others as required	

Theodolite levels, prismatic compass, chain, steel and metallic tapes and all other surveying instruments found necessary on the works shall be provided by the contractor for the due performance of this contract as instructed by the Site Engineer. All measuring tapes shall be of steel and suitable scaffolding and ladders that may be required for safely taking measurement and shall be supplied by the contractor.

The mistries and the supervisors on the works shall carry with them always a one meter or two meter steel tape, a measuring tape of 30 meters, a spirit level, a plumb bob and a square and shall check the work to see that the work is being done according to the drawing and specifications. The Site Engineer will use any or all measuring instruments or tools belonging to the contractors as he chooses for checking the works executed or being executed on the contract.

The contractor should cover in his rates for making provisions for all reasonable facilities for the use of his scaffolding, tools and plant etc., by subcontractors for their work.

Clause 19 C, D, G & K:

Clause 19 C	Authority to decide penalty for each default	Chief Technical Officer (CTO), DSCL with the prior approval of COO,DSCL
Clause 19 D		
Clause 19 G		
Clause 19 K		

Clause 25:

Constitution of Dispute Redressal Committee (DRC) Chairman: Chairperson & Managing Director (CMD), DSCL Member: Chief Operating Officer (COO), DSCL Member: Shall be jointly appointed by CMD & COO	(a) For total claims more than Rs. 25.00 lakh. As per manual provision (b) For total claims up to Rs. 25.00 lakh. As per manual provision
Place of Arbitration	Diu District

Clause 32:

Requirement of Technical Representative (s) and Recovery Rates

Sl. No	Minimum Qualification of Technical Representative	Discipline	Designation (Principal Technical / Technical Representative)	Minimum Exp. (In Years)	Nos.	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 32	
						Figures (in INR)	Words
1	Heritage Expert	Architect/ Civil Engineer /Conservation architect	Project Manager	8 (and having experience of one similar nature of work)	01	Rs. 40000/- per Month	Rs. Forty Thousand per Month Only
2	Craftsman	Decorative art /Flooring works	Domain Experts with experience in flooring work	5	02	Rs. 25,000/- per Month	Rs. Twenty Five Thousand per Month Only
3	Graduate Engineer	Electrical	Site engineer	3	02	Rs. 20,000/- per Month	Rs. Twenty Thousand per Month Only

4	Diploma Engineer	Civil	Conservator foreman	5	01	Rs. 20,000/- per Month	Rs. Twenty Thousand per Month Only
5	Quality Control Engineer	Civil	Graduate Engineer	3	01	Rs 20,000/- per month	Rs. Twenty Thousand per Month Only

Assistant Engineers retired from Government services that are holding Diploma will be treated at par with Graduate Engineers.

Diploma holder with minimum 10 year relevant experience with a reputed construction co. can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

Clause 38

(i)	a) Schedule/statement for determining the theoretical quantity of cement & bitumen on the on basis Junagadh District SOR 2015-2016 /Market rate	
(ii)	Variations permissible on theoretical quantities:	
a)	<u>Cement</u> for works with estimated cost put to tender not more than Rs. 25 lakhs	3% plus/minus
	for works with estimated cost put to tender more than Rs 25 lakh	2% plus/minus
b)	Bitumen for all works	Not Applicable
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

Sl. No	Description of Item	Rates in figures and words at which recovery shall be made from the Contractor.	
		Excess beyond permissible variation	Less use beyond the permissible variation
1	Cement	Nil	Rs. 4756/- (Rupees Four thousand Seven Hundred Fifty six only) Per MT

2	Reinforcement Bars (TMT) (a) Primary Producer (b) Secondary Producer	Nil Nil	Rs. 42000/- (Rupees Forty Two Thousand only) Per MT
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4.9 Form For Earnest Money (Bank Guarantee)

FORM OF EARNEST MONEY DEPOSIT

BANK GUARANTEE BOND

WHEREAS, contractor..... (Name of contractor) (hereinafter called "the contractor") has submitted his tender dated for the construction of (name of work) (hereinafter called "the Tender") KNOW ALL PEOPLE by these presents that we (name of bank) having our registered office at (hereinafter called "the Bank") are bound into Chief Executive Officer, DSCL, Diu, (hereinafter called "Employer") in the sum of INR. (INR In words) for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank thisday of 2021

THE CONDITIONS of this obligation are:

- (1) If after tender opening the Contractor withdraws, his tender during the period of validity of tender (including extended validity of tender) specified in the Form of Tender;
- (2) If the contractor having been notified of the acceptance of his tender by Employer:
 - (a) Fails or refuses to execute the Form of Agreement in accordance with the Instructions to contractor, if required;

OR

- (b) Fails or refuses to furnish the Performance Guarantee, in accordance with the provisions of tender document and Instructions to contractor,

We undertake to pay to the Employer either up to the above amount upon receipt of his first written demand, without the Employer having to substantiates his demand, provided that in his demand the Employer will note that the amount claimed by his is due to him owing to the occurrence of one or any of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date* after the deadline for submission of tender as such deadline is stated in the Instructions to contractor or as it may be extended by the Employer , notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

DATE

SIGNATURE OF THE BANK

WITNESS

SEAL

(SIGNATURE, NAME AND ADDRESS)

*Date to be worked out on the basis of validity period of 6 months from last date of receipt of tender.

4.10 Performance Guarantee

PERFORMANCE GUARANTEE

(i) The contractor shall submit an irrevocable Performance Guarantee of 5% (Five percent) of the tendered amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within period specified in Schedule 'F' from the date of issue of letter of acceptance. This period can be further extended by the Engineer-in-Charge up to a maximum period as specified in schedule 'F' on written request of the contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This guarantee shall be in the form of Cash (in case guarantee amount is less than Rs. 10,000/-) or Deposit at Call receipt of any scheduled bank/Banker's Cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay Order of any scheduled bank (in case guarantee amount is less than Rs. 1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the form annexed hereto. In case a fixed deposit receipt of any Bank is furnished by the contractor to the Government as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the Government to make good the deficit.

(ii) 50% of said Performance Guarantee Amount or 20 Lakhs whichever is less shall have to deposit in the shape of Fixed Deposit Receipt (FDR) and the remaining amount shall be submitted in the form of an irrevocable bank guarantee bond of any scheduled bank or the State Bank of India in the prescribed form given in this document

(iii) The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 60 days beyond that. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the contractor, without any interest. However, in case of contracts involving maintenance of building and services/any other work after construction of same building and services/other work, then 50% of Performance Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

(iv) The Engineer-in-Charge shall not make a claim under the performance guarantee except for amounts to which the Chief Executive Officer, DSCL, Diu, is entitled under the contract (not withstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

(a) Failure by the contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.

(b) Failure by the contractor to pay Chief Executive Officer, DSCL, Diu, any amount due, either as agreed by the contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer-in-Charge.

(v) In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Chief Executive Officer, DSCL, Diu.

4.11 Form Of Performance Guarantee

Form of Performance Security (Guarantee)

Bank Guarantee Bond

In consideration of the President of India (hereinafter called "The Government") having offered to accept the terms and conditions of the proposed agreement between.....and (hereinafter called "the said Contractor(s)") for the work..... (hereinafter called "the said agreement") having agreed to production of an irrevocable Bank Guarantee for Rs. (Rupees only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement.

1. We, (hereinafter referred to as "the Bank") hereby undertake to pay to the Government an amount not exceeding Rs. (Rupees..... Only) on demand by the Government.

2. We,(indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demure, merely on a demand from the Government stating that the amount claimed as required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the bank shall be conclusive as regards the amount due and payable by the bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. (Rupeesonly)

3. We, the said bank further undertake to pay the Government any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment thereunder and the Contractor(s) shall have no claim against us for making such payment.

4. We, (indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the Government under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in- Charge on behalf of the Government certified that the terms and conditions of the said agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

5. We, (indicate the name of the Bank) further agree with the Government that the Government shall have the fullest liberty without our consent and without affecting in any manner our obligation hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Government against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such

variation, or extension being granted to the said Contractor(s) or for any forbearance, act of omission on the part of the Government or any indulgence by the Government to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

7. We, (indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of the Government in writing.

8. This guarantee shall be valid up tounless extended on demand by the Government. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs. (Rupees) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged.

Dated theday offor.....(indicate the name of the Bank)

4.12 Additional Conditions

- 4.12.1. The contractors are advised to inspect and examine the site and its surroundings and satisfy himself with the nature and extent of site and work, the hydrological and climatic conditions the means of access to the site, the constraints of space for stacking material/machinery, labour etc. he requires, if any, weather conditions at site, general ground/subsoil conditions etc. or any other circumstances which may affect or influence their bid. No claim, whatsoever, shall be entertained from the bidder, on the plea that the information supplied by the Owner is insufficient or is at variance to the actual site conditions.
- 4.12.2. The work shall be carried out as per CPWD specifications for works-2019 Vol. I & II/ IS codes/ Archaeological Survey of India Specifications with up to date correction slips unless otherwise specified in the nomenclature of individual item or in the specifications and special conditions, where specifications are silent, the decision of Engineer-in-Charge shall be final and binding on contractors.
- 4.12.3. The selected/L1 contractor to take Labour licence registered under U.T. administration at Diu.**
- 4.12.4. The work executed would be under the supervision of ASI and hence the contractor should strictly abide protocol/ rules and regulations that are applicable by ASI including working timings within the protected monument, taking permissions for entry and exit, safety measures, restrictions of entering machineries, vehicles, manual work execution only etc.**
- 4.12.5. As the property fall under ASI monument all efforts to be taken not to damage the existing project premise/structure, failure to that strict action to be undertaken as suggested by ASI officials/ Engineer-in-Charge.**
- 4.12.6. All outdoor exposed lighting fixtures/ wiring/ mounting materials to be matched with the heritage character, texture and colour of the monument.**
- 4.12.7. All intervention works including fixing of lighting fixtures should not look inappropriate or out of place in comparison to the overall monument look for which if required the items have to be painted, textured or cladded with appropriate materials as per approval of Engineer-in-Charge without any additional cost.**
- 4.12.8. Light/ Civil mounting fixtures to the existing structures to be mounted with chemical anchoring and matching the grout work with structure.**
- 4.12.9. Shape, size and colour of all cobble stone/slabs/ kerbs should match with the existing and adjacent material.**
- 4.12.10. Cobble stone/slabs/ kerbs should be of Single batch procurement similarly grey in colour.**
- 4.12.11. For all Horticulture works, the contractor to set up plant nursery near the site at his own cost.**

- 4.12.12. A pilot area or sample area to be developed with all finishes including flooring, furniture, utilities, signages, illumination, horticulture etc on their own cost and post approval of the same, further work to be undertaken. No deviation to be undertaken post approval in material quality.**
- 4.12.13. The contractor should undertake construction changes or revisions during working stage if the work is not as per ASI or Engineer-In-Charge requirements.**
- 4.12.14. Any faulty or non-approved work has to be dismantled by the contractor on his own cost and redone on his own cost without charging any additional amount.**
- 4.12.15. As the project site is in coastal zone so all reinforcement used to be Fe 500D with Fusion Bonded Epoxy Coated.**
- 4.12.16. Construction lineout work will be undertaken through Co-ordinate marking hence the contractor should carry out detail Total station survey with Differential Global Positioning Systems (DGPS) TBM and marking of all spot levels, trees with trunk diameters, utility services like Manhole locations, Electric boxes, poles, all buildings, compound wall and civil works before commence of the construction activity.**
- 4.12.17. The construction work will be carried depending upon areas available and phases as and when required and hence the contractor should quote the rates keeping in mind various phases.**
- 4.12.18. The rates of all items of work shall, unless clearly specified otherwise are including cost of all labor, material, GST, all kind of taxes and other inputs involved in the execution of the item.**
- 4.12.19. The contractor should carry out SBR soil testing reports where and when required as per the design.**
- 4.12.20. In case of extra item which is not part of the BOQ shall be calculated as per Junagadh SOR 15-16.**
- 4.12.21. All illumination/electrical/civil works including working along Fort wall heights and tidal condition, the contractor should undertake scaffolding for all heights without any additional costs.**
- 4.12.22. All shuttering to be of steel or Plywood only and no ordinary timber works.**
- 4.12.23. In case of any MoU signed and uploaded between the Main contractor and specialized contractor like Electrical, then only specialized contractor is eligible to execute the work during the construction stage.**
- 4.12.24. The rates for different items of work shall apply for all heights and depths, leads and lifts unless otherwise specified in the agreement or specifications applicable to the agreement.**

- 4.12.25. Any damage done by the contractor to any existing work during the course of execution of the work shall be made good by him at his own cost.
- 4.12.26. The contractor should preserve and protect the construction already carried out by him during the entire course of work as well as during rainy season from flood. Any such damage to works will be rectified by contractor at his risk and cost.
- 4.12.27. Articles manufactured by the reputed firms and approved by Engineer-in-Charge shall only be used. Only articles classified, as 'first quality' by the manufacturer shall be used unless otherwise specified. In case articles bearing ISI certification are not available in the market, quality of samples brought by the contractor shall be judged by standards laid down in the relevant CPWD specifications. For the items not covered by CPWD specifications relevant BIS standards shall apply. The sample of materials to be brought to site for use in work shall be got approved from the Engineer-in-Charge before actual execution of work.
- 4.12.28. The contractor shall submit a detailed program of work within 15 days of the date of issue of letter of intent. Detailed program should include all the mile stone, cash flow, material procurement, manpower deployment. Program must show clearly the critical path to complete the project in time. The Engineer-in-Charge can modify the program and the contractor shall have to work accordingly. During review of work progress, Engineer in Charge can ask to modify the program. Contractor shall resubmit the modified program in 2 days.
- 4.12.29. The quantities of each item shall not be exceeded beyond the agreement quantities without prior permission of Engineer-in-Charge.
- 4.12.30. Statutory deductions on account of GST, income tax and surcharge as applicable shall be made from the gross amount of the bill.
- 4.12.31. The contractor shall make his own arrangements for obtaining electric connection, if required and make necessary payments directly to the department concerned.
- 4.12.32. The Employer shall in no way be responsible for either any delay in getting electric and/or water and/or telephone connections for carrying out the work or not getting connection at all and no claim whatsoever on this account shall be entertained from the contractor. Also contingency arrangement of standby water & electric supply shall be made by the contractor for smooth progress of the work on account of power failure or disconnection for any reason whatsoever it may be. No claim of any kind whatsoever shall be entertained on this account from the contractor. Nothing extra shall be payable on this account.
- 4.12.33. All types of Cement mortars to be used in the work shall be mixed in the mechanical mixer and hand mixing shall not be permitted.
- 4.12.34. The contractor shall make his own arrangement for getting the permission to ply the trucks from the traffic police.

- 4.12.35. Some restrictions may be imposed by the security staff etc. on the working and or movement of labor and materials, etc., the contractor shall be bound to follow all such restrictions / instructions and nothing shall be payable on this account
- 4.12.36. The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrance shall be caused to traffic during the execution of the work by storing materials on the road if any
- 4.12.37. Testing of Materials: In case there is any discrepancy in the frequency of testing as given in the list of mandatory test and that in the individual sub-head of work as per the CPWD specifications for works-2019 Vol-I & II and relevant IS-Code with upto date correction slips, the higher of the two frequencies shall be followed and nothing extra shall be payable to the contractor on this account. Contractor shall carryout all required test pre and post construction including NDT for cement, steel, etc., or any other item related to construction without claiming any extra cost what so ever from the employer in this regard. Samples of all fittings and fixture to be provided shall be got approved from the Engineer-in-charge before use in the work.
- 4.12.38. The rate for all items of work, shall unless otherwise clearly specified include cost of all labour, material, equipment, technical man powers, transportation and other inputs, etc. involved in the execution of the items. All Items to be executed in line with the drawings provided in the tender. Rates to be quoted taking in account tender drawings and details as well as 5 year defect and maintenance liability period. No extra payment shall be entertained against such items.
- 4.12.39. The order of preference in case of any discrepancy may be read as the following.
- a. Description of Schedule of quantities.
 - b. Particular Specifications and Special conditions, if any.
 - c. Drawings
 - d. Contract clauses of General conditions of contract for Central P.W.D works 2020
 - e. CPWD Specifications.
 - f. Indian Standard Specifications / BIS.
 - g. Sound engineering practice

Any reference made to any Indian Standard Specifications in these documents, shall imply to the latest version of that standard, including such revisions / amendments as issued by the Bureau of Indian Standards up to last date of receipt of tenders. The contractor shall keep at his own cost all such publications of relevant Indian Standards applicable to the work at site

- 4.12.40. Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labor, local or other, and their payment, housing, feeding and transport
- 4.12.41. The contractor shall make his own arrangement of water for construction and drinking purpose as well for electricity and its distribution at his own cost. The department will

render only assistance to the contractor for making application to authorized Electric supply agency, if required. All the fees and charges including consumption charges shall be borne by the contractor. The water should be as per CPWD specifications, 2019.

- 4.12.42. The garbage generated at site due to construction activities shall be removed from the site immediately & shall be disposed off by the contractor to the approved dumping site identified by the Engineer-in-charge. The surplus soil/earth shall be disposed of as per the directions of Engineer-in-charge separately.
- 4.12.43. The contractor shall clean the site thoroughly of scaffolding materials, rubbish, equipments left out of his work and dress the site around the building to the complete satisfaction of the Engineer-in-charge before the work is treated as completed.
- 4.12.44. Relation with Public Authorities: The contractor shall comply with all obligations arising out of legal orders and directions that may be given to him from time to time, by any local or public authorities and shall pay out of his own money, all charges becoming payable to such authorities. He shall co-ordinate his activities during execution, with all agencies including PWD, Design Consultants, and Construction management consultants, agencies like Electricity department, DMC (Diu Municipal Corporation) etc., and their representatives without any dispute.
- 4.12.45. Foreign Exchange Requirement: It should be clearly understood that no foreign exchange sanction would be made available for either purchase of equipments, plants, machinery's, material of any kind or any other thing, required for execution of the work. It should also be clearly understood that no request for importing equipments, materials, plants, etc. that may be required in carrying out the work shall be entertained
- 4.12.46. The labor welfare cess/ fund and TDS at gross work done as applicable shall be deducted
- 4.12.47. Maintenance of Register of Tests- All the registers of tests carried out at Construction Site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-Charge
- 4.12.48. Maintenance of Material at Site (MAS) Register- All the MAS Registers shall be maintained by Contractor which shall be issued to the contractor by Engineer-in-Charge
- 4.12.49. Contractor shall be responsible for safe custody of all the test registers
- 4.12.50. Avoidance to damage of roads: The Contractor shall ensure that no damage to roads and bridges on the route to the sites occurs due to his traffic. He shall ensure minimum possible hindrance to the traffic movements on public roads and bridges due to his materials, plant, temporary works etc. No materials shall be stacked on public roads and thoroughfares.
- 4.12.51. Barricading
- a. The site is to be barricaded on all sides with 3m high GS sheets as appropriate
 - b. The detailed design of barricading of considering height of barricade, wind load etc. should be prepared by contractor. The design calculation and working drawing will be

provided by the contractor & approved by Engineer- in- Charge. The G.S sheet barricading will be designed above the wall area on the iron frame embedded properly in concrete block.

- c. Access gate of adequate sized opening in barricading should be provided to allow smooth flow of contractor's machinery, trucks, trailers etc.
- d. Contractor shall take measures to maintain the integrity of the barricade and will maintain safe work condition at site.
- e. Contractor shall write DSCL, name and logo at suitable interval over a primary coat of red oxide zinc chromate primer and paint as directed by Engineer-in-Charge.
- f. After successful completion of work, all the barricading will be dismantled / removed by contractor and it will be the property of contractor.
- g. The work of barricading mentioned as above shall be executed by the agency at his own cost and nothing shall be paid on this account.

4.12.52. Discoveries: Anything of geological or archaeological or other interest or articles of value or antiquity discovered on the Site shall be the absolute property of the Employer. The Contractor is to notify the Engineer of such discoveries and carry out the Engineer-in-charge instructions for dealing with them without damages, thefts etc. In carrying out the Engineer-in-charges instructions to dealing with such articles if the contractor incurs extra costs or suffers delays, the Engineer-in-charge shall determine after due consultation with the Employer and the Contractor amounts of such costs and extension of time in accordance with the corresponding clauses of the contract.

4.12.53. Refund of security deposit regarding specialized items of work

- a. For some of the specialized items of work such as waterproofing works, etc. that are entrusted to specialized firms or registered contractors who associate specialized agencies, the contractor/firm executing the work should be asked to give a specific 10 years guarantee that they shall be responsible for removal of any defects cropping up in these works executed by them during the guarantee period. The form of the guarantee to be executed by the contractors will be discussed with Engineer In Charge.
- b. It has further been decided that 2.5% of the security deducted from the bills of the contractors shall be refunded to him after expiry of Defect and maintenance Liability period in accordance with the terms of the contract in this behalf.

4.12.54. Settlement of Disputes

- a. Except where otherwise provided in the contract, all questions and disputes relating to the meaning of the specifications, design, drawings and instructions here-in before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the

cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter:

(i) If the contractor considers any work demanded of him to be outside the requirements of the contract, or disputes any drawings, record or decision given in writing by the Engineer-in-Charge or if the Engineer in Charge considers any act or decision of the contractor on any matter in connection with or arising out of the contract or carrying out of the work, to be unacceptable and is disputed, such party shall promptly within 15 days of the arising of the disputes request the CTO, DSCL, who shall refer the disputes to Dispute Redressal Committee (DRC) within 15 days along with a list of disputes with amounts claimed if any in respect of each such dispute. The Dispute Redressal Committee (DRC) to give its decision within a period of 60 days extendable by 30 days by consent of both the parties from the receipt of reference from CTO, DSCL. The constitution of Dispute Redressal Committee (DRC) shall be as indicated in Schedule 'F'. Provided that no party shall be represented before the Dispute Redressal Committee (DRC) by an advocate/legal counsel etc.

The DRC will submit its decision to the CTO, DSCL for acceptance. CTO, DSCL in a time limit of 30 days from receipt of DRC decision will convey acceptance or otherwise on the said decision. If the Dispute Redressal Committee (DRC) fails to give its decision within the aforesaid period or the CTO, DSCL fails to give his decision in the aforesaid time limit or any party is dissatisfied with the decision of Dispute Redressal Committee (DRC) / CTO, DSCL the neither party may within a period of 30 days from the receipt of the decision of Dispute Redressal Committee (DRC)/CTO, DSCL or on expiry of aforesaid the time limits available to DRC/ CTO, DSCL, may give notice to the CTO, DSCL, in charge of the work for appointment of arbitrator on prescribed proforma as per **Appendix XVII** under intimation to the other party.

- b. It is a term of contract that each party invoking arbitration must exhaust the aforesaid mechanism of settlement of claims/disputes prior to invoking arbitration.
- c. The Board of Directors, DSCL shall in such case appoint the sole arbitrator or one of the three arbitrators as the case may be within 30 days of receipt of such a request and refer such disputes to arbitration. Wherever the Arbitral Tribunal consists of three Arbitrators, the contractor shall appoint one arbitrator within 30 days of making request for arbitration or of receipt of request by Engineer-in-charge to for appointment of arbitrator, as the case may be, and two appointed arbitrators shall appoint the third arbitrator who shall act as the Presiding Arbitrator. In the event of
 - (a) A party fails to appoint the second Arbitrator, or
 - (b) The two appointed Arbitrators fail to appoint the Presiding Arbitrator, then the Board of Directors, DSCL shall appoint the second or Presiding Arbitrator as the case may be.
- d. Dispute or difference shall be referred for adjudication through arbitration by a Tribunal having sole arbitrator where claimed amount is Rs. 20 Crore or less. Where claimed Value is more than Rs. 20 Crore, Tribunal shall consist of three Arbitrators as above. The requirements of the Arbitration and Conciliation Act, 1996 (26 of 1996) and any further

statutory modification or re-enactment thereof and the rules made there under and for the time being in force shall be applicable.

- e. It is a term of this contract that the party invoking arbitration shall give a list of disputes with amounts claimed, if any, in respect of each such dispute along with the notice for appointment of arbitrator and giving reference to the decision of the CTO, DSCL on the finding / recommendation of DRC.
- f. It is also a term of this contract that member(s) of the Arbitration Tribunal shall be a Graduate Engineer with experience in handling public works engineering contracts, and further he shall have earlier worked at a level not lower than Chief Engineer/ equivalent (i.e. Joint Secretary level of Government of India). This shall be treated as a mandatory qualification to be appointed as arbitrator.
- g. Parties, before or at the time of appointment of Arbitral Tribunal may agree in writing for fast track arbitration as per the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015.
- h. Subject to provision in the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015 whereby the counter claims if any can be directly filed before the arbitrator without any requirement of reference by the appointing authority. The arbitrator shall adjudicate on only such disputes as are referred to him by the appointing authority and give separate award against each dispute and claim referred to him and in all cases where the total amount of the claims by any party exceeds Rs. 1,00,000/-, the arbitrator shall give reasons for the award.
- i. It is also a term of the contract that fees payable to arbitral tribunal shall be as approved by DG, CPWD, OM issued vide no.2/2006/SE(TLC)/CSQ /137 dated 19-11-2019 (or its latest amendment as approved by DG, CPWD). This fee shall be shared equally by parties.
- j. The place of arbitration shall be as mentioned in Schedule F. In case there is no mention of place of arbitration, the arbitral tribunal shall determine the place of arbitration.
- k. The venue of the arbitration shall be such place as may be fixed by the Arbitral Tribunal in consultation with both the parties. Failing any such agreement, then the Arbitral Tribunal shall decide the venue.

4.12.55. Cost control

Variation Clause shall be applicable as per GCC 2020.

4.12.56. Defect and Maintenance Liability Period: The Defect & Maintenance Liability Period for the Work shall be of the Five years (05) years from the date of completion construction work. The above mentioned period shall supersede the defect liability period provided in the Clause 17 of General condition of Contract (GCC) and shall be applicable for the Work with reference to the provisions of clause 17 of GCC and Article 6 of the Integrity Agreement as per the GCC and as well as per Clause 1.7 of Section 1.

4.12.57. All the materials during the Defect and Maintenance Liability period shall be readily available at the site. The replacement of the materials shall be taken place within 48 hours by the notice of Engineer-in-Charge if not penalty will be applicable on the Contractor.

4.12.58. Important Instructions to the Contractor/ Works being executed:

- a. This is an important restoration project involving an early 20th century building, which has a great heritage value not only for the DSCL now but also for the city of Diu. For this reason the agencies involved in the project will have to exercise tremendous sensitivity in handling the work on this building and will strictly follow the Engineer-In-Charge instructions on drawings and specifications for the works.
- b. The agencies will require especially skilled work force in different trades involved which vary from ceramics to metal and stained glass inlay, in order to restore the building elements, which have suffered degradation due to ageing
- c. The entire work shall have to be carried out strictly under the instructions of the Engineer-In-Charge, and at no point the work shall proceed without sufficient details and mock-ups required to carry out the details on actual site.
- d. Any new work as per the details and specifications on the existing building will have to be properly inserted with least interference to the original structure and it has to be carefully achieved as per the instructions of the Engineer-In-Charge, such that it is reversible and does not damage the existing structure in any case.
- e. Appropriate laboratory test and sampling shall be carried out while using new materials to match them with the existing materials to avoid and mismatch and material incongruity. The agencies will have to undertake these investigations as directed by the Engineer-In-Charge.
- f. The agency will maintain appropriate record of supervision and a log kept of any new evidence and additional decision during the process of executing. The agency must appoint a well-qualified Supervisor, trained in dealing with historic buildings for the period of execution of works. The Engineer-In-Charge shall approve this appointment.
- g. No action of the agency should amount to removal of parts of the building from its original location at any cost. If this has become necessary for the reasons of safety of the building, the Engineer-In-Charge instructions will be communicated with a procedure to deal with such a situation and his instructions will be considered final in the matter.
- h. Agency must take all the precaution to safeguard the historic property while the restoration work is in progress by proper cordons and boundary limits.
- i. The entire affected portion where the work is being carried out shall be temporarily secured and supported as the case may be. The scaffolds and such temporary work shall be independent and shall not be attached to the existing building in any manner.
- j. The agency must appoint required trained security personnel to watch the site during the process of execution.

4.12.59. Materials, workmanship, samples, testing of materials

- a. All the works specified and provided for in the specifications or which may be required to be done in order to perform and complete any part thereof shall be executed in the best and most workmanlike manner with materials (to be provided by Employer) of the best and approved quality of the respective kinds in accordance with the particulars contained in and implied by the specifications and as represented by the drawings or according to such other additional particulars, and instructions as may from time to time be given by the Engineer-in-charge, during the execution of the work, and to his entire satisfaction.
- b. If required by the Engineer-in-charge, the contractor shall have to carry out tests on materials and workmanship in approved materials testing laboratories or as prescribed by the Engineer-in-charge, at his own cost to prove that the materials etc., under test conform to the relevant IS Standards or as specified in the specifications. The necessary charges for preparation of mould (in case of concrete cube) transporting, testing etc., shall have to be borne by the contractor. No extra payment on this account should in any be entertained.

4.12.60. All the materials (except where otherwise described to be provided by Employer) stores and equipment required for the full performance of the work under the contract must be provided through normal channels and must include charge for import duties, sales tax, octroi and other charges and must be the best of their kind available and the contractor/s must be entirely responsible for the proper and efficient carrying out of the work. The work must be done in the best workmanlike manner. Samples of all materials to be used must be submitted to the Engineer-in-charge, when so directed by the Engineer/ Engineer-in-charge

4.12.61. Any damage (during constructions) to any part of the work for any reasons due to rain, storm, or neglect of contractor shall be rectified by the contractor in an approved manner at no extra cost. If the work would be suspended by reason of rain, strike, lockouts or any other cause, the contractor shall take all precautions necessary for the protection of work and at his own expenses shall make good any damage arising from any of these causes. The contractor shall cover up and protect from damage, from any cause, all new work and supply all temporary/doors, protection to windows, and any other requisite protection for the execution of the work whether by himself or special tradesmen or subcontractor and any damage caused must be made good by the contractor at his own expense.

4.12.62. Contractor's employees

The contractor shall employ technically qualified and competent supervisors for the work who shall be available (by turn) throughout the working hours to receive and comply with instructions of the Engineer-in-charge, The contractor shall engage at least one experienced Engineer as site-in charge for execution of the work. The contractor shall employ in connection with the work persons having the appropriate skill or ability to perform their job efficiently. The contractor shall employ local labourers on the work as far as possible. No labour below the age of sixteen years who is not an India National shall be employed on the work. Any labourer supplied by the contractor to be engaged on the work on day-work basis either wholly or partly under the direct order or control of the Employer or his representative shall be deemed to be a person employed by the contractor. The

contractor shall comply with the provisions of all labor legislation including the requirements of

- a) The payment of Wages Act
- b) Employer's Liability Act
- c) Workmen's Compensation Act
- d) Contractor Labour (Regulation & Abolition) Act, 1970 and Central Rules 1971.
- e) Apprentices Act 1961
- f) Any other Act of enactment relating thereto and rules framed there under from time to time.

The contractor shall keep the Employer saved harmless and indemnified against claims if any of the workmen and all costs and expenses as may be incurred by the Employer in connection with any claim that may be made by any workmen. The contractor shall comply at his own cost with the order of requirement of any Health Officer of the State or any local authority or of the Employer regarding the maintenance of proper environmental sanitation of the area where the contractor's labourers are housed or accommodated, for the prevention of small pox, cholera, plague, typhoid, malaria and other contiguous diseases. The contractor shall provide, maintain and keep in good sanitary condition adequate sanitary accommodation and provide facilities for pure drinking water at all times for the use of men engaged on the works and shall remove and clear away the same on completion of the works. Adequate precautions shall be taken by the contractor to prevent nuisance of any kind on the works or the lands adjoining the same.

The contractor shall arrange to provide first-aid treatment to the labourers engaged on the works. He shall within 24 hours of the occurrence of any accident at or about the site or in connection with execution for the work, report such accident to the Employer and also to the competent authority where such report is required by law.

4.12.63. Concealed work

The contractor shall give due notice to the Engineer-in-charge, whenever any work is to be buried in the earth, concrete or in the bodies of walls or otherwise becoming inaccessible later on, in order that the work may be inspected and correct dimensions taken before such burial, in default whereof the same shall, at the opinion of the Engineer-in-charge, be either opened up for measurement at the contractor's expense or no payment may be made for such materials. Should any dispute or differences arise after the execution of any work as to measurements etc., or other matters, which cannot be conveniently tested or checked, the notes of the Engineer-in-charge, shall be accepted as correct and binding on the contractor.

4.12.64. Contractors to Supply Plant Ladders, Scaffolding Etc. And Is Liable For Damages Arising From Non Provision Of Lights, Fencing Etc.

The Contractor shall supply at his own cost all materials, (except such special materials, if any, as may, in accordance with the contract be supplied from the Corporation Store), plant, tools,

appliances, implements, ladders, cordage, tackle, scaffolding, and any temporary work tools, appliances, implements, ladders, cordage, tackle, scaffolding, and any temporary work which may be required for the proper execution of the work, whether in the original, altered or substituted form and whether included in the specifications, or other documents forming part of the contract or referred to in these conditions or not and which may be necessary for the purpose of satisfying or complying with requirement of the Engineer-in-charge, as to any matter or to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with damage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works and counting, weighing and assisting in the measurement of examination at any time and from time to time of the work or the materials.

Failing this, the same may be provided by the Engineer-in-charge, at the expense of the Contractor and the expenses may be deducted from any money due to the Contractor under the contract or from his security deposit the proceeds of sale thereof or of a sufficient portion thereof. The Contractor shall provide all necessary fencing and lights required to protect the public from accident and shall also be bound to bear the expenses of defence of every suit, action or other legal proceedings, at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damage and costs which any be awarded in any such suit, action or proceeding to any such person, or which may, with the consent of the Contractor be paid in compromising any claim by any such persons.

4.13 Special Conditions

- 4.13.1. Site to be clean:** The contractor undertakes to have the site clean, free from rubbish to the satisfaction of the Engineer-in-Charge. All surplus materials, rubbish, etc. will be removed to the place fixed by the Engineer-in-Charge and nothing extra will be paid. Contractor shall divert/ remove/ maintain/ repair all the existing services like water supply, drainage, storm water, electric etc. at his own cost which will affect the construction activity up to end of the project. During excavation of any kind of activity, if any existing lines of any type come in a way throughout construction area, it is contractor responsibility to divert/repair/replace/provide new lines if required contractor has to take necessary approval from any authority for the same. No extra cost will be given for the same.
- 4.13.2. Inconvenience to be activities:** The contractor shall not deposit materials on any site which will seriously inconvenience to any of the activities. The Engineer-in-Charge may require the contractor to remove any materials which are considered by him to be dangerous or inconvenient to the construction activities and get them removed at the contractor's cost.
- 4.13.3. Employment of licensed electrical foreman (for electrical work only):** The contractor should employ a licensed electrical engineer / foreman to supervise the Electrical works

(MoU signed between main agency to subletting agency for electrical works and same shall be submitted by the contractor during uploading of bid documents and as well as in hard format).

4.13.4. Conditions relating to the execution of additional work: No deviation from specification stipulated in the contract of additional items shall be carried out by the contractor unless the rates of the substituted, altered or additional item have been approved in writing by the competent authority, failing which will not be bound to entertain any claim on this account.

4.13.5. Inspection of works and recommendation by consultant

- a. **Materials, its sample approval, its procurement and storage:** The Contractor should make his own arrangement to obtain all materials required for the work, except otherwise stated. All materials shall, so far as procurable, be of the respective kinds described in the Schedule of Items/Quantities and/or specifications and in accordance with the Architect's and Engineer In-charge instructions, and the Contractor shall upon the request of the Architect furnish him with all invoices, accounts, receipts and other vouchers to prove that the materials comply therewith. The Contractor shall at his own cost arrange for and/or carry out any test of any materials which the Architects may require. The Contractor shall submit, samples of all the finishing materials, to the Architects/ Consultants, for approval, as directed by the Architects/Consultants much in advance, so as to avoid any complications regarding availability. Also, whenever samples are to be prepared for approval the same shall be prepared immediately on receipt of the drawings and got approved by the Architect. Approval of the samples of various materials given by the Engineer-in-charge and Architects shall not absolve the Contractor from the responsibility of replacing defective material brought on site or materials used in the work found defective at a later date. The Contractor shall have no claim to any payment or compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge and Architects. No collection of material shall be made before it is approved by the Engineer-in-charge and Architects. The Architect shall, during the progress of the works, have to order in writing from time to time the removal from the works, within a period specified in the order, of any materials which in his opinion are not in accordance with the specifications or his instructions, the substitution of proper materials, and the removal and proper re-execution of any work executed with materials or workmanship not in accordance with the drawings, specifications or instructions; and the Contractor shall forthwith carry out such order at his own cost. In case of default on the part of the Contractor to carry out such order, the Employer shall have the power to employ and pay other persons to carry out the same; and all expenses consequent thereon, or incidental thereto, as certified by the Architect shall be borne by the Contractor, or may be deducted by the Employer from any moneys due, or that may become due, to the Contractor. Inspect and approve, if found appropriate, samples (loose & installed) to be prepared as per the list already prepared during starting of work and subsequent to approval of same, give clearance for commencement of construction works at site.
- b. Undertake frequent visits for periodic inspection of the site to examine the work being executed and to provide clarification and guidance to the contractor in respect to the design, specifications, workmanship and overall performance of the work and inform the contractor under intimation to DSCL, about defects, deficiencies and nonconformities with respect to the specifications and drawings. The architect will ensure that the

contractor has complied with all the instructions in his subsequent visit. Any query related to drawing may be solved by architect/ consultant in co-ordination with PIU & contractor

- c. Engineer-in-charge will check that the work is done satisfactorily and the contractor has complied with all the remarks, comments, defects or deficiencies suggested by the team of architect/structural engineers of the department. For any noncompliance, Department may recommend for retention of the total bill or part thereof. The work not complied with by contractor to the satisfaction of the consultant; retention kept will be subject to forfeiture. The contractor shall not be eligible to get any compensation for such retention or any benefit of extension of time limit.
- 4.13.6. RETENTION OF MONEY FOR NOT FOLLOWING SAFETY MEASURES:** Retention @ 1% of the work done of RA bill will be kept if it is observed that the contractor has not taken sufficient safety precaution. The retention of money is subjected to be forfeit if the contractor is found not to comply / intentionally not taking safety precaution after such notice / retention.
- 4.13.7. RATES INCLUDING COST OF CEMENT AND REINFORCEMENT STEEL:** Cement and Reinforcement Steel will be supplied by the contractor at site. Rates to be quoted by the contractor shall be inclusive of the cost of cement, reinforcement and structural steel. The structural steel rate shall in inclusive of all forms of steel sections, channels, boxes etc. as applicable to the project.
- 4.13.8. TAXES:** The rates shall also be firm and not subject to exchange variations, labor conditions, fluctuations in railway freights or any conditions whatsoever. It shall also include all taxes/duty including GST and labor cess or other levy levied by the Central or State Governments or local authorities, etc.,. No claim in respect to the variation in taxes shall be considered for payment, by the Employer, as an extra amount till the work is completed.
- 4.13.9. Contractor to provide site office:** (within 15 days after getting work order otherwise Rs. 10,000/- Per day penalty will imposed as penalty over and above L.D. Contractor shall provide a permanent site office (Masonry & RCC structure) and portable stores (Metal / Wood / PVC) at the location suggested by the Employer in the area identified by DSCL. The site office shall be utilized exclusively for the Engineer- In- Charge staff. Site office shall be fully furnished computer, internet, printer, furniture, cooler and such necessary facilities. The site office shall room with allied utilities like toilets, pantry etc. Intermediate shifting of portable structures (such as stores) may be required during any stage of project, hence contractor is abided to do so without any cost or time factor. Contractor should maintain the site office till the project tenure and hand it over to PIU without claiming any extra cost. Following utility services shall be provided for PIU staff / engineer in charge with water supply, drainage, electricity and housekeeping services etc. free of cost up to finalization of the project within 15 days after getting work-order.
- a. Site office toilet block
- b. Office furniture: - tables, rack, computers with latest configuration and version, printer with scanner.
- c. Peon

- d. pedestal fan
- e. Security Guard for 24 hrs.

4.13.10. No Permanent Structures to be constructed within Area Identified by DSCL:

Contractor will not be permitted to construct any pucca structure (except site office) for any purpose in the area identified by DSCL for what so ever reason.

4.13.11. Pre-Bid Meeting: Bidders to submit their queries at least 3 days before the scheduled pre-bid meeting to PIU.

4.13.12. Contractor to Arrange Water & Power by Own: The contractor shall have to make own arrangement for the water & power required for the construction purpose.

4.13.13. Contractor's Responsibility to Fill Daily, Weekly and Monthly Progress Report & Quality check list on Day to Day Basis: (Format shall be provided by the Engineer-In-Charge).

- a. Daily Progress Report stating the information of work done of all items categorized labor strength, cement and steel consumption on day to day basis.
- b. Concrete Pour Card as per standard engineering practice should be filled by contractor and after having signature of engineer in-charges, contractor may proceed for concreting
- c. Cube testing register also to be maintained at site.
- d. Testing charges 1% may apply and deducted from each interim Payment bills.
- e. Contractor will have to submit filled and duly signed (Signed by Engineer-in-charge from side & from Contractor side) Daily Progress Reports on immediate next day & Concrete Pour Card before casting of any RCC elements. Contractor will be solely responsible and if failing to do so shall be liable for penalty which will be solely upon discrete on of Engineer-in-charge which shall be deducted from RA Bill.

4.13.14. Contractor's Responsibility to Get Approval on Material Sample / Mock Up / Sample Room: Contractor shall have to get approval from Engineer in Charge and Architect on loose samples (i.e. Lime products, flooring material, stone, light fixtures etc.) prior to starting of any works. Loose samples approval is required for the product conformity, specification and shade selection. A sample room, as per the layout proposed by Architect and specifications recommended by Architect, shall be prepared and up to date maintained in lock and key arrangement till completion of work awarded under the specific tender. Sample room approval is required for workmanship, fast process in repetitive work and save time for repetitive activity. Contractor will be solely responsible if failing to do so and shall be liable for penalty, which will be solely upon discretion of Engineer-in-charge, which shall be deducted from RA Bill. If contractor cannot show sample room within two months, firm shall be panelized by.

4.13.15. Machinery to Deploy on Site: Contractor shall have to deploy (Must owned or hired) machinery/ equipment as indicated in the tender on site within 1 month from date of award of work. The machinery shall be of good working condition and relevant

certificates shall be submitted. The Contractor has to take necessary approval prior to shift / remove such machineries from Engineer – in – Charge.

- 4.13.16.** During execution of work, any quantity shall be increased more than 30% than rate will be applicable as per SOR rate and where SOR rate is not available than estimated rate will be applicable. Contractor cannot misinterpret the meaning of word written in tender.
- 4.13.17.** Agency has to submit day to day computerized consumption statement of cement/Lime when using batching plant with cement/Lime purchase bill and challan of weigh-bridge
- 4.13.18.** Bidders shall require referring detail specification as well as BOQ for complete understanding for through work. In case any additional clarification required, agency shall be put up discrepancy and ambiguity in writing to prior to pre-bid meeting. After award of work, not a single argument for discrepancy and ambiguity was accepted. For the same case, Contractor to execute the work as per the instruction given by EIC and Architect
- 4.13.19.** Contractor is responsible to find out suitable site location (Non Objectionable Place) required for disposal of surplus excavated earth and/ or debris etc. with prior permission from competent authority.
- 4.13.20.** The contractor has to establish his own dedicated testing laboratory fully equipped and shall have to deploy a qualified quality Control Engineer (Minimum Qualification as B.E. with 3 years' experience of Q.C. / lab operation.
- 4.13.21.** All the bylaws of labor, labor arrangement, insurance, safety, as per the central Govt. and state Govt. shall be strictly followed.
- 4.13.22.** The compensation for any accident, causality etc. shall be the full responsibility of the contractor and shall be as per the law governing for the same.
- 4.13.23.** Sub- letting of the work is permitted, unless a written permission is obtained from the, CTO, DSCL Diu.
- 4.13.24.** No deviation from the approved list of makes shall be permitted. In case, certain items of equivalent is mentioned, the same shall be got approved from COO, DSCL, before ordering.
- 4.13.25.** On instructions from Engineer-in-Charge, the material, finished product, construction item, shall be immediately removed from the site within 72Hrs of written instruction without any compensation of whatsoever nature.
- 4.13.26.** All the drawings supplied by the consultant/Client to the contractor shall be carefully studied by the contractor before implementation and any discrepancy /changes /suggestions shall be brought to the notice of consultant for clearance.
- 4.13.27.** Bid document is not submitted with duly signed by contractor, shall not allowed for the bid selection.

- 4.13.28.** The execution of the work may entail working in the monsoon also. The contractor must maintain labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No special/ extra rate will be considered for such work in monsoon. The contractor's rate shall be considered inclusive of cost of dewatering required if any and no extra rate shall be payable on this account.
- 4.13.29.** Contractor to provide necessary certificate where ever it is asked for in the items of BOQ or in specifications or elsewhere in the tender or as per requirement of EIC or Architect.
- 4.13.30.** Items of Repairs, Restoration & Consolidation work provided in Schedule of quantities are included with all type of works to be done for such a project, i.e. Scaffolding work, Demolition work, Repairs to masonry, plastering & pointing, flooring, structural steel work etc. and only against these items payments shall be made as & wherever applicable.
- 4.13.31.** General list of IS codes is annexed hereto (Appendix IV) however, latest IS Codes shall be referred and provision of such latest IS Codes shall be enforced in regard to the construction items covered under this tender
- 4.13.32.** The contractor has to make his own arrangement for labor colony
- 4.13.33.** The special conditions of contract shall be read in conjunction with General Conditions of Contract, Specification of work and drawings. The following clauses shall be considered as an extension and not limitation of obligations of contract.
- 4.13.34.** Items of Repairs, Restoration & Consolidation work provided in Schedule of quantities are included with all type of works to be done for such a project, i.e. Scaffolding work, Demolition work, Repairs to masonry, plastering & pointing, flooring, structural steel work etc. and only against these items payments shall be made as & wherever applicable.
- 4.13.35.** The erection and display of any device, sign of advertisement by the contractor or any sub-Contractor or persons supplying labour, materials or services to the works is prohibited. However, signs relating to fire, danger and safety are exempted from this
- 4.13.36.** The contractor shall prepare a layout plan showing the location of various areas for temporary office stores, materials stocks, construction plants etc. making due allowance for the requirements of subsidiary contractors who may have been appointed either by the contractor himself or by the Employer
- 4.13.37. Special Conditions for Procurement of Cement**
- a. The contractor shall procure OPC cement in work from reputed manufacturers of cement having a production capacity not less than one million tonnes or more per annum, such as ACC, Ultra Tech, Siddhi, Sanghi Cement, Birla Cement & cement corporation of India etc., as approved by Ministry of Industry, Government of India and holding license to use ISI certification mark for their product. The tenderers may also submit a list of names of

cement manufacturers which he proposes to use in the work. The tender accepting authority reserves rights to accept or reject name (s) of cement manufacturer(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer fully or partially.

- b. The supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking. Samples of cement arranged by the contractors shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant BIS codes. In case of test results indicate that the cement arranged by the contractor does not conform to the relevant BIS Codes, the same shall stand rejected, and it shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-in-Charge to do so.
- c. The cement shall be brought at site in and store in water proof cement godown of the adequate capacity and shall be constructed by the contractor at site of work for which no extra payment shall be made
- d. Double lock provision shall be made to the door of cement go-down. The keys of one lock shall remain with Employer, Diu, or his authorized representative and the keys of the other lock shall remain with the contractor. The contractors shall be responsible for the watch and ward and safety of the cement go-down. The contractor shall facilitate the inspection of the cement go-down by the Engineer-in-Charge at any time.
- e. The cement shall be got tested by the Engineer-in-Charge and shall be used on the work only after satisfactory test results have been received. The contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratory. The cost of tests shall be borne by the contractor / department in the manner indicated below:
 - i. By the contractor, if the result shows that the cement does not conform to relevant BIS code.
 - ii. By the department, if the result shows that the cement conforms to relevant BIS codes.
- f. The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 A of CPWD GCC 2020. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 38 of CPWD GCC 2020 and shall be governed by conditions laid therein. In case of cement consumption is less than theoretical consumption including permissible variation; recovery at the rate show prescribed shall be made. In case of excess consumption no adjustment need to be made.
- g. Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of Engineer-in-Charge.
- h. The damaged cement shall be removed from the site immediately by the contractor on receipt of a notice in writing form the Engineer-in-Charge. If he does not do so within

three days of receipt of such notice, the Engineer-in-Charge shall get it removed at the cost of the contractor.

4.13.38. Special Condition for Procurement of Steel: The contractor shall procure TMT bars of Fe500-D grade (the grade to be procured is to be specified) from primary producers such as SAIL or TISCO or RINL or JINDAL or JSW Steel Ltd. as approved by the Ministry of Steel. In case of non-availability of steel from primary producers the NIT approving authority may permit use of TMT reinforcement bars procured from secondary producers. In such cases following action is to be taken by NIT approving authority

- a. The grade of the steel Fe500-D grade to be procured is to be specified as per BIS 1786-2008.
- b. The secondary producers must have valid BIS license to produce HSD bars conforming to IS 1786: 2008. In addition to BIS license, the secondary producer must have valid license from either of the firms Tempcore, Thermex Evcon Turbo & Turbo Quench to produce TMT Bars.
- c. The TMT bars procured from primary producers shall conform to manufacturer's specifications.
- d. The TMT bars procured from secondary producers shall conform to the specifications as laid by Tempcore, Thermex, Evcon Turbo & Turbo Quench as the case may be.
- e. TMT bars procured either from primary producers or secondary producers, the specifications shall meet the provisions of IS 1786 : 2008 pertaining to Fe500-D grade of steel as specified in the tender of steel as specified in the tender
- f. All TMT Bars to be duly factory coated against corrosion in coastal environments.

The contractor shall have to obtain and furnish test certificates to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work.

Sample shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications as defined above para (d) & (e) above, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time after the written orders from the Engineer-in-Charge to do so.

The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, or as decided by the Engineer-in-Charge.

The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

For checking nominal mass tensile strength bend test, re-bend test etc. specimen of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below.

The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of test shall be borne by the contractor.

The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment need to be made.

The steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer-in-Charge.

In case contractor is permitted to use TMT reinforcement bars procured from secondary producers then:

The rate of providing & laying TMT reinforcement bars as quoted by the contractor in the tender shall also be reduced by Rs.2.25 per kg.

The steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer-in-Charge

4.13.39. Safety Code

- a. Works related to Fort wall façade illumination and civil involves working at a height upto 9-10 meter from ground level. Working at such an height is very risky, therefore, it will be necessary for contractors to employ all safety equipment's and means to carry the job in safe manner as described hereafter in various Para. It will also be necessary for contractor to conduct short duration training & demonstration workshops for all his labours & artisans in presence of site in charge for making them aware about the safety means and to train them about the use of safety equipment's, when working above ground level. All new entrants shall also be given such training before deploying them for working on heights, approved by engineer in charge. Contractor shall adhere to safe construction practices and guard against hazardous and unsafe working conditions and shall comply with safety code as set forth herein. Any expenses/cost to be incurred for this purpose shall be fully borne & paid by the Contractor.
- b. Suitable scaffoldings shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration work, which can be done safely from ladders. When a ladder is used, it shall be of rigid construction made either of good quality wood or steel. The steps shall have a minimum width of 450 mm and a maximum rise of 300 mm. Suitable hand holds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than 1/4 to 1(1/4 horizontal and 1 vertical).

- c. Scaffolding or staging more than 4.00 m., above the ground floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly bolted, riced or otherwise secured at least 1.00 m. above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.
- d. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform, gangway or stairway is more than 4.00 Mts. above ground level or floor level, they shall be closely boarded and shall have adequate width and be suitable fenced
- e. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1.00 m. Wherever there are open excavations in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.
- f. Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9.00 m. in length while the width between side rails in rung ladder shall in no case be less than 290 mm for ladder up to and including 3.00 m. in length. For longer ladders this width shall be increased at least 20 mm for each additional meter of length. 5.8 A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer-in-charge in charge obtained prior to construction.
- g. Other Safety Measures**
- h. All personnel of the Contractor working within the building area outside or inside site shall be provided with safety helmets. All welders shall wear welding goggles while doing welding work and all metal workers shall be provided with safety gloves. Person employed on metal cutting and grinding shall wear safety glasses.
- i. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.
- j. A competent third part certified person is allowed for scaffolding job.
- k. Cold work permit is required.
- l. Employees shall use chin straps, leather gloves and safety harness full time.
- m. Tools and spanners shall be secured with body.
- n. Area shall be barricaded and signs board to be displayed.
- o. Non-sparking tools shall be used in hazardous area.

- p. Materials, clamps shall not drop or thrown
- q. Leather bags shall be used for shifting.
- r. While erection and modifications, red tag shall be display on height equal to eye level.
- s. If height exceeding the ratio, additional tie-in with nearby existing structure shall be given.
- t. Job shall be suspended in case of heavy wind more than 65kmph and rain.
- u. Dismantling start from top.
- v. Scaffolding tag shall be renewed after one week and checklist shall be maintained.
- w. Ladder shall be raised at least one meter above landing platform and should be secure at three locations.
- x. Loose materials, clamps shall not be kept unattended on working platform.
- y. Risk Assessment is required If Wind speed is More than 50kmph.
- z. Gin Wheel (pulley & rope) Should be use for light material lifting.

Section 5 Technical Specifications (Civil)

Specifications of proposed works in order of their preference are compliant to the latest versions of CPWD (volume I & II), Non Scheduled works have detailed specifications supported by detailed design drawings.

The works in General shall be carried out as per latest CPWD Specifications unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works, the work shall be done as per latest relevant BIS Codes of Practice or as per approval of Engineer-in-charge.

All the works shall be executed as per the approved drawings / designs. The patterns shown in the tender drawings can be modified as per the site requirements by the Engineer- in-charge and nothing extra whatsoever shall be payable over and above the quoted rates.

Material should be of the best approved quality obtainable and they shall comply with the respective Indian Standard Specifications. Samples of all materials shall be got approved before placing order and the approved sample shall be deposited with the Client/Engineer In-Charge.

List of Applicable Indian Standard Codes

IS: CODE NO.	IS: CODE NO.
GENERAL	
IS: 4082	Stacking & storage of construction materials and components at site – Recommendations
IS:6313	Code of Practice for Anti-termite measure in buildings Part I- Constructional measures Part II: Code of practice for Anti-termite measures in Building - Preconstruction Part III: Code of practice for Anti-termite measures in Building – Existing
EARTH WORK	
IS: 3674	Safety code for excavation work
IS: 1498	Classification and identification of soils for general engineering purposes.
IS: 4081	Safety code for Blasting and related drilling operation
IS:4988 (Part-4)	Excavators
IS: 12138	Earth moving equipment
LIME & LIME PRODUCTS	
IS: 712	Specifications for building limes
IS: 1514	Method of sampling and test for quick lime and hydrated lime
IS: 1624	Method of field testing of building limes
IS: 1635	Code of practice for field slaking of building lime and preparation of putty
IS: 2686	Specifications for cinder as fine aggregate to use in lime concrete
IS : 3068	Specification for broken brick (burnt clay) coarse aggregate for use in lime concrete
IS : 3182	Specification for broken brick (burnt clay) fine aggregate for use in

IS: CODE NO.	IS: CODE NO.
	lime mortar
IS : 4098	Specification for lime-pozzolana mixture
IS : 5817	Code of practice for preparation and use of lime-pozzolana mixture concrete in buildings and roads
IS : 6932	Method of test for building limes, Part 1 to Part 11
MORTARS	
IS: 1269	Specification for 53 grade ordinary Portland cement
IS: 2116	Specification for sand for masonry mortar
IS: 2250	Code of practice for preparation and use of masonry Mortar
IS: 3406	Specification for masonry cement
IS: 8042	Specification for white cement
FORMWORK	
IS: 303	Specification for plywood for general purpose.
IS: 2750	Specification for Steel Scaffolding
IS: 4900	Specification for plywood for concrete shuttering work.
IS: 4990	Specifications for plywood formwork for concrete.
REINFORCED CEMENT CONCRETE WORK	
IS: 432 (Part-I)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement part-I mild steel and medium tensile steel bars
IS: 432 (part-II)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement part-II hard drawn steel wire
IS: 456	Code of practice for plain and reinforced concrete
IS: 1200 (Part-II)	Method of measurement of building and civil engineering work – concrete work
IS: 1200 (Part-V)	Method of measurement of building and civil engineering work – concrete work (Part 5 – Form work)
IS: 2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
IS: 13311 (Part-I)	Indian standard for non-destructive testing of concrete. Method of test for ultrasonic pulse velocity
IS: 13311 (Part-II)	Indian standard for non-destructive testing of concrete. Method of testing by rebound hammer.
IS: 1568	Wire gauge for general purposes
IS:3370	Code of practice for concrete structures for storage of liquids (Parts 1 to 4).
STEEL WORK	
IS: 226	Structural steel
IS: 2062	Steel for general structural purpose
IS: 800	Code of practice for use of structural steel in general in steel construction
IS: 806	Code of practice for use of steel Tubes in general building construction
IS: 816	Code of practice for use of metal arc welding for general construction in mild steel

IS: CODE NO.	IS: CODE NO.
IS: 822	Code of procedure for inspection of welds
IS: 1200 (Pt. 8)	Method of measurements of steel work and iron works
IS: 4736	Hot – dip zinc coating on mild steel tubes
IS: 6188	Metal rolling shutters and rolling grills
BRICK WORK	
IS: 712	Specification for building limes
IS: 1077	Common burnt clay building bricks
IS: 1200 (Part 3)	Method of measurements of brick works
IS: 2212	Code of practice for brick work (1 st Revision)
IS: 3495	Method of test for burnt clay building bricks
IS: 5454	Methods of sampling of clay building bricks
FLOORING	
IS: 1200 (Part-XI)	Method of measurement of Building and Civil Engineering work (Part 11) paving, floor finishes, dado and skirting
IS: 1237-Edition 2.3	Specification for cement concrete flooring tiles
IS: 1443	Code of practice for laying and finishing of cement concrete flooring tiles
IS: 2114	Code of practice for laying in-situ terrazzo floor finish
IS: 3622	Specification for sand stone (Slab & Tiles)
IS: 4457	Acid and / or alkali Resistant tiles
IS: 5318	Code of practice for laying of hard wood parquet and wood block floors
IS: 5766	Code of practice for laying of burnt clay brick floor
IS: 13630 (Part-1 to 15)	Methods of Testing for ceramic tiles
IS: 13712	Specification for ceramic tiles, definition, classification characteristic and marking
FINISHING WORKS	
IS: 1542	Sand for plaster
IS: 427	Distemper, dry colour as required
IS: 428	Distemper, oil emulsion, colour as required
IS: 6278	Code of practice for white washing and colour washing
IS: 106	Ready mixed paint, brushing, priming for enamels for use on wood.
IS: 102	Ready mixed paint, brushing, red lead, non- setting, priming
IS: 123	Ready mixed paint, brushing, finishing, semi-gloss, for general purposes
IS: 2074	Ready mixed paint, red oxide-zinc chrome priming
IS: 2339	Aluminium paint for general purposes in dual container
IS: 137	Specification for ready mixed paint, brushing, matt or eggshell flat finishing interior to Indian Standard colour as required
WATER SUPPLY, SANITARY INSTALLATIONS & DRAINAGE	
IS: 771 (Pt.1)	Specification for glazed fire clay sanitary appliances : part 1: General requirements
IS: 1703	Water fittings – copper alloy float valves (horizontal plunger type) – Specification
IS: 4127	Code of practice for laying of glazed stoneware pipes

IS: CODE NO.	IS: CODE NO.
MATERIALS	
IS: 269	Specification for 33 grade Ordinary Portland Cement.
IS: 455	Specification for Portland Slag Cement.
IS: 1489	Specification for Portland Pozzolana Cement (Parts 1 & 2)
IS: 8112	Specification for 43 grade Ordinary Portland Cement.
IS: 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS: 9103	Specification for admixtures for concrete.
IS: 2645	Specification for integral cement waterproofing compounds.
IS: 4926	Ready Mixed Concrete.
IS: 12269	Specification for 53 grade Ordinary Portland Cement.
IS: 12089	Specification for Granulated Ground Blast Furnace Slag.
BS: 6699	Specification for Granulated Ground Blast Furnace Slag.
BS: 6073 (Part 1)	Specifications for precast concrete masonry units
MATERIAL TESTING	
IS: 4031	Methods of physical tests for hydraulic cement. (Parts 1 to 15)
IS: 4032	Method of chemical analysis of hydraulic cement.
IS: 650	Specification for standard sand for testing of cement.
IS: 2430	Methods for sampling of aggregates for concrete.
IS: 2386	Methods of test for aggregates for concrete (Parts 1 to 8)
IS: 3025	Methods of sampling and test (physical and chemical) water used in industry. (Part 1 to 51)
IS: 6925	Methods of test for determination of water soluble chlorides in concrete admixtures.
CONCRETE MIX DESIGN	
IS: 10262	Recommended guidelines for Concrete Mix Design.
SP: 23	Handbook on Concrete Mixes.
CONCRETE TESTING	
IS: 1199	Method of sampling and analysis of concrete.
IS: 516	Method of test for strength of concrete.
IS: 9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.
IS: 8142	Method of test for determining setting time of concrete by penetration resistance.
IS: 9284	Method of test for abrasion resistance of concrete.
IS: 2770	Methods of testing bond in reinforced concrete.
EQUIPMENT	
IS: 1791	Specification for batch type concrete mixers.
IS: 2438	Specification for roller pan mixer.
IS: 4925	Specification for concrete batching and mixing plant.
IS: 5892	Specification for concrete transit mixer and agitator.
IS: 2505	General Requirements for concrete vibrators: Immersion type.
IS: 2514	Specification for concrete vibrating tables.
IS: 4656	Specification for form vibrators for concrete.

IS: CODE NO.	IS: CODE NO.
CONSTRUCTION SAFETY	
IS: 7969	Safety code for handling and storage of building materials.
IS: 8989	Safety code for erection of concrete framed structures.
MEASUREMENTS	
IS:1200	Method of measurement of building and engineering works
REINFORCEMENT	
IS: 226-1975	Structural steel (Standard Quality).
IS: 280-1978	Mild steel wire for general Engineering purposes.
IS:814-1974	Covered electrodes for metal or welding of structural steel.
IS:814-1974(part-I)	For welding products other than sheets.
IS:814-1974(part-II)	For welding sheets
IS:1139-1966	Hot rolled mild steel medium tensile steel and high yield strength steel deformed bars for concrete
IS:1278-1972	Filler rods and wires for gas welding.
IS:1481-1970	Metric steel scales for Engineers.
IS:1521-1972	Method for tensile testing of steel wires.
IS:1566-1967	Hard drawn steel wire fabrics for concrete reinforcement.
IS:1608-1972	Method for tensile testing of steel products.
IS:1786-1979	Cold twisted steel bars for concrete reinforcement.
IS:2502-1963	Code of practice for bending and fixing of bars for concrete reinforcement
IS:5525-1969	Recommendations for detailing of reinforcement in reinforced concrete works.
IS:9417-1979	Recommendations for welding cold worked steel bars for reinforced concrete construction

5.1 Site Documents

The following site documents shall mainly be maintained by the Contractor at site:

- i. Copy of contract documents and drawings.
- ii. Computerized bill format.
- iii. Site Order Book.
- iv. Material testing registers / Quality Inspection Reports.
- v. Measurement books on computerized format.
- vi. Progress bar chart.
- vii. Sample approval register.
- viii. Hindrance Register.

- ix. Work Diary.
- x. Deviation/variation order registers.
- xi. Cement consumption register.
- xii. Reinforcement registers.
- xiii. Concrete cube test register.
- xiv. Slump test register.
- xv. Silt content and sand bulkage register.
- xvi. Request for Work Inspection
- xvii. Joint Measurement book
- xviii. Daily Labor report
- xix. Quality Check list

5.2 General

5.2.1 Special Structures

- a. For building works Level, at 1.2 m above the ground level shall be the floor 1 level as well as plinth level. Level at a height of 3.5 m above floor 1 level will be reckoned as floor 2 level and level at a height of 3.5 m above the floor 2 level will be floor 3 level and so on, where the total height above floor 1 level is not a whole number multiple of 3.5 meter. Top most floor level shall be the next in sequence to the floor level below even if the difference in height between the two upper most floor levels is less than 3.5 meters.

5.2.2 Foundation and Plinth

The work in foundation and plinth shall include:

- a. For buildings: All works up to 1.2 meter above ground level or up to floor 1 level whichever is lower
- b. For abutments, piers and well steining: all works up to 1.2 m above the bed level:
- c. For retaining wall, wing walls, compound walls, chimneys, overhead reservoirs/tanks and other elevated structures: All works up to 1.2 meter above the ground level.

- d. For reservoirs/ tanks (other than overhead reservoirs/ tanks): All works up to 1.2 meter above the ground level:
- e. For basements: All works up to 1.2 m above ground level or up to floor 1 level whichever is lower.

Note: Specific provision shall be made in the estimate for such situations where the foundation level is more than 3 (three) meter depth from the plinth for all types of structures mentioned above.

5.2.3 Measurements

- a. In booking dimensions, the order shall be consistent and in the sequence of length, width and height or depth or thickness.
- b. Rounding off: Rounding off where required shall be done in accordance with IS: 2-1960. The number of significant places rounded in the rounded off value should be as specified.

5.2.4 Materials

- a. Samples of all materials to be used on the work shall be got approved by the contractor from the Engineer-in- Charge well in time. The approved samples duly authenticated and sealed shall be kept in the custody of the Engineer-in-Charge till the completion of the work. All materials to be provided by the contractor shall be brand new and as per the samples approved by the Engineer-in-Charge.
- b. Materials obtained by the contractor from the sources approved by the Department shall be subjected to the Mandatory tests. Where such materials do not conform to the relevant specifications, the matter shall be taken up by the Engineer-in-Charge for appropriate action against the defaulters. In all such cases, necessary documents in original and proof of payment relating to the procurement of materials shall be made available by the contractor to the Engineer-in-Charge.
- c. Samples, whether submitted for approval to govern bulk supplies or required for testing before use and also the sample of materials bearing 'Standard mark,' if required for testing, shall be provided free of cost by the contractor. All other incidental expenditure to be incurred for testing of samples e.g. packaging, sealing transportation, loading, unloading etc. including testing charges shall be borne by the contractor.
- d. The materials, supplied by the Department shall be deemed to be complying with the specifications.
- e. Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric effects due to rain, sun, wind and moisture to avoid deterioration.

- f. Materials like timber, paints etc. shall be stored in such a way that there may not be any possibility of fire hazards. Inflammable materials and explosives shall be stored in accordance with the relevant rules and regulations or as approved by Engineer-in-Charge in writing so as to ensure desired safety during storage.
- g. The unit weight of materials unless otherwise specified shall be reckoned as given in IS: 1911-1967.

5.2.5 Safety in Construction

- a. The contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.
- b. The contractor shall take all precautions and measures to ensure safety of works and workmen and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, working at heights, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by CPWD safety code, relevant safety codes and the direction of Engineer-in-Charge.

5.3 Stacking and Storage of Material

5.3.1 Cement & Lime

In case cement is received in bags.

- 5.3.1.1. Cement shall be stored at the work site in a building or a shed which is dry, leak-proof and as moisture proof as possible. The building or shed for storage should have minimum number of windows and close fitting doors and these should be kept closed as far as possible.
- 5.3.1.2. Cement shall be stored and stacked in bags and shall be kept free from the possibility of any dampness or moisture coming in contact with them. Cement bags shall be stacked off the floor on wooden planks in such a way as to keep about 150 mm to 200 mm clear above the floor. The floor may comprise of lean cement concrete or two layers of dry bricks laid on well consolidated earth. A space of 600 mm minimum shall be left all-round between the exterior walls and the stacks. In the stacks the cement bags shall be kept close together to reduce circulation of air as much as possible. Owing to pressure on the bottom layer of bags sometimes 'warehouse pack' is developed in these bags. This can be removed easily by rolling the bags when the cement is taken out for use. Lumbed bags, if any should be removed and disposed off.
- 5.3.1.3. The height of stack shall not be more than 10 bags to prevent the possibility of lumping up under pressure. The width of the stack shall be not more than four

bags length or 3 meters. In stacks more than 8 bags high, the cement bags shall be arranged alternately length-wise and cross-wise so as to tie the stacks together and minimize the danger of topping over. Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received; a label showing date of receipt of cement shall be put on each stack to know the age of cement.

- 5.3.1.4. For extra safety during the monsoon, or when it is expected to store for an unusually long period, the stack shall be completely enclosed by a water proofing membrane such as polyethylene, which shall close on the top of the stack. Care shall be taken to see that the waterproofing membrane is not damaged any time during use.
- 5.3.1.5. Cement in gunny bags, paper bags and polyethylene bags shall be stored separately.
- 5.3.1.6. In case cement is received in drums
- 5.3.1.7. These shall be stored on plane level ground, as far as possible near the concrete mixing place. After taking out the required quantity of cement, the lid of the drum shall be securely tied to prevent ingress of moisture.
- 5.3.1.8. In case cement is received in silos
- 5.3.1.9. The silos shall be placed near the concrete batching plant. Proper access shall be provided for the replacement of silos.

Different types of cements shall be stacked and stored separately.

5.3.2 Lime

Un-slaked lime shall be stored In a place inaccessible to water and because of the fire hazard, shall be segregated from the consumable material

5.3.3 Bricks / Bela Stones

- 5.3.3.1. Bricks shall be stacked in regular tiers as and when they are unloaded to minimize breakage and defacement. These shall not be dumped at site.
- 5.3.3.2. Bricks stacks shall be placed close to the site of work so that least effort is required to unload and transport the bricks again by loading on pallets or in barrows. Building bricks shall be loaded or unloaded a pair at a time unless palletized. Unloading of building bricks or handling in any other way likely to damage the corners or edges or other parts of bricks shall not be permitted.
- 5.3.3.3. Bricks shall be stacked on dry firm ground. For proper inspection of quality and ease in counting the stacks shall be 50 bricks long, 10 bricks high and not more than 4 bricks in width, the bricks being placed on edge, two at a time along the

width of the stack. Clear distance between adjacent stacks shall not be less than 0.8 m. Bricks of each truck load shall be put in one stack.

- 5.3.3.4. Bricks of different types, such as clay bricks, clay fly ash bricks, fly ash lime bricks, sand lime (calcium silicate) bricks, Bela stone, auto-clave bricks etc. shall be stacked separately. Bricks of different classification and size consideration (such as, conventional and modular) shall be stacked separately. Also bricks of different types, such as, solid, hollow and perforated shall be stacked separately.

5.3.4 Floor, Wall and Roof Tiles

- 5.3.4.1. Floor, wall and clay roof tiles of different types, such as, cement concrete tiles (plain, colored and terrazzo) and ceramic tiles (glazed and unglazed) shall be stacked on regular platform as far as possible under cover in proper layers and in tiers and they shall not be dumped in heaps. In the stack, the tiles shall be so placed that the mould surface of one faces that of another. Height of the stack shall not be more than one metre. During unloading, these shall be handled carefully so as to avoid breakage.
- 5.3.4.2. Tiles of different quality, size and thickness shall be stacked separately to facilitate easy removal for use in work. Tiles when supplied by manufacturers packed in wooden crates shall be stored in crates. The crates shall be opened one at a time as and when required for use.
- 5.3.4.3. Ceramic tiles and clay roof tiles are generally supplied in cartons which shall be handled with care. It is preferable to transport these at the site on platform trolleys.

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5.3.6 Aggregates

- 5.3.6.1. Aggregates shall be stored at site on a hard dry and level patch of ground. If such a surface is not available, a platform of planks or old corrugated iron sheets, or a

floor of bricks, or a thin layer of lean concrete shall be made so as to prevent contamination with clay, dust, vegetable and other foreign matter.

- 5.3.6.2. Stacks of fine and coarse aggregates shall be kept in separate stock piles sufficiently removed from each other to prevent the material at the edges of the piles from getting intermixed. On a large job, it is desirable to construct dividing walls to give each type of aggregates its own compartment. Fine aggregates shall be stacked in a place where loss due to the effect of wind is minimum.
- 5.3.6.3. Unless otherwise specified or necessitated by site conditions stacking of the aggregates should be carried out in regular stacks.

5.3.7 Steel

- 5.3.7.1. For each classification of steel, separate areas shall be earmarked. It is desirable that ends of bars and sections of each class be painted in distinct separate colors.
- 5.3.7.2. Steel reinforcement shall ordinarily be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. It is desirable to coat reinforcement with cement wash before stacking to prevent scaling and rusting.
- 5.3.7.3. Bars of different classification, sizes and lengths shall be stored separately to facilitate issues in such sizes and lengths so as to minimize wastage in cutting from standard lengths.
- 5.3.7.4. In case of long storage, reinforcement bars shall be stacked above ground level by at least 150 mm. Also in coastal areas or in case of long storage a coat of cement wash shall be given to prevent scaling and rusting.
- 5.3.7.5. Structural steel of different classification, sizes and lengths shall be stored separately. It shall be stored above ground level by at least 150 mm upon platforms, skids or any other suitable supports to avoid distortion of sections. In coastal areas or in case of long storage suitable protective coating of primer paint shall be given to prevent scaling and rusting.

5.3.8 Water

Wherever water is to be stored for construction purposes this shall be done in proper storage tanks to prevent any organic impurities getting mixed up with it.

5.3.9 Other Materials

Small articles like nails, screws, nuts and bolts, door and window fittings, polishing stones, protective clothing, spare parts of machinery, linings, packing, water supply and sanitary fittings, electrical fittings, insulation board, etc, shall be kept in suitable and properly protected store rooms. Valuable small material such as, copper pipes and fittings shall be kept under lock and key.

5.3.10 Measurements

Length, breadth and height of stacks shall be measured correct to a cm. The quantity shall be worked out in cubic meter correct to two place of decimal. The volume of stacks shall be reduced by percentages as shown against each for looseness in stacking to arrive at the net quantity for payment. No reduction shall be made in respect of articles or materials for which mode of payment is by length or weight or number.

5.3.11 Earth

- 5.3.11.1. In loose stacks such as cart loads, lorry loads, etc. – 20%
- 5.3.11.2. In fills consolidated by light mechanical machinery – 10%
- 5.3.11.3. In fills consolidated by heavy mechanical machinery but not under OMC (Optimum Moisture Content) – 5%
- 5.3.11.4. In fills consolidated by heavy mechanical machinery at OMC – Nil
- 5.3.11.5. Consolidated fills in confined situation such as under floors. etc. – Nil

5.3.12 Other Materials

- 5.3.12.1. Murrom, building rubbish Lime and sand – Nil
- 5.3.12.2. Stone metal, 40 mm nominal size and above – 7.5%
- 5.3.12.3. Coarse aggregate/ stone metal below 40 mm nominal size – Nil
- 5.3.12.4. Soling stone/ Boulder 100 mm and above – 15%
- 5.3.12.5. Excavated rocks – 50%

5.4 Clearance of Grass and De-vegetation

Clearing and grubbing operation involving only the clearance of grass shall be measured and paid for separately and shall include removal of rubbish and disposing outside the periphery of the area under clearance.

The growth of vegetation in the joints of historic brick buildings is the principle factor in causing their ruin. Therefore the plants and trees growing on and close to the structure need to be completely eradicated.

- i. In removing weeds, trees or shrubs, etc. from walls, it is essential that the roots should be completely destroyed, and during the process of raking out, any tendrils found in the joints should be followed up and removed. The stumps can be injected with chemical called Round up or tree killer, arsenic or hot lime slurry shall be poured around the roots.

- ii. Joints which have to be raked out in order to destroy the vegetation should, after the earth etc. has been removed, be immediately re-pointed.
- iii. No trees shall be cut without permission. For this purpose, a tree shall be defined as a growth, which is more than 3 meters high and whose diameter of the trunk at the base is not less than 30 cm
- iv. The cutting of trees from historic masonry is an operation that demands special care. As a rule large trees should be removed in sections in order to prevent injury being done to the masonry. When jungle has to be cleared from around an ancient monument, it should be cut for at least 30 yards on all sides, unless special reasons to the contrary exists, and its roots should be completely eradicated so as to prevent them from sprouting again.
- v. Refilling shall be done by using earth in layers of 200mm. thickness with compaction in pits. Another method which can be employed for the de vegetation of small saplings is drilling by mechanical or manual means and then extracting the remnants by vacuum suction

5.4.1 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.

5.5 Excavation in All Kinds of Soils

5.5.1 Scope

This specification covers the general requirements of earthwork in excavation in different materials, site grading, filling in areas as shown in drawing, filling back around foundations and Gabion retaining wall, conveyance and disposal of surplus soils or stacking them properly as shown on the drawings and as directed by the ENGINEER-IN-CHARGE and all operations covered within the intent and purpose of this specification.

5.5.2 Applicable Codes

For Indian Standard Codes, please refer Clause 1.3. In all cases, the latest revision of the codes shall be referred to.

5.5.3 General

The CONTRACTOR shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the job in accordance with the specification requirements.

The excavation shall be done to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and

maintaining of substantial barricades around excavated areas and warning lamps at night for ensuring safety.

The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, riprap with regular slopes and levelling the same so as to provide natural drainage, with all leads and lifts as directed by the ENGINEER-IN-CHARGE,. Rock/ soil excavated.

5.5.4 Clearing

The area to be excavated filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by the ENGINEER-IN-CHARGE. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

5.5.5 Precious Objects, Relics, Objects of Antiquity, Etc.

All gold, silver, oil, minerals, archaeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the OWNER and the CONTRACTOR shall duly preserve the same to the satisfaction of the OWNER and from time to time deliver the same to such person or persons as the OWNER may from time to time authorise or appoint to receive the same.

5.5.6 Classification

All materials to be excavated shall be classified by the ENGINEER-IN-CHARGE, as per relevant codes and standards shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of the ENGINEER-IN-CHARGE regarding the classification of the material shall be final and binding on the CONTRACTOR and not be a subject matter of any appeal or arbitration.

5.5.7 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 metre 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.

5.5.8 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.

5.5.9 In firm soils, the sides of the trenches shall be kept vertical upto 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 meters 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 meters.

- 5.5.10** 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. Where shuttering is not required excavation width will be measured with PCC width mentioned in drawing.
- 5.5.11** 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 levelling/ 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.
- 5.5.12** 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 the knowledge of EIC.
- 5.5.13** 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.
- 5.5.14** Only the excavation 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.
- 5.5.15** 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 equipment's 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.

5.5.16 Back filling around foundation

Back filling around completed foundations shall be done to the lines and levels shown on the drawings, including any trimming of the surfaces as may be necessary. The refilling shall be done in horizontal layers of thickness not exceeding 25 cm. Free from pockets and rammed with rollers, rammers to achieve firm compaction. In case manual ramming is employed, at least two men shall be engaged for ramming for each layer filling. Water shall be sprinkled as necessary in the consolidation process. The Engineer-In-Charge may order the use of different materials in alternate layers of fill.

5.5.17 Temporary supports for excavation

The contractor shall support sides of excavation with shoring, strutting, sheeting, sandbags etc. if necessary and shall keep the excavation thoroughly secure until the works for which they were made are completed, without any extra costs. Unless otherwise directed by the Engineer-In-Charge, the contractor shall remove all shoring, strutting sheeting as the work proceeds. The Engineer-In-Charge may instruct in writing such support for excavation to be left permanently in position, if he thinks that removal of the support would result in undue settlement, collapse of the adjacent ground or endanger the adjoining structures. All such supports left in as per the direction of the Engineer-In-Charge, will be paid for.

5.5.18 Stripping Loose Rock

All loose boulders, semi-detached rocks (along with earthy stuff which might move therewith) not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of the ENGINEER-IN-CHARGE, to fall or otherwise endanger the workmen, equipment, or the work, etc., shall be stripped off and removed away from the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal as contemplated in the work, but which, in the opinion of the ENGINEER-IN-CHARGE, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed as directed by the ENGINEER-IN-CHARGE. The cost of such stripping will be paid for at the unit rates accepted for the class of materials in question.

5.6 Fill, Back Filling and Site Grading

5.6.1 General

All fill material will be subject to the ENGINEER-IN-CHARGE's approval. If any material is rejected by the ENGINEER-IN-CHARGE, the CONTRACTOR shall remove the same forthwith from the site at no extra cost to the OWNER. Surplus fill material shall be deposited/ disposed off as directed by the ENGINEER-IN-CHARGE after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the ENGINEER-IN-CHARGE

5.6.2 Material

To the extent available, selected surplus soils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixture used for filling.

If any selected fill material is required to be borrowed, the CONTRACTOR shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of the ENGINEER-IN-CHARGE. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish, etc. top soil containing salts/ sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by the ENGINEER-IN-CHARGE. The CONTRACTOR shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, at his cost.

Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or half ($\frac{1}{2}$) tonne roller. Where specified, every third and top most layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metres, vibratory power roller shall be used to consolidate the filling unless otherwise directed by ENGINEER-IN-CHARGE. The CONTRACTOR shall make good all subsidence and shrinkage in earth fillings, embankments, traverses, etc. during execution and till the completion of work unless otherwise specified.

5.6.3 Filling In Pits and Trenches around Foundations of Structures, Walls

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc. shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm., each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of the ENGINEER-IN-CHARGE. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the ENGINEER-IN-CHARGE is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and levelled to proper profile as directed by the ENGINEER-IN-CHARGE or indicated on the drawings.

5.6.4 Filling in Trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm, backfilling above the level of the centre line of the pipe shall be done with selected earth by hand compaction or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling upto a level 30 cm above the top of the pipe shall be done with fine materials, such as earth, murrum etc. The filling up of the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

GENERAL SITE GRADING: Site grading shall be carried out as indicated in the drawings and as directed by the ENGINEER-IN-CHARGE. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as Indian standard Codal provision.IS:2720

If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the CONTRACTOR at his cost. Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well. The CONTRACTOR shall protect the earth fill from being washed away by rain damaged in any other way. Should any slip occur, the CONTRACTOR shall remove the affected material and make good the slip at his cost. The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained. If specifically permitted by the ENGINEER-IN-CHARGE, compaction can be obtained by allowing loaded trucks conveying fill or other material to ply over the fill area. Even if such a method is permitted, it will be for the CONTRACTOR to demonstrate that the desired/ specified compaction has been obtained. In order that the fill may be reasonably uniform throughout, the material should be dumped in place in approximately uniform layers. Traffic over the fill shall then be so routed to compact the area uniformly throughout.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent

operations are taken up.

5.6.5 Fill Density

The compaction, only where so called for, in the schedule of quantities/ items shall comply with the specified (Standard Proctor/ Modified Proctor) density at moisture content differing not more than 4 percent from the optimum moisture content. The CONTRACTOR shall

demonstrate adequately at his cost, by field and laboratory tests that the specified density has been obtained.

5.7 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 the agreement.

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.

5.7.1 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.

5.7.2 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.

5.7.3 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.

5.8 Dismantling and Demolishing

5.8.1 Terminology

(i) Deconstruction – Means a selective demolition in which salvage, reuse and recycling of demolished structure is maximized. The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

(ii) Demolition: The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work either manually or using mechanical force (various equipment) or

by implosion using explosion, including all relevant items as specified or shown on the drawings.

5.8.2 Precaution

- 5.6.2.1. All materials obtained from dismantling or demolition shall be the property of the Government unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer-in-charge-in-Charge/ authorized representative.
- 5.6.2.2. The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-charge- before starting the work. Due care shall be taken to maintain the safety measures prescribed in **IS 4130 and construction and demolition waste management rules 2016** shall be followed.
- 5.6.2.3. Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge. It shall be ensured that no dust is generated while demolishing. Demolition Rules – 2016 shall be followed.
- 5.6.2.4. Necessary steps shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety jackets, safety belts, dust masks, ear plug etc., should be used whenever required and as directed by the Engineer-in-Charge. The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public. Barricading shall be provided as per NGT guidelines.
- 5.6.2.5. Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cutters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.
- 5.6.2.6. Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.
- 5.6.2.7. Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within all leads and lift. All unserviceable materials, rubbish etc. shall be disposed off at authorized locations by urban local bodies as directed by the Engineer-in-Charge.

5.6.2.8. The contractor shall maintain/disconnect existing services, whether temporary or permanent, wherever required by the Engineer-in-Charge

5.6.2.9. No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area

5.6.2.10. Appropriate screens shall be placed where necessary to prevent injuries due to falling pieces.

5.6.2.11. Water spray shall be used to reduce dust while tearing down plaster from brick work.

5.6.2.12. Safety belts shall be used by labourers while working at higher level to prevent falling from the structure. Wherever, possible mechanized working platform shall be used

5.6.2.13. First-aid equipment shall be made available at all demolition works of any magnitude.

5.8.3 Measurements

All work shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter.

- A. Dimensions shall be measured correct to a cm.
- B. Areas shall be worked out in sqm correct to two places of decimal.
- C. Cubical contents shall be worked out to the nearest 0.01 cum.

5.8.4 Flooring and Paving

Dismantling of floors (except concrete and brick floors) shall be measured in square meters. Concrete and bricks paving shall be measured

5.8.5 Concrete and Brick Roofs and Suspended Floors

Demolition of floors and roofs of concrete or brick shall be measured in cubic meters. Beams cantilevers or other subsidiary supports of similar materials, shall be included in the item. In measuring thickness of roofs provided with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

5.8.6 Walls and Piers

- i. RCC in Column, Beam, Slab, brick work columns of brick, stone or concrete shall be measured in cubic meters. All copings, corbels, cornices and other projections shall be included with the wall measurements.
- ii. In measuring plaster of walls, the thickness of plaster shall be ignored and wall to wall length and height will be measured.

- iii. Ashlar face stones, dressed stone work, pre-cast concrete articles, etc. if required to be taken, shall be measured separately in cubic meters.
- iv. Cleaning bricks stacking for measurements including all extra handling and removal and disposing off the rubbish as stated shall be enumerated in thousands of cleaned bricks
- v. Cleaning stone obtained from demolished/dismantling stone masonry of any description including ashlar facing dressed stone work, stone slabs or flagging and pre-cast concrete blocks including all extra handling and disposing off the rubbish as stated shall be measured in cubic meters of cleaned stone.
- vi. Honey comb works or cavity walls of bricks stone or concrete shall be measured as solid.

5.8.7 Reinforced Concrete and Brick Work

Reinforced concrete structures and reinforced brick roofs and walls shall be measured in cubic meters and if reinforcement is required to be salvaged, it shall be so stated. Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in quintal of salvaged steel.

5.8.8 Steel and Iron Work

- i. All steel and iron work shall be measured in Kg. The weight shall be computed from standard tables unless the actual weight can readily be determined.
- ii. Riveted work, where rivets are required to be cut, shall be measured separately.

Marking of structural steel required to be re-erected shall be measured separately. In framed steel items, the weight or any covering material or filling such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.

5.8.9 Surface brushing

Preparing surface by brushing with wire brushes for removing caked mud etc. Sweeping with brooms and finally fanning the cleared surface with gunney bags to remove all loose dirt etc.,

5.8.10 Measurements

All work shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter.

- A. Dimensions shall be measured correct to a cm.
- B. Areas shall be worked out in sqm correct to two places of decimal.

5.8.11 Filling

The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish.

Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 meter vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified.

5.8.12 Measurements

The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic meters

5.8.13 Felling Trees

Felling: While clearing jungle, growth trees above 30 cm girth (measured at a height of one metre aboveground level) to be cut, shall be approved by the Engineer-in-Charge and then marked at site. Felling trees shall include taking out roots upto 60 cm below ground level or 30 cm below formation level or 15 cm below sub-grade level, whichever is lower.

All excavation below general ground level arising out of the removal of trees, stumps etc. shall be filled with suitable material in 20 cm layers and compacted thoroughly so that the surfaces at these points conform to the surrounding area. The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Engineer-in-Charge.

Stacking and Disposal: Wood, branches, twigs of trees and other useful material shall be the property of the Government.

The serviceable materials shall be stacked in the manner as directed by the Engineer-in-Charge upto a lead of 50m.

All unserviceable material, which in the opinion of Engineer-in-Charge cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Engineer-in-Charge. Care shall be taken to see that unsuitable waste materials are disposed off in such a manner that there is no likelihood of these getting mixed up with the materials meant for construction.

Measurements: Cutting of trees above 30 cm in girth (measured at a height of one metre above level) shall be measured in numbers according to the sizes given below:

- (a) Beyond 30 cm girth, upto and including 60cm girth.
- (b) Beyond 60 cm girth, upto and including 120 cm girth.

(c) Beyond 120 cm girth, upto and including 240 cm girth.

(d) Above 240 cm girth.

Rate: The rate includes the cost involved in all the operations described above. The contract unit rate for cutting trees above 30 cm in girth shall include removal of stumps as well.

5.9 P.C.C. Work

5.9.1 Materials

Water shall conform to M-1. Sand shall conform M-6. Cement shall conform to M-3. Stone aggregate 40 mm. nominal size shall conform to M-12. Providing cement, sand and grit mixture as cement concrete for leveling purpose wherever required. Spreading of graded stone aggregate for Hard Quality up to 63 mm size and screened cleaned pea gravel of 12mm nominal size.

5.9.2 General :

Before starting concrete bed of foundation trenches shall be cleared of all loose materials, leveled, watered, and rammed as directed.

5.9.3 Proportion of Mix :

The proportion of cement, sand and coarse aggregate shall be one part of cement, 3 parts of sand, 6 parts of stone aggregates and shall so measure by volume.

5.9.4 Mixing :

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge incase of break-down of machinery's and in the interest of the work. It shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1 to 2 minutes. The quantity of water shall be sufficient to produce a dense concrete of required workability for the purpose.

5.9.5 Transporting & Placing the concrete :

The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

The concrete shall be laid in layers of 15 cms. to 20 cms.

5.9.6 Compacting :

The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

5.9.7 Curing :

After the final set, the concrete shall be kept continuously wet, if required by pounding for a period of not less than 7 days from the date of placement.

5.9.8 Mode of measurement and payment :

The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed.

The rate shall be for a unit of one cubic meter.

5.10 Concrete Work

5.10.1 MATERIAL

Water, cement, fine aggregate or sand, surkhi, and fly ash shall be as specified in Chapter Cement Mortar.

Coarse Aggregate

General: Aggregate most of which is retained on 4.75 mm IS Sieve and contains only as much fine material as is permitted in IS 383 for various sizes and grading is known as coarse aggregate. Coarse aggregate shall be specified as stone aggregate, gravel or brick aggregate and it shall be obtained from approved/ authorized sources.

Stone Aggregate: It shall consist of naturally occurring (uncrushed, crushed or broken) stones. It shall be hard, strong, dense, durable and clean. It shall be free from veins, adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided. **Aggregates from other than natural resources shall comply with the requirements of IS 383.**

- A. **Gravel:** It shall consist of naturally occurring (uncrushed, crushed or broken) river bed shingle or pit gravel. It shall be sound, hard and clean. It shall be free from flat particles of shale or similar laminated material, powdered clay, silt, loam, adherent coating, alkali, vegetable matter and other deleterious substances. Pit gravel shall be washed if it contains soil materials adhering to it. These shall conform to IS 383 unless otherwise specified.
- B. **Brick Aggregate:** Brick aggregate shall be obtained by breaking well burnt or over burnt dense brick/ brick bats. They shall be homogeneous in texture, roughly cubical in shape and clean. They shall be free from unburnt clay particles. Soluble salt, silt, adherent coating of soil, vegetable matter and other deleterious substances. Such aggregate should not contain more than one percent of sulphates and should not absorb more than 10% of their own mass of water, when used in cement concrete. It shall conform to IS 306 unless otherwise specified.
- C. **Light weight aggregate** such as sintered fly ash aggregate may also be used provided the Engineer-in-Charge is satisfied with the data on the proportion of concrete made with them.

Stacking: Aggregate shall be stacked on a hard, dry and level patch of ground. When stack piling, the aggregate shall not form pyramids resulting in segregation of different sized materials. It shall be stacked separately according to nominal size of coarse aggregates. Stacking shall be done in regular stacks, of height not exceeding 100 cm.

Testing: Coarse aggregate shall be tested for the followings (as per IS 2386)

- 5.17.1.1. Determination of particle size and shape (Appendix 'A' of Chapter 4 of CPWD Vol-I)
- 5.17.1.2. Estimation of organic impurities (as per IS 2386 - Part II)
- 5.17.1.3. Surface moisture (Appendix 'B' of Chapter 4 of CPWD Vol-I)
- 5.17.1.4. Determination of 10% fine value (Appendix 'C' of Chapter 4 of CPWD Vol-I)

Measurements: The aggregates shall be measured in stacks and paid for after making a deduction of 7.5% of the gross measurements of stacks in respect of aggregates of nominal size 40 mm and above. No deduction from the gross measurements of the stacks is to be made in respect of aggregate of nominal size below 40 mm.

Chemical Admixtures When required, admixtures of approved quality shall be mixed with concrete, as specified. The admixtures shall conform to IS 9103

5.10.2 CEMENT CONCRETE

Grades of Cement Concrete

The concrete shall be in grade designated as under:

Group	Grade Designation	Specified characteristic compressive strength of 150 mm Cube at 28 Days in N/mm ²
(1)	(2)	(3)
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55

	M60	60
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Notes :

1. In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm²
2. For concrete of compressive strength greater than **M60**, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.
3. The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

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, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency. Before mixing the brick aggregate shall be well soaked with water for a minimum period of two hours and stone aggregate or gravel shall be washed with water to remove, dirt, dust and other foreign materials. For guidance, the mixing time may be 1½ to 2 minutes, for hydrophobic cement it may be taken as 2½ to 3 minutes.

Mixing Efficiency: The mixer shall be tested under normal working conditions in accordance with the method specified in IS 4643 with a view to check its ability to mix the ingredients to obtain concrete having uniformity within the prescribed limits. The uniformity of mixed concrete shall be evaluated by finding the percentage variation in quantity (mass in water) of cement, fine aggregate and coarse aggregate in a freshly mixed batch of concrete.

The percentage variation between the quantities of cement, fine aggregate and coarse aggregates (as found by weighing in water) in the two halves of a batch and average of the two halves of the batch shall not be more than the following limits:

Cement 8%

Fine aggregate 6%

Coarse aggregate 5%

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. Areas shall be worked out to nearest 0.01 sq.m and the cubic contents of

consolidated concrete shall be worked out to nearest 0.01 cum. Any work done in excess over the specified dimension or sections shown in the drawing shall be ignored.

Concrete work executed in the following conditions shall be measured separately:

- (a) Work in or under water
- (b) Work in liquid mud
- (c) Work in or under foul positions

5.10.3 Reinforcement

Reinforcement bars shall conform to IS: 432 and/ or IS: 1786 and welded wire fabric to IS: 1566 as shown on the drawing. Grade of Reinforcement shall be Fe500 TMT/CRS as approved by Engineer in Charge.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust or any other substance that will destroy or reduce bond.

The work includes supplying, cutting, bending, binding, welding and erecting in position high yield strength deformed (H.Y.S.D.) steel bars and mild steel (M.S.) bars as reinforcement for concrete of various components. For Indian Standards code Refer Clause 1.3.

5.10.4 Steel reinforcing bars

a. General

Steel reinforcing bars shall be placed in concrete where shown on the drawings or as directed by the Engineer-in-charge. The drawings issued with these specifications show only in part the requirement of reinforcement and further drawings shall be issued by the Engineer-in-charge during the course of the contract.

As far as possible, high yield strength deformed bars conforming to IS: 1786-1979 shall be used as reinforcement. However, in case of Non-availability of such bars other steel bars conforming to IS: 432-1966 and / or IS: 1139-1966 shall be used as per the directions of the Engineer-in-charge.

b. Cutting, Bending and Binding

The contractor shall be responsible for the accuracy of the cutting, bending and placing of the reinforcement as shown in the drawing. Reinforcement shall be inspected for compliance with the requirement of grade, size, shape, length splicing and locations after it has been placed. No concreting shall be started unless the reinforcement as placed in the work is finally checked, recorded and certified by the Engineer-in-charge.

Before the reinforcement is placed, the surface of the bars and the surfaces of any metal bar supports shall be cleaned of the rust, loose mill scale, dirt, grease and other objectionable foreign substances. After being placed, the reinforcing bars shall be maintained in a clean condition until they are completely embedded in the concrete.

G I Wire for binding reinforcement shall be of soft and annealed G I mild steel and shall conform to IS: 280-1978. The binding wire shall have tensile strength of not less than

56kg/sqmm. The wire shall have minimum diameter of 1 mm. Chairs, hangers, spacers and other supports for reinforcement, may be of concrete, metal or other approved material. Where portions of such supports will be exposed on concrete surfaces designated to receive F2 or F3 finish, the exposed portion of support shall be galvanized or coated with other corrosion resistant material without which the concreting will not be permitted. Such supports shall not be exposed on surfaces of F4 finish unless otherwise shown on the drawings. The minimum allowable clearance between parallel round bars shall not be less than 1.50 times the diameter of the larger bars and for square bars shall not be less than twice the side dimensions of the larger bars. In no case the minimum clearance between the bars shall be less than 1.50 times the maximum size of aggregate irrespective of the shape of the reinforcing bar. Bars crossing each other where required shall be secured by binding wire in such a manner that they do not slip over each other at the time of fixing and concreting. Wire used for binding reinforcement shall not be measured for payment.

c. Splicing

Where it is necessary to splice reinforcement the splices shall be made by lapping, by welding or by mechanical means.

Joints or splices in reinforcing bar shall generally be made at the locations where neither shear nor bending moment is maximum, but the contractor would be permitted to take joints or splices at other position provided that such positions are approved by the Engineer-in-charge and joints and splices in adjacent bars are staggered as directed by the Engineer-in-charge. Approval of such additional splices will generally be restricted to splices not closer than 9 mtrs. in horizontal bars and 4 mtrs. in vertical bars measured between midpoints of laps.

If the contractor proposes to use welded splices in reinforcing bars the equipment, the material and all welding testing procedures shall be subject to the approval of the Engineer-in-charge. The contractor shall also carry out test welds as required by the Engineer-in-charge.

For welded splices for reinforcing bars conforming to IS : 1786-1979, welding shall be done in accordance with IS : 9419-1979. For reinforcing bars conforming to IS: 432 (part-I) 1966 and IS : 1139-1966 welding shall be done in accordance with IS : 2751-1966. Electrodes for manual metal arc welding shall conform to IS : 814 (part-I) 1974 and IS : 814 (part-II) 1974, mild steel filler rods for oxyacetylene welding shall conform to IS : 1278-1972 provided they are capable of giving a minimum butt weld tensile strength of 41 kg / sq mm.

Reinforcing bars 28mm in diameter and larger may be connected by butt welding, provided that lapped splices will be permitted if found to be more practicable than butt welding and if lapping does not encroach on cover limitation or hinder concrete or reinforcement placing.

Reinforcing bars 25mm diameter and less may be either lapped or butt welded, whichever is most practicable.

Butt welding of reinforcing bars shall be performed under cover from weather and may be performed either by the gas pressure or flash pressure welding process, or by the electric arc methods. The following requirements shall apply to all welding of reinforcing bars including butt welding and the preparation of welded reinforcement mats.

Welded pieces of reinforcement shall be tested at the rate of 5% of total number of joints welded. Specimen shall be taken from the actual site of work. Strength of the weld provided shall be at least 25% higher than the strength of bar.

If the contractor proposes to use mechanical couplings for reinforcing bars he shall submit samples of the proposed coupling to the Engineer-in-charge for approval not less than 60 days prior to their proposed use.

Table 5.10: Lapped Splices

6 mm	Structural Plain	300 mm
10 mm	Structural Plain	460 mm
12 mm	Structural deformed	380 mm
16 mm	Structural deformed	480 mm
20 mm	Structural deformed	580 mm
22 mm	Structural deformed	660 mm
25 mm	Structural deformed	860 mm
30 mm	Structural deformed	970 mm
35 mm	Structural deformed	1070 mm

d. Reinforcement Fabrication and Placement

Reinforcing bars supplied in the form of bent coils shall be straightened cold without damage at no extra cost. No bending shall be done when ambient temperature is below 5 Deg C. Suitable preheating may be permitted if steel bar bending is to be done at or above 0 Deg C. Bars supplied in bent coils shall be straightened only by machine. All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by ENGINEER-IN-CHARGE. Bar bending machines shall be used to achieve desired accuracy. Re-bending or straightening incorrectly bent bars shall not be done without approval of ENGINEER-IN-CHARGE. Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire, etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by ENGINEER-IN-CHARGE prior to concrete placement. Spacers (PVC or Concrete) shall be of such material and design as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover. Binding wire shall be 16 gauge soft annealed wires. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be proposed by CONTRACTOR and approved by ENGINEER-IN-CHARGE.

If permitted by ENGINEER-IN-CHARGE, welding of reinforcement shall be done in accordance with IS: 2751, IS: 9417 and SP: 34 as applicable.

Tolerance on placement of reinforcement shall be as per Cl. 12.3 of IS: 456.

E. Care of Placed Reinforcement and Concrete

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care shall be taken to ensure that at no time the radius of the bend is less than 6 times the diameters for deformed bars and 4 times diameters for plain mild steel bars. Care shall also be taken, when bending such bars, to ensure that the concrete around the bars is not damaged.

f. Assembly of Rebars

The rebars shall be bend correctly and precisely to the size and shape as shown in the detailed drawing or as directed by Engineer-in-charge. 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 25 mm or 1¼ 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 light. The overlaps/splices shall be staggered as per direction 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.

Bonds and Hooks Forming End Anchorages: Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for concrete reinforcement.

Anchorages Bars in Tension: Deformed bars may be used without end anchorages Development length of bars will be determined as per IS: 456.

Anchorages Bars in Compression: The anchorages length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS: 456. The projected length of bend and straight length beyond bend, if provided for a bar in compression, shall be considered for development length.

Binders, stirrups, link etc.: In case of binders, stirrups, link etc. the straight portion beyond the curve at the end shall be not less than eight times the nominal size of bar.

g. Welding of Bars

Wherever facility for electric arc welding or gas pressure welding is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got approved by the Engineer in-charge. Welding shall be as per IS 2751 and 9417.

h.Placing in Position

Fabricated reinforcement bars shall be placed in position as shown in the drawings or as directed by the Engineer-in-charge. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm thickness twisted

tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete.

i. Steel for reinforcement

Anticorrosive treatment to HYSD/Fe 500D bars with FUSION BONDED EPOXY COATING (FBEC) confirming to IS13620:1993 at approved plant including testing of coating as per relevant IS, before bringing the coated bars on site including To & Fro transportation of bars for sending at plant site etc. complete. Steel shall treated bar Fe-500D as per IS1786-2008 (with amendments) or more as per as per clause 5.1.3 of CPWD Specification Vol.I, 2019 with upto date correction slips.

5.10.5 Quality Control

CONTRACTOR shall ensure that workmanship and plant shall be maintained at peak efficiency. Degree of control on all the concrete operation from selection of the ingredients to the final testing of specimen shall be in line with the assumptions made in mix design with respect to the standard deviation and co-efficient of variation.

The CONTRACTOR shall ensure that any compromise in quality is not done for the pumped concrete. To be pumpable, a high level of quality control for the assurance of uniformity must be maintained. Sampling at both the truck discharges and point of final placement shall be done by the CONTRACTOR and the ENGINEER-IN-CHARGE jointly, as frequently as the ENGINEER-IN-CHARGE desires to determine, if any change in the slump air content, and other significant mix characteristics occur take necessary corrective actions.

The CONTRACTOR shall engage experienced supervision at all levels. The placing crew shall be experienced and qualified and each operation shall be well planned and properly scheduled.

All the crew engaged in each of the concrete activities shall demonstrate in the presence of the ENGINEER-IN-CHARGE, their skills and capabilities to produce the final product as specified.

5.10.6 Construction Joints and Keys

Construction joints (location and type) shall be as shown on the drawing or as approved by ENGINEER-IN-CHARGE. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of ENGINEER-IN-CHARGE.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as directed by ENGINEER-IN-CHARGE.

Before resuming concreting on a surface which has hardened all laitance and loose aggregates shall be thoroughly removed by wire brushing and/ or hacking, the surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and a 15 mm thick layer of cement sand mortar for horizontal joints, the ratio of cement and sand being the same as in the concrete mix.

When concreting is to be resumed on a surface, which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

Approved epoxy Bonding agent, for bond between old (say 28 days or more) and new concrete may also be used as per manufacturer's specifications.

5.10.7 Foundation Bedding

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy area shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as directed by ENGINEER-IN-CHARGE. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

5.10.8 Base Concrete

The thickness and grade of concrete and reinforcement shall be as specified in the item of work. Before placing the blinding concrete of 1:4:8 mix, 50/75mm thick as per the item of work, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

5.10.9 Hot Weather Requirement

- Concreting during hot weather shall be carried out as per IS: 7861 (Part I).
- Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40°C at the time of placement of fresh concrete.
- Where directed by ENGINEER-IN-CHARGE, CONTRACTOR shall spray non-wax based curing compound on unformed concrete surface at no extra costs.

5.10.10 Cold Weather Requirements

- Concreting during cold weather shall be carried out as per IS: 7861 (PART 2).
- The ambient temperature during placement and upto final set shall not fall below 5°C. Approved anti-freeze/ accelerating additive shall be used where directed.
- For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

5.10.11 Mode of Measurement and Payment

The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items and leaving holes, embedding inserts, etc. shall be entertained unless separately provided for in the Schedule of Quantities. No extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift, lead of scaffolding, etc. All these factors shall be taken into consideration while quoting the unit rates. Unless provided for in the schedule of Quantities the rates shall also include fixing inserts in all concrete work, whenever required.

Payments for concrete will be made on the basis of unit rates quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 0.100 sq.m, in areas where concrete is measured in sqm and 0.010 cum where concrete is measured in cubic meters. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly, the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the Schedule of Quantities.

Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs.

The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Reinforcement and inserts shall be measured and paid for separately under respective item rates.

Only the actual quantity of steel embedded in concrete including laps as shown on drawings or as approved by ENGINEER-IN-CHARGE shall be measured and paid for, irrespective of the level or height at which the work is done. The unit rate for reinforcement shall include all wastage, binding wires, chairs, spacer bars etc. for which no separate payment shall be made.

Where the formwork is paid for separately, it shall be very clearly understood that payment for formwork is inclusive of formwork, shuttering, shoring, propping, scaffolding, deshuttering, etc. complete. Only the net area of concrete formed (shuttered) shall be measured for payment.

5.10.12 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honeycombed surfaces, rough patches, etc. shall be brought to the notice of ENGINEER-IN-CHARGE who may permit patching of the defective areas or reject the concrete work. ENGINEER-IN-CHARGE's decision on rejection of concrete work shall be final.

All through holes for shuttering shall be filled with cement mortar for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as directed by the ENGINEER-IN-CHARGE.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the ENGINEER-IN-CHARGE as to be the method of repairs to be adopted shall be final and binding on the CONTRACTOR and no extra claim shall be entertained on this account. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as directed by ENGINEER-IN-CHARGE. CONTRACTOR shall submit a method statement for such repairs to ENGINEER-IN-CHARGE for approval.

5.10.13 Optional Test

If ENGINEER-IN-CHARGE feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the ENGINEER-IN-CHARGE, as per relevant IS Codes. OWNER shall pay only for the testing of material supplied by the OWNER, otherwise CONTRACTOR shall have to pay for the tests. Transporting of all material to the laboratory shall however be done by the CONTRACTOR at no extra cost to OWNER.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strength, ENGINEER-IN-CHARGE reserves the right to order the CONTRACTOR to test structure, as per relevant IS specifications. All these tests shall be carried out by CONTRACTOR at no extra cost to the OWNER. Alternately ENGINEER-IN-CHARGE also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR. If the structure is certified by ENGINEER-IN-CHARGE as having failed, the cost of the test and subsequent dismantling/reconstruction shall be borne by CONTRACTOR.

The quoted unit rates/prices of concrete shall deemed to provide for all tests mentioned above.

5.10.14 Quality Control

CONTRACTOR shall note that it is required to adopt quality control formats. A copy of formats shall be furnished to CONTRACTOR by ENGINEER-IN-CHARGE/ OWNER after the contract is awarded. Alternatively, if CONTRACTOR has his own QC formats he may adopt them subjected to such modifications considered necessary by ENGINEER-IN-CHARGE.

In either case CONTRACTOR shall submit his detailed Quality Assurance Plan along with the bid. This would be reviewed, appropriately modified and approved by CONSULTANT/ ENGINEER-IN-CHARGE after the award of contract.

5.10.15 Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of ENGINEER-IN-CHARGE. Materials rejected by ENGINEER-IN-

CHARGE shall be expressly removed from site within 3 working days and shall be replaced by CONTRACTOR immediately at no extra cost to OWNER.

5.10.16 Clean-Up

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

5.10.17 Acceptance Criteria

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

- (a) properties of constituent materials;
- (b) characteristic compressive strength;
- (c) specified mix proportions;
- (d) minimum cement content;
- (e) maximum free-water/cement ratio;
- (f) workability;
- (g) temperature of fresh concrete;
- (h) density of fully compacted concrete;
- (i) cover to embedded steel;
- (j) curing;
- (k) tolerances in dimensions;
- (l) tolerances in levels;
- (m) durability;
- (n) surface finishes;
- (o) special requirements such as :
 - i. Water tightness
 - ii. resistance to aggressive chemicals
 - iii. resistance to freezing and thawing
 - iv. very high strength
 - v. improved fire resistance
 - vi. wear resistance
 - vii. resistance to early thermal cracking

ENGINEER-IN-CHARGE's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the CONTRACTOR.

For work not accepted, ENGINEER-IN-CHARGE may review and decide whether remedial measures are feasible so as to render the work acceptable. ENGINEER-IN-CHARGE shall in that case direct the CONTRACTOR to undertake the remedial

measures. These shall be expeditiously and effectively implemented by CONTRACTOR. Nothing extra shall become payable to CONTRACTOR by OWNER for executing remedial measures.

5.11 Propping and Centering

5.11.1 Scope

This specification covers the general requirements for formwork as well as mode of measurement and payment for completed works.

This specification shall be read in conjunction with Specification Reinforced concrete and allied works. It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by Engineer-in-charge from time to time. The decision of Engineer-in-charge as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on contractor and no claim whatsoever will be entertained on this account.

5.11.2 Applicable Codes and Specifications

For all codes and specifications, refer Clause no.-1.3.

5.11.3 General

Engineer-in-charge shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials and the quality control system. Such an inspection shall be arranged and Engineer-in-charge's approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials, which do not conform to this specification, shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/ standards shall only be used. Other materials may be used after approval of the Engineer-in-charge and after establishing their performance suitability based on previous data, experience or tests.

5.11.4 Materials

Storing of Materials

All material shall be stored in a manner so as to prevent its deterioration and contamination, which would preclude its use in the works. Requirements of IS: 4082 shall be complied with.

Contractor will have to make his own arrangements for the storage of adequate quantity of formwork/ shuttering material

5.11.5 Formwork

Formwork shall be all inclusive and shall consist of but not limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs, etc. including ties, anchors, hangers, inserts, falsework, wedges, etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of Contractor. However, if so directed by Engineer-in-charge, the drawings and calculations for the design of the formwork shall be submitted to Engineer-in-charge for approval.

Formwork shall be designed to fulfill the following requirements:

- (a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
- (b) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
- (c) Capable of withstanding without deflection the worst combination of self-weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
- (d) Capable of easily striking without shock, disturbance or damage to the concrete.
- (e) Soffit forms capable of imparting a camber, if required.
- (f) Soffit forms and supports capable of being left in position, if required.
- (g) Capable of being cleaned and/ or coated, if necessary, immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of waterproof/ plastic coated plywood, steel, plastic depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of ENGINEER-IN-CHARGE. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structure shall be sufficiently tight to prevent loss of slurry from concrete using foam and rubber seals.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces, dust, etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of Engineer-in-charge. Contractor shall equip himself with enough quantity of shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves may be used. Formwork spacers left in situ shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures sleeves shall not be provided for through bolts nor shall through bolts be removed, if provided. The bolts, in the latter case, shall be cut at 25 mm

depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified or shown on drawings all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of Engineer-in-charge, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavation shall be slightly larger, as directed by Engineer-in-charge, than that required as per drawing to compensate for irregularities in excavation.

Contractor shall provide adequate props of adjustable steel pipes carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.5 m or as directed by Engineer-in-charge. Contractor shall temporarily and securely fix items to be cast (embedment/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be removed. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

The striking time for formwork shall be determined based on the following requirements:

- (a) Development of adequate concrete strength,
- (b) Permissible deflection at time of striking form work,
- (c) Curing procedure employed - its efficiency and effectiveness,
- (d) Subsequent surface treatment to be done,
- (e) Prevention of thermal cracking at re-entrant angles,
- (f) Ambient temperatures; and Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Before removing formwork of soffit of slabs/ beams compressive strength at 7/ 14/ 21 days shall be checked.

Under normal circumstances (generally where temperatures are above 20 Deg C) forms may be struck after expiry of the period given in IS: 456 unless directed otherwise by Engineer-in-charge. For Portland Pozzolana / Slag Cement the stripping time shall be suitably modified as directed by the Engineer-in-charge. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resists surface damage and any stresses arising during the construction period.

5.11.6 Formwork-Finishes

The formwork for concrete works shall be such as to give the finish as specified in relevant Indian code for formwork. . The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete)

will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

5.11.7 Re-use of forms, etc.

Forms required to be used more than once shall be maintained in serviceable condition and shall be thoroughly cleaned and repaired before reuse. Where metal sheets are used for lining forms the sheets shall be placed and maintained in the forms with minimum amount of wrinkles, lumps or other imperfections. All forms shall be checked for shape and strength before reuse. Steel forms shall be cleaned by buffing before reuse.

5.11.8 Execution and Removal of Forms

Before placing concrete the surface of all forms shall be coated with suitable non-staining form releasing agents such as raw linseed oil so as to prevent adhesion of concrete and to facilitate removal of forms. The form releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken to prevent form releasing agents from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to thoroughly cover form strips for narrow grooves, so as to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms. Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and tightened.

Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface so as to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface. Forms shall be left in place until their removal is authorized and shall then be removed with care so as to avoid injury to concrete. Removal of forms shall never be started until the concrete is thoroughly set and adequately hardened such that it can carry its own weight, besides the live load which is likely to come on the work during construction. The length of time for which the forms shall remain in place shall be decided by the Engineer-in-charge, with reference to weather conditions, shape and position of the structure or structural member and nature and amount of dead and live loads. In normal circumstances and where ordinary Portland cement is used, forms can be allowed to be struck as under:

Table 5.11: Minimum days for Removal of Form

1.	Beam sides, walls, unloaded columns	-	after 24 hours
2.	Slabs and arches (props left under)	-	after 4 days
3.	Props to slabs and arches	-	after 10 days
4.	Beam soffit (props left under)	-	after 8 days
5.	Props to beams	-	after 21 days
6.	Lean concrete (sides)	-	after 2 days

Note: Time shall be measured from last batch concreted in respect to the structural member under consideration.

In no case shall forms be removed until there is an assurance that removal can be accomplished without damaging the concrete surface. Heavy loads shall not be permitted until after the concrete has reached its design strength. The forms shall be removed with great caution and without causing any jerks to the structure.

Re-propping shall be done to the below during construction of upper floor and props left under till the period of removal of props supported to or any other load due to construction load on the upper floor. Re-propping shall be part of shuttering/formwork for concrete without any claim for extra cost.

5.11.9 Settlement of Formwork and Camber

Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflections, elastic shortening of form members or formwork, deflections, settlement may occur. The Contractor shall take precautions, including using adequately rigid formwork, in order to prevent excessive settlement/ deflection; the usual acceptable limit being 1/500 of the spans of the formwork.

In the absence of any specified camber on the drawings, soffit of all beams more than 5 m in span and other than pre-stressed concrete beams shall be laid to a camber, the amount of which at mid span shall not be less than 1/500 of the span of the structure. The profile of soffit shall be parabolic.

5.11.10 Mock-Ups

The method for pouring difficult zones of concrete will be pre-studied on mock-ups. Mock-ups will be particularly necessary for the following:

- (a) Zones around penetrations and openings.
- (b) Behind anchorage of pre-stressed members.
- (c) Dome and shell in general requiring single and double forms.
- (d) Various zones of large thickness for studying placement temperatures in relation to internal temperature build-ups.

Work involved in mock-up pours will be paid for at the rates entered under relevant items of work. Sampling and testing of all samples will be done by the Contractor. Unsuccessful mock-ups may have to be repeated in full or in part as required by the Engineer-in-charge. Pockets, duct, cut-outs or any kind of holes in/ at ends/ edges of slabs/ beams kept for pre-stressed post tensioning operations shall be finished to the mark of formwork finish by the Contractor with the same grade of concrete without any claim for extra costs.

5.11.11 Mode of Measurement and Payment

Where the formwork is paid for separately, it shall be very clearly understood that payment for formwork is inclusive of formwork, shuttering, shoring, propping, scaffolding, deshuttering, etc. complete. Only the net area of concrete formed (shuttered) shall be measured for payment. All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

5.11.12 Centering/Staging : 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.

5.11.13 Guidelines for Multistage Centering: The proper handling the situation of multistage centering in buildings or where height of casting of concrete is higher than normal height of 3.5 M or where higher loadings are coming during casting of concrete or large span structures and in situations of casting of some special structures like Domes, Vaults etc. In all situations, centering/scaffolding/staging for casting of these structures should be properly designed by a qualified and experienced person/agency having past experience in design of false work (centering) for concrete structures and should be proof checked by similar experienced person/ agency and it should be properly approved and issued to contractor by Engineer-In-Charge. The provisions of clause 7 of IS:14687 may be referred for design of false work (centering). A method statement for erection and dismantling of the centering/scaffolding/staging and process of concreting shall be prepared by contractor and submitted to Engineer-in-Charge for approval and the work shall be commenced only after approval of method statement by Engineer-in-Charge. The provisions of clause 9 of IS:14687 may be referred for erection of false work (centering), safety precautions and other site operations, pertaining to false work (centering). Experienced form watcher shall be engaged during erection, concreting and dismantling for early detection of any movement or instability in the system. The field engineers shall ensure that CPWD specifications and provisions of BIS codes are strictly followed. A detailed programme of field safety inspection of centering/scaffolding/form work of such structures during different stages should be chalked out and strictly followed. Provision of safety net, fall arresting system including other safety gears, for workers, working over these structures shall be made in contract and should be followed strictly.

5.12 STEEL WORKS

5.12.1 Scope

This specification covers the general requirements for steel works as well as mode of measurement and payment for completed works.

MS Rolled Steel Sections, ISMB, ISMC, UC, H-Section, Hollow sections, Tubular Sections, MS Plates, Chequered Plates, MS Pipes, Perforated Sheet, Flats, Bars, Angles, MS Sheet, Girder, Beam, cattle trap, deep threaded MS bolts.

5.12.2 Workmanship

The steel sections as specified or required shall be cut, square and to correct lengths, as per drawings and design. The cut ends exposed to view shall be finished smooth. No. two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawings or as directed. All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out

in such a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed/permitted.

Steel riveted or bolted in built up sections, frame work.

The steel structure as shown in the drawings or as per direction of the Engineer-in-charge shall be laid out one level platform to full scale and to full size or in parts. A steel tape shall be used for measurements to ensure maximum accuracy.

Wooden templates 12 mm to 19 mm thick or metal sheet template shall be made to correspond to each connecting gussets plate and rivet holes shall be accurately marked on them and drilled. The template shall be laid on the steel members, and holes of the steel members shall also be marked for cutting. The base of steel columns and the position of Anchor bolts shall be carefully set out.

All stiffeners shall be formed by pressure and where practicable, the metal shall not be cut and welded in making these. In major works or where so specified shop drawings giving complete details and information for the fabrication of the component parts of the structure, including location type size, length and details of rivets, bolts, or weld shall be prepared in advance of the actual fabrication and as approved. The drawings shall indicate the shop and field rivets and bolts. The steel member shall be distinctly marked or stencilled with paint with the identification mark as given in the shop drawings.

The bars shall be thickened at the ends, so as to provide for screwed threads and gradually tapered off to meet their normal section.

Great accuracy shall be observed in fabrication of various member, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, knicks, buckles, or open joints. Before making holes individual members for fabrication, the steel work intended to be welded or bolted together shall be assembled or clamped properly and tightly so as to ensure close abutting or lapping of the different members. All stiffeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight and fitted close together.

Web splice plates and filters under stiffeners shall be cut to fit within 3 mm or flange angles, web plates of girders shall have not cover plates, shall have their ends flush with the top of angles forming the flanges unless otherwise required. The web plates when spiced shall have clearance of more than 6 mm.

The erection, clearance for cleared ends of members connecting steel to steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall to be more than 3 mm at each end but where for a practical reason greater clearance is necessary, suitably designed seating shall be provided.

Pins and rollers shall be accurately turned to gauge. These shall be straight and smooth and free from flaws. The roller bearing shall be provided with adequate arrangement for holding the girders or truss resting on it. In columns caps and bases, the ends of shafts together with the attached gussets angles, channels etc., after welding together shall be accurately mechanized so that the parts connected butt against each other over the entire surfaces of contact connecting angles or channels shall be fabricated and placed in position with greater accuracy so that they are not unduly reduced in thickness by machining.

The ends of bearing stiffeners shall be mechanised or ground to fit tightly both at the top and bottom. All holes shall generally be drilled to the required size and at the required position. Sub punching shall be permitted, provided it is done 3 mm or less in diameter and remade thereafter to the required size. The holes for rivets and bolts shall be larger by 0.4 to 6 mm than the nominal diameter of rivets or black bolts depending up on the diameter of rivets.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reamering shall be free form butts, and the holes should be clean and accurate. Holes for counter sunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing.

The fabrication work shall be completed in workshop as far as it is practicable to do so. Site joints shall be done with rivets and fitted bolts or black bolts, as shown in the drawings or as directed. Generally the following principles shall govern the use of rivets turned and fitted bolts, and black bolts.

Rivets and turned and fitted bolts shall be used where the connection is such that slip under load has to be avoided.

Welding shall generally be done by electric process. Gas welding shall be resorted to using oxyacetylene flame with specific approval. Gas welding shall not be permitted for structural steel work.

The welding work shall conform to I. S. 816-2000.

5.12.3 Preparation of surfaces

Surface, which is to be welded together, shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted. Assembly for welding: Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. The temporary connection has to be strong enough to hold the plates accurately in place without displacement.

5.12.4 Precautions

All operations connected with welding and cutting equipment shall conform to safety requirement given in I. S. 818-1968

The following points shall be borne in mind during the process of welding:

Welds shall be made in flat position wherever practicable.

Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.

The segments of welding shall be such that where possible, the members who offer the greatest resistance to compression are welded first.

Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed welds and adjacent parts shall be painted after the same are approved.

All the members shall be thoroughly cleaned of rust, scales, dust etc., and given a priming coat of red lead paint before fixing them in position.

The rate includes cost of all material, labour, erection, hoisting, scaffolding protective measure, required for proper completion of the item of work. This shall also include conveyance and delivery handling, loading, unloading and storing etc. required for completing the item described above including necessary wastage involved.

The rate shall be for a unit of one Kg.

Measurement of steel shall be on the basis of length of the sections as per drawings and standard weight as per IS code. Weight of bolt / welding shall not be considered for payment.

5.13 STAINLESS STEEL RAILING

5.13.1 Railing as per Architectural Design.

Stainless steel of 304/316 grade is most common in 300 series of Austenitic stainless steel.

It is still sometimes referred to by its old name 18/8 which is derived from the nominal composition of type 304 being 18% chromium and 8% nickel.

Fabrication of all stainless steel sections should be done only with tools dedicated to stainless steel materials. Tooling and work surfaces must be thoroughly cleaned before use. These precautions are necessary to avoid cross contamination of stainless steel by easily corroded metals that may discolour the surface of the fabricated product. Some specific hints are as under:

1. Remove all moisture by blowing with dry air or heating with a torch.
2. Eliminate organic contaminants like oil, paints, anti-spatter compounds, grease, pencil marks, cutting compounds, adhesive from protective paper, soap used for leak testing etc.
3. Stainless steels cannot be flame cut with a torch. Acceptable results are achieved with an arch plasma cutter.
4. Be particularly careful to avoid zinc contamination. Do not use brushes or tools previously used on galvanized steel.
5. Use only stainless steel wire brushes and use these brushes only on stainless steel.

5.13.2 Fixing

Fixing railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc. of required size. on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge.

5.13.3 Measurements

Only weight of stainless steel members shall be considered in kg, excluding fixing accessories such as nuts, bolts, fasteners etc.

5.13.4 Rate

The rate shall include the cost of materials and labour involved in all the operations described above. Nothing extra shall be paid for fixing arrangements i.e. drilling, nut & bolts etc.

5.14 COURSED RUBBLE MASONRY

5.14.1 Stone

The stone shall be of the type specified such as granite, trap, limestone, sand stone, quartzite, etc. and shall be obtained from the quarries, approved by the Engineer-in-Charge. Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes, injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance.

As far as possible stones shall be of uniform colour, quality or texture. Generally stone shall not contain crypst crystalline silica or chart, mica and other deleterious materials like iron-oxide organic impurities etc.

Stones with round surface shall not be used. The percentage of water absorption shall generally not exceed 5% for stones other than. For laterite this percentage is 12%.

5.14.2 Size of Stones

Normally stones used should be small enough to be lifted and placed by hand. Unless otherwise indicated, the length of stones for stone masonry shall not exceed three times the height and the breadth on base shall not be greater than three-fourth of the thickness of wall, or not less than 150 mm. The height of stone for rubble masonry may be upto 300 mm.

The selection and grading of stones for rubble masonry is largely done at site and the smaller stones are used in the hearting of wall.

5.14.3 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.

5.14.4 Mortar

The mortar for jointing shall be as specified.

5.14.5 Laying

All stones shall be wetted before use. The walls shall be carried up truly plumb or to specified batter. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The height of each course shall not be less than 15 cm nor more than 30 cm.

Face stones shall be laid alternate headers and stretchers. No pinning shall be allowed on the face. No face stone shall be less in breadth than its height and at least one third of the stones shall tail into the work for length not less than twice their height.

The hearting or the interior filling of the wall shall consist of stones carefully laid on their proper beds in mortar; chips and spalls of stone being used where necessary to avoid thick

beds of joints of mortar and at the same time ensuring that no hollow spaces are left anywhere in the masonry. The chips shall not be used below the hearting stone to bring these upto the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10% of the quantity of stone masonry.

The masonry in a structure shall be carried up uniformly but where breaks are unavoidable, the joints shall be raked back at angle not steeper than 45°. Tothing shall not be allowed.

5.14.6 Bond Stones

Shall be as specified except that a bond stone or a set of bond stones shall be inserted 1.5 to 1.8 metres apart, in every course.

5.14.7 Quoins

The quoins shall be of the same height as the course in which these occur. These shall be at least 450 mm long and shall be laid stretchers and headers alternatively. These shall be laid square on the beds, which shall be rough-chisel dressed to a depth of at least 100 mm. In case of exposed work, these stones shall have a minimum of 25 mm wide chisel drafts at four edges, all the edges being in the same plane.

5.14.8 Joints

All bed joints shall be horizontal and all side joints vertical. All joints shall be fully packed with mortar, face joints shall not be more than one cm thick.

When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. Otherwise, joints shall be raked to a minimum depth of 20 mm by raking tool during the progress of work, when the mortar is still green.

5.14.9 Scaffolding

Single scaffolding having one set of vertical support shall be allowed. The supports shall be sound and strong, tied together by horizontal pieces, over which the scaffolding planks shall be fixed. The inner end of the horizontal scaffolding member may rest in a hole provided in the masonry. Such holes, however, shall not be allowed in pillars under one metre in width or near the skew back of arches. The holes left in masonry work for supporting scaffolding shall be filled and made good with cement concrete 1 : 3 : 6 (1 cement : 3 coarse sand : 6 stone aggregate 20 mm nominal size).

5.14.10 Curing

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

5.14.11 Protection

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

5.14.12 Measurements

The length, height and thickness shall be measured correct to a cm. The thickness of wall shall be measured at joints excluding the bushing. Only specified dimensions shall be allowed; anything extra shall be ignored. The quantity shall be calculated in cubic metre nearest to two places of decimal.

5.14.13 Rate

The rate shall include the cost of materials and labour required for all the operations described above and shall include the following :

- (a) Raking out joints for plastering or pointing done as a separate item, or finishing flush as the work proceeds.
- (b) Preparing tops and sides of existing walls for raising and extending.
- (c) Rough cutting and waste for forming gables cores, skew backs or spandrels of arches, splays at eaves and all rough cutting in the body of walling unless otherwise specified.
- (d) Bond stones or cement concrete bond blocks.
- (e) Leading and making holes for pipes etc.
- (f) Bedding and pointing wall plates, lintels, sills etc. in or on walls, bedding roof tiles and corrugated sheets in or on walls.
- (g) Building in ends of joists, beams, lintels etc.

5.15 Anti-Termite Treatment

The chemicals used for the treatment shall be only one of the following with concentration shown against each in aqueous emulsion

Chemicals Concentration

- 1 Aldrin 0.50%(by weight)
- 2 Heptachlor 0.50%(" ")
- 3 Chordane 1.00%(" ")

The chemical barrier shall be complete and continuous under whole of the structure to be protected.

The bottom and the sides of foundations upto a highest of 30 cms from the bottom of excavation made form masonry foundation and for basement column pits shall be treated with the chemical emulsion at the rate 5 litre/sq meter of the surface area.

The chemical treatment shall be Carry out when the surface is quite dry chemical treatment shall not be carried out when it is raining or when the soil is wet with rain or sub soil water.

Once formed treated soil barriers shall be not disturbed if by chance treated soil barrier system. The treatment against termite infection shall remain full effective for aneroid not less than 10 year from date of issue of the final certificate of completion of work . If at any time during this period any defects in treatment are revealed or any evidence of infection in any

part of the building or structure is noticed the contractor shall be rectify the concerned defects within 15 days on receipt of notice from Engineer-in-charge .On contractor 's failure to do so the Engineer-in-charge may get the same rectified through any other agency at contractor's risk and cost, and decision Engineer in charge as to the cost payable by the contractor for the same shall be final and binding to the contractor.

A guarantee bond on appropriately stamped paper shall be given by the contractor to the department in the manner in prescribed form.

This guarantee shall remain force for the period of 10 year from the completion of the work under the contract and it shall remain binding to the contractor for period of 10years.

The deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after the completion of the completion of the guarantee period.

Pre-construction anti-termite treatment will be carried out using 5% concentration Dieldrin or Aldrin solution diluted with water in the proportion specified by the manufactures. Hand operated pressure pump and graduated container shall be used to ensure uniform spraying of chemicals.

Treatment should not be carried out when the soil is wet with rain or sub soil water. Soil treatment should start when foundation trenches and pits are ready to take mass concrete. Laying of mass concrete should start when the chemical has been absorbed by the soil and the surface is quite dry; care being exercised to ensure that the treated soil barrier is not disturbed.

The bottom surface and sides (upto a height of 300 mm) of the excavations for column pits, wall trenches and basements shall be treated at the rate of 5 liters per Sq.mt. of the surface area.

The backfill in immediate contact with the foundation structure shall be treated at the rate of 5 liters per Sq.mt. of the surface before the subgrade is laid. Holes 50 mm to 75 mm deep at 150 mm centers shall be made to facilitate saturation of the soil with chemicals emulsion. 30 mm x 30 mm channel shall be made at all junctions of walls and columns with the floor, red holes made at 150 mm centers and emulsion poured along the channel at 15 liters per Sq.mt. of the vertical surface and the soil tamped back in place thereafter. After the building is completed 300 mm deep holes shall be provided along the perimeter at 150 mm centers using iron rods and filled with chemical emulsion at the rate of 5 liters per meter of the wall. Anti-termite treatment shall be supplemented through the expansion joint after the subgrade has been laid at 2 liters per linear meter of the expansion joint.

Soil surrounding the points of entry of pipes and conduits shall be loosened for a distance of 150 mm and to a depth of 75 mm and treated at 15 liters per sq. m. of the vertical surface. Chemical shall be brought to the site in sealed original containers and empties shall not be removed without permission of the Engineer-in-charge.

If the area is rocky, the contractor's quoted rate shall be deemed to include doing work in rocky area and drilling of rock etc. and minimum 10 years guarantee shall be furnished by contractor for anti-termite treatment.

5.15.1 Measurements

For anti-termite treatment The actual plinth area at ground floor level shall be measured upto two decimals in square meters and the amount shall be paid for all the anti-termite treatment work to be done from foundation to top as specified for various elements like foundation trench, filling in trenches, earth filling in plinth, brick work upto plinth, door and window frames and shutters and such other items to be provided for anti-termite treatment.

5.16 Wood Work

5.16.1 List of Mandatory Tests

Material	Clause	Test	Field/ Laboratory Test	Test Procedure	Min, Quantity of Material for carrying out the test	Frequency of Testing
1	2	3	4	5	6	7
Timber	9.1.6	Moisture content	Field (by moisture meter) laboratory test as required by Engineer-in-Charge	Appendix 'C'	1 cum	Every one cum or part thereof.
Flush door	9.7.10	End immersion Test Test knife test Adhesion Test	Laboratory	IS 2202 Appendix 'F'	26 shutters	As per sampling and testing specified in clause 9.7.11
Mortice Locks	9.15.13	Testing of spring	Laboratory	IS 2209 Appendix 'G'	50 Nos	100 or part thereof.

5.16.2 Terminology

Ballies : Thin round poles usually without bark.

Beam: A structural timber generally long in proportion to its width and thickness and used for supporting load primarily by its internal resistance to bending.

Hard Wood: A conventional term used to denote the wood obtained from broad-leaved trees. It has no relationship to the physical properties of hardness or strength. On account of the confusion this word might cause, its use is discouraged.

Seasoned Timber: Timber whose moisture content has been reduced to the specified minimum, under more or less controlled processes of drying.

Structural Timber: Timber used in framing and load bearing structures or timber used or intended for use in buildings where strength is the primary consideration.

First Class Wood: Individual hard and sound knots shall not be more than 25 mm in diameter and the aggregate area of all the knots shall not exceed one per cent of the area of the piece.

Second Class Wood: Individual hard and sound knot shall not be more than 40 mm in diameter and aggregate of all the knots shall not exceed one and half per cent of the area of the piece. Wood shall be generally free from sapwood, but traces of sapwood may be allowed.

5.16.3 Timber

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 Chapter 9.0 of CPWD Spec Vol 1. 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.

5.16.4 Grade Of Teak

Grade A teak is the highest quality teak wood. It refers to timber that is taken from the very center of the log (heartwood) of a fully mature tree. Grade A teak can be recognized by a uniform, golden brown colour, close grains and glossy surface that feels oily to touch. It is high in teak natural oils which play the key role in teak outstanding resistance to outdoor elements by protecting it from unfavourable weather elements and repelling insects. Unfortunately, it makes up only about a fifth to one quarter of the log and as a result, it has a high price

Grade B teak refers to timber from the outer heartwood section, making up about one fourth to one third of the log. In comparison to grade A teak, grade B teak has a lighter colour, uneven grain and less shine. It contains only traces of teak natural oils and as a result, it is unable to withstand the exposure to the outdoor extremes without protective treatments. But even then, it doesn't last even close as long as furniture made from the highest quality teak.

Grade C teak is an inferior quality teak wood. It refers to timber from the outer sections of a mature log (sapwood) and logs of immature trees. Grade C teak contains virtually no teak natural protective oils, has a very uneven colour and is easily damaged because it is very soft. Furniture that is made from grade C teak is even considered unsuitable for indoor use due to its softness that makes it highly susceptible to damage. Although it is taken from the very same tree species, grade C teak has no similarity to the highest quality teak neither in regard to outdoor performance, beauty or durability. Grade C teak garden furniture is relatively inexpensive but it has a very short lifespan even if it is treated with protective coating or periodically oiled

Moisture Content: Control on moisture content of timber is necessary to ensure its proper utility in various climatic conditions. For specifying the permissible limit of moisture content in the timber the country has been divided into four climatic zones as per Appendix B of Chapter 9 of CPWD specifications 2019 . In each of the zones, maximum permissible limit of moisture content of timber for different uses, when determined in accordance with the procedure laid down in Appendix 'C' shall be as per Table 9.2 of Chapter 9. Of CPWD

TABLE 9.2

Maximum Permissible Moisture Content of Timber

S. No.	Use	Max Moisture Content Percent			
		Zone I	Zone II	Zone III	Zone IV
1.	Beams, Rafters & Posts	12	14	17	20
2.	Doors and windows				
	(a) 50 mm and above thickness	10	12	14	16
	(b) Thinner than 50 mm	8	10	12	14
3.	Flooring strips	8	10	10	12
4.	Furniture & Cabinet making	10	12	14	15

Tolerance on Moisture Content: Average Moisture content of all the samples from a lot shall be within + 3 per cent and moisture content of individual samples within + 5 per cent of maximum permissible moisture content specified in Table 9.2. These tolerances are the absolute values over the percentage moisture content for Sl. No. 1 & 2 of Table 9.2. No tolerance on moisture content is permitted for Sl. No. 3 & 4 of Table 9.2.

Seasoning of Timber: The process of drying timber under controlled conditions is called seasoning of timber. Timber shall be either air seasoned or kiln seasoned and in both cases moisture content of the seasoned timber shall be as specified in Table 9.2 of Chapter 9 unless otherwise specified, air seasoned timber shall be used. 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 preservative before jointing. Preservative treatment of timber shall be done as per IS 401 in a plant approved by the Engineer-in-Charge.

5.16.5 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.

Veneered Decorative Plywood: Decorative plywood shall be of two grades namely BWR and MR Decorative Plywood shall be of two types. Type I and type 2 and shall conform to IS 1328.

Requirement of Type-I Veneered decorative plywood shall be as under:

- (a) Open slits checks or open joints not more than 150 mm in length and 0.5 mm in width shall be permissible provided the same are rectified with a veneer insert bounded with synthetic resin adhesive, as the case may be and further provided that the insert matches with the surrounding veneer in color as well as figure.
- (b) The decorative veneered surface shall be free from torn grain, dead knots discolorization and sap wood
- (c) The decorative veneered surface shall be selected for figure, texture, colour and grain etc. It shall be free from all manufacturing and wood defects except

to the Engineer-in-charge permitted under para 9.2.8.1 (a). All veneers shall be matched or mismatched to achieve a decorative effect in colour figure and grain.

Adhesive: The adhesive for bonding veneers shall be MR and BWR type synthetic resin adhesive conforming to IS 848 for MR and BWR grade veneered decorative plywood respectively.

Dimensions and Tolerances:

i. The dimensions of plywood boards shall be as follows:

2400 mm x 1200 mm,

2100 mm x 900 mm,

2100 mm x 1200 mm,

1800 mm x 900 mm,

1800 mm x 1200 mm

ii. Thickness: The thickness of plywood board shall be 3 mm, 4 mm, 6 mm, 9 mm, 12 mm, 19 mm and 25 mm.

Note: Any other dimensions (length, width and thickness) as agreed to between the manufacturer and the purchaser may also be used.

iii. **Tolerances:** Tolerances on the nominal sizes of finished boards shall be as follows:

Dimension	Tolerance
Length	+6 mm - 0
Width	+3 mm -0 mm
Thickness:	
(i) Less than 6 mm	±10 per cent
(ii) 6 mm and above	+ 5 per cent
Edge straightness	2 mm per 1000 mm or 0.2 per cent

Squareness	2 mm per 1000 mm or 0.2 per cent
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Note: Edge straightness and squareness shall be tested as per Appendix I.

Finish: The decorative plywood shall be uniform in thickness within the tolerances limits specified. The ends shall be trimmed straight and square edge straightness and squareness when tested as per Appendix I shall be within the tolerance specified in 21.3.3.3 (iii)

Sampling and Criteria for Conformity: The method for drawing representative samples and criteria for conformity shall be as per IS 7638.

Tests : Boards shall be subjected to following tests :

- (i) Moisture content: Decorative veneered plywood of either type when tested in accordance with IS 1734 (Pt. I) shall have moisture content not less than 5 per cent and not more than 15 per cent.
- (ii) Water Resistance Test: Three test specimen of size 250 mm x 100 mm shall be prepared for each of the boards selected and submerged in water at $62 \pm 2^\circ\text{C}$ for a period of 3 hours and dried for 8 hours at a temperature of $65 \pm 2^\circ\text{C}$ and then followed by two more cycles of soaking and drying under same conditions described above. Decorative Veneered plywood of either type shall not show delamination or blister formation.

Marking: Each ply wood board shall be legibly and indelibly marked or stamped with the following on the face of board near one corner.

- (a) Indication of the source of manufacture
- (b) Year of manufacture
- (c) Batch no.
- (d) Type of plywood
- (e) Criteria for which the plywood has been labelled as ECO mark

The decorative veneered plywood may also be marked with standard BIS certification mark.

5.16.6 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-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates, rounding or moulding shall be done before the members are jointed into

frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of ± 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 upto three places of decimal.

5.16.7 Window / Door Hardware and Fittings

Materials for all hardware except for fixing shall have at least the equivalent corrosion resistance of EN 1670- 1988 grade 4 (240 hrs) when subjected to natural salt spray testing in accordance with EN ISO 9227. Testing shall be carried out on complete hardware items and also duly approved by the Engineer - in - charge before use at the site of work.

Hardware like hinges, rollers and locking devices which have been life cycle tested in accordance with EN 199 (Windows and Doors - Resistance to repeated opening and closing - Test method) and have achieved at least 10,000 operating cycles (i.e. opening and closing) without deterioration, failure or excessive wear.

These shall be provided as per nomenclature of item of approved make and duly approved by Engineer-in- Charge before fixing at site of work. Hardware / fittings such as handle, roller, touch lock, multipoint locking, 3D hinges, friction hinges etc. shall be directly screwed not pre-drilled or hammered.

5.16.8 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 or 35 mm. Thickness and type of shutters shall be as specified.

Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer- in- 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 75mm. 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.

Face Panel: The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross -bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

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.

Rebating: In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing

where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

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.

Venetian Opening: Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

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

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

Tests: Samples of flush door shutters shall be subjected to the following tests:

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

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter. Test shall be done as laid down in Appendix F of Chapter 9 of CPWD 2019 specifications.

Sample Size: Shutters of decorative and non-decorative type from each manufacturer, irrespective of their thickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shall be as specified in Table 9.10. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the Engineer-in-Charge and in such cases extra payment shall be made for the sample shutter provided the sample does not fail in any of the test **specified in 21.5.9.**

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of Table 9.10.

TABLE 9.10

Sample Size and Criteria for Conformity

Lot Size	Sample Size	Permissible no. of defective	Sub. Sample size
(1)	(2)	(3)	(4)
Upto 26 to 50	8	0	1
51 – 100	13	1	2
101 – 150	20	1	2
151 – 300	32	1	3
301 – 500	50	2	4
501 and above	80	2	5

Criteria for Conformity: All the sample shutters when tested shall satisfy the requirements of the tests laid down in Appendix F of Chapter 9 of CPWD Specifications 2019. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of Table 9.10. If the number of sample shutters found unsatisfactory for a test is one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

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

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

5.16.9 Painting on door and window

Preparation of Surfaces for Enamel Painting on external face of door and window

Wooden surface: The woodwork 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 or red

Lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where specified.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty of wood putty respectively. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack. Iron and 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 Application The primer shall be applied with brushes, worked well into the surface and spread even and smooth. Before pouring into small containers for use, the paint shall be stirred thoroughly in its container, while applying also; the paint shall be continuously stirred in the small container 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 grain 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 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.

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 panel, angels of mouldings etc. shall be left on the work.

In painting doors and windows, the putty round the glass panes must be painted, but care should 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.

In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps, etc.

Materials for Painting: Oil based enamel of approved brand and manufacture shall be used. Ready mixed paint 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 or thinner recommended by the manufacturer or as instructed by EIC, shall be used. Painting of external surface should not be done in adverse weather condition like hail, storm or dust storm. Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

Wood Tech Touchwood exterior grade polish

It is a one pack readymade PU polish which gives better hardness than ordinary French polish. Surface preparation is similar to painting on wood. First of all sand papering by 180

no is done along the grain of wood and then by paper no 320 or 400. Then wipe the surface to clean up the loose particles. If the surface has dents, apply Aquadur Dent Filler with a putty knife over the dented area. To colour, apply Wood Tech Wood stains or Aquadur Wood stain by ragging. Allow to dry for 30 to 120 minutes. After surface cleaning 1st coat of wood tech touch wood with 20-25 % dilution with mineral turpentine oil is brushed. It can be done with spray also. 2nd and final coat is done after 24 hrs. after sand paring by 320 no .

5.16.10 Equivalent Plain Areas of Uneven Surfaces

- 5.20.10.1. Panelled or framed and braced doors, windows etc Measured flat (not girthed) including 1.30 (for each side)
- 5.20.10.2. Ledged and battened or Ledged, battened and braced, doors, windows etc. CHOWKAHT or FRAME Edges, chocks, cleats etc. shall be deemed to be included in the items
- 5.20.10.3. Flush doors etc. -do- 1.20 (for each side)
- 5.20.10.4. Part Panelled and part glazed or glazed doors, windows etc. -do- 1.00 (for each side)
- 5.20.10.5. Fully glazed or glazed doors, windows etc. -do- 0.80 (for each side)
- 5.20.10.6. Fully Venetian or louvered doors, windows -do- 1.80 (for each side)
- 5.20.10.7. Trellis (or Jaffrey) work one way or two way measured flat overall, no deduction shall be made for open spaces, and supporting members shall not be measured separately. 2 (for each side)
- 5.20.10.8. Carved or enriched work Measured flat 2 (for each side)
- 5.20.10.9. Weathered boarding Measured flat (not girthed) supporting frame work shall not be measured separately 1.10(for each side)
- 5.20.10.10. Wood single roofing Measured flat (not girthed) 1.05(for each side)
- 5.20.10.11. Boarding with cover flats and match hoarding measured flat (not girthed) 1.50(for each side)
- 5.20.10.12. Tee and state battening Measured flat overall, no deductions shall be made for open spaces 0.80(for each side) II. STEEL WORK DOORS AND WINDOWS, ETC.
- 5.20.10.13. Plain sheeted steel doors or windows Measured flat (not girthed) including frame 1.10
- 5.20.10.14. Fully glazed or glazed steel door and windows -do- 0.050
- 5.20.10.15. Part Paneled and part glazed or glazed doors, windows -do- 0.080
- 5.20.10.16. Corrugated steeled doors and windows -do- 1.25
- 5.20.10.17. Collapsible Measured flat 1.50

5.20.10.18. Rolling shutters of interlocked laths Measured flat (size of opening all over jamb guides, bottom latches and locking arrangement etc. shall be included in the item (top cover shall be measured separately) 1.10

5.20.10.19. Explanatory Notes

The measurements of guard bars, expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings, when fixed in frame work, painting of which is once measured elsewhere, shall be taken exclusive of the frames. In other cases, the measurements shall be taken inclusive of the frames.

For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisades do not go below it (or from the lower end of the palisades, if they project below the lowest rail) upto the top of rails or palisades whichever are higher, but not upto the standard when the letter are higher than the top rails of the palisades.

5.17 Aluminium Works

- **Aluminium Sections**

Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in- Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-in- Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge and nothing extra shall be paid on this account.

- **Anodising**

Standard aluminium extrusion sections are manufactured in various sizes and shapes in wide range of solid and hollow profiles with different functional shapes for architectural, structural glazing, curtain walls, doors, window & ventilators and various other purposes. The anodizing of these products is required to be done before the fabrication work by anodizing/electro coating plants which ensures uniform coating in uniform colour and shades. The extrusions are anodized up to 30 micron in different colours. The anodized extrusions are tested regularly under strict quality control adhering to Indian Standard.

- **Powder Coating**

Material: The powder used for powder coating shall be Epoxy/polyester powder of make approved by the Engineer- in-Charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by Engineer-in-Charge or his authorized representative.

Pre-treatment: Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions or chromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure for application of conversion coating for approval of Engineer- in-Charge. The metal surface after the conversion coating pretreatment and prior to the application of the coating shall be free from dust or powdery deposits.

Process: The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-in-Charge. The powder coating shall be applied as per the specification approved by Engineer-in-Charge.

Thickness: The thickness of the finished polyester powder coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

- **Performance Requirements for the Finish**

Surface appearance: The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

Adhesion: When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-in-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shall be wrapped with self adhesive non-staining PVC tape, approved by Engineer-in-Charge.

- **Measurement**

All the aluminium sections including snap beading 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, labours involved in all the operations as described in nomenclature of item and particular specification.

- **EPDM- Gaskets**

The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer- in- Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge.

- **Sealant**

The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer in Charge.

5.17.1 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 joints shall be corner crimped or fixed with self tapping stainless steel screws using extruded 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.

5.18 HARDWARE/ 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 finish black stone enamelled or copper oxidised (black finish), nickel chromium plated or as specified.

The fittings generally used for different type of doors and windows. 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.

5.18.1 Sliding Door Bolts (Aldrops)

These shall be of mild steel, cast brass, aluminium or as specified, and shall be capable of smooth sliding action.

- **M.S. Sliding Door Bolts:** These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS 281. M.S. sliding door bolts shall be copper oxidised (black finish) or as specified.

- **Sampling and Criteria for Conformity:** The number of sliding door bolt to be selected from a lot shall depend on the size of lot and shall be in accordance with Table 9.15. For testing shall be taken at random from at least 10 percent of the package subject to a minimum of three, equal number of door bolts being selected from each package. All door bolts selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirement of this specification if the number of defects sliding door bolts among those tested does not exceed the corresponding number given in Table 9.15.

TABLE 9.15

<i>Lot size</i>	<i>Sample Size</i>	<i>Permissible speed Decorative sliding door bolts</i>
Upto 150	5	0
151 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	81	5

5.18.2 Mortice Lock and Latch

- This should generally conform to IS 2209. The size of the mortice lock shall be denoted by the length of the body towards the face and it shall be 65 mm, 75 mm and 100 mm as specified. The measured length shall not vary more than 3 mm from the length specified.
- **Non-interchangeable Keys:** Testing of non-interchangeable keys shall be as per IS 2209.
- The clear depth of the body shall not be more than 15 mm. The fore end shall be firmly fitted to the body suitably by counter sunk head screw. The latch bolt shall be of specified material and of section not less than 12 x 16 mm for all sizes of locks. If made of two piece construction both parts shall be rivetted. Ordinary lever mechanism with not less than two levers shall be provided. False levers shall not be used. Lever shall be fitted with one spring of phosphor bronze or steel wire and shall withstand the tests as provided in IS 2209.
- Locking bolts, spring and strike plate shall conform to IS 2209.
- **Handles:** These shall conform to IS 4992.
- **Keys:** Each lock shall be provided with two keys.
- **Sampling, Criteria for Conformity:** It shall be the same as specified in clause 9.15.1.4.
- **Tests:** The finally assembled locks shall be tested as prescribed.

5.18.3 Door Handles (Doors and Windows)

These should generally conform to IS 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the base piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

Door handles shall be of the following types according to the material used:

- **Cast or Sheet Aluminium Alloy Handles:** These shall be of aluminium of specified size, and of shape and pattern as approved by the Engineer-in-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No.6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC 15-IS 1868 as specified. The finish can be bright natural, matt or satin or dyed as specified.
- **Mild Steel Handles:** These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6., Iron handles shall be copper oxidised (black finish) or stove enamelled black or as specified.
- **Stainless Steel Handles:** These shall be of stainless steel of specified size, shape and pattern as approved by Engineer-in-Charge for using in doors, windows and kitchen cabinets. Doors handles shall be of 125 mm or 100 mm size and window handles of 75 mm size unless, otherwise specified. Kitchen cabinet handles shall of 125 mm, 100 mm or 75 mm as specified. These shall be fixed with stainless steel screws 20 mm long. Stainless steel handles shall not be less than grade 304. The finish can be bright or matt finish as specified. 9.15.19.3 Sampling and Criteria for Conformity: The number of handles to be selected from a lot shall depend on the size of lot and shall be in accordance with Table 9.16. Handles for testing shall be selected at random for at least 10 percent of packages. Subject to a minimum 3, equal number of door handles being selected from each such package. All door handles shall be checked for dimensional requirement and finish. Any door handle which fails to satisfy the requirement of dimensions or finish or both shall be considered as defective.

A lot shall be considered as conforming to requirement of this specification, if the number of defective handles among those tested does not exceed the corresponding number of defectives is greater than or equal to rejection number given in column 4 of Table 9.16, the lot shall be deemed as not meeting the requirements of this specification.

TABLE 9.16
Scale of Sampling and Criteria for Conformity

<i>Lot size</i>	<i>Sample size</i>	<i>Acceptance no.</i>	<i>Rejection no.</i>
<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>
Upto 50	8	0	1
51 to 90	13	1	2
91 to 150	20	1	2
151 to 280	32	2	3
281 to 500	50	3	4
501 to 1200	80	5	6
1201 and above	125	7	8

5.18.4 Universal Hydraulic Door Closer (Exposed Type)

- These shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern as approved by the Engineer-in-Charge.
- These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564.
- The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove greese, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618.
- The nominal size of door closers in relation to the weight and the width of the door size to which it is intended to be fitted shall be given in Table 9.19.

TABLE 9.19
Type and Designation of Door Closers

<i>Designation of closers</i>	<i>Mass of the door (kg)</i>	<i>Width of the door (mm)</i>	<i>Remarks</i>
1.	Upto 35	Upto 700	For light doors such as double leaved and toilet doors.
2.	36 to 60	701 to 850	Interior doors, such as of bed rooms, kitchen and store
3.	61 to 80	851 to 1000	Main doors in a building, such as entrance doors

Sampling and Criteria for Conformity: All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. (Table 9.20). The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance in accordance of Table 9.20. Any door closer failing in any one or more of these characteristics shall be considered as defective. If in the first sample, the number of defective door closer is less than or equal to corresponding acceptance number, the lot shall be declared as conforming to the requirement of these characteristics. If the number of defective door closer is greater than or equal to the rejection number, the acceptance number but less than the rejection number, lot shall be deemed as

not meeting with requirements of these characteristics. If the number of defectives is greater than the acceptance number, but less than the rejection number, a second sample of the size equivalent to that of the first shall be taken to determine the conformity or otherwise of the lot. The number of defective door closers found in the first and the second sample shall be combined and if the combined number of defective thus obtained is less than or equal to the corresponding acceptance number, the lot shall be declared as conforming to the requirements of these characteristics.

5.18.5 HOLD FASTS

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

Measurements for the hold fasts shall be in number.

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

5.18.6 ADJUSTABLE STAINLESS STEEL CRAMPS

The cramps shall be stainless steel of make approved by the Engineer-in-charge.

The weight of the stainless steel clamp (including weight of nut and washer) shall not be less than 260 gms.

Necessary holes at suitable locations are to be done on steel frame work for dry stone cladding to be fixed.

Necessary recessed are required to be done in stone slab which is required to be supported by clamps.

The one end of steel clamp is fixed on frame with nut and bolt and other end is inserted into recesses/hole for fixing the dry cladding stone on frame.

The rate includes cost of materials and other operations mentioned as above.

5.19 Flooring

5.19.1 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.

Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges. The sides thus dressed shall have a full contact if a straight edge is laid along. The sides shall be table rubbed with coarse sand before paving. All angles and edges of the slabs shall be true square and free from chippings and giving plain surface.

Preparation of Surface

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 laying is commenced. The floor shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge. In no case the skirting should project by more than thickness of stone.

Laying

The risers of steps, skirting and wall surface shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement: 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible but not more than 1 mm. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched as shown in drawings or as instructed by the Engineer-in-Charge. 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

The surface shall be left dry for air-curing for duration of 12 to 18 hours depending on atmospheric temperature conditions. It shall then be cured by allowing water to stand in pools over it for a period of not less than 4 days. The grinding and polishing may be commenced not before 2 days from the time of completion of laying for manual grinding and not before 7 days for machine grinding. For polishing by machines, the surface shall be watered and ground evenly with machine fitted with special rapid cutting grit blocks (carborundum stone) of coarse grade (No. 60) till the marble chips are evenly exposed and the floor is smooth. After the first grinding, the surface shall be thoroughly washed to remove all grinding mud and covered with a grout of cement and colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. The surface shall be allowed to dry for 24 hours and wet cured for 4 days and then rubbed with machine fitted with fine grit blocks (No. 120). Curing shall be done by ponding of water between panels formed with fine sand. The surface is cleaned and repaired as before and allowed to cure again for 3 to 5 days. Finally the third grinding shall be done with machine fitted with mere fine grade grit

blocks (No. 320) to get even and smooth surface without pin holes. The finished surface should show the marble chips evenly exposed.

Where use of machine for polishing is not feasible or possible, rubbing and polishing shall be done by hand, in the same manner as specified for machine polishing except that carborundum stone of coarse grade (No. 60) shall be used for the 1st rubbing, stone of medium grade (No. 80) for second rubbing and stone of fine grade (No. 120) for final rubbing polishing.

After the final polish either by machine or by hand, oxalic acid shall be dusted over the surface @ 33 gm per square metre sprinkled with water and rubbed hard with a nemdah 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.

Curing shall be done by suitable means such as laying moist sawdust or ponding water.

Measurements

Length shall be measured along the finished face of riser or skirting; correct to a cm. Height shall be measured from the finished level of tread or floor, to the top (the underside of tread, in the case of steps) correct to 0.5 cm. The areas shall be calculated in square metre correct to two places of decimal. Dado and lining of pillars etc. shall be measured as 'Marble work in wall lining. If the thickness is upto 25 mm or as "Marble Work" in Jambs, walls, columns and other plain work' if the thickness is more.

5.19.2 Granite/ Granite gang saw cut

The granite stonework shall, in general, be carried out as per the CPWD Specifications. The specifications for dressing, laying, curing, finishing, measurements, rate etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the CPWD Specifications. The wall lining / veneer work with granite stone shall be as per the CPWD Specifications for Marble work Sub Head.

Granite stone tiles and slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the Engineer-in-charge architectural drawings and as directed by the Engineer-in-Charge.

Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in-Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Granite stone slabs shall be individually packed in cardboard paper. These shall be handled carefully to prevent any damage. The stone slab procured shall be free of any surface defect or any edge damage. The damaged stones shall not be allowed to be used in the work. So the Contractor shall procure additional such quantities, to cover such contingencies. However nothing extra shall be payable on this account. The stone slabs shall not be waxed or touched up with dyes / colours.

The granite stone slabs to be procured for the work shall match the samples shown to the Contractors before submission of the tenders. Before starting the work, the Contractor shall procure and submit the samples of granite stone slab (matching to the samples shown to the Contractors before submission of the tenders) for the approval of the Engineer-in-Charge. The samples shall be submitted along with the following details:

- a. Three representative samples for each type of granite stone specified.
- b. Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.
- c. Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.
- d. Company profile of Suppliers.
- e. The decision of the Engineer-in-Charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor. No claim of any kind whatsoever shall be entertained from the Contractor on this account. The Contractor shall then procure and get the mock up prepared at site of work for approval of quality of workmanship and the granite stone as specified. The mock up shall be prepared, on one of the floors at the location as decided by the Engineer-in-charge. The size of the stones shall be as per the Engineer-in-charge architectural drawings. If the quality of the workmanship and the material is as per the required standards, the mock up shall be allowed as part of the work and measured for payment and shall not be dismantled. Otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge and taken away from the site of the work at his own cost. Nothing extra shall be payable on this account.
- f. The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also no claim of any kind shall be entertained from the Contractor on this account.
- g. The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the approved Engineer-in-charge architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account. For the purpose of payment, only the actual area of each type of granite stone provided and fixed shall be measured separately under the relevant items.
- h. The following tolerances shall be allowed in the dimension of granite stone slab:

Slabs:	Tolerance
a). Length	± 1mm
b). Width	± 1mm

c). Thickness - 1mm

d). Angularity at corners $\pm 0.25\%$

i. The stones (slab and tiles) not meeting the above tolerance limits shall be rejected and not permitted to be used in the work. Nothing extra shall be payable on this account.

j. Stones slabs shall have uniform thicknesses with-in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work. Nothing extra shall be payable on this account.

k. The flooring work shall be carried out as per the Engineer-in-charge architectural drawings in design and pattern (geometric, abstract etc.) and in linear and / or curvilinear portions and in combination with stones of different colour and shade and ceramic tiles etc. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the Engineer-in-charge architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost of such items. For the purpose of payment, the actual area of each type granite stone as laid shall be measured separately under the relevant items.

l. The anchor fasteners following details are applicable. The anchor fasteners to be used for fixing the dry stone cladding shall be of stainless steel grade 316 or as specified and of approved make of Hilti/Fischer/Bosch or any other approved make. Dry stone cladding work shall be carried out in general as per the CPWD specification.

m. For the granite flooring in the curvilinear profile of the steps in the building the same shall be negotiated in segmental manner (using trapezoidal shaped granite stone pieces with straight edges for treads and rectangular stone pieces for the risers) and not in curved profiles as specified earlier. However the granite stone slabs shall be cut to required sizes and shapes, as per the Engineer-in-charge architectural drawings, to negotiate the curved steps in segmented manner. The risers shall also be cut to required sizes and shapes and the edges chamfered at the joints, all as per the approved Engineer-in-charge architectural drawings. However, the Contractor shall prepare the detailed shop drawings for the same and commence work only after the approval by the Engineer-in-Charge. The rate shall also include any consequent wastage, incidental charges involved in this work. Nothing extra shall be payable on this account. For the purpose of payment, the actual area of each type of granite stone as laid shall be measured.

n. For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m as per the Engineer-in-charge architectural drawings, unless otherwise specifically permitted by the Engineer-in-Charge. Wherever grooves are required to be provided the same is to be done as per Engineer-in-charge architectural drawings and as directed by the Engineer-in-charge. Wherever required, the joints shall be provided as per the Engineer-in-charge architectural drawings and as directed by the Engineer-in-charge.. Nothing extra shall be payable on these accounts.

o. The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the Engineer-in-charge architectural drawings and

as per the directions of the Engineer-in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the Engineer-in-charge architectural drawings and as directed by Engineer-in-Charge.

p. While fixing the granite slabs in sills, soffits and jambs of doors, windows, ventilators etc., rebates shall be made by overlapping the stones at the required places for fixing shutters for doors, windows and ventilators etc. as shown in the Engineer-in-charge architectural drawings and as per the directions of the Engineer-in-Charge. Epoxy based adhesives shall be used for fixing the granite stones to each other, as per the manufacturer's recommendations. The authorized overlap as per the Engineer-in-charge architectural drawings or as directed by the Engineer-in-Charge shall be measured for payment under the same item. However, any extra mortar thickness required due to the overlap arrangement shall be deemed to have been included in the rate of this item. Nothing extra shall be payable on this account. The cut exposed edges of the granite stones shall be polished as per the Engineer-in-charge architectural drawing and such cost shall not be payable. However, the polished moulded edges / nosing as per the Engineer-in-charge architectural drawing of the granite stones shall be payable under the relevant item.

q. The granite stone slab shall be fixed over low level storage cabinets using necessary adhesive as per the manufacturer's specification. The stone shall have uniform thickness and shall be provided in sizes as per the Engineer-in-charge architectural drawings. The stone slab shall have uniformly levelled surface after fixing. All the joints shall be finished smoothly in a workmanlike manner.

r. Granite stone in flooring , skirting and in stair area as covered under the scope of work shall be laid and fixed in portion using suitable adhesive /cement mortar as specified in the schedule of the item in profile, design and pattern as per the approved drawing and direction of the Engineer-in-charge, for which nothing extra shall be paid.

s. The granite work shall be adequately protected by a layer of Plaster Of Paris, which shall be maintained throughout and removed just before handing over of the works and for which nothing extra shall be payable.

t. Wherever the granite stone slab dry cladding is provided exposed to environment, both the surfaces of the granite stone slabs shall be treated to make the surfaces hydrophobic by applying water repellent/hydrophobic clear coating of water soluble silicate based impregnating agent of approved make. The formulation shall be prepared and applied as per the manufacturer's recommendations. Before applying the formulation the surface preparation shall be done as per the manufacturer's recommendations. The surface shall be cleaned using water and the formulation shall be applied on the damp surface. The payment for this treatment to the granite stone slabs shall be made separately under relevant item.

u. It shall be applied by spray application before installation of stone on vertical surface has been completed and after necessary surface preparation. The Contractor shall impart training to his supervisors and labour to take adequate precautions and safeguards as per the manufacturer's specifications while handling the chemical. He shall also provide required gears and protective accessories like face masks, gloves, goggles, respiratory masks etc. for the labour for executing the work. Nothing extra shall be payable on this account.

5.19.3 White Glazed Tiles Pieces

The pieces of white glaze tiles shall be of approved make. They shall be flat and free from cracks, crazing and spots. The glazing shall be of uniform shade. The pieces of tiles shall be of any size but shall not be less than 25 mm to 33 mm. The thickness of these pieces shall be 5 mm to 6 mm. The top surface of these pieces shall be glazed. The glaze shall be of glossy type. The underside of pieces shall be completely free from glaze in order to have proper adhesion with the base.

5.19.4 Coloured Glazed Tiles Pieces

Only the glaze shall be coloured as specified. The size of pieces and specifications shall be same as for white glazed tiles pieces.

Preparation of Surface and Laying: Sub-grade concrete or the R.C.C. slab or any water proofing treatment on which the tile pieces are to be laid shall be properly cleaned, wetted and mopped. The bedding for the tile pieces shall be with cement mortar 1:3 (1 cement: 3 medium coarse sand) or as specified.

The average thickness of the bedding shall be 10 mm while the thickness under the portion of the tile pieces shall not be less than 6 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tile pieces to set and to enable the mason to place wooden plank across and squat on it. Over this mortar bedding neat grey cement slurry of honey-like consistency shall be spread at the rate of 3.5 Kgs. of cement per Sq.mt. over such an area as would accommodate about half Sq.mt. area. Small selected pieces of tiles shall be soaked in water, washed clean and shall be arranged and fixed in this grout one after another, each piece gently being tapped with wooden mallet till is properly bedded and in level with adjoining pieces. The joints shall be in crazy pattern and shall be kept as thin as possible.

The surface of the flooring during laying shall be frequently checked with a straight edge of two meter so as to obtain a true surface with the required slope. The same process shall be followed to fix pieces for finishing curved fillets at the junction of wall and floor as per the details or/and instruction issued by Additional City Engineer. The tiles pieces, which are fixed in the floor adjoining the wall and where fillets are not provided, shall enter not less than 10 mm under plaster, skirting or dado. After tile pieces have been laid, surplus cement grout shall be cleaned off.

Pointing and Finishing: The joints shall be cleaned off the grey cement grout with wire brush to a depth of 2 mm to 3 mm and all the dust and loose mortar removed. Joints shall then be finish pointed with white cement added with pigment if required to match color of glazed tiles pieces. The floor shall be kept wet for fourteen days. After curing, the surface shall be washed and finished clean, The finished floor shall not sound hollow when tapped with a wooden mallet.

Measurements: Length and breadth shall be measured correct to a cm. between the exposed surfaces of skirting or dado, where the junction of floor with skirting or dado is square and its area as laid shall be calculated in square meter correct to two places of

decimal. Where curved fillets are provided at the junction and finished with china mosaic, the length and breadth shall be measured upto top edge of finish. No deduction shall be made nor extra paid for any opening in the floor of area upto 0.10 Sq.mt. Nothing extra shall be paid for laying the floor at different levels in the same room.

5.19.5 PRESSED CERAMIC TILE FLOORING

Pressed Ceramic Tiles : The 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.

The tiles shall be square or rectangular of nominal size. Table 1,3,5, and 7 of IS 15622 give the modular preferred sizes and table 2,4,6 and 8 give the most common non modular sizes. Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side. Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width upto 2mm for unrectified floor tiles and upto 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. 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 preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges.

Preparation of Surface and Laying

- i.** Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.
- ii.** Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.
- iii.** Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being 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 and in straight lines or to suit the required pattern.
- iv.** The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required

slope. In bath, toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

- v. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints.
- vi. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.
- vii. After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing: The joints shall be cleaned off the grey cement slurry 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 pigment if required to match the color of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Mode of Measurements: Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster and the area calculated in square meter correct to two places of decimal. Where coves are used at the junctions, the length and breadth shall be measured between the lower edges of the coves.

No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square meters.

Areas, where glazed tiles or different types of decorative tiles are used will be measured separately.

5.19.6 Rajula Cobblestone/ slab/ kerb Stones

Providing and laying 80 mm thick Rajula Cobble stone/ slabs size as specified, block hand cut with machine cut 25 mm deep top edges, rounded edges as required and chisel dressed on top, for paving in floors, drains etc. laid over 50mm minimum thick base of cement mortar 1:4 (1 cement: 4 coarse sand) with 10-15mm wide pointing work of lime mortar 1:1:1 (1 lime : 1 surkhi : 1 coarse sand). Grouting to be done using crystal clear epoxy resin, including dressing, rubbing, curing, rounded edges, wedge, tapering, cleaning etc. Complete with no more than 5mm floor top level variation. All sides of stone to be 25mm deep machine cut to achieve best edge quality and design. (Colour: Grey)

Providing and fixing Rajula Kerb stone thickness as specified, Length from 300mm to 600mm and Ht. 300 mm to the required line, level, curvature, including rubbing and polishing complete with pointing of lime mortar 1:1:1 (1 lime :1surkhi:1 coarse sand) true to line and level,(thickness of joints except at sharp curve shall not to more than 10mm), including filling up of joints with finishing, cleaning, rubbing making drainage opening wherever required complete etc. as directed by Engineer-in-charge.

Cobble stones shall be free from flaws, injurious veins, cavities and similar imperfections that would impair its structural integrity and adversely affect its strength and appearance. Cobble stones shall be rectangular or square and of specified dimensions. The tolerance in length and breadth shall be ± 2 mm and thickness ± 1 mm. The bottom face may be rough but the top surface shall be fine dressed and joint faces shall be dressed back square with the top surface for at least 50 mm, without hollowness or spalling off. The dimensions of the blocks shall be as specified. The tolerances shall be allowed ± 5 mm for facing blocks. The edges of the blocks shall be dressed according to IS: 1129.

Dressing of stone: Every stone shall be cut to required size and fine chisel dressed to give a smooth and even surface on all sides to the full depth.

A straight edge laid along the sides of the stone shall be fully in contact with it. Chisel dressing shall also be done on top surface to remove any waviness. The sides and top surface to rajula slabs shall be machine rubbed or table rubbed with bourse sand before using. All angles and edges of slabs shall be true square and free from chippings.

The thickness of stone shall be 100 mm. The allowable tolerance shall be 2 mm. allowable.

Bedding: Bedding of Cobble stones shall be with cement mortar 1:4 (1 cement : 4 coarse sand) of average thickness 25 mm. thick as given in description of item. Minimum thickness at any place shall not be less than 10 mm.

Laying : The surface of sub grade shall be cleared wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one rajula slab, The stones shall be washed clean before laying. It shall be laid on top pressed and tapped gently to bring it in level with other slabs. It shall then be lifted and laid a side. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows, or depressions. The mortar shall then be allowed to harden it over this surface cement slurry of honey like consistency at 4.4 Kg. of cement per sq. meter. The edges of stones already paved shall be buttered with grey cement. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. The joints shall be as fine as possible: Surplus cement on the surface of the slabs shall be removed. The slab fixed in the floor adjoining the walls shall enter not less 10 mm. under the plaster skirting or dado. The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

Curing: The floor shall be cured for minimum period of seven days.

Polishing and finishing: Unevenness at the meeting edges of slab shall be removed by fine chiseling. Finishing etc. shall be done as per relevant specifications of item no. kotah stone flooring except that cement slurry with/or without pigments shall not be applied on the surface before each polishing.

Mode of Measurements: Cobble stone flooring with various kinds of rajula shall measure in sq. meter. The length and breadth shall be measured between the finished face of skirting or dado or wall plaster. No deduction shall be made not extra shall be paid for any openings in the floor or area upto 0.05 sq. mt. Nothing extra shall be paid for laying stone at different

levels in the same room. Treads and steps of stairs paved with rajula stone slabs shall also be measured under flooring.

The rate shall be for different patterns and details provided by the Architect. No extra amount will be paid for residues to be used to achieve the pattern.

5.19.7 Dhrangdhra Stone

Providing and laying flooring works of Local/ Dhangdhra Stone Slabs 80 mm thickness, sizes as per design over 80 mm (average), 50mm minimum thick base of cement mortar 1:4 (1 cement: 4 coarse sand) with 10-15 mm wide flushed pointing work of lime mortar 1:1:1 (1 lime : 1 surkhi : 1 coarse sand), including dressing, rubbing, curing, rounded edges, wedge, tapering, cleaning etc. Complete with no more than 15mm floor top level variation

The rate shall be for different patterns and details provided by the Architect. No extra amount will be paid for residues to be used to achieve the pattern.

Dressing of stone: Every stone shall be cut to require size and fine chisel dressed to give a smooth and even surface on all sides to the full depth.

A straight edge laid along the sides of the stone shall be fully in contact with it. Chisel dressing shall also be done on top surface to remove any waviness. The sides and top surface to slabs shall be machine rubbed or table rubbed with bourse sand before using. All angles and edges of slabs shall be true square and free from chippings.

Bedding: Bedding of stones shall be with cement mortar 1:4 (1 cement : 4 coarse sand) of average thickness 25 mm. thick as given in description of item. Minimum thickness at any place shall not be less than 10 mm.

Laying : The surface of sub grade shall be cleared wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one slab, The stones shall be washed clean before laying. It shall be laid on top pressed and tapped gently to bring it in level with other slabs. It shall then be lifted and laid a side. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows, or depressions. The mortar shall then be allowed to harden it over this surface cement slurry of honey like consistency at 4.4 Kg. of cement per sq. meter. The edges of stones already paved shall be buttered with grey cement. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. The joints shall be as fine as possible: Surplus cement on the surface of the slabs shall be removed. The slab fixed in the floor adjoining the walls shall enter not less 10 mm. under the plaster skirting or dado. The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

Curing: The floor shall be cured for minimum period of seven days.

Polishing and finishing: Unevenness at the meeting edges of slab shall be removed by fine chiseling. Finishing etc. shall be done as per relevant specifications of item no. kotah stone flooring except that cement slurry with/or without pigments shall not be applied on the surface before each polishing.

Mode of Measurements: Stone flooring with various kinds of shall measure in sq. meter. The length and breadth shall be measured between the finished face of skirting or dado or wall plaster. No deduction shall be made not extra shall be paid for any openings in the floor or area upto 0.05 sq. mt. Nothing extra shall be paid for laying stone at different levels in the same room.

The rate shall be for different patterns and details provided by the Architect. No extra amount will be paid for residues to be used to achieve the pattern.

5.19.8 Flame Finish/ machine cut Rajula stone

Providing and laying Flamed finish machine cut Rajula stone of 20-22 mm thk stone slab/ flooring/wall mounted with edge cutting in required sizes, design and patterns, in linear as well as curvilinear portions all complete as per the architectural drawings over 25 mm (average) thick base of lime mortar 1:1:1 (1 lime : 1 surkhi : 1 coarse sand) laid and jointed

with lime slurry of matching shade including rubbing, curing and polishing of granite etc. all complete as specified and as directed by the Engineer-in-Charge.

Providing and fixing 20-22 mm thick machine cut Rajula stone for wall cladding, platforms, vanity counters, window sills, facades, in linear as well as curvilinear surfaces and similar locations of required size, approved shade, colour and texture backing filled with a grout of average 20-25 mm thick base of lime mortar 1:1:1 (1 Slaked lime: 1 Surkhi: 1 Coarse sand), including pointing with grouting with same mortar, (To be secured to the backing by means of cramps where necessary), including rubbing, curing and polishing to edges to give high gloss finish etc. complete at all levels. Including fixing stone, over and above corresponding basic item, in fascia, wall cladding and drops stucked with polymer based Chemical adhesive, including cleaning etc. complete. For all wall Cladding and Copping work as per drawing including all colour and texture.

5.19.9 Engraved Polished Granite

Providing and fixing Engraved Polished Granite stone of 20-22 mm thk with Machine engraving/etching of alphabets/ map /diagram in flooring/wall vertically fixed upto 10m height in required design and patterns, in linear as well as curvilinear portions all complete as per the architectural drawings backing filled with 20 mm thick cement mortar 1:3 (1 cement : 3 coarse sand) and jointed with same including fixing the stone with polymer based Chemical adhesive for strength.

5.19.10 Rajula stone flooring with Tactile floor pattern

Providing and laying Rajula stone flooring with Tactile floor pattern including making machine cut/engraving patterns in stone (for vision impaired persons as per standards) in 25 mm thk stone flooring with edge cutting in required sizes, design and patterns, in linear as well as curvilinear portions, conforming to IS: 15622 of approved make for outdoor areas, laid over 25 mm (average) thick base and jointed with lime slurry. Grouting to be done using crystal clear epoxy resin, including rubbing and polishing complete with base of lime mortar 1:1:1 (1 lime :1surkhi:1 coarse sand) including wastage, cutting, curing, polishing etc all complete as specified and as directed by architectural drawings, Engineering- Charge in all shapes & patterns including grouting the joints. Laying and design of tiles as per IRC 103- 2012 guidelines.

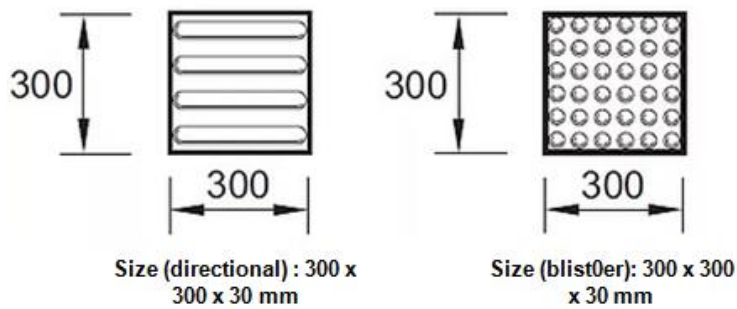
Etching of stone to be done by manually/machine directed as per architect. Sample to be approved with architect. all complete as specified and as directed by the Engineer-in-Charge.

The stone work to be inclusive of rubbing, curing and polishing etc all complete: Colour Jet Black, Cherry Red, Steel grey, Elite Brown, Cat Eye or equivalent.

Source: IRC 103-2012: Guidelines for Tactile Pavers. Design recommendations -

- The Tactile Paving should be minimum 300mm wide so that someone can't miss it by stepping over it.

A continuous tactile guide (guiding & warning tile) in the direction of pedestrian travel, which has a different texture to the rest of the footway, can provide this guidance.



- **Maintenance**

Cleaning should be done at regular intervals. Broken and missing tiles should be replaced as and when required.

- **Security & Safety parameter**

Pavers should be abrasion and slip resistant. They must conform to IS 13801:1993.

- **Durability parameter**

The parts used shall be of better durability for all seasons. It should be shock resistant. The manufacturing company must be an ISO 9001:2015 certified Company or should have equivalent quality management systems in place to ensure quality product.

- **Design parameter**

The purpose of the tile is to warn visually impaired people of a potential hazard or danger. The looks shall be simple and modular.

5.19.11 Stainless Steel Tactile strips and studs

Providing and laying Stainless Steel Tactile strips and studs (grade-316) (for vision impaired persons as per standards) conforming to IS: 15622 of approved for outdoor floors fixed over stone flooring in all shapes & patterns.

Fixing SS 316 studs of size 35mm x 25mm x 5 mm in floor and SS 316 strips of size 280mm x 35 mm x 5mm including screw fix or direct sticking on the floor.

To be installed with 4 tactile bars along the direction with correct spacing between each unit after 12mm drilled, cleaned, injected with epoxy glued floor laid over stone floor complete as per direction of Engineer-in-Charge.

A sample to be made for approval as per design.

5.20 Waterproofing (WATER PROOFING TREATMENT WITH BITUMEN FELT)

Water proofing treatment with self finished felt shall be four courses or six courses as described in the item. Four course water proofing treatment with self finished felt is a normal duty treatment suitable for buildings where the cost of roof treatment is required to be restricted.

Six course water proofing treatment with self finished felt is a heavy duty treatment suitable for important structures.

5.20.1 Materials

Self finished felt (Appendix A and B) shall conform to the type and grade given in the description of the item. This shall be one of the following types:

- (i) Type 3 grade 1 hessian base felt conforming in all respects to IS 1322.
- (ii) Type 2 grade 1 fibre base bitumen felt conforming to IS 1322.
- (iii) Type 2 grade 2 glass fibre base felt conforming in all respects to IS 7193.

5.20.2 Bonding Materials

This shall consist of blown type petroleum bitumen conforming to IS 702 or residual petroleum bitumen conforming to IS 73. The bonding material shall be so selected as to withstand the local condition of temperature and gradient satisfactorily. The penetration of bitumen used shall not exceed 40 in any case. Suitable residual type petroleum bitumen of penetration 30/40 (IS grade S-35), residual type petroleum bitumen with higher penetration and low softening point and suitable blown type petroleum bitumen of IS grade 85/25 or 90/15 of approved quality shall be used.

Where proprietary brands of bonding materials are proposed to be used they shall conform in all respects to the specifications in the preceding paras.

5.20.3 Stone Grit and Pea- sized Gravel

Stone grit shall be 6 mm and down size. Where peasized gravel is used it shall be hard, round and free from dust, dirt etc. The stone grit or pea-sized gravel shall not be spread over vertical and sloping faces of flashings and at drain mouths. At these places the surface shall be painted with two coats of bituminous solution.

The quantity of stone grit or pea-sized gravel required for the final course of four or six course treatment with hessian base self finished bitumen felt type 3 grade 1 shall be 6 cubic decimeter/ sqm.

5.20.4 Preparation of Surface

The surface to be treated shall have a minimum slope of 1 in 120. This grading shall be carried out with cement concrete or cement plaster with coarse sand, as per direction of Engineer-in-charge, to the average thickness required and finished smooth. Such grading shall be paid for separately.

Junctions between the roof and vertical faces of parapet walls, chimneys etc. shall be cased by running triangular fillets 7.5 x 7.5 cm size, in cement concrete. At the drain mouths, the fillets shall be suitably cut back and rounded off for easy application of water proofing treatment and easy flow of water. Cement concrete where used shall be 1:2:4 mix (1 cement: 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The provision of fillets shall be deemed to be covered by the item of water proofing and shall not be measured or paid for separately.

In existing roof where gola and drip course are provided at the junction of roof and vertical face of parapet wall, chimney stacks etc., these shall be dressed suitably and finished smooth so as to ensure an easy and gradual turning of the flashing. Any dismantlement or forming and finishing smooth the junction for forming the base of the flashing shall not be measured or paid for separately and shall be deemed to form part of the preparation of the surface in the water proofing treatment.

While the grading of roof surface is being done, it shall be ensured that the outlet drain pipe have been fixed and mouth at the entrance have been eased and rounded off properly for easy flow of water.

When any pipe passes through the roof to be treated, angular fillet of shape shall be built around it for the water proofing treatment to be taken over it. These fillets shall not be measured or paid for separately.

For carrying over and tucking in the water proofing felts into the parapet walls, chimney stacks etc. a horizontal groove 6.5 cm deep, 7.5 cm wide section with its lower edge at not less than 15 cm above the graded roof surface shall be left on the inner face of the same during construction if possible. When such groove has not been left, the same shall be cut out neatly and the base at rear of the groove shall be finished smooth with cement plaster 1:4 (1 cement: 4 coarse sand). Such cutting of the groove and its finishing smooth shall be deemed to be part of the water proofing item and shall not be measured or paid for separately. No deduction shall be made either for not making the groove or when the later has already been left in the masonry by the construction agency.

Tucking in the water proofing felt will be required where the parapet wall exceeds 45 cm in the height from the graded surface. Where the height is 45 cm or less, no groove will be required as the water proofing treatment will be carried over the top of the parapet wall to its full thickness. In the case of low dividing walls of height 30 cm or less, outlets therein shall be cut open for full height and the bottom and sides shall be rendered smooth and corners rounded and such treatment shall not be measured and paid for separately.

Where expansion joints are left in the slab, the provision of dwarf walls and/or RCC slabs for covering them and finishing the surface smooth shall be the responsibility of the construction agency, which had laid the roof slab and will not be included the operation of water proofing.

The graded surface of the roof and concrete fillets and the faces of walls shall be thoroughly cleaned with wire brushes and all loose scales etc. removed. The surface shall then be dusted off.

Any crack in the roof shall be cut to 'V' section, cleaned and filled up flush with cement mortar slurry 1:4 (1 cement: 4 coarse sand) or blown type petroleum bitumen of IS grade 85/25, or approved quality conforming to IS 702. Such cleaning of the surface or treating the cracks shall not be paid for separately.

5.20.5 Priming Coat

Where so specified, or required by the Engineer- in-Charge for example under slightly damp conditions a priming coat consisting of a bitumen primer conforming to IS 3384 should be applied with brush on the roof and wall surface at 0.24 litres per sqm to assist adhesion of the bonding material (i.e. bitumen).

Such application of primer shall be paid for separately, unless specifically included in the water proofing item.

5.20.6 Underlay

Where a floating treatment of water proofing with self finished bitumen felt is required i.e. where water proofing treatment is required to be isolated from the roof structure, a layer of bitumen saturated felt (underlay) shall be spread over the roof surface and tucked into the flashing groove. No bonding material shall be used below the underlay in order to keep the

underlay free of the structure. The adjoining strips of the underlay shall overlap to a minimum of 7.5 cm at sides and 10 cm at ends. The overlaps shall be sealed with the same bonding material as used for the self finished felt treatment.

Unless specifically included in the water proofing item, the underlay treatment shall be paid for separately.

The underlay shall be of type 1 saturated felt conforming to IS 1322 in all respects and having a total minimum weight of the finished bitumen felt in dry condition with mica dusting powder @ 6.8 kg per 10 sqm. The roll shall not be damaged or crack on being unrolled on a fairly smooth and flat surface.

5.20.7 Treatment

The water proofing shall consist of a four or six course treatment, as given in the description of the item, each layer of bonding materials, self finished bitumen felt or stone grit or pea sized gravel being counted as a course.

The choice of a four or six course treatment will depend on the climatic condition, the importance of the building, the durability required, cost and other relevant considerations.

A four course treatment shall consist of the following layers:

- (a) Initial layer of bonding material applied hot at specified weight per unit area.
- (b) 2nd layer of self finished bitumen felt conforming to the type and grade given in the description of the item.
- (c) Third layer of bonding material.
- (d) Final layer of stone grit of pea sized gravel spread at specified volume of material per unit area.

In a six course treatment, the first, second and third layer shall be of the same as in the four course treatment. The fourth and fifth layer shall consist of self finished felt and bonding material respectively. The sixth layer shall consist of stone grit or pea sized gravel.

The primer or underlay where required to be provided shall not count against the number of courses specified.

5.20.8 Laying

Bitumen bonding material of required grade shall be heated to the working temperature specified for the particular grade by the bitumen manufacturers and conveyed to the roof in buckets or pouring canes in weighed quantities.

Suitable working temperature for different grades of bitumen are as under:

- (i) Blown type petroleum bitumen of IS grade 85/25 or 90/15 - 180 degree C.
- (ii) Residual type petroleum bitumen of penetration 30/40 - 180 degree to 190 degree C (IS grade S-35).

Drain outlets shall be given a four or six course treatment as specified for the roof in the description of the item in the manner specified for the flat roof surface. Water proofing treatment shall be carried into the drain pipe or outlets by at least 10 cm. The water proofing treatment laid on the roof surface shall overlap the upper edge of the water proofing treatment in the drain outlets by at least 10 cm.

The self finished felt shall be cut to the required length, brushed clean of dusting material and laid out flat on the roof to eliminate curls and subsequent stretching. The felt shall normally be laid in length at right angles to the direction of the slope and laying shall be commenced at the lowest level and worked upto crest. The felt shall not be laid in single piece of very long lengths as they are likely to shrink; 6 to 8 m are suitable lengths. The roof surface shall be cleaned and dried before the felt treatment is begun. Each length of felt shall be laid in position and rolled up for a distance of half its length. The hot bonding material shall be poured on the roof across the full width of the rolled felt as the latter is steadily rolled out and pressed down. The pouring shall be so regulated that the correct weight of bonding material per unit area is spread uniformly over the surface. Excess bonding material that gets squeezed out at the ends shall be levelled up as laying proceeds. When the first half of the strip of felt has been bonded to the roof, the other half shall be rolled up and then unrolled on the hot bonding material in the same way. Subsequent strips shall also be laid in the same manner. Each strip shall overlap the preceding one by at least 7.5 cm at the longitudinal edges and 10 cm at the ends. All overlaps shall be firmly bonded with hot bitumen. Streaks and trailings of bitumen near edges of laps shall be levelled by heating the overlap with a blow lamp and levelling down unevenness.

The third layer of bonding material in the four course treatment shall be carried out in a similar manner after the flashing has been completed.

In a six course treatment the third and fourth layers of bonding material and self finished felt shall be laid in the manner already described, taking care that laps in the felt are staggered from those in the second layer. The fifth layer of bonding material shall be carried out after the flashing is done.

5.20.9 High Parapet Walls, Chimney Stacks etc.

Felts shall be laid as flashings wherever junctions of vertical and horizontal surfaces occur. Longitudinal laps shall be 10 cm. The lower layer of flashing felt in a six course treatment shall overlap the roof water proofing by not less than 20 cm while the upper layer shall overlap the roofing felt by 10 cm. The minimum overlap of the flashing felt in four course specification over the roofing felt shall be 10 cm.

The flashing shall consist of the same four or six course treatment as for the roof except that the final course of stone grit or pea-sized gravel shall be replaced by an application of bituminous solution of approved quality in two coats on the vertical and sloping faces only, of the flashing. The overlap along the length of flashing shall stagger with those in the second layer of flashing felt (in a six course treatment and with the joints in the roof felt).

The upper edge of the flashing felt shall be well tucked into the flashing grooves in the parapet, chimney stacks etc. to a depth of not less than 6.5 cm. Corresponding applications of bonding material shall also be made. The flashing treatment shall be firmly held in place in the grooves with wood edges at intervals and the grooves shall be filled up with cement mortar 1:4 (1 cement: 4 coarse sand) or cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) and surface finished smooth with the rest of the wall. The cement work shall be cured for 7 days. When dry, the exposed plaster joints of grooves shall be painted with bitumen and two coats of bituminous solution shall be applied on the vertical and sloping surface of flashing.

After the top flashing felt layer has been fixed, the penultimate layer of bonding material shall be applied over the roofing felt and the horizontal overlaps and vertical and sloping surfaces

of the flashings at the specified rate. Stone grit or pea sized gravel shall then be spread uniformly over the hot bonding material on the horizontal roof surface at the specified quantity per unit area and pressed into it with a wooden roller.

5.20.10 Low Parapet Walls

Where parapet walls are of height 45 cm or less, bitumen felt flashings shall be provided in the same manner as for flashings in the case of high parapet walls except that the upper edge shall be carried upto the full height of the wall and taken right across the top of the parapet and down on the external vertical faces to a minimum distance of 5 cm.

5.20.11 Low Dividing Walls

Where low dividing walls or inverted beams are met with, the same shall be covered with a four or six layer treatment as for the main roof, the latter bearing carried down both sides of the wall and overlapping the roofing treatment as in the case of flashing of high parapet walls.

Drain outlets where formed in the low dividing walls, shall be given water proofing treatment of the same number of courses as specified for the flat roof surface. The bottom and sides shall be so treated that all overlaps are in the direction of flow of drainage.

5.20.12 Expansion Joints

Where the expansion joints are provided in the slabs, the joints and their cover slabs shall be suitably treated with water proofing. A typical sketch of an expansion joint with the RCC slabs on either side of the joint turned vertically up and covered with precast RCC cover slabs as given in Fig. 22.7. The cover slabs shall cover the vertical turned up dwarf walls by not less than 7.5 cm and are provided with throatings on their underside along their length. The water proofing treatment shall be taken up the sloping junction fillets and the vertical faces of the walls to the underside of the cover slabs. The cover slabs are given the water proofing treatment like the roof slabs, after the cross joints between adjacent cover slabs are first sealed with 15 cm width of roofing felt struck to them with bitumen. The water proofing treatment shall be carried down the sides of the cover slabs to their full thickness. Care shall be taken to see that overlaps if any in the roofing over the cover slabs stagger with the joints between cover slabs.

The formation of the expansion joints and provision of cover slabs shall be the responsibility of the construction agency. The formation of the junction fillets and the water proofing treatment of the joint and cover slabs shall be carried out by the water proofing agency. No extra shall be paid for the junction fillers or for the sealing of the cross joints in the cover slab with 15 cm width of bitumen strips.

5.20.13 Pipes

Where vertical pipe outlets are met with 7.5 x 7.5 cm fillets of lime or cement concrete of the type and section shown in Fig. 22.7 shall be provided and flashing of four or six course treatment, same as for the roofing treatment shall be laid.

The upper edge of the flashing shall be laid sloping down forward and butted against the pipe and annular depression so formed shall be filled with hot bitumen. A circular metal collar in the shape of an inverted truncated cone shall be fixed on the pipe to throw off the rain water clear of the flashing and this shall be paid for separately.

5.20.14 Terrace

Where roof surfaces are expected to be used precast cement concrete tiles or 40 mm thick cement concrete shall be laid on the water proofing treatment. In such cases, the final course of stone grit or pea sized gravel shall not be laid in the water proofing treatment. Suitable adjustment in the rates will be effected for not providing the stone grit or pea sized gravel layer.

Cement concrete in situ flooring shall be laid in panel not exceeding 0.4 square metres each. Precast tiles or in situ concrete flooring where laid shall be paid for separately unless included in the description of the water proofing item.

5.20.15 Measurements

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

Measurements shall be taken over the entire exposed area of roofing and flashing treatment including flashing over low parapet walls, low dividing walls and expansion joints and at pipe projections etc. Overlaps and tucking into flashing grooves shall not be measured.

Vertical and sloping surfaces of water proofing treatment shall also be measured under the four or six course treatment as the case may be, irrespective of the fact that the final course of grit or pea sized gravel is replaced by bitumen primer.

Primer or saturated felt underlay, where provided, shall also be measured in the same manner as the water proofing treatment and paid for separately. No deduction in measurements shall be made for either openings or recesses for chimney stacks, roof lights and the like, for areas upto 40 square decimetre (0.4 sqm) nor anything shall be paid for forming such openings.

For similar areas exceeding 40 sq. decimetre deductions will be made in measurements for full opening and nothing extra shall be paid for forming such openings.

5.20.16 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above and the particular specifications given under the different items, with the corrections noted in the relevant sub-paras.

5.20.17 Copy of work order mentioning the rate issued to the specialized agency shall be attached with guarantee bond.

A guarantee bond on appropriately stamp paper shall be given by the contractor to the client in the manner form prescribed below:

FORM OF GUARANTEE BOND

"I/We(Contractor) hereby guarantee that work will remain unaffected and will not be in any way damaged by water or any other form of humid condition, for a period of 10 years after completion of the work of water-proofing as per the terms and conditions of the contract and the Contractor hereby indemnifies and agrees to save the Client from any loss and or damage that might be caused on account of water and or other similar form of humid

conditions and hereby guarantees to make good any loss or damage suffered by the Client and further guarantees to redo the affected work without claiming any extra cost."

This guarantee shall remain in force for a period of 10 years from the completion of the work under the contract and it shall remain binding to the Contractor for period of 10 years.

5.21 Lime Mortar

5.21.1 Materials: Materials shall comply with the specifications and standards as specified.

Lime: This specification lays down the general characteristics of lime to be used for the conservation work. No readymade or factory made lime is to be used for any of the work.

The classification of lime to be used for various purposes is as follows:

Lime for making lime mortar: Class B lime: Feebly hydraulic limeii. Lime for making lime plaster: Class C lime: Fat lime

Supply and Storage: The class B and Class C lime shall be supplied as quick lime. Lime supplied as quick lime or lump lime at the site should be in a sealed condition and subsequently stacked in a store or any other place which is dry and under cover well protected from rain. This is necessary because quick lime deteriorates quickly as it attracts moisture and carbon dioxide from atmosphere. For storing it should be piled up and covered with a blanket of lime dust to exclude moist air. Therefore it should be slaked as soon as possible in a pit called a 'Haudi' specially constructed for this. It should be slaked for at least 10 days prior to its use for making lime mortar and plaster.

Rejection of Lime: The lump or quick lime having stone pieces, impurities and powdery shall be rejected. The Implementing agency at his own expense shall remove lime, which has been rejected by the Engineer-in-charge, from the site of work within 3 days.

Lime slaking in tank: A tank or the 'Haudi' lined with stone or brick and finished with cement large enough to permit, stirring and hoeing shall be prepared (generally tanks suitable for 5 quintals or 10 quintals of quick lime are used in practice). The tank shall be filled to half its depth with water.

Quick lime shall be gradually added till it fills the entire bottom to about half the depth of water. (Never add water to lime). While quick lime is being added it shall be constantly stirred and hoed so as to break up the lumps. No part of the lime shall be allowed to expose above water level. As the lime slakes with evolution of heat temperature begins to rise and more lime or water may be added till the required temperature is reached and that temperature should be maintained by the addition of more lime or water till all the lime apparently has slaked, the stirring and hoeing shall be continued during the above process and for some period even after the slaking is apparently over. This whole act has to done with utmost precaution to the body by covering the eyes with glass goggles and wearing rubber boots.

Maturing: After the lime has cooled, more water shall be added if required and it shall be left undisturbed for not more than 7 days. The putty shall be allowed to mature but not allowed to dry out till it is used. Therefore the tank will need to be filled with water to allow the slaked lime to be constantly in submerged in water.

Surkhi: Surkhi is the powdered burnt bricks, brickbats and is used as an admixture to lime both for making lime mortar and lime plaster. Surkhi shall always be obtained from fully burnt or slightly under burnt, but never from over burnt bricks. Surkhi obtained from burnt loam shall not contain any un-burnt soil. Surkhi shall be perfectly clean, free from an admixture or any foreign element. Surkhi shall not contain soluble sulphate more than 0.5% for exposed work and work in damp situations and not more than 1.0% when used for works in dry and internal situations.

Stacking: Surkhi shall be stacked on masonry or wooden platform in regular stacks as of size 2.0M x 2.0M x 0.6M at the places as directed by the Engineer and shall be protected from dust, rains and dampness and shall be kept under adequate coverings provided by the implementing agency.

Sand: Sand used in the making of mortar should be fine sand, perfectly clean and sharp and preferably of a yellow and variegated colour. It should, if possible, be obtained from local pits

It is absolutely essential that it should possess the above mentioned qualities in order that a successful result may be obtained for the lime mortar. Fine grained, Dusty or dirty sand must not be allowed, and each fresh consignment should be carefully inspected in order to see that it corresponds with the sample approved in the first case. Many sands which would otherwise be of good quality contain lumps of foreign matter, or a quantity of dusty particles. Such sand may with the Engineer-in-charges consent, be used after it has been thoroughly washed and sifted.

5.21.2 Mortar mixes: Lime Sand mortar and Lime surkhi plaster

5.21.3 Materials used: Lime: Lime B and Lime C class shall be used in the preparation of mortar

Surkhi Aggregates: It shall conform to Surkhi specification

Sand aggregate in lime mortar: shall conform to sand specification

Water: For all mortars water used shall be free from mud, clay, and acidic, basic or organic impurities and shall be drinkable.

Proportion: The lime mortar shall be for lime in 1:1.5 (1 lime putty: 1.5 fine sand).

The lime surkhi mortar shall be in conformance to the DSR-2016 specification for lime in 1:1:1 (1 lime putty: 1 surkhi: 1 fine sand).

The proportion of mix for mortar shall also depend upon the percentage purity of lime with regard to its CaO content. In case the CaO content of lime is lower, the proportion of lime shall be suitably increased to compensate, for the lower CaO content of the lime used.

5.21.4 Preparation of mortar: Mortar mill (Lime Chakki or Mill) mixing: Slaked lime in the required quantity and fine aggregates in proportions (For lime mortar, 1:1:1 (1 lime putty: 1 surkhi: 1 fine sand) and (For lime mortar, 1:1.5(1 lime putty: 1.5 fine sand) shall be put along with limewater/water in the chakki spreading uniformly all along its circumference and ground with a stone chakki till a mortar of uniform colour and desired consistency is obtained. As grinding is done the mixture shall be continuously raked and turned over and over especially from corners and sides.

Mortar is to be ground to the required consistency depending on the mode of grinding i.e. bullock or tractor for 3 hrs and 1and half hour (at least) respectively. The prepared masala has to be then removed to a rectangular pit that would be used for storing of the masala with enough space to allow the masala to be mixed well for a short duration using feet before delivering it for application.

5.21.5 Strengthening of the mortar: The prepared lime mortar should be added with the admixture of Lapti kapaani + methi+ gulgul ka paani, which should be added only after being filtered properly. The filtered admixture will be thoroughly mixed with the lime mortar and then added with rumimastagi ka paani for extra strengthening of the mortar.

5.21.6 Storage of Mortar: Lime mortars prepared shall be used up as soon as possible after mixing 2 days for Class B limes from the time of making Putty or first grinding. Mortars from Class C limes can be used for periods longer than 3 days after the making of mortar provided they are protected from drying out. The mortar left over at the end of the working hour should be properly covered with moistened jute bags. When the mortar is used after a gap of two days it should be sprinkled with limewater and mixed well using feet covered with gumboot.

5.21.7 Rejection of Mortar: Mortar not found in accordance with the specifications above and unsuitable according to field and laboratory tests of lime mortar shall be rejected. The implementing agency at its own cost shall remove rejected mortar from the site of work within 3 days.

5.21.8 Cutting and Cleaning cement/ lime pointing from masonry joints: When modern lime or cement pointing has to be cut out from old joints and stone faces from the historic building in the complex, great care is to be taken such that the edges and surfaces of the brick/stone are not touched with chisel. When the cement pointing is hard and compact, a very small chisel is to be used and the centre of the cement joint is cut out, after which the sides of the joints where the cement adheres, are to be picked off with a steel tool, but without the use of a hammer.

5.22 Cement Mortars

5.22.1 Materials

Water

Water used for mixing and curing shall be clean and free from injurious quantities of alkalis, acids, oils, salts, sugar, organic materials, vegetable growth or other substance that may be deleterious to bricks, stone, concrete or steel. Potable water is generally considered satisfactory for mixing. The PH value of water shall be not less than 6. The following concentrations represent the maximum permissible values: (of deleterious materials in water).

The physical and chemical properties of ground water shall be tested along with soil investigation and if the water is not found conforming to the requirements of IS 456-2000; the tender documents shall clearly specify that the contractor has to arrange good quality water for construction indicating the source.

Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

Sea water shall not be used for mixing or curing

Water from each source shall be tested before the commencement of the work and thereafter once in every three months till the completion of the work. In case of ground water, testing shall also be done for different points of drawdown. Water from each source shall be got tested during the dry season before monsoon and again after monsoon

Cement

The cement used shall be any of the following grade and the type selected should be appropriate for the intended use.

- a. 33 grade ordinary Portland cement conforming to IS 269-**2013**.
- b. 43 grade ordinary Portland cement conforming to IS 8112-**2013**.
- c. 53 grade ordinary Portland cement conforming to IS 12269-**2013**.
- d. Rapid hardening Portland cement conforming to IS 8041-**1990, Reaffirm Apr 2014**
- e. Portland slag cement conforming to IS 455-**1989, Reaffirm Apr 2014**.
- f. Portland Pozzolana cement (fly ash based) conforming to IS 1489 (Part 1)-**1991, Reaffirm Apr 2014**.

- g. Portland Pozzolona cement (calcined clay based) conforming to IS 1489 (part 2)-1991, **Reaffirm Apr 2014.**
- h. Hydrophobic **Portland** cement conforming to IS 8043-1991, **Reaffirm Apr 2014.**
- i. Low heat Portland cement conforming to IS 12600-1989, **Reaffirm Apr 2014.**
- j. Sulphate resisting Portland cement conforming to IS 12330-1988, **Reaffirm Apr 2014.**
- k. White cement conforming to IS 8042-1989, **Reaffirm Apr 2014.**

Different types of cement shall not be mixed together. In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

Compressive Strength: Compressive strength requirement of each type of cement for various grades when tested in accordance with IS 4031 (part 6) shall be as under:

Sample	Strength in N/mm ² not less than for		
	Gr. 33	Gr.43	Gr. 53
Age at testing			
72 + 1 hr	16	23	27
168 + 2 hrs	22	33	37
672 + 4 hrs	33	43	53

Fine Aggregate

Aggregate most of which passes through 4.75 mm IS sieve is known as fine aggregate. Fine aggregate shall consist of natural sand, crushed stone sand, crushed gravel sand stone dust or marble dust, fly ash and broken brick (Burnt clay). It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities e.g. iron pyrites, alkalies, salts, coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearance of mortar, plaster or concrete. The sum of the percentages of all deleterious material shall not exceed 5%. Fine aggregate must be checked for organic impurities such as decayed vegetation humps, coal dust etc. in accordance with the procedure prescribed in Appendix 'A' of Chapter 3 of CPWD Specifications (Vol 1).

Silt Content: The maximum quantity of silt in sand as determined by the method prescribed in Appendix 'C' of Chapter 3 (CPWD Specification – Vol 1, 2109) shall not exceed 8%. Fine aggregate containing more than allowable percentage of silt shall be washed as many times

as directed by Engineer-in-charge so as to bring the silt content within allowable limits for which nothing extra shall be paid.

Grading: On the basis of particle size, fine aggregate is graded in to four zones. The grading when determined in accordance with the procedure prescribed in Appendix 'B' of Chapter 3 CPWD Specifications Vol 1 2019 shall be within the limits. Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron IS sieve, by a total amount not exceeding 5 per cent, it shall be regarded as falling within that grading zone.

5.22.2 PREPARTATION OF MORTARS AND ITS GRADE

Grade of Masonry Mortar

The grade of masonry mortar will be defined by its compressive strength in N/mm² at the age of 28 days as determined by the standard procedure detailed in IS 2250.

For proportioning the ingredients by volume, the conversion of weight into volume shall be made on the following basis:

a) Burnt Clay Pozzolana	860 Kg/cum
b) Coarse Sand (dry)	1280 kg/cum
c) Fine sand (dry)	1600 kg/ cum
d) Fly Ash	590 / cum

Cement Mortar

This shall be prepared by mixing cement and sand with or without the addition of pozzolana in specified proportions as per Appendix 'F' of Chapter 4 of CPWD Specification (Vol 1).

Proportioning:

Proportioning on weight basis shall be preferred taking into account specific gravity of sand and moisture content . Boxes of suitable size shall be prepared to facilitate proportioning on weight basis. Cement bag weighting 50 kg shall be taken as 0.035 cubic meter. Other ingredients in specified proportion shall be measured using boxes of size 40 x 35 x 25 cm. Sand shall be measured on the basis of its dry volume in the case of volumetric proportioning.

Mixing: The mixing of mortar shall be done in mechanical mixers operated manually or by power as decided by Engineer-in-Charge. The Engineer-in-Charge may, however, permit hand mixing at his discretion taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the use of mechanical mixer is not feasible. In cases, where mechanical mixers are not to be used, The contractor shall take permission of the Engineer-in-Charge in writing before the commencement of the work.

Mechanical Mixing: Cement and sand in the specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least three minutes. Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste. Only the quantity of mortar, which can be used within 30 minutes of its mixing, shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

Hand Mixing: The measured quantity of sand shall be levelled on a clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff paste of necessary working consistency.

Precautions: mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

5.23 Plastering and Pointing

Sand faced lime plaster 1:1:1 (1 lime putty : 1 surkhi: 1 finesand), dashed over and including the fresh plaster in two layers,

First coat will be in 12mm and second coat will be in 8 mm. Including scaffolding, curing, finishing, making grooves, forming pattas etc. complete as directed by the Engineer-in charge.

Providing and applying lime plaster by Wetting the surface. Remove all the dust particles .Applying lime plaster up to required thickness.

Jikki Plaster with Mortar in lime, surkhi (50% red and 50% light yellow) and marble dust 1:1.5:0.5, in single layer of 6 mm. Including scaffolding, curing, finishing, making grooves, forming pattas etc. complete as directed by the Engineer-in charge.

5.23.1 Tools and Accessories

Tools and accessories used in the work shall be in conformity with IS: 630. All tools shall be cleaned by scrapping and washing at the end of each day's work or after use with different materials. Metal tools shall be cleaned and greased after each operation. The tools shall be examined and thoroughly cleaned before plastering work is commenced.

5.23.2 Scaffolding

Scaffolding shall be independent double scaffolding free from surfaces, which are to be plastered. Scaffolding shall be checked to make sure that it is suitable and safe. Steel scaffolding, if use, shall conform to IS:2750

5.23.3 Plastering (Method)

Programme of work in relation to plastering:

Operation before plastering and pointing Construction of walls, columns, beams etc. so done requiring subsequent plastering shall be so programmed that they are sufficiently cured and dry to receive the plaster without subsequent damage to plaster or pointing. All service pipes, conduits, cables that are to be embedded in masonry work and covered with plaster shall be completed and suitably protected against corrosion where necessary, before plastering and pointing is begun and the time of plastering and pointing shall be scheduled accordingly.

Operation during plastering: Where other building operations are required to proceed Simultaneously with plastering, special care shall be taken to programme the work so as to cause the minimum amount of interference. Plastering operations shall be so scheduled as to allow as specified keeping sufficient interval between successive coats. Invariably, the plastering work shall proceed from top to bottom. The entire plastered surface shall be truly plane. It shall not show any deviation more than 4 mm when checked with a straight edge of 2.0 m. length placed against the surface. Excessive floating, working or rubbing or the surfaces shall not be permitted. All corners, junctions, turning and edges shall be rounded and finished in the true line, level, and plumb. At the junctions or where directed by the EIC, to the projections, chhajjas, canopies etc. cement angle fillet shall be formed.

Care shall be taken to avoid the splashing of mortar on to finished surfaces, such as Brick work, joinery, paintwork and glass. However, in case of such splashes of mortar on above materials, they shall be cleaned off immediately. Operation after plastering Care shall be taken to protect the plaster surface against damage from rain, sun, frost etc.

All necessary preparation of the different types of background shall be done as follows fulfilling the requirements conforming to IS: 1661

Brick, stone masonry or block masonry. The joints of the masonry work shall be racked out and kept clean upto depth of 12mm at the end of the masonry work while it is green.

The surface and joints of the wall shall be washed and cleaned and kept wet for two days before pointing or plastering. In case of old masonry work the joints washed and cleaned and kept wet for two days before pointing and plastering. Projecting bricks shall be trimmed off where necessary. The surface shall be thoroughly brushed down to remove dust and loose particles or efflorescence where it has occurred with coir brush. Wherever necessary, hollow spots shall be dubbed out at this stage by means of a mix similar to that intended for the first coat of plaster and ample time shall be allowed for the filling material to dry out before the base coat (first coat) is applied

Preparation of Mortar Mix proportion of materials, quantity of water to be added to mortar for mixing fresh mortar to be used for plastering shall be done conforming to IS: 2402 for cement, cement-lime mortar and conforming to IS:2394 for lime and lime mortars.

Proportioning of different materials shall be done as specified for different items; if not specified, it shall be done according to Indian Standard Specifications. Any mortar for plastering which is particularly set, shall be rejected and removed from the site.

Preparation of Samples for Plastering before starting actual work of plastering or pointing different samples of each item shall be made of 100 mm x 100 mm size as specified or as directed by Additional City Engineer, for approval of the item at contractor's cost. The samples shall be made isolated but on same type of base surface and of the same material on which it is supposed to be done.

Same materials, workmanship, methods shall be used while doing the actual work, the samples shall be kept as it is until the building construction work is over.

Application of Undercoats

The Rendering of First Coat: The background surface shall be prepared as described in 5.17.4 and damped evenly. The plaster shall be of specified thickness (as specified in different types of plaster) but not less than 12 mm and more than 18 mm of specified proportion. It shall be carried out to the full length of the wall or to the natural breaking point like doors or windows. The mortar used for plastering shall be stiff enough to cling and hold when laid on surfaces. The dashing of the rendering coat shall be done using a strong whipping motion at right angles with a plaster-machine or cement-gun. The plastering shall then be levelled with wooden float forcing it into joints to obtain a good bond and surface in perfect level and line. The surface then shall be rubbed smooth with a plaster trowel for final finish whichever is specified in drawings. Curing shall be started after 24 hrs of plastering.

The plaster shall be kept wet for a minimum period of fourteen days. Before the rendering coat hardens, it shall be roughened by scratchier to provide mechanical key for the second coat.

Before starting to apply 2nd coat the surface of rendering coat should be damped evenly before applying the plaster. The second coat will be approximately 6 to 8 mm thick It shall be brought to a true, and leveled surface and then roughened to provide bond for the next finishing coat. Each under coat shall be damp cured for a minimum period of fourteen days. Each plaster shall be provided with no of under coat as specified.

Application of Finishing Coat: Lime Punning or Neeroo finish is prepared as described in 5.17.4 then it shall be plastered with one coat (first coat) of 12mm thick cement mortar in the ratio of 1:4 as described in 5.17.8.1

The surface thus rendered shall then be finished smooth with good quality of lime neeroo. It shall be prepared at site out of best quality of fat lime conforming to IS:712 slacked with fresh potable water and stored in accordance with relevant IS:1635. It shall be applied with a thin coat (3 mm thick) of lime putty (neeroo) mixed with an equal amount of fine sand. Before actual use, putty shall be matured for two to three days but it shall be used within seven days only. It shall be finished to a smooth as the punning has hardened but in any case not earlier

than 24 hours after the punning has completed minimum period of fourteen days. The punning shall be kept wet for minimum period of fourteen days.

Sand face Plaster the surface to be plastered and finished shall be first prepared as described in 1.4 Then it shall be plastered with one coat (first coat) of 12 mm thick cement mortar in 1:4 proportion described in 5.12.5.1 The surface thus rendered shall then be applied a finishing coat 6 mm thick consisting of grey or coloured cement, or white cement with coloured pigments as specified in items, mixed with uniform Coarse sand in proportion of one part of cement of three parts of sand with water proofing compound mixed thoroughly and laid with and finished rough with small wooden float generally termed "Gutka".

The texture shall be as per the sample approved by an Engineer-in-Charge. The finished plaster surface shall be cured for a minimum period of fourteen days.

Roughcast finishing the surface to be plastered and finished shall be first prepared as described in 5.12.4. Then it shall be plastered with one under coat of 10 mm thick cement mortar in 1:4 proportions as described in 5.12.5.1 then a mix containing three parts of aggregate to one part of cement shall be thrown at right angle wall. It shall then be done in level and plumb keeping it rough finished as directed and approved by Engineer-in-charge, . Aggregates used for this finish shall conform to IS:383. Pebbles, medium granite chips, approved crushed stone or fine gravel upto 12 mm maximum size shall be used. The proportion of mix shall be of 1:2.

Final finish shall be kept dried upto 24 hours and then cured for a minimum period of fourteen days.

5.23.4 Pointing (Method)

Preparation of Joints : The joints of all the types of brick and stone masonry work shall be racked out and kept clean upto a depth of 20 mm at the end of the day's work while it is green. In case of old masonry work the joints of the masonry shall be racked out to a depth of 20 mm without disturbing or damaging the masonry units.

Preparation of Mortar The materials of mortar, cement, sand, lime, surkhi etc. shall be used as specified in materials for plastering. The materials of mortar shall be first dry mixed to have the required proportion as specified in different pointing items and then mixed by adding water slowly and gradually and thoroughly mixed on water-tight platform.

Laying Mortar in Joints the mortar shall be laid inside the joints slightly in excess with a small trowel or suitable small tool and pressed well to have a solid contact with the internal joint so as to leave no hollow at the junction. Care shall be taken that mortar does not stain the edges or surface of the brick or/and stone.

The joints shall be finished off neatly as described in type of pointing. Extra mortar if any is removed and surface shall be finished. Mortar should not spread over the face of bricks or/and stones and the edges of bricks or/and stones and shall be clearly defined to give a neat appearance. After pointing the surface shall be kept wet for a minimum period of fourteen days.

Type of Pointing

Flat or Flush Pointing It shall be formed by pressing the mortar of specified materials and proportion, with a small trowel into the joints previously opened out and removing the excess of mortar beyond the face of the wall, leaving the joints flush with the face.

Flat Jointed or Flush Jointed Pointing After doing flush pointing, it shall be again pressed to form a semi-circular groove or line by a special tool called 'Naila' as specified in the drawings.

Weathered or Struck Pointing Here mortar shall be struck back at the upper edge throughout the length evenly as shown and specified in the drawing.

Recessed pointing the face of the pointing mortar shall be pressed behind the plane of the wall and shall be left vertical at a specified depth throughout the length in every joint as specified and shown in the drawing.

Tuck pointing The raked joints, which are prepared, as described earlier, shall be filled with mortar, pressed and flushed with surface of the wall. The mortar shall be coloured with pigments to suit the colour of bricks. Then it shall be cut in the center a narrow channel or groove as specified in drawing and then it shall be filled in with white lime putty projecting beyond the surface of the joint by length specified in drawings to form the straight projection of the face on straight edge.

Mason's V-Shape Pointing It shall be done as described in 1.11a but instead of semi-circular groove the perfect triangular groove of 60 degree shall be done in perfectly straight line.

Curing of Pointing Fresh pointing shall be allowed to set and dry for 24 hours. Then the whole surface shall be cured thoroughly by sprinkling water for a minimum period of fourteen days.

Measurement for plasterwork

Length and breadth shall be measured correct to a cm and its area shall be calculated in Sq.mt. Correct to two places of decimals.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brickwork.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before plastering shall be taken) for the length, and from the top of the floor or skirting to the ceiling for the height.

5.23.5 Cement Plastering

a. Materials

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand) unless otherwise specified under the respective item of work. Cement and sand shall be mixed thoroughly in dry condition and then water added to obtain a workable

consistency. The quality of water and cement shall be as per relevant IS. The quality and grading of sand for plastering shall conform to IS: 1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by ENGINEER-IN-CHARGE. If so desired by the ENGINEER-IN-CHARGE sand shall be screened and washed to meet the specification requirements. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances

b. Workmanship

Preparation of surfaces and application of plaster finishes shall generally confirm to the requirements specified in IS: 1661 and IS: 2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/ window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/ stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean-water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior Plain Faced Plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by ENGINEER-IN-CHARGE. Rate quoted for plaster work shall be deemed to include for plastering of all these surfaces.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in clause 30.2.

To overcome the possibility of development of cracks in the plastering work following measures shall be adapted.

- (a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.
- (b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement. This steel item shall be measured and paid for separately.

- (c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

c. Measurement

Measurement for plastering work shall be in sq.m correct to two places of decimal. Unless a separate item is provided for grooves, mouldings, etc., these works are deemed to be included in the unit rates quoted for plastering work. The quantity of work to be paid for under these items shall be calculated by taking the projected surface of the areas plastered after making necessary deductions for openings for doors, windows, fan openings etc. The actual plaster work carried out on jambs/sills of windows, openings, etc. shall be measured for payment.

5.24 Raking of Joints

5.24.1 Preparation of Surface:

The purpose of surface preparation is to remove all kinds of loose material, debris, leaves, paper etc. from the surface where raking of the joints is to be carried out for re-plastering or re-pointing the stone masonry as the case may be.

The surface should be cleaned with brooms to remove of any loose material like dirt and dust. Now, the surface should be cleaned by using high pressure Jet machines having dual benefit of removal of the loose material and softening of the mortar in the stone masonry. Every effort should be made to avoid dust nuisance.

5.24.2 Safety:

Contractor shall be advised to ensure that all workers should wear helmets, safety belts, proper shoes, tight clothes etc. while working at all heights including working on domes etc. Every effort should be made to avoid free falling of the material and necessary protection should be provided along the scaffolding (if any). Care shall be taken by the agency to avoid any damage to the heritage building. If any structural or aesthetic damage is caused to the building the same shall be made good by the agency at its own cost and nothing extra shall be paid for this.

5.24.3 Tools and Plants (T&P)

Agency will provide all the requisite tools and plants like hammer & chisel for manual raking and Power or Pneumatically driven mechanical mortar raking equipments of approved manufacturers' as per site conditions and as per directions of the Engineer-in-charge. The agency will take prior permission of the Engineer-in-Charge to use Power or pneumatically driven mechanical mortar rakers depending upon the noise level that can be approved in the area where work is to be carried out. The work should be carried out in most professional manner so that no interference is caused to the working of various offices/residences housed in or in the vicinity of the heritage

building. Mechanical Jet Spray machines of requisite power shall be procured by the Agency and also shall make own arrangement of the water for the purpose.

To ensure efficient and effective functioning, all T&P must be checked on-site at regular intervals and work must not hold up for want of repairs of the T&P.

5.24.4 Skilled Site Personnel

Only skilled workers shall be employed by the contractor. They must possess knowledge of working in heritage structures and must have required special training and/or practical experience in executing such works. At least the supervisory staff and major workers should have requisite expertise in the field.

5.24.5 Scaffolding

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

Double Scaffolding: Where the joints in the masonry of heritage structures are to be exposed by raking, manual or mechanical, double scaffolding system (cup & lock type) shall be provided in the interior as well as exterior side of the building wherever it is feasible/required to provide the scaffolding system. The scaffolding system shall be stiffened with bracings, runners, and connectors etc. to secure it to the structure. Size of the members shall be dependent upon the height at which raking of the joints is to be done.

5.24.6 Raking of Joints

Proper working space/platform shall be provided to the workers by providing scaffolding (if required) so that raking of the joints could be done easily. The surface where raking of joints is to be done, shall be clearly marked with chalk or any other material, so that it can be easily distinguished.

Raking with hand tools like hammer and chisel shall be resorted to in case the location is not easily accessible for mechanical equipments, sufficient power supply is not ensured or the area is too small to be economical for mechanical raking. Raking of joints should progress from one end to other first raking the one horizontal joint at a time to the requisite depth as decided by the Engineer-in-Charge. Then next horizontal joint is taken up and so on. Once all horizontal joints are raked up vertical joints shall be raked from either ends. The raked joints are then cleaned by brushing and watering.

The debris/rubbish shall be collected in most professional manner and disposed of to the dumping ground with all lead or as per direction of the Engineer-in-Charge.

The whole process shall be considered complete if approved from the Engineer-in-Charge.

5.24.7 Measurements

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

For jambs, soffits, sills etc. for opening not exceeding 0.5 sqm each in area, ends of joists,

Beams, posts, girders, steps etc. not exceeding 0.5 sqm each in area and opening not exceeding 3 sqm each deductions and additions shall be made in the following way, in case of raking on external face only.

(a) No deduction shall be made for ends of joists, beams, posts etc. and openings not exceeding 0.5Sqm each, and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.

(b) Deductions for openings exceeding 0.5 sqm but not exceeding 3 sqm each shall be made as follows and no additions shall be made for reveals, jambs, soffits, sills, etc. for these openings.

(c) When both the faces of the wall are raked deduction shall be made for one face only.

(d) When only one face is raked deduction shall be made from one side of frame for doors, windows, etc. on which the width of the reveal is less than that on the other side, but no deduction shall be made from the other side.

(e) Where width of reveals on both faces of wall is equal, deduction of 50% of area of opening on each face shall be made from the raked area.

(f) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each pointed face of wall.

In case of openings of area above 3 sqm each, deduction shall be made for the openings, but jambs, soffits and sills shall be measured.

5.25 Whitewashing and Painting

5.25.1 Whitewashing with Whiting

Scaffolding wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal piece, over which scaffolding planks shall be fixed. No bullies, bamboos or planks shall rest on or touch the surface, which is being white washed. For all exposed brickwork 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.

In case of special type of brickwork, scaffolding shall get approved from Engineer-in-charge, in advance. Where ladders are used, places of old gunny bags shall be tied on their tops to

avoid damage of scratches to walls. For white washing the ceiling, proper stage scaffolding shall be erected.

Preparation of Surface Before new work is white washed; the surface shall be thoroughly brushed free from mortar droppings and foreign matter. In the case of old work, all loose pieces and scales shall be scrapped off and holes in plaster as well as patches or less than 50 sq. 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.

Preparation of Mix Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form thin slurry which shall then be screened through a clean coarse cloth. Two Kg. of gum and 0.4 Kg of copper sulphate dissolved separately in hot water shall be added for every cubic meter of the slurry, which shall then be diluted with water to the consistency of milk so as to make a wash ready for use.

Application The white wash shall be applied with moonj brushed 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 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.

For old work, after the surface has been prepared as described in Para 1.2, a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patches do not appear. The washing on ceiling should be done prior to that on walls.

Protective measures Doors, windows, floors, articles of furniture etc. and such other parts or the building not to the white washed shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surface cleaned. Damage if any to furniture or fittings shall be recoverable from the contractor.

Measurement

Length and breadth shall be measured correct to a cm and area shall be calculated in square meter correct to two places of decimal.

5.25.2 Oil Emulsion (Oil Bound) Distempering

Materials Oil emulsion (oil bound) distemper shall conform to IS: 428 and shall be of approved brand and manufacture. The primer, where used as on new work, shall be cement 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 tin 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 sandpapering 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 by 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 fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patches surface shall be allowed to dry thoroughly before regular coat of distemper is applied.

2 Application Priming Coat: The priming coat shall be with distemper primer or cement primer, as required in the description in item. The application of the distemper primer shall be as described in 5.22.2.5.

Note: If the wall surface plaster has not dried completely, cement primer shall be applied before distemping the walls. But if the distemping is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied within six months of the completion of wall plaster. For oil work, no primer 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 stipulate 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 consecutive coats to permit the 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.

15 cm double bristled distemper brushes shall be used. After each day's work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes, which are dirty and caked with distemper, shall not be used on the work.

Measurement

Description same as provided in "White Washing with whiting"

5.25.3 Painting Iron and 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/Aluminium surfaces shall be as specified below:

TABLE 13.2

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

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 litre.

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.
- (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 (distillate product of oleeresin of conifers) 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**

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.

- **Epoxy Paint**
- **Material**

This product has got excellent adhesion properties and offers a balanced aesthetic and corrosion protective surface. Epoxy offers good resistance to water and humidity.

Epoxy coating are used because of their outstanding chemical resistance, durability, low porosity and strong bond strength and it provides dry tough and protective coatings. Epoxy coatings are created, by chemical reaction using an epoxide resin and polyamine hardener.

- **Painting new surface**

Surface must be dried, cleaned & made free from oil, grease, dirt, dust & all other contaminants that could interfere with adhesion of coating.

- **Application**

The application of priming coat for relevant steel or cement surface shall be as per the description of para no. 13.24. Epoxy paint is supplied in two parts i.e. (base and hardener). Stir the base and hardener separately. Mix hardener gradually into the base under continuous stirring as per mixing ratio as specified by the manufacturers.

The epoxy paint shall be consumed within the working pot life as specified by the manufacturers. Part mixing should be avoided. To achieve optimum performance of the product, minimum 2-3 coats by brushing would be required to get the desired dry film thickness (DFT) as specified by the manufacturer. Relative humidity in the environment should preferably be below 85%.

- **Cleaning**

All equipments/apparatus shall be cleaned immediately after use with thinner especially the hose pipes, gun, all spray equipments etc. All surplus material should be disposed off in compliance with environmental pollution rules etc.

- **General Safety**

Contact of the product with skin especially with eyes should be avoided. Use of face mask is mandatory during whole process. Proper ventilation is required and all safety procedures and precautions are to be adopted for executing epoxy painting process.

- **Measurement**

Measurements, Rate and other details shall be as specified in Para 13.23 as far as they are applicable which shall include the cost of all labour and material involved in all operation including priming coat as described above.

5.25.4 Hot dip Galvanised coating including Zinc coating

- **Material :**

Zinc used for galvanizing shall conform to any of the grades specified in IS 209: 1992 'Zinc ingot' or IS 13229: 1991 'Zinc for Galvanizing'. The molten metal in the galvanizing bath shall contain not less than 98.5 percent by mass of zinc.

- **Procedure :**

Requirement for the mass of the zinc coating shall be as per the relevant IS: 4759 -1996 of Table1. The zinc coating shall be uniform, adherent, reasonably smooth and free from such imperfections as flux, ash bare patches, black spots, pimples, lumpiness, runs, rust stains, bulky white deposits and blisters.

The coating shall withstand the pivoted hammer and knife tests as prescribed in IS 2629 : 1985 for testing adhesion of zinc coatings on fabricated products and hardware respectively. Rate shall include all the operations, loading, unloading of materials from plant and sites, total zinc coating process as per the above specs in standard approved plant, wastages, etc. complete as per the engineer in charge.

- **Measurement :**

Measurement shall be on the weight basis of the galvanized or steel members which has to be zinc coated.

5.26 External and Internal Wall Painting

As lime paint product started from Verona Italy by OIKOS company it is famous as lime paint Verona.

5.26.1 LIME PAINT VERONA by OIKOS India is a mineral, water based paint for interior and exterior, formulated with mature lime putty that gives a smooth and matt finish. It is ideal for the restoration of prestigious buildings of historical importance where the ancient style and materials of the Italian tradition have to be maintained or proposed. The product creates a stable link with the surface, maintaining the level of vapour permeability of the support facilitating the evaporation of internal humidity.

Its level of alkalinity prevents the development of mould and bacteria. LIME PAINT VERONA by OIKOS confers to the wall a warm appearance with tones of colour typical of the ancient decorations made with lime products. LIME PAINT VERONA by OIKOS has a low odour level, is non-inflammable and is friendly to both humans and the environment

5.26.2 Process- After cleaning the top surface of lime plaster with brush one coat of lime putty made by the company is applied. If possible fine pot hole is filled with Oikos lime putty and base is prepared by sand paring. After preparing the surface matured lime paint of historical building color is made by brush or roller in two coats.

5.27 Street Furniture and Signage Works

5.27.1 Dhangadhra Sand Stone Bench

Providing and fixing machine cut Dhangadhra Sand Stone Bench length of around 1.75 m x 0.5m width x 0.4m clear height after foundation anchor as per drawing with expose equally flattened, polished and smooth finished top as per Architects choice including dressing, rubbing, rounded edges, wedge, tapering, cleaning etc. with cost of loading -unloading and placing in place.

Bench should be made as per drawings provided by the architect.

1	Dimensions	1750mm X 500mm X 400mm
2	Colors	As per specifications
3	Materials	Dhranghdhra Sand stone
4	Surface finish	Smooth or textured finish (optional)

- **Maintenance**

Twice in a year, Rinse the top with warm water to remove surface dirt and wipe dry with a clean, soft cloth for routine maintenance. Wash with a soft cloth and a mixture of a mild detergent and warm water. Rinse with warm water, and wipe dry with a clean, soft cloth. Do not use abrasive, acid, alcohol-based, or solvent-based cleaners; they will damage the surface. Fixing of damaged part and replacement if necessary.

- **Security & Safety parameter**

The finishing of the bench shall be such that it is safe for users and does not have any sharp edges that may cause injury; also, it shall be either bolted or fastened to ground as mentioned earlier. All the edges should be of smooth finish. The bench should be either bolted or installed with a foundation by anchor fasteners or chemical fasteners which will make the furniture more vandal proof.

- **Design parameter**

The design shall be elegant with smooth curves that make it aesthetically good and appealing for the users. It shall be innovative & contemporary. Modular design is recommended for Street Furniture.

- **Universal design**

The furniture should also cater to differently-abled users. Design and manufacture should comply with ISO requirements.

5.27.2 Hand cut Hard Stone Bench

Providing and fixing hand cut Hard Stone Bench length of around 1.8 m, 0.5 wd x 0.4m ht as per drawing with rough natural cut looking surface and smooth finished top including dressing, rubbing, rounded edges, wedge, tapering, cleaning etc. with cost of loading - unloading and placing in place. Stone selection as per Engineer-in-charge.

Bench should be made as per drawings provided by the architect.

1	Dimensions	1800mm X 500mm X 400mm
2	Colors	As per specifications
3	Materials	Hard Stone as specified
4	Surface finish	Smooth or textured finish (optional)

- **Maintenance**

Twice in a year, Rinse the top with warm water to remove surface dirt and wipe dry with a clean, soft cloth for routine maintenance. Wash with a soft cloth and a mixture of a mild detergent and warm water. Rinse with warm water, and wipe dry with a clean, soft cloth. Do not use abrasive, acid, alcohol-based, or solvent-based cleaners; they will damage the surface. Fixing of damaged part and replacement if necessary.

- **Security & Safety parameter**

The finishing of the bench shall be such that it is safe for users and does not have any sharp edges that may cause injury; also, it shall be either bolted or fastened to ground as mentioned earlier. All the edges should be of smooth finish. The bench should be either bolted or installed with a foundation by anchor fasteners or chemical fasteners which will make the furniture more vandal proof.

- **Design parameter**

The design shall be elegant with smooth curves that make it aesthetically good and appealing for the users. It shall be innovative & contemporary. Modular design is recommended for Street Furniture.

- **Universal design**

The furniture should also cater to differently-abled users. Design and manufacture should comply with ISO requirements.

5.27.3 Stone Litter Bin

Providing and fixing Stone Litter Bin of 60x60x98 cm (LxBxH) as per drawing. Each unit will have smooth finish, engrave lettering/designs and with top cover and draining facility as per

design including providing SS inner dustbin, fixing, making grooves, cleaning surfaces, including cost of loading -unloading and placing in place.

Dustbin should be made as per drawings provided by the architect.

- **Maintenance**

Quarterly checking and cleaning at regular intervals should be done. Broken and missing bins should be replaced as and when required.

- **Security & Safety parameter**

The design shall be free of any sharp edges, surface shall be smooth & the material used to be non-flammable. Bins shall be secured by an anti-vandalism locking arrangement to prevent any mishaps. The supporting structure shall be safely secured to the ground by either bolting, or by a foundation with anchor fasteners.

- **Universal design**

The furniture should also cater to differently-abled users. Design and manufacture should comply with ISO requirements.

5.27.4 Information Signage

Providing and fixing machine cut signage made from local stone with natural rock cut edge on sides as per design.

Information Signage should be made as per drawings provided by the architect.

Signage slab of 100mm thick with 15mm machine cut stone as per drawing including engraving of stone slab for alphabets/ drawings/motifs/maps including inclined support.

The signage to be anchored with foundation as per structural design including cost of making grooves, dressing, rubbing, rounded edges, wedge, tapering, cleaning etc. with cost of loading -unloading and placing in place.

5.27.5 Directional Signage

Providing and fixing machine cut signage made from local stone with natural rock cut edge on side as per design around 1.4 m clear height excluding below ground ht. of around 0.45m

Directional Signage should be made as per drawings provided by the architect.

Mounted on 100mm thick machine cut stone as per drawing including engraving of stone slab for alphabets/ drawings/motifs/maps.

The signage to be anchored with foundation as per structural design including cost of making grooves, dressing, rubbing, rounded edges, wedge, tapering, cleaning etc.

5.27.6 Stone Boulders

Providing and laying Large Stone Boulders used in Landscape of minimum size of 1.5 x1.5x 1 m including carving for sculpture works, loading-unloading with crane, labour, dressing, rubbing, curing, cleaning etc. complete at all levels and heights as per the design, shapes and sizes provided by the Architect.

5.28 Battery Operated Electric Golf Cart Vehicle

Providing battery operated electric golf cart vehicle-4 seater capacity with DC Shunt Wound / AC Motor. With frame made from Robotic welded automotive ladder-style steel frame protected with a multistep full immersion phosphate treatment, electro-deposition epoxy-based coating and an electrostatic applied polyester including all accessories like mirror, lights, raincover with voltage of 48 volts, output 6.7 HP (Make Hitachi), Stationery Constant Current Charger with 3 year warranty.

5.29 LANDSCAPING AND HORTICULTURE WORKS

5.29.1 General

The planting contractor shall provide all horticultural operations and services specified on the drawings/ schedule of quantities as specified herein or both, as instructed by the Engineer-in-charge (Hort)/ including: -

- a) Provide all equipment services and transport i.e. at least 4 Nos. Tractors with Trolleys, Water Tankers, Levellers, Spray Pumps, and Augers etc. as required for the project.
- b) Provide all plant material
- c) Provide topsoil for all plants
- d) Provide fertilizers, chemicals and manure as specified
- e) Preparation of planting locations
- f) Prepare plants pits, back filling, and prepare "saucers" at least 5" deep for watering, adding soil after settlement.
- g) Spraying before planting
- h) Staking supporting, wrapping and tying plant materials
- i) Transplanting, if any
- j) Disposal of debris and unused materials
- k) Guarantee of trees and plants for a period as per the tender requirement
- l) Plant material – Trees, Shrubs etc.
- m) Plant list – plants are listed in the drawings. The plants list is enclosed herein.
- n) Nomenclature – The names of the plants species confirm to standardized botanical names.

5.29.2 Quality and general requirements of plants

Plants shall be typical of their species and variety has normal growth habits, well developed branches, densely foliated with vigorous and fibrous root systems. Plant shall be free from disease and insects. Bark shall be free from abrasion.

Plants shall be grown in pots/bags. Plants shall have been grown under climatic conditions similar to those in locality of project. Nursery grown plants shall have been at least once transplanted. Plants growing in natural ground prior to supply shall not be accepted.

Each plant shall be properly identified by weather-proof labels securely attached there to before delivery to project site. No plant shall be delivered to the project site, except for required samples, until inspection has been made in the field or at the nursery or unless

specifically authorized in writing by the Engineer-in-charge (Horticulture)/Landscape Architect.

Baled and Burlap plants must be moved with the root system as solid units in balls of earth firmly wrapped with burlap. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous and feeding root system necessary for the healthy development of the plant. No plant shall be used when the ball of earth surrounding its roots have been badly cracked or broken prior to or during the process of planting or after the equipment required in connection with its transplanting has been removed. The plant and earth ball shall remain intact as one unit during all operations.

Container grown stock shall have been grown in container long enough for the root system to have developed sufficiently to hold its soil together, firm and whole. No plant shall be loose in container.

All plants shall be hardy under climatic conditions similar to those in the locality of the project. When plants of kinds or sizes specified are not available, substitution may be made upon request by the contractor if approved by the Project Engineer/Landscape Architect.

All plants should be strong sufficiently to stand straight without any support, but exceptional trees, soon after planting shall be properly supported to ensure their safety against wind or other factor which may affect it adversely.

5.29.3 Excavation Work

The land for the landscape development shall be cleared of all waste vegetation other than the existing trees. The removal of existing roots of small plants and stumps shall be removed up to 90 cm. Removing debris of previously executed civil works up to 100mm depth wherever required as directed by Engineer-in-charge and disposing off the debris anywhere outside the site premise is required. The place of disposal shall be directed by engineer in-charge. (up to 1 km outside the plot boundary.)

5.29.4 All kind of soil

Loose & soft soil -Any soil which generally yields to the application of pickaxes and shovels, phawaras, rakes or any such ordinary excavating implement or organic soil, gravel, silt, sand turf loam, clay, peat, etc. falls under this category.

Dense & hard soil -Any soil which generally requires close application of pickaxes or jumpers or scarifiers to loosen it, stiff clay and cobble stone etc., fall under this category

Hard murrum- The hard murrum shall be disintegrated rocks, which contain silicone material and natural mixture of clay of calcareous origin. The size of hard murrum will not be more than 20 mm

Black cotton soil- Soil which generally possesses typical characteristics of shrinkage and swelling due to moisture movement through it with atmospheric changes and soil which has its grains in the form of platelet or sheet is termed as Black Cotton Soil. It easily yields to the application of pick axes and shovels, phawaras, rakes or any such ordinary excavating implement. This soil type will have very low bearing capacity and will be blackish in color.

For workmanship for earthwork and excavation, relevant specifications of safety from IS: 3764 shall be followed. The depth of the excavation shall be as per the item description.

5.29.5 Clearing the Site

The site on which the structure is to be built shall be cleared and all obstructions, loose stones, materials and rubbish of all kind, bush, and wood shall be removed, as directed. The materials so obtained shall be the property of the Government and shall be conveyed and stacked as directed, within 50- m. lead. The roots of the trees coming in the sides of the trenches shall be cut and coated with hot asphalt.

All types of trees, woods etc. which requires prior permission of Govt. /Forest Authority, before cutting shall be cut after obtaining such permission from them. It shall be the Contractor's responsibility to obtain such permission from the respective authorities.

The rate of site clearance is deemed to be included in the rate of earthwork, for which no extra will be paid.

5.29.6 Setting out

After cleaning the site, the centerlines will be given by the Architect and Engineer-in-charge. The Contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labours, materials, etc. required for setting out the reference marks and bench marks made of MS angle iron and embedded in 1:2:4 CC. They shall maintain the same as long as required and directed.

5.29.7 Excavation

The excavation in the foundation shall be carried out either manually or by mechanical means, in true line and level and shall have the width and depth, as shown in the drawings or as directed. The Contractor shall do the necessary shoring and strutting or shall provide necessary slopes to a safe angle or steps, as required or directed, at his own cost. No extra payment shall be made for such precautionary measures, taken. The bottom of the excavated area shall be leveled both longitudinally and transversely, as directed, by removing excess soil and watering, as required. No earth filling will be allowed for bringing it to level, if by mistake or any other reason, excavation is made deeper or wider than shown on the drawings or as directed. The extra depth or width shall be made up with concrete of the same proportion, as specified for the foundation concrete, at the cost of the Contractor.

The Contractor shall at his own expense and without extra charge make provision of supporting all utility services, lighting the trenches, separating and stacking serviceable materials neatly, shoring, timbering, strutting, bailing out water either sub-soil or rainwater, including pumping at any stage of the work. Trenches shall be kept free of water while masonry or concrete works are in progress and till the Architect and Engineer-in-charge considers it necessary, i.e. till the concrete is sufficiently set.

5.29.8 Disposal of the Excavated Stuff

The excavated stuff of the selected type shall be used in filling the trenches and plinth or levelling the ground in layers, including ramming and watering etc. complete.

The Contractor shall remove the balance of the excavated quantity from the site of work, to a place, as directed, within a lead up to 50 m. measured from the outer face of the building / work under consideration and for all lift.

The lead is the shortest practical route and not necessarily the route actually taken. The decision of Engineer -In charge shall be final in this regard.

5.29.9 Mode of Measurement and Payment

The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Architect or Engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stepping and sloping back as found necessary, on account of conditions of soil and requirements of safety.

The rate shall include for clearing the site, surface dressing, making layout of the building, fixing permanent grid points with MS iron posts, embedded in C.C. 1:2: 4, placed sufficiently away from the building and establishing bench marks etc.

The rates shall include for necessary shoring, timbering and strutting for protection of sides of the excavated trenches and pits, pumping out rain or surface water at any stage of construction so as to keep the trenches/pits dry, to the satisfaction of the Architect/Engineer-in-charge.

The rate shall include leveling and ramming the bottoms of excavations to receive concrete, etc. including trimming to slope wherever necessary etc. complete.

The rate shall be for a unit of one Cum.

5.29.10 Garden Soil Filling

The good quality garden soil shall be obtained from outside which can be useful for all plants. Laying of soil shall be done in proper slope as per mention in drawing including watering, compacting and dressing etc. complete, as directed.

The stacked Earth and manure shall before mixing is broken down to particles of size not exceeding 6mm, in any direction. Good earth shall be thoroughly mixed with and Fertilizer in specified proportion as described in the items or as directed by the Engineer-in-charge.

The pits and beds shall first be excavated to the required depth and the excavated soil shall be stacked on the sides of the beds.

With a mixture of red earth, river silt, manure, in the proportion 5:4:1 The mixed Earth, Manure and river silt nutrients shall be refilled over the trenched bed, leveled neatly and profusely flooded so that water reaches the bottom most layers of the trenched depth of the beds and pits. The surface after full subsidence shall again be refilled with the earth and manure mixture.

Supply of healthy specified Trees, Shrubs, Hedges species supply of Garden soil, River Sand, Manure. Labour charge for spreading the media mixing in the desired proportion, surface preparation and planting of Trees, Shrubs, Hedges species and maintenance for a period 45 days from the date of virtual completion of the works.

5.29.11 Planting Specification

Height refers to the vertical height of the plant from the stem to the top of the stem. The height of the plant does not include the root system or the height of the polybag/ pot in which the plant is supplied.

Spread refers to the dia. of the canopy of the plant at the top of leaf which is determined by the average of the longest and the smallest diameter as viewed from the top of the plant.

5.29.12 Trees Plantation

Supplying of Trees

Supplying and planting of trees of specified variety in existing prepared tree pit including pesticides, termite treatment, and planting of mature plants (height minimum 15' or above as approved). Soil mounts 2' - 3' in size. Tree plantation should be carried on neatly accurately and with perfection as per drawing and instruction given by the Engineer-in-charge. Plants shall be planted by manual/ mechanical means and rate shall be inclusive of all material, labour, equipments as per description. Plant must be supply in bag size of 25"X25" or above. Plastic bags or pots should be removed carefully and soil around the roots should not be dropped or disturbed much. Rates for mortality to be inclusive. Work shall be done as shown in the drawing or as directed and approved by Engineer-in-charge.

5.29.13 Shrubbery Plantation

Supplying of Shrub/Creepers/ Ficus/ Indoor Plants

Supplying well grown shrub plants and ground cover plants of height as specified and planting as per drawing by providing and mixing garden soil with manure in depth of planter as instructed by Engineer-in-charge. Plants should be disease free and fungus free in 8"x 10" polythene bag. Plastic bags or pots should be removed carefully and soil around the roots should not be dropped or disturbed much. Bill shall be placed after completion of maintenance period but not before stabilizing the shrubs. Mortality rates to be inclusive. Work shall be done as shown in the drawing or as directed and approved by Engineer-in-charge. The ground coverage should be dense and uniform throughout the planting area.

To be planted in planting beds of size indicated and 600 mm or as shown in drawing depth and filled red earth, river silt, manure, in the proportion 5:4:1. A saucer shall be created around the plant to facilitate proper watering of the plant. After installing the sapling, a thorough watering is to be done on the same day to counteract any wilting that may take place. Thereafter, watering is to be done as outlined in the maintenance section of these specifications.

Shrubs shall be supplied in poly bags or earthen pots and shall be an average size as per BOQ above the level of the soil. Any reductions in size shall have to get approved by the Engineer-in-charge. Shrubs shall be obtained from Nursery Stock approved by the Engineer-in-charge and shall be free of any damaged stems. Whenever possible multi-stemmed planted shall be supplied.

5.29.14 Rate to include the following

- a. Supply of Shrub species and Soil media.
- b. Labour for planting beds, mixing the soil media, filling the planting beds with soil media, planting the sapling and maintaining for a period up to 45 days from the date of issuance of virtual completion certificate by site supervisor including necessary tools and tackles, pesticides, manures, watering etc., complete.

5.29.15 Maintenance

During the maintenance period

The maintenance time as part of the guarantee period will be up to 45 days from the date of issuance of virtual completion certificate by site supervisor or as per contract data. Maintenance will cover irrigation and the general care of the plant material including all necessary consumables.

Maintenance as part of the guarantee is to ensure that the plant material is growing healthy and without disease. If any plant dies due to neglect and poor maintenance, the contractor will be held responsible for the replacement of plants with installation free of cost. The replacement will include cost of plant, labour, materials and transportation.

The contractor shall record and inform the client of any damage to plant materials due to causes beyond the control of the contractor such as the digging of the soil for services and dumping of materials after completion of the installation.

Any multiplication of plants during the guarantee will belong to the AMC will be kept on the site for replacement and use in future phases.

- **Watering:** Once a day in the morning or evening. Watering will not be carried out during the middle of the day.
- **Removal of Weeds & Hoeing:** To be carried out also on a regular basis, i.e. a minimum of once a week based on the need. Hoeing is to be carried out when the soil is dry.
- **Pruning:** If the plant develops too many shoots or grows lanky, tall and weak. It is essential to retain the leader in most situations and maintain only healthy shoots and remove injured, dead and subsidiary shoots causing overlapping and overcrowding. Pruning should be done with a pruning knife or saw and to prevent infection, the open wounds should be tarred. However, pruning should not be indulged in for its own sake, as every tree has its natural crown and symmetry, which should be maintained.
- **Pest Control & Fertilizers Application:** Plants are to be treated once a month, or more frequently as the need arises with organic pesticides and fertilizers (unless unavoidable) for better growth. Diseased plants are to be treated / removed immediately to prevent spreading of the pest to adjacent plants.
- **Time Schedules, Procedures and Conditions:** All rates for items of work will include supply of materials, transportation and labour, in additions to soil and plant materials, rates are to include pit digging and back fill, manure pesticides, top dressing, fertilizers, stakes and supports as needed and maintenance during the guarantee period.

All landscape work is to be scheduled so that there is healthy growth of plant material and sufficient grass coverage at the time of inauguration of the project.

Hoses and any other heavy-duty items and all hand tools, insecticides, sprayers, portable sprinklers, pesticides, fertilizer, manure, etc., to be provided by the Contractor during the guarantee period.

The guarantee period with maintenance will be up to 45 days of virtual completion certificate by supervisor of AMC.

All landscape work will be carried out as per the drawings and specifications, with no deviations unless instructed by the supervisor of AMC in writing. Modifications may occur due to non-availability of materials, or on-site conditions that may require changes to the design.

The Planting plan may undergo revisions due to a requirement of AMC. Any new species will have to be quoted for separately.

- **Cleaning:** Upon completion work under this section, leave the site in a tidy condition, free from rubbish and surplus excavated materials to the satisfaction of the supervisor as appointed by the AMC.
- **Completion:** Complete contracted work in accordance with contract documents and any written variations orders issued by the supervisor as appointed by the AMC.

Important Note: All selected plants will have to be approved by the SSCL before planting. No plant shall be changed without written approval of the SSCL. All plants sizes shall be strictly adhered to.

Section 6 Technical Specifications –Plumbing and Irrigation works

6.1 BASIS OF DESIGN AND INSTRUCTIONS

6.1.1 BASIS OF DESIGN

The Plumbing, Sanitary, Drainage & Rain water disposal System for the Fort is designed keeping in view the following:

Requirement of adequate and equal pressure availability of water lines in Toilet as well landscape sprinklers.

Adequate storage of water in Over head water tanks, preferably for a day consumption.

Provision of Pressure pumps installation for filling overhead tanks as well irrigation system.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

6.1.2 CONCEPT OF THE SYSTEM

The following services are envisaged:

Domestic water shall be supply to Over head tank of toilet block by Pressure Pumping system.

Flushing water shall be supply to landscaping and irrigation system by Pressure Pumping system.

Sewage and Sludge collection system based on IS: 1742 and applicable standards for domestic drainage.

Storm / Rain water drainage system from various levels of the site and disposal to available in the storm water system.

Separate Garden water supply hydrant taps from Flushing water lines at required distance.

6.1.3 WATER STORAGE & DISTRIBUTION SYSTEM

Water Requirement

The water requirement for the project is proposed to be based on the provisions of IS: 1172, SP 35 and prevalent practice. The estimated requirement of water per day for the fort is based on the number of users and visitors. Landscape water demand based on Green area and water demand as per Landscape consultant.

Source of Water

Main source of water supply shall be Diu municipal corporation and alternative source of water should be bore well water.

Water Distribution

The water distribution for cold water supply for the toilet block shall be designed on principle of availability of adequate residual head required at Terminal. Provision of pressure reducing station and non-return valve shall be made for effective and efficient water distribution in the line if required.

6.1.4 SEWAGE, SULLAGE AND STORM WATER

Soil & waste stacks of different line shall be diverted & connected to sewer network which will be terminated at Septic tank to sock well.

Design Limitations

The system is designed considering the following:

- a. High thrust developed at soil & water pipe connections.
- b. Termination of vent cowl at terrace level.
- c. Provision of adequate slope for horizontal header pipes for achieving self-cleaning velocity in the pipes.
- d. Provision of cleanout plug.

6.1.5 WORKMANSHIP

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Owner's Site Representative. All materials and/or Workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

6.1.6 MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Owner's Site Representative / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

6.1.7 PRECEDENCE

Any conflict between the technical requirements stated in the Data sheet or Purchase Order and the technical requirements of this specification shall be referred to Owner for clarification. The precedence of purchase documents is as follows:

- This specification / Data Sheet
- Documents referenced in this specification

The technical requirements specified in the Data sheet or Purchase Order including terms, conditions and legal requirements.

6.1.8 TEST CERTIFICATE

The contractor shall submit test certificates for all the relevant material / system installed. These shall be issued by a government recognized inspection office certify that all equipment, materials, construction and functions are in agreement with the requirements of these specifications, ISI and when ISI is not applicable other approved certify agencies.

6.1.9 INSTRUCTION MANUAL:

The contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and maintenance of the supplied equipment and installations, and submit hard copy to client.

6.1.10 PRODUCTS SAMPLES AND CATALOGUE:

Before ordering the material necessary for these installations, the contractor shall submit to consultant / client for approval, a sample of every material such as pipes, valves, accessories etc., along with the catalogues.

Prior to ordering any plumbing equipment/material/system, the contractor shall submit catalogues, along with the samples, at least from 2-3 different manufacturers to consultant / client. After the selection of manufacturer by consultant / client, the contractor shall arrange inspection and testing at the manufacturer's factory or assembly shop for final approval. No material shall be procured prior to the approval of the consultant / client.

6.1.11 SHOP DRAWINGS:

The contractor shall prepare and submit Shop drawing to Consultant/Client, for his approval, two sets of detailed drawings of all water supply drainage pipe route, valve arrangement, connection details, support details etc to be provide with respect to site condition by the contractor, or other vendor within 15 days of signing of the contract.

The consultant / client reserve the right to alter or modify these drawings if they are found to be insufficient or not complying with the established technical standards or if they do not offer the most satisfactory performance or accessibility for maintenance.

6.1.12 AS BUILT DRAWINGS

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit to consultant / client., three sets of layout drawing drawn at appropriate scale indicating the complete wiring system “as installed” duly approved by Consultant. These drawings must provide with plan, elevation and section.

6.2 SANITARY FIXTURES & FITTINGS

SCOPE:

Work under this section shall limited up to receiving , unloading, shifting, testing, safe keeping, storing, installing & commissioning etc. and all labor as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

All the sanitary fixtures & C.P. fittings shall be check as per the specified / approved catalogue no. of specified manufacturer as per selected.

General Requirements

- All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings or not.
- All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.
- Fixing screws shall be half round head chromium plated brass / GI with C.P. washers wherever required as per directions of Client's Representative.
- All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows 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, wall or ceiling surfaces shall be made good at Contractors cost.
- All fixtures of the similar materials shall be by the same manufacturers
- All fitting shall be of the chromium plated materials.
- Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.
- Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, and hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.
- For the installation of the CP fittings, Teflon tape shall be used.

6.2.1 EUROPEAN W.C.:

- European W.C. of glazed vitreous china shall be wash down, single or double siphonic type, floor or wall mounted set (P trap or S Trap), flushed by means of concealed dual flush tank as specified in Bill of Quantities. Flush pipe/bend shall be

connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair / Anchor Fastener.

- Each W.C. quiet close seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of approved color & type solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.
- Dual concealed Flush tanks shall be of the best approved quality procurable within built C.P. control valve and C.P. flush pipe.
- The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.
- Alternatively if flushing cistern to be used shall confirm to the requirements of IS: 774-1971. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Owner/Architect/ Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.
- The levels of the WC should be checked by placing strip level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out, the fixing will have to be rectified / re-aligned.

6.2.2 HEALTH FAUCET

- The C. P. Health faucet shall be of best quality, as specified in BOQ item and of approved make. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958. Each health faucet provided with 1 mtr. Long flexible PVC tube and wall hook etc.
- The health faucet Hook & health faucet shall be fixed in position as per drawings or as directed by Architect / EIC. The height shall be approx. 45cm from floor level if not mentioned in the drawing. The one end of 1.0 meter long pipe shall be connected to faucet & other end to the angle cock.

6.2.3 FLUSHING CISTERN

- The Concealed Cistern material shall be of best of quality conforming to IS 776 - 1979. It should be green building approved with low flow type with dual flush 2/4 liters capacity. Designed for low volume flushing from 3/6 or 2/4 liters of water, flushed by means of a porcelain flushing cistern or an exposed or concealed type (as detailed in the drawings or as directed by the Owner's Site Representative) and a low level cistern with maximum height of 30 cm between the top of the pan and under side of the cistern.
- Low level cistern handle shall be Plastic cistern, operation of cistern shall be through Push Button at the top for dual system and beyond plastic handle.

6.2.4 SEAT AND COVER

- The seat and cover shall be of the best Indian make conforming to I.S. 2548-1980. They shall be made of molded from PP heavy duty material which shall be tough and hard with high resistance to solvents and shall be free from blisters and other surface defects and shall have chromium plated brass hinges and rubber buffer of suitable size.

- Installation of seat and cover to water closet- The seat shall be fixed to the pan by means of two corrosion resistant hinge bolts with a minimum length of shank of 65 mm and threaded to within 25 mm of the flange supplied by the manufacturer along with the seat. Each bolt shall be provided with two suitably shaped washers of rubber or other similar materials for adjusting the level of the seat while fixing it to the pans. In addition, one non-ferrous or stainless steel washer shall be provided with each bolt. The maximum external diameter of the washer fixed on the underside of the pan shall not be greater than 25 mm. Alternative hinging devices as supplied by the manufacturer of the seat can also be used for fixing with the approval of Engineer-in-Charge.

6.2.5 SQUATTING PANS (INDIAN TYPE W.C.)

- Squatting pans shall be of white vitreous china conforming to IS 2556 Part-I for General Requirements and relevant IS codes for each pattern as described below: (i) Long pattern-conforming to IS 2556 (Part-3).
- Orissa pattern-conforming to IS 2556 (Part-3).
- Integrated type conforming to IS 2556 (Part-14).
- Preferably Orissa type pan should be used.
- Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes, as shown in Fig. 17.19, 17.20 & 17.21. The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the Engineer-in-Charge.
- The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.I. trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the Engineer-in-Charge.

6.2.6 WASH BASINS:

- Wash basin shall be of approved color & type vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.
- Wash basin shall be of required size, shape, type as specified in detailed BOQ shall be supported on a pair of C.I. brackets of approved design.
- The wash basin shall be fixed in position as indicated in the drawing or as directed by Client's Representative. Basin shall be supported on a pair of C.I brackets which is embedded in cement concrete (1:2:4) block 100 x 75 x 150 mm.
- Oval shape or round shape wash basins are required to be fixed in RCC platform with stone tapping either fully sunk in stone top or flush with stone topping.
- The wall plaster on seat shall be cut to rest over the top edge of the basin so as not to leave any gap for water seepage through between wall plaster & skirting of basin. The gap between basin and wall shall be finished with white matching cement.

6.2.7 WASTE COUPLING

- Waste Coupling shall conform to IS 3311. Waste fittings shall be of CP with thickness of CP coating not less than service Grade No.2 of IS 4827 which is capable of

receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed. The waste fitting for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

- Waste coupling shall be fixed to wash basin, sink or urinal as ordered with necessary specials. Jointing shall be done with white zinc, yarn etc. A few turns of fine hemp yarn dipped in the linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

6.2.8 BOTTLE TRAP

- Bottle trap shall be of C.P with thickness of CP coating not less than service grade No. 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect of IS 2963 and shall be sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed and be truly machined so that nut smoothly moves on the body. The Bottle trap for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.
- Bottle trap shall be 31mm single piece molded with height of 300 mm, effective length of tail pipe 200 mm from the centre of the waste coupling, 77 mm breadth with 25 mm minimum water seal, weighing not less than 260 gms.
- Bottle trap shall be fixed to wash basin, sink or urinal as indicated in the drawing with necessary specials or as ordered by the Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall remade to make it leak proof.

6.2.9 MIRROR

- The mirror shall be of superior sheet glass with edges rounded off or beveled, size 600 x 450 mm unless specified in the schedule. It shall be free from flaws, specks or bubbles and thickness plated and should not be less than 5.0 mm. The back of mirror shall be uniformly silver plated and should be free from silvering defects. Silvering shall now have a protective uniform covering of red lid paint, where beveled edge mirror are not available. Fancy looking mirrors with PVC beading/border or aluminum beading on stainless steel beading/border based on manufacturer's specification, provided nothing extra shall be paid on this account. The backing of mirror shall be provided with 6mm thick marine plywood or environmentally friendly material other than asbestos cement sheet.
- Mirror shall be fixed in position with 6mm thick marine ply wood backing. It shall be fixed by means of 4 nos. of CP brass screws & caps over rubber washers and roll plug or as per the manufacturer's specification unless specified otherwise the longer side shall be fixed horizontally.

6.2.10 PAPER HOLDER

- The C.P. Toilet paper roll holder shall be of chrome plated of specified size and design as approved by the Architect / Engineer-in-charge. Tissue roll holder shall conform as per IS standard and should have ISI mark. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958

- Tissue roll holder shall be fixed in position as per drawings or as directed by Architect / EIC to the wall with C.P brass or SS screws as approved by Architect / EIC, with the help of PVC grip of Jaquar/Cera/Parryware/Hindware or equivalent.

6.2.11 TWO WAY BIB COCK

- The item pertains to provide chromium plated brass combination tap assembly wall mounted for wc, sink, basin etc. including free flanges and fixing. Basin mixer shall be as specified in item, and as approved by Architect / EIC. PVC water inlet connections compatible for hot and cold water as specified in item, shall conform to IS specifications and shall be of standard pattern with braided hose of minimum 450 mm long with CP brass check nut at both the end and shall be able to withstand the testing pressure of 1 Mpa (10 kg/sq. cm.)The combination tap assembly shall be 15 mm nominal size or as specified in the schedule.
- It shall be of C.P. brass approved and heavy quality, and shall conform to I.S. 8931. Combination tap assembly shall be chromium plated-brass and shall conform to IS 8931.The nominal size of combination tap assembly shall be 15 mm nominal size or as specified. Casting of combination tap assembly shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.
- Combination tap assembly shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with Teflon tape, etc. Combination tap assembly shall withstand and internally applied hydraulic pressure of 1.6Mpa (16 kg/sq. cm) for period of 1 minutes during which, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof.

6.2.12 PILLAR COCK

- The item pertains to provide chromium plated brass combination tap assembly wall or floor mounted hot & cold mixing for sink, basin etc. including free flanges and fixing. Pillar cock shall be as specified in item, and as approved by Architect / EIC. The combination tap assembly shall be 15 mm nominal size or as specified in the schedule. It shall be of C.P. brass approved and heavy quality, and shall conform to I.S. 8931. Combination tap assembly shall be chromium plated-brass and shall conform to IS 8931. Casting of combination tap assembly shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.
- Combination tap assembly shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with teflon tape, etc. Combination tap assembly shall withstand and internally applied hydraulic pressure of 1.6Mpa (16 kg/sq. cm) for period of 1 minutes

during which, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof.

6.2.13 URINAL WITH SENSOR

- The lipped type urinal shall be flat back and shall conform to I.S. 771-1979. It shall be of best Indian make, size and color as specified and approved by Architect / EIC. It shall be of the first class quality and free from any defects. The urinals shall have fixing arrangement 32 mm dia. CP domicile waste and CP pipes with a wall flange. The urinal shall be fixed to the wall by one CI bracket and two CI wall clips, as approved by the manufacture complete as directed. The auto flushing sensor and closing valve shall be fixed with inlet connection of urinal. The auto flushing sensor should be low flow green building approved fixture. Unit automatically serves (the range in about 40 cms.) and flushes in two steps. The pre flush is for 2 seconds duration and the final flushing is for 7 seconds duration.
- The urinals shall be fixed in position by using fastener/CI brackets and shall be at a height 60 cms from the floor level to the top of the lip or urinal, unless otherwise directed. The bracket shall be 50 mm x 50 mm at base lapping to 38 mm x 38 mm at top and 50 mm in length shall be fixed in wall in cement mortar 1 : 3 (1 cement : 3 coarse sand). The urinal shall be connected to 50MM mm. dia. PVC waste pipe (through bottle trap) which shall discharge in the floor trap. The connection between the urinal bottle trap and flush or waste pipe shall be made by means of putty or white lead mixed with chopped hemp/rubber gasket of bottle trap.

6.2.14 ANGLE VALVE

- Angle stop cock is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. These shall be of size 15 mm sizes or as specified and shall be of screw down type. The closing device shall work by means of disc. Carrying a renewable non-metallic washer with shuts against the water pressure on seating right angles to the axis of the threaded spindle which operates it. The handle shall be crutch, butterfly or fancy design type securely fixed to the spindle. The tap shall open anti clock wise direction.
- Angle stop cocks shall conform to IS 781, they shall be polished bright. They shall be sound and free from taps, blow hole and fitting. Internal & External surface shall be clean, smooth and free from sand and neatly dressed. Taps shall be nickel chromium plated and thickness of coating shall not be less than service grade No.2 of IS 4827 and plating shall be capable of taking high polish which shall not be easily tarnished.
- Every tap complete with its component shall with stand an internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) maintained for a period of 2 minutes during the period it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from contractor.
- The body of stop cock of 15mm diameter with adjustable flange shall be as specified above shall be fixed on water supply line keeping the arrow in the direction of flow as per drawing or as directed. Transition male /female adopter with shall be used on either side on PVC pipes. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the cock. On completion the tiling work, the outer part of stop cock shall be fixed to the brass body.

6.2.15 CP BRAIDED HOSE PIPE

- The CP braided hose pipe connection shall be of Make as specified / approved by architect/ consultant and of size and design as approved by the Architect / Engineer-in-charge. Hose pipe shall conform as per Manufacturer standard and should have ISI mark. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958
- The CP braided hose pipe shall be fixed in position as per drawings or as directed by Architect / EIC to the wall with C.P brass or SS screws as approved by Architect / EIC
- The hose pipe shall be 450 mm long Braided Hose pipe with M10X1 Nipple, 15mm Nut, O-Ring & Rubber Washer (Suitable for Wash Basin, Kitchen Sink etc) of approved make and conforming to Manufacturers Standards.

6.2.16 TOWEL RING

- The Towel ring shall be of Make as specified and of size and design as approved by the Architect / Engineer-in-charge. Towel Ring shall conform as per Manufacturers standard and should have ISI mark. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958
- Towel Ring shall be fixed in position as per drawings or as directed by Architect / EIC to the wall with C.P brass or SS screws as approved by Architect / EIC, with the help of PVC grip of HILTI/Fischer or equivalent.

6.2.17 SHOP DISPENSER

- The Soap Dispenser shall be of Make as specified and of size and design as approved by the Architect / Engineer-in-charge. Towel Ring shall conform as per Manufacturers standard and should have ISI mark. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958
- Soap Dispenser shall be fixed in position as per drawings or as directed by Architect / EIC to the wall with C.P brass or SS screws as approved by Architect / EIC, with the help of PVC grip of HILTI/Fischer or equivalent.

6.2.18 COAT HOOK

- The Robe Hook shall be of Make as specified and of size and design as approved by the Architect / Engineer-in-charge. Robe Hook shall conform as per Manufacturer standard and should have ISI mark. The chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958
- The Robe Hook shall be fixed in position as per drawings or as directed by Architect / EIC to the wall with C.P brass or SS screws as approved by Architect / EIC, with the help of PVC grip of HILTI/Fischer or equivalent.

6.2.19 MEASUREMENTS:

- Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.

- Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

6.3 WATER SUPPLY

SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for external services as follows:

Domestic Water Supply – Cold

Flushing Water Supply – Cold

PIPING MATERIALS

The piping system shall also consist of uPVC pipes Sch-40/80 conforming to ASTM D-1785, for flushing water supply & expose pipe with solvent /screwed based fittings conforming to ASTM D-2467.

Outside the building the piping shall be installed at least 1.0 m below the finished grade level.

6.3.1 CPVC Pipes & Fittings

The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -13.5 at a working pressure of 320 PSI at 23 deg C and 80 PSI at 82 deg.C, using solvent welded CPVC fittings i.e. Tees, Elbows, Couplees, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-441, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager. The material shall have to be gotten approved from Chief Fire Officer.

i. 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 which provides optimal bonding area within a joint.

b. Deburring / Beveling:

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

c. Fitting preparation:

A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application:

Only CPVC solvent cement confirming to ASTM-F493 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, otherwise too much of cement solvent can cause clogged water ways.

e. 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 ¼ to ½ 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.

An even bead of cement should be evident around the joint and if this bead is not continuous remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table.

Minimum Cure prior to pressure testing at 150 PSI

Ambient Temperature during Core period	Pipe Size	
	½ " - 1"	1.¼" - 2"
Above 15 deg. C	1 Hr	2 Hrs
4-15 deg.C	2 Hrs	4 Hrs
Below 4 deg C	4 Hrs	8 Hrs

Special care shall be exercised when assembling flow guard systems in extremely low temperature (below 4°C) or extremely high temperature (above 45°C) In extremely hot temperatures, make sure that both surfaces to be joined are till wet with cement solvent when putting them together.

f. Testing

Once an installation is completed and cored as per above mentioned recommendations, 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 and replacing the same with new one by using couplers.

ii. Transition of Flow guard CPVC to 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 torqued Hard tight pluts one half turn should be adequate.

iii. Threaded Sealants

Teflon tape shall be used to make threaded connections leak proof.

iv. Solvent Cement

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves. Flowguard CPVC cement solvents have a minimum shelf life of 1 year. Aged cement solvent will often change colour or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company’s seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below

Diameter of pipe in inch (flowguard)	½"	¾"	1"	1¼"	1½"	2"
Approx. nos. of joints which can be mode per litre of solvent cement.	200	180	150	130	100	70
	Nos		Nos	Nos	Nos	

v. Hangers and supports

For Horizontal runs, support should be given at 3 foot (90 cm) intervals for diameters of one inch and below and at 4 foot (1.2m) intervals for larger sizes.

Hangers should not have rough or sharp edges which come in contact with the tubing.

Supports should be as per the below mentioned table:

Size of Pipe	21°C	49°C	71°C	82°C
Inch	Ft.	Ft.	Ft.	Ft.
½"	5.5	4.5	3.0	2.5
¾"	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
1½"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

6.3.2 VALVES

- i. The scope of this section comprises the supply, installation, testing and commissioning of various valves – butterfly, gate, globe, check, safety, ball, sluice, float valves etc. on all the water supply pipe lines.
- ii. Schedule of Rates shall also be read in conjunction with this technical specification so as to have a complete view of the specifications for the particular item.
- iii. Necessary unions shall be provided on both ends of the valves for easy replacement.
- iv. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.
- v. Different piping materials for the water supply are used in the project and so based on the type and material of pipe used; the material of valves shall be selected.
- vi. Tail pieces as required shall be supplied along with valves.

6.3.3 Ball Float valve

- i. The ball float valve shall be of cast Brass as specified conforming to IS 1703 The ball float Valve shall be of following two classes:—
- ii. High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.
- iii. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers.

- iv. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets.
- v. Tail pieces as required shall be supplied along with valves.
- vii. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

S.No	Type of Valve	Size	Construction	Ends
a.	Ball Valve (Isolation valve)	15 mm to 50 mm	Brass/ Bronze	Screwed
b.	Butterfly Valve	65 mm and above	Cast Iron	Flanged
c.	Non return valve	15 mm to 50 mm 65 mm above	Gun metal Gun Metal	Screwed Flanged
d.	Flap Type – Non return valve	65 mm and above	Cast Iron	Flanged

All valves shall be suitable for the working pressure involved.

6.3.4 Pressure Reducing Valve Set

- i. Each pressure reducing valve set for cold and hot water supply shall comprise of 3 nos GM / brass ball valves on inlet, outlet, and bye-pass, 1 No Gun metal pressure reducing valve with flanged connection, 1 No. 'Y' strainer, 2 Nos Pressure gauge on inlet & outlet, and 1 No. 15 mm dia safety valve. The upstream pressure will be up to 16 Bars and the downstream pressure may be as low as 1.0 Bars.
- ii. Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.
- iii. Valves shall be capable of operating at the maintaining automatically the respective delivery pressure and flow rates as indicated and shall not be liable to creep. Valves shall also be capable of maintaining the pre-set down stream pressure under static condition.
- iv. The filter on each inlet to a pressure reducing valve shall be of replaceable porous sintered metal type.
- v. For pipe sizes 15 mm to 32 mm dia direct acting pressure reducing valves shall be provided with integral strainer and have an adjustable pressure range from 1.0 Bar to 16 bars.

- vi. Automatic diaphragm actuated, pilot controlled, hydraulically operated pressure reducing valve shall be provided for pipe sizes 40 mm dia and above
- vii. Suitable insulation shall be provided, wherever required, when used for hot water applications.

6.3.5 Air release Valve

- i. Double acting, of approved make, having 2 chambers with ebonite ball, small and large orifices with isolating stop screw down valve, GM seats, high tensile brass spindle with cap.
- ii. At least 501 m³/hr of air is released when fully open.
- iii. Released air volume is at least 0.026 m³/hr at 5 psi with 225.

6.3.6 WATER FITTINGS

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.

6.3.7 BALL FLOAT VALVES

- Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having PVC balls screwed to the arm integrally.
- The ball shall have bronze welded seams.
- The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers.
- The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system.
- Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe. Globe valves on Hot-water line shall be union bonnet with stem/disc and body seat ring of SS. Suitable for temperature up to 80° C.
- The rate shall be for a unit of One Number

6.3.8 WATER TANKS

- IS 12701
- The item includes providing polyethylene plastic water tank with cover of capacity as mentioned in the schedule including fixing and making connections such as inlet, outlet, scour, overflow etc.
- The water tank shall be made out of best moulded Polyethylene plastic. It shall be vertical or horizontal type as specified, watertight and non-absorbent and shall not contaminate water.
- Adhesives shall not be used in joints.
- The cover shall be of polyethylene / M.S. / C.I. as approved.
- The plastic water tank with cover shall be installed and fixed as per the manufacturer's specification.

- The connections such as inlet, outlets, over flow, scour etc. of specified diameter shall be made as mentioned in the schedule including the cost of fittings, fixtures and pipe of approximate 400 mm long.
- The measurement shall be for each polyethylene water tank of specified capacity installed or per litre capacity of water tank.
- The rate shall be for a unit of One Litre.

6.3.9 WATER COOLER

- Water cooler shall be storage type heavy duty faster cooling unit suitable for installation. With in hot shop bay/ office premises The water coolers shall be conforming to IS:1475-1978 and energy performance shall be as per IS:1475(Part1).- 2001 The Water cooler shall be SS body and SS Storage tank free from any corrosion and bacteria/algae formation. Necessary interconnecting water piping (having a maximum length of 20m) & fittings shall be included for connection of drinking water network within each of the places (Refer electrical portion of the TS – For location) to the water coolers. Water coolers shall be supplied with lead cable and industrial duty 240V, 15/5A switch socket unit suitable for installation
- On shop columns of each of the above areas. The features of water cooler & water purifier are as follows.
- Cooling Capacity - 40 Litres/Hr and 80 Litres/Hr
- Water Flow Rate - Not less than 1 LPM
- Compressor - Energy efficient hermetically sealed Compressor with Suction gas cooled, equipped with over load protector, Relay and other accessories
- Refrigerant Non-CFC, Non-toxic, Non-inflammable preferably R-134a/R-22
- Input Power Supply - 180-230 Volts, 50 Hz, Single Ph. AC supply with 3 Pin plug top and proper earth connection
- Body Material Tank - stainless Steel
- No of Taps/Faucets - 1 for 40 litres capacity and 2 /3 for 80 liters capacity
- Make - Voltas/Blue star/Usha/Eureka Forbes/Kent/Electrolux/Approved equivalent
- Mounting - Floor
- Standard - IS /ISO certified IS1475(PART 1):2001
- Application - Industrial

6.3.10 REVERSE OSMOSIS WATER PURIFICATION

- The water purifier shall be connected to the Water cooler of 40/ 80 Litres/hr cooling capacity. It must have advanced 3 stage purification processes deploying last point purification process to ensure delivery of 100 % safe drinking water. Other specification shall be as follows
- Safety Mechanisim - Built-in Electronic monitoring system to ensure Complete purification of water before allowing the flow.
- Purification Processes - 3 stage Purification process. Should meet drinking water quality as per IS – 10500 (1991)
- Integration with Water cooler - Either inbuilt or from outside,
- No of Taps/ Faucets - 1 for 40 liters units and 2/3 for the 80 litre units(same nos. and type as in water cooler)
- Make - Eureka Forbes/Kent/Voltas/Blue star/Electrolux/Usha/ Approved equivalent
- Standard - IS/ISO certif.
- Application - Industrial

6.3.11 LAWN/ GARDEN HYDRANTS

- Lawn hydrants shall be of 15mm size unless otherwise indicated. All hydrants shall be provided with ball valves and threaded nipple to receive hose pipes. Also the GI hydrant pipe support with base plate and clamp, Lawn hydrant valves shall be of approved make and design. Where called for lawn hydrants shall be located in masonry chambers of appropriate size.
- Hydrant shall be provided Note board “NO DRINKING WATER” to prevent use Sewage treatment plant recycled water for drinking.

6.4 SOIL, WASTE, VENT, RAIN WATER PIPES AND CHAMBERS

SCOPE OF WORK

- Work under this section consists of furnishing all labour, materials, equipment and appliances necessary and required to completely install soil, waste, vent pipes and rain water as required by the drawings, specified herein after and given in the bill of quantities.
- Without restricting to the generality of the foregoing, the soil waste and vent piping system shall include the following.
- Vertical and Horizontal Soil & Waste centrifugal CI pipes and fittings, joints, clamps and connections to fixtures.
- Connection of all pipes to sewer lines as shown on the drawings.
- Floor and urinal traps cleanout plugs and inlet fittings.
- Testing of all pipelines.

GENERAL REQUIREMENTS

- Materials shall be of the approved make and quality specified. They shall conform to the respective Bureau of Indian Standards Specifications and supported by Manufacturing test certificate.
- Pipes and fittings shall be fixed truly aligned to vertical, horizontal or on slopes as required for proper functioning of the system. 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.,
- Pipes shall be fixed securely to walls and ceilings by suitable clamps at intervals specified.
- Access door for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

6.4.1 INTERNAL SEWERAGE (UPVC PIPES AND FITTINGS)

6.4.2 SPECIFICATION OF PIPES:

- POLYVINYL CHLORIDE (PVC) PIPES AND FITTINGS MATERIAL Soil, waste & vent pipes shall be PVC pipes & fittings.

- PVC (SWR) class pipes of dia 75mm, 110mm and 160mm, of Type A for use in rain water, and ventilation system (unless otherwise specified) and of Type B for soil, waste water system and conforming to IS 13592: 1992, shall be used.
- The pipes shall be supplied in nominal lengths of 2,3,4 or 6 meters.
- Any physical test requirements shall be as per IS13592-1992.

6.4.3 HANDLING:

- Because of their lightweight, there may be a tendency for the PVC pipes to be thrown much more.
- Reasonable care should be taken in handling and storage to prevent damage to the pipes.
- The pipes shall be stored as per manufacturer's specification. The contractor will hold full responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

6.4.4 LAYING

- The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as shown in the drawings.
- The minimum thickness of fittings shall be of 3.2 mm. the fittings shall be of injection mould type with solvent cement joint or rubber ring joint.
- The pipes and fittings shall be capable of withstanding sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets /supports as detailed in the drawings.
- All pipes laid under Floor/ Suspended Ceiling shall be solvent Cement Joint.
- All Pipes laid vertically in shafts and other areas shall be rubber Ring Joint.

6.4.5 JOINTING

- The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations.
- The PVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows
- Cut the spigot end of the pipe square.
- All burrs from the internal and external surfaces should be removed.
- The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
- Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
- Insert the pipe end into the socket of the fitting and push it in upto the mark.
- Remove the excess solvent cement and hold the joint firmly in position for 30seconds to dry. Gluing should be avoided in a rainy or foggy weather.
- The other method of jointing shall be by rubber rings.
- The material of rubber ring should conform to IS 5382-1969. The ring is housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and housing.

- Lubricating paste should be applied before compressing the rubber. Where natural rubber rings are used, mineral oil or petrol or grease should be used.

6.4.6 TESTING

- PVC pipes and fittings assembled shall be tested in accordance with IS 13592 - 1992. The openings of the pipes shall be sealed for the section to be tested.
- The water column of 5m and shall be maintained for a maximum of 15 minutes.
- The contractor with the attendance of the Client team shall examine carefully all the joints for leakage.

6.4.7 PVC PRESSURE PIPES AND FITTINGS

- The PVC pressure pipes and fittings shall be used for conveying wastewater from washbasins, kitchen sinks etc., to floor drains.
- The pipes shall be class III, 6 Kg/cm². PVC pipes and fittings shall be jointed with solvent cement.
- The pipes shall conform to IS 4985 - 2000. Fittings shall be of injection moulded PVC conforming to IS 7634 (Part1) -1975.

6.4.8 LAYING AND FIXING

- The pipe laying and jointing shall be done in accordance with IS 7634 (Part 3) – 1975. Pipes shall be cut to size and chamfered well.
- Burrs if any shall be removed. Pipes and fittings shall be jointed using solvent cement or rubber ring joints.
- The pipes and fittings shall be jointed accurately without any stress to achieve leak proof joints.

6.4.9 TESTING

- Testing procedure will comply with the relevant IS code for testing of such pipelines.
- The rate shall be for a unit of One Rmt.

6.4.10 TRAPS:

- Nahani traps or floor traps/P-TRAP shall be cast iron/Low noise PVC (SKYRISE), deep seal with an effective seal of 50 mm.
- The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor.
- The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level.
- Contractor shall provide all necessary shuttering and cantering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.
- The trap shall be installed at lowest point ensure no pending occurs at perimeters of the drain.

- Floor traps gratings shall be in two pieces. Outer frame 150mm square with round SS-316 grating with hinge or without hinge as approved by Architect / EIC shall be used.
- The grating shall be embedded in white cement sand mortar 1:2. The joint shall be leakage proof as per drawings and as directed. Rate shall be inclusive of cutting of floor in best workmanship manner. Centre of jali and center of the floor trap shall be coinciding. The trap shall be installed at lowest point to ensure no pending occurs at perimeters of the drain.

6.5 UNDER GROUND DRAINAGE DOUBLE WALL CORRUGATED PIPES:

- All underground sewer lines where specified Double wall corrugated pipes SN8 for general. Pipes shall be true and straight with uniform bore throughout. Cracked, wrapped, Bend pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.
- These shall conform to IS: 16098 Part II and ISO – 21138 Part III of Stiffness class SN 8. Pipes shall be Rodent prevent.
- All pipes shall be true to shape, straight, perfectly sound and free from cracks, Bend and flaws. The external and internal surface of the pipes shall be smooth and hard.

6.5.1 LAYING:

- Pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre-cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and boning rods, etc. Cradles or concrete bed may be omitted, if directed by the Client's Representatives.

6.5.2 JOINTING:

- Pipes shall be one time joint by interlocking jointing system with Rubber ring, all joints shall be water tested.

6.5.3 PIPE SUPPORTS:

- Unless otherwise directed by the Client's Representative cement concrete for bed, all round or in haunches shall be laid as follows:

	Upto 1.5m depth (5')	Upto 3m depth (10')	Beyond 3m depth (10')
Pipes in open ground (no sub soil water)	all round (1:5:10)	in haunches (1:3:6)	all round (1:5:10)
Pipes in sub soil water	all round	in haunches	in haunches

	(1:3:6)	(1:3:6)	(1:3:6)
Pipes (in all conditions)	all round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
Pipes under road or building	all round (1:3:6)	all round (1:3:6)	all round (1:3:6)

- Pipes may be supported on brick masonry or pre-cast RCC or in situ cradles. Cradles shall be as shown on the drawings.
- Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

6.5.4 TESTING:

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water head maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 metres head of water at the highest point of the section under test. The pipes shall be plugged preferably with standard drain plugs (with rubber rings) on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.
 - There should not be any pressure drop in pipe.

6.5.5 MEASUREMENT:

- Excavation: Measurement for excavation of pipes trenches shall be made per linear meter.
- Trenches shall be measurement between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 meter or as given in the Bill of Quantities.
- Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the Bill of Quantities and above the rate for depth upto 1.5 m.
- pipes shall be measured for the length of the pipe line per linear meter i.e.:
- Length between manholes shall be recorded from inside of one manhole to inside of other manhole.
- Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole.

6.5.6 GULLY TRAP

- Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters.

- Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.
- Excavation: The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer-in-Charge.
- Fixing: The gully traps shall be fixed on cement concrete foundation 65 cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes described above.
- Brick Masonry Chamber : After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 mm (inside) in brick work of specified class in cement mortar 1:4 (1 cement: 4 fine sand) shall be built with a half brick thick brick work round the gully trap from the top of the bed concrete up to ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.
- C.I. cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth. The finished top of cover shall be left about 4 cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

6.6 MANHOLE

- At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 30 m.
- Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer - in-Charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.
- Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at lower level but in such cases the peak flow level of the two sewers shall be kept the same.
- Sewers of unequal sectional area shall not be jointed at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewers shall deliver

sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

- No drain from house fittings, e.g. gully trap or soil pipe, etc. to manhole shall normally exceed a length of 6 m unless it is unavoidable.
- Manholes 90 × 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage. Manholes 1.2 m × 90 cm are generally constructed for main drainage work for depths less than 1.5 m.
- Manhole 1.4 m × 90 cm is of the arched type and is generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side of the channel is minimum 20 cm.
- Manholes 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than 450 mm in the same manner as in the case of rectangular manholes.
- Before deciding size of manholes, Local Municipal Bye Laws shall be consulted. As a general guide some typical type designs of manholes followed in Delhi have been shown in Fig. 19.4 to 19.7. When manholes are constructed on foot path, these shall be provided with cover of medium duty casting and when built within the width of the road under vehicular traffic, these shall be provided with cover of heavy duty casting.

EXCAVATION

- The excavation for manhole shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-Charge.

BED CONCRETE

- The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) unless required by local authorities. The thickness of the bed concrete shall be 20 cm for manholes up to 4.25 m depth and 30 cm for depths beyond 4.25 m unless otherwise specified or directed by the Engineer-in-Charge. In bad ground, special foundations as suitable shall be provided.

BRICK WORK

- The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof. For arched type and circular manholes, brick masonry in arches and arching over the pipes shall be in cement mortar 1:3 (1 cement: 3 fine sand). In the case of manholes of circular type the excess shaft shall be corbelled inwardly on three sides at the top to reduce its size to the cover frame to be fitted.
- The walls shall be built of one brick thickness for depths up to 4.25 m. Below a depth of 4.25 m in ordinary subsoil the wall thickness shall be increased to one and half brick and at 9.75 m below ground two brick thick walls shall be built.

PLASTER AND POINTING

- The walls of the manholes shall be plastered inside with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth. In the case of arched type manhole

the walls of the manhole shall be plastered inside all-around only up to the crown level, and flush pointed for the shaft with cement mortar 1:2 (1 cement: 2 fine sand). Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth up to 30 cm above the highest sub-soil water level with the approval of the Engineer-in-Charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

- For earth work excavation, bed concrete brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.

BENCHING

- The channels and benching shall be done in cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth with neat cement. The depth of channels and benching shall be as given in Table 19.5.

<i>Sizes of drain mm</i>	<i>Top of channel at the centre above bed concrete cm</i>	<i>Depth of benching at side walls above bed concrete cm</i>
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

FOOT RESTS

- All manholes deeper than 0.8 m shall be provided with M.S. foot rests. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:3:6 (1 cement: 3 coarse sand 6 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its centre shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth.
- Foot rests which shall be of 20 x 20 Sq. M.S. bars as shown in Fig. 19.8 shall be fixed 40 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.
- Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing. 19.4.7

MANHOLE COVERS AND FRAMES

- The frame of manhole shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, manhole covers shall be sealed by means of thick grease.

SEWER TRAP CHAMBER

- The item includes supplying, laying and fixing the Stone ware sewer trap of specified diameter including fixing, jointing and embedding.
- Sewer trap shall be made from Pvc of specified diameter and shall be approved quality.
- Sewer trap should be free from pin holes, cracks and other imperfections.
- Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charge.
- Sewer trap shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other free material into the trap during laying. The trap shall be on bedded in CC 1:2:4 including necessary form work.
- The testing shall be done along the testing of sewer line with the same specification.
- The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.
- The measurement shall be for each unit of sewer trap fixed.

6.6.1 SEPTIC TANK

- In unsewered area, every house shall have arrangements for its sewage being treated in septic tank, effluent from which should be given secondary treatment either in a biological filter or on the land, or in a sub-surface disposal system.
- Surface and sub -soil water should be excluded from finding way into the septic tank. Waste water may be passed into the septic tank provided the tank and the means for effluent disposal are designed to cope up with this extra liquid. Depending on the location of the water table and the nature of the strata, the type of disposal for the effluent from the septic tank shall be decided.
- Dimensions

Septic tanks shall have minimum width of 75 cm, minimum depth of one metre below water level and a minimum liquid capacity of the one cubic metre. Length of tanks shall be 2 to 4 times the width. Suitable sizes of septic tanks for use of 5, 10, 15, 20 and 50 persons based on certain assumptions are given in Appendix II.

Cover and Frame

Every septic tank shall be provided with C.I. cover of adequate strength. The cover and frames shall be 500 mm dia. (M.D.) minimum or 610 mm x 455 mm (LD). The specification for frames and cover given in 19.3.1 shall apply.

Ventilating Pipe

Every septic tank shall be provided with C.I. ventilating pipe of at least 50 mm diameter. The top of the pipe shall be provided with a suitable cage of mosquito proof wire mesh.

The ventilating pipe shall extend to a height which would cause no smell nuisance to any building in the area. Generally the ventilating pipe may extend to a height of about 2 m, when the septic tank is at least 15 m away from the nearest building and to a height of 2 m. above the top of the building when it is located closer than 15 metres. The ventilating pipe may also be connected to the normal soil ventilating system of the building where so desired. CPWD SPECIFICATIONS 2019 1034

Disposal of Sludge

The sludge from septic tanks may be delivered into covered pit or into a suitable vehicle for removal from the site. Spreading of sludge on the ground in the vicinity shall not be allowed.

Testing

Before the tank is commissioned for use, it shall be tested for water-tightness by filling it with water and allowing it to stand for 24 hours. It shall then be topped up, if necessary, and allowed to stand for a further period of 24 hours during which time the fall in the level of the water shall not be more than 1.5 cm.

Commissioning of Septic Tank

The tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall, preferably, be seeded with small quantities of well digested sludge obtained from septic tanks or sludge digestion tanks. In the absence of digested sludge a small quantity of decaying organic matter, such as digested cow-dung, may be introduced.

Sub-Surface Absorption System

The effluent from septic tank shall be disposed of by soak pit or dispersion trench depending on the position of the sub-soil water level, soil and sub-soil conditions and the size of the installation.

Measurements

Septic tank shall be enumerated.

Rate The rate shall include the cost of materials and labour involved in all the operation, except subSurface absorption system which shall be paid for separately.

SOAK PITS

Construction

The earth excavation shall be carried out to the exact dimensions as shown in the figure. In the soak pit shall be constructed a honey-comb dry brick shaft 45 x 45 cm and 292.5 cm high. Round the shaft and within the radius of 60 cm shall be placed well burnt brick bats. Brick ballast of size from 50 to 80 mm nominal size shall be packed round the brick bats up to the radius of 90 cm. The remaining portion shall be filled with brick ballast of 40 mm nominal size. The construction of shaft and filling of the bats and the ballast shall progress simultaneously.

Cover and Drain

Over the filling shall be placed single matting which shall be covered with minimum layer of 7.5 cm earth. The shaft shall be covered with 7.5 cm thick stone or R.C.C. slab 10 cm wide and 10 cm deep brick edging with bricks of class designation 75 shall be provided round the pit. The connection of the open surface drain to the soak pit shall be made by means of 100 mm diameter S.W. pipe with open joints.

Measurements

Soak pit shall be enumerated.

Rate

Rate shall include the cost of labour and material involved in all the operations described above.

6.7 PUMPING EQUIPMENTS & PUMP ROOM

PUDDLE FLANGE

Puddle Flanges shall be fabricated from MS pipe, Heavy duty conforming to IS 1239 part 1 and 6mm thick MS plate of specified dimension and flange shall be welded at one end of the puddle for connection with header the complete arrangement shall be made as per typical details drawings provided by consultant and the complete arrangement shall be galvanized post fabrication of set as required. Installation of puddle flanges under RCC tank should be done as per drawing provided by consultant / approved drawings. In any case no puddle flange should be installed prior approval of drawings from engineering consultant

PUMPING SYSTEM

SCOPE This section of the contract involves the design, supply, installation, testing and commissioning of the complete Hydro-pneumatic pumping system and other pumping systems complete with all controls and electrical work for domestic water supply / water supply for flushing / for cooling tower make-up. All submersible water re-circulation, drainage and ejector pumps for the project are also included in this contract. It also involves testing and commissioning of the pumping system with the

domestic water and flushing water supply & distribution. This specification described the particulars of the contract, designs and systems chosen, and mode of operation. All installation work shall comply with the latest rules and regulations. The work embraced by this specification covers the design, submission to authorities, supply, and delivery on site, installation, testing, commissioning and maintenance of the Hydro-pneumatic pumping system, other pumping system installation of the building in accordance with this specification and associated drawings. The scope of work shall include the following (list is indicative and not exhaustive):

- Variable speed pumping unit's domestic water & flushing water supply & distribution.
- Suitably sized food grade quality, non-toxic diaphragm type pressure vessels complete with necessary interconnections and controls.
- Control panel for pump control complete with variable speed drives, circuit breakers, fuses, pressure transmitters etc. complete with all interconnections to pumps and electrical supply panels.
- Pump control units complete with pre-programmed micro-processor chip.
- Pump monitoring units to monitor operation of pumps.
- Skid mounting arrangement including supports for piping and valves of complete system
- Each Hydro-pneumatic Pumping unit shall be supplied as a complete set including variable speed pumps, pressure vessels suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitters on the discharge side and level electrode at the suction tank. Each unit shall be provided with electronic microprocessors for unit control and all necessary electrical work for the unit.
- All the pipe work etc. shown in the system drawings is meant for information only and shall be carried out by others. The Hydropneumatic system supplier shall provide the pumping units in the designated pump rooms as complete units included all necessary piping within plant such that only discharge connections are required to be connected into the unit's discharge manifolds just inside the plant room, by the Plumbing contractor. The Hydro-pneumatic system contractor shall guarantee specified pump performance at various pump speeds and Hydro-pneumatic pumps must be able to supply at least 2 bar pressure at the highest/farthest fitting.
- Electrical equipment and installation work including the PLC in Control panel.
- Painting and labeling of pipe work and equipment;
- Provision of all hold down bolts, spigots struts and the like required to be built in during construction;
- Provision of dry contacts to BMS indicating the status of the pumps and pressure vessel in form of hardware interfacing panels inside each pump room and control panels of all pumps.
- Provision of all level switches, flow switches and other sensing devices for status indication.
- All interfacing work with other trades.
- Testing & commissioning and balancing of the Hydro-pneumatic & Pumping system;
- Provision of twenty four (24) months operational maintenance and breakdown services;
- Provisions of operating instructions and maintenance manuals;
- Provision of spare parts; - Training of the employer's staff for proper operation of the entire systems;

- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees and charges. All the costs for all the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;
- Provisions of the necessary installation which include pumping works, pipe work within the pumping unit up to suction and discharge manifolds, conduit and control wiring, etc. to form a workable system required;
- All other works and systems as specified in the Contract document and or shown on the drawings.
- All cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of pipes, conduits and the like including providing GI pipes sleeves of required size corresponding to pipe dia., wherever pipes crossing fire rated walls and floors and sealing with glass wool in between and fire sealant compound on either end. Details on shop drawings shall also be provided.

GENERAL

Equipment offered for supply and installation shall include the following: All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installations in accordance with the true intent and meaning of this Specification. All necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including relief valves, belt guards, fan inlet and/or discharge guards, safety railing, effective earthing of electrical components, electrical interlocks, warning lights and alarms. Readily accessible, dust-proof lubricating facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning. Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc. The Contractor also shall allow provision for the inspection of all plant and equipment by the Manufacturer or his licensed representative, at least twice during the course of the installation.

PIPING

The pipes and fittings shall be GI class `C' (heavy class) conforming to IS: 1239 (Part-I) for pipes and IS: 1879 (Part 1 to 10) for malleable cast iron galvanized fittings.

PUMPS

- Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts in SS 304 shall be made for pumps required in Hydro-pneumatic System and water fountain re-circulation system. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with

approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.

- The Contractor shall supply and install pumps of the type and performance as shown on the drawings. All duties of pumps given in the Tender Drawings shall be checked and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless steel construction. Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point.
- The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty. The pump shall have a speed of not more than 1500 rpm. However pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets. Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.
- Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable. Leakage from pump gland shall be drained to the nearest floor waste.
- Pump curves for all pumps offered shall be submitted. All curve indicating excessive shut-off head will not be approved.
- Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.
- Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.
- Local Motor Control Panel
- The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions:
- Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system preset delivery pressure to operate the pumps within the specified maximum and minimum Delivery ranges.
- Built-in frictional loss compensation factor which will automatically increase the delivery Pressure setting, in collaboration with the increase in flow demand. This shall be able to minimize the system pressure differences and provide a more constant pressure along the Supply line and also to save the energy consumption of the motor when running at low speed.
- Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps to run at variable speed.
- Built-in clock functions with weekly programming and with switch on system to operate at least 10 different pre-set pressure points as required
- When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s). In

event of control failure, the pumps shall be able to be start/stopped manually at the local panel by means of pressure switches.

- The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.
- The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps from running dry.
- Automatically starting the pumps when the water level is back to normal.
- In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.
- Functions to limit the no. of start/stop of pumps per hour.
-

6.8 IRRIGATION WORKS

SCOPE OF IRRIGATION SYSTEM CONTRACTOR

- A. Scope of works listed below shall not be considered as comprehensive description of the Contract, but only as an indication of the extent of works.
- B. Design verification, Selection, supply, installation, testing, commissioning and handing over of following System / Equipment for the satisfactory operation of the plant.
 - 1. Complete installation of sprinkler heads, section valves, isolation valves, quick coupling valves, etc.
 - 2. Complete installation of automation units including direct burial cables, solenoid valves, irrigation controllers, central controls, cables in conduits, trench, tray and trucking etc. with all fixtures.
 - 3. Complete installation of pumps, filtration units, etc. with all fixtures.
- C. Provision of Design Verification, detailed calculation, selection of equipment, verification of pipe sizing, working drawings, builder work drawings, supply, installation, testing, commissioning and handing over for the complete Irrigation System to the requirement as stipulated in this specification and local government authority shall be in the contractor's scope.
- D. The pump heads indicated in the tender documents are tentative. The contractor shall estimate the actual pump head required based on final coordinated shop drawings and submit the pump head calculation and pump selection for approval by consultant.
- E. Contractor's tank and equipment layout must comply with the space allocated for the same and as allocated in the Tender drawings.
- F. Testing and commissioning of installation under normal operational conditions shall be conducted.
- G. As-built drawings and operation / maintenance manual shall be provided.

PERFORMANCE REQUIREMENTS

- A. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100% irrigation coverage of areas indicated.
- B. Refer to soil investigation reports for soil conditions. Including:
1. Type,
 2. Texture,
 3. Density,
 4. Moisture content,
 5. Infiltration rate
- C. Minimum Working Pressures and flow rates:
1. For pipe sizing, mean velocity of flow in main or lateral pipes shall not exceed 1.5 m/sec.
 2. The total head loss in main line shall not exceed 2.5 metre/100metre and not to exceed 4.0m for sub-main.
 3. Contractor shall provide ring main with suitable number of tapping points and isolation valves to the approval of The Engineer-in-charge.
 4. Total friction loss from the far end of the lateral up to solenoid valve shall not exceed 2.5m. The total head loss in solenoid valve assembly shall not exceed 3.0m.
 5. The total head loss in pump station shall not exceed 7.0m.
- D. The Contractor shall provide detailed calculations for head loss including all necessary breakdowns for Engineer-in-charge review.
- E. Type of irrigation for each type of plantation shall be as per the contract drawing for installation details.
- F. Water requirement for the plantation at maximum (peak) demand shall be as follows:
1. Palm trees 180 ltr./day
 2. Ornamental trees 80 ltr./day
 3. Shrubs 15 ltr./day
 4. Ground covers & Ornamental Grass 16 ltr./day
 5. Lawn 12 ltr./day
 6. Hedges 13 ltr./M/day
 7. Cactus & Succulents 7 ltr./plant/day
- G. All materials shall be as per the proposed suppliers list (or equal and approved) and execution of works shall be to the approval of The Engineer-in-charge. **Any deviations without prior approval will disqualify the contractor.**

SUBMITTALS

- A. Shop Drawings: The Contractor shall carefully check and verify all dimensions on the tender drawings and shall prepare shop drawings for approval by The Engineer-in-charge. **Non submission of Shop Drawings will result in the disqualification of contractor.** Shop drawings to include but not limited to:
1. Detailed layout of main, sub-main and lateral pipes, valves, irrigation heads and other typical connections, including hydraulic pressure loss calculation

2. Wiring diagram including conduits, pull boxes, sizing and calculations to verify that cable sizing is in accordance with cable and valve manufacturer's recommendations.
 3. Details for connection to the main line network and control system.
 4. Electric power and control wiring diagrams system for irrigation controller, site wiring and grounding and computerized system control components.
 5. Shop drawings shall incorporate approved materials and equipment that will be shown to scale.
- B. Construction Programme: Contractor should submit a construction Programme for the whole of the works in a detailed format in MS Project or Primavera, latest editions for the approval of the Engineer-in-charge before starting works at site.
- C. Product Catalogue/Data: For each type of product indicated, Include rated capacities, operating characteristics, electrical characteristics & furnished specialties and accessories.
- D. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- E. Pre-qualification Data: For qualified Installer.
- F. Zoning Chart: Show each irrigation zone and its control valve.
- G. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- H. Site quality-control reports.
- I. Equipment/Material Test Reports from approved laboratory.
- J. Operation and Maintenance Data: For sprinklers, controllers, and automatic control valves to include in operation and maintenance manuals.
- K. A detailed valve schedule shall be prepared to show the daily timing for irrigation system and to ensure achievement of the daily water requirement for each plant type.
- L. All materials shall be as described in the specifications. The Contractor shall submit samples of all materials, which are proposed to be used in the system to the Engineer-in-charge, for approval, prior to their installation. Any materials used which are neither approved nor to the satisfaction of the Engineer-in-charge, may be rejected and the Contractor shall replace them, at his own cost, with acceptable items and will result in blacklisting of the contractor.
- M. As Built Drawings: The Contractor shall maintain one set of contract drawings for the sole purpose of recording "As-Built" conditions of the irrigation system as a whole. All changes, previously approved, and all completed work shall be recorded on these drawings. All valve locations and piping shall be dimensioned and recorded (except cable routes, common to pipe runs, need not be dimensioned).
1. The As-Built drawings shall be supplied to the Engineer-in-charge for approval prior to the issue of the Completion Certificate.
 2. On approval of the As-Built drawings the Contractor shall forward following for the Engineer-in-charge's retention:
 3. Three (3) complete sets of As-Built drawings properly folded and provided in the plastic folders as part of the Operations and Maintenance manual.
 4. One set of computer discs (CAD Format) properly labeled and marked

- N. Operation and Maintenance Manual: The Contractor shall provide three copies of the operation and maintenance manual for the Engineer-in-charge's approval prior to issuing of the completion certificate. Manuals shall contain comprehensive operational schedules, recommended spare parts lists, manufacturer's operating data, catalogues, warranties and exploded parts diagrams where applicable for the entire irrigation scheme. The material used for the irrigation system shall be listed in the manual. Draft, manuals shall be submitted for approval prior to commencement of commissioning and shall be revised in accordance with Engineer-in-charge's instructions and reflect and record the results of the commissioning procedures described above. Non Submission of O & M Manual will disqualify the contractor.

QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Indian Irrigation Association.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Arrange for Factory Visit during the assembly of Pump Control Panel
- D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Client or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
- B. Notify the Engineer-in-charge no fewer than three (3) days in advance of proposed interruption of water service.
- C. Do not proceed with interruption of water service without Engineer-in-charge's written permission.

EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Pop-up Sprayers: Equal to 1% of amount installed for each type and size indicated, but no fewer than 10 units.
- C. Rotary Sprinklers: Equal to 1% of amount installed for each type and size indicated, but no fewer than 10 units.
- D. Bubblers: Equal to 1% of amount installed for each type indicated, but no fewer than 10 units.

DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, according to the following:
Ensure that valves are dry and internally protected against rust and corrosion.
Protect valves against damage to threaded ends and flange faces.
Set valves in best position for handling. Set valves closed to prevent rattling.

- B. During Storage: Use precautions for valves, according to the following:

Do not remove end protectors unless necessary for inspection; then reinstall for storage.

Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, specialties and equipment from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- H. Transport, delivery, storage, safe handling and necessary logistic shall be in contractor's scope. Storage space will be provided by client

6.9 PRODUCTS

PVC PIPES AND FITTINGS.

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Supreme - pipes
 2. Finolex – pipes
 3. Polypack – pipes
 4. Swastik – pipes
 5. Jain - pipes
 6. George Fischer - fittings up to 150mm dia
 7. Dura pipe – fittings up to 150mm dia
 8. FIP – fittings up to 100mm dia
 9. Atlas – fittings up to 75mm dia
 10. Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.
- B. All pipes and fittings shall be sized according to Indian Standard (BIS)
- C. All pipes shall be manufactured from new materials
- D. Main pipelines sized 12 inch or larger shall be GRP pipes while main pipelines sized 10 inch or smaller shall be uPVC class D
- E. Pipes class shall be as follow:

1. Pressure pipes: Class D (less than 25mm dia. pipes) and Class E (for 25mm dia. pipes)
 2. Non pressure pipes: Class C (for conduits & ducts)
- F. Joints and fittings for pipes sized 50mm and less shall generally be solvent welded type while for 75mm or larger will generally be integral bell socket with rubber ring
- G. All uPVC fittings shall be Class E (15 bar working pressure)

POLYETHYLENE PIPES AND FITTINGS.

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Jain
 2. Dura line
 3. Emco
 4. Finolex
 5. Oriplast
 6. Reliance
 7. Aaram
 8. Pioneer
 9. Hunter (with built in emitters)
 10. Euro drip (with built in emitters)
 11. Toro Ag. (with built in emitters)

Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.

- B. Polyethylene pipes and fittings for emitter lines shall be manufactured from linear low density polyethylene incorporating a minimum of 2.8% carbon black and shall have a working pressure of 4kg/cm²
- C. PE risers connecting the secondary uPVC pipe with the PE tertiary pipe shall be as follows:
- D. Be of a 12mm size for sprayers, sprinklers and bubblers and 16mm for drippers
- E. An independent riser shall be allowed for each sprayer, sprinkler bubbler and for drippers if used for irrigating palm tree
- F. A common riser shall be allowed for ornamental trees, shrubs, ground covers, seasonal flowers, rockery plants and succulents. Such riser shall be extended to the allowable length as per irrigation design.
- G. All PE fittings shall be compression fitting suitable for pressure rating up to 10 bar, barbed type fittings secured by plastic ratchet clips shall not be allowed.
- H. Pipe suppliers have to be pre-qualified and approved by The Engineer-in-charge.

CONTROL VALVES

- A. Valves in this article are typically available as "normally closed" valves that open on signal from the controller and are the recommended type. "Normally open" valves that automatically close if power failure occurs are also available.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Solenoid Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Hunter
 - b) Toro
 - c) Hit
 - d) Weathermatic
 - e) Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.
2. Automatic remote control valves shall be of the sizes prescribed on the plan.
3. Be a normally closed 24 volts 50 cycles, unless otherwise specified, solenoid actuated globe pattern with a balanced pressure diaphragm design.
4. The valve pressure rating shall not be less than 200 PSI.
5. Have both internal and external manual open/close control (internal and external bleed) for manually opening and closing the valve without electrically energizing the solenoid. The internal manual bleed shall prevent flooding of the valve box.
6. Have a captured plunger with a removable retainer for easy servicing and leverage handle for easy turning.
7. Have a stainless steel flow control stem and cross handle for regulating or shutting off the flow of water.
8. Must open or close in less than one minute at 200 psi, and less than 30 seconds at 20 psi.
9. Shall be constructed such as to provide removable tops for all internal parts of the valve without disturbing the valve installation. It shall have a contamination-proof (CP) self-flushing nylon filter screen located at the valve inlet to filter out grit and prevent clogging of hydraulic control ports and assure reliable operation.
10. Shall be capable of working under dirty (Treated sewage) water conditions, inlet and outlet shall be threaded B.S.P.
11. Shall be provided with a pressure regulator capable of regulating downstream pressure between 15 to 100 PSI (within an accuracy of +or- 5 PSI) regardless of upstream pressure. IT shall provide full and accurate pressure regulating capabilities irrespective of whether it is operated electrically or manually.
12. Rated working pressure shall be equal to or greater than 16 bars (PN16). The valve body shall be Hybrid (Brass and Plastic) or Glass Reinforced filled Nylon. Gate valves of the solenoid valve assembly shall be brass gate valves up to 3" and Kite marked.
13. Valve assembly shall be equipped with PRS.
14. Solenoid valves suppliers have to be pre-qualified and approved by The Engineer-in-charge.

C. Isolation Gate Valves:

1. Gate valves 75mm dia and above:

- a) Be double flange, ductile iron waterworks valves, with wedge type gate and non-rising stem
- b) Coated with epoxy internally and externally to average DFT 300 microns for protection against corrosion of body components
- c) Valves installed below ground shall be provided with stem cap for key operation while the valves above ground shall be provided with hand wheel.
- d) Stem shall be stainless steel and stem nut is brass or cast aluminum bronze with gunmetal

2. Gate valves 50mm dia. and smaller:

- a) Have a non-rising stem manufactured from brass or bronze according to (BS 5154)
- b) Inlet and outlet shall be screwed BSP
- c) Pressure nominal rating at PN 16

Table No. 2

Sr.No	TypeofValve	Size	Body Construction	Ends/Joint	PressureRatin g
A	Isolating Valve (Ball Valves)	(Up to 63 mm)	UPVC/PVC	Solvent welded joint	10 Bar (Working Pressure.)
B.	Isolation Valve (Butterfly Valve)	(above 63mm)	Cast Iron	Flanged	10 Bar (Working Pressure.)
C.	Y Strainers	Up to 50mm / above 50mm	Brass / cast iron	Screwed/ Flanged	8 Bar (Working Pressure.)
D	Pressure Relief valve	Upto 50 mm.	Gun Metal	Screwed / Flanged	8 Bar (Working Pressure.)
E	Pressure reducing valve	Above 50 mm	Ductile Iron	Flanged	8 Bar (Working Pressure.)
F	Foot Valve	(15-50mm) (above 50mm)	Brass / Cast Iron	Screwed Flanged	8 Bar (Working Pressure.)
G	Non return valve	(15-50mm) / (above 50mm)	Brass/ Cast Iron	Screwed / Flanged	8 Bar (Working Pressure.)

H	Solenoid Valve		FRP		10 Bar (Working Pressure.)
I	Sprinklers		Gun Metal	Screwed / Flanged	10 Bar (Working Pressure.)

- i. All valves and strainers shall be of the particular duty and design as specified. Valves and strainers shall be either of screw type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets.
- ii. Tail pieces as required shall be supplied along with valves. Gate, Butterfly, Ball, Balancing and PRV shall conform to Indian Standard IS:778 and non return valves and swing check type reflux to IS:5312.
- iii. All valves PN rating shall be 1.5 times of system working pressure

D. Quick Coupling Valves:

1. Made of solid red brass with a rubber or thermoplastic cover marked with "DO NOT DRINK" warning.
2. Lockable, Used for non-potable water.
3. Made of a strong corrosion-resistant stainless steel spring to prevent leakage.
4. Sized 12mm or 25mm and shall be operated at pressure ranging from 5 to 125 psi.
5. For every five valve assemblies, contractor shall provide one set of key, swivel elbow and 50 mtr of 19mm reinforced garden hose.

E. Check Valves:

1. Check valves 75mm and above :
 - a) Be double flanged single door swing type having ductile iron body and gun metal seat (BS 1400)
 - b) Pressure nominal rating 16 bars
 - c) Coated with epoxy internally and externally to average DFT 300 microns for protection against corrosion of body components
 - d) Nut bolts made of a stainless steel type 316.
2. Check valves of 50mm dia and smaller:
 - a) To be of spring type manufactured from Brass or Bronze
 - b) Inlet and outlet to be BSP female threaded
 - c) The spring shall be a stainless steel
 - d) Pressure nominal rating 16 bars

F. Air Valve:

Air valves shall be provided at all high points on the pressure mains as per the following specifications:

1. Have automatic double orifice air vents.

2. Have non-corrosive floats in chambers with clear space ensuring blockage free operation.
3. All actuating mechanism components including lever shall be stainless steel. The body and cover should be of bronze or ductile iron with phenolic primer coating.
4. Nozzles with seals and actuating mechanism shall be located in the removable upper plate connected to the valve body using stainless steel (grade 316/A4-70) bolts.
5. Coated with epoxy internally and externally to average DFT 300 microns for protection against corrosion of body components.
6. Nut bolts and internal components shall be stainless steel grade 316/A4-70.
7. Pressure nominal rating at PN 16

G. Electrically Actuated Butterfly Valve:

1. Comply in all respects with DIN 3354-PN 16 Body of ductile iron SG GGG-50 with stainless steel grade 316 valve discs.
2. Coated with epoxy internally and externally to average DFT 300 microns for protection against corrosion of body components.
3. Nut bolts shall be stainless steel grade 316.
4. Open and close of at least 60 seconds and shall be provided with an auxiliary operating wheel. The motor control should allow for stepped closing of valve pausing at ½ closed and ¼ closed.
5. Motors shall be rated to operate at an ambient temperature of 50 degrees centigrade and a relative humidity of 100%.
6. Electrical component shall be protected from condensation.

H. Pressure Relief Valve:

1. Flanged and of ductile iron body, diaphragm type, hydraulically operated, pilot control and modulating type.
2. The pilot shall be brass and tubing of copper/brass.
3. Fast opening and slow closing.
4. All internal and external exposed surfaces shall be FDA approved epoxy coated to minimum DFT 300 microns.
5. Nut bolts shall be stainless steel grade 316

I. Wash-Out Valve:

1. Wash-out valves shall be installed at the lowest point of the irrigation main pipe in order to clean the pipe periodically. The size of the valve shall match the pipe size

J. Strainers.

- a. "Y" strainers (according sizes as specified in Table 2, Point D) shall be of Brass/ Cast iron body and of suitable class as indicated in drawings & schematics or higher as required.
- b. Strainers shall incorporate removable stainless steel screen with 3.175 mm (1/8") perforations and permanent magnet.
- c. Strainers shall be provided with flanges at both inlet and outlet.
- d. Strainers shall be designed to enable blowing out of accumulated dirt and replacement of the screen without disconnection of the main pipe.

- e. Strainers shall be provided with equal size isolating butterfly valves of approved brands as shown in drawings so that the strainer may be cleaned without draining the system.

K. Ball Valves

For manual operation of the system, imported PVC ball valves are provided to form a group of sprinklers and thus to form a section, also to regulate the flow in the irrigation system. Working pressure shall be 10kg/cm² or above, with a Solvent welded joint. The body shall be of rigid PVC / uPVC. All ball valves shall be enclosed in 10" Round valve boxes with openable lid if fixed in earth.

- Compact Single Union (SU) design.
- Manufactured from high performance rigid PVC compound.
- Excellent chemical & corrosion resistance.
- Low frictional losses.
- Easy to install and dismantle.

L. Butterfly Valves

- b. Butterfly valves (according sizes as specified in Table 2, Point B) used in high pressure (head) piping shall be made of C.I material of ANSI class 125 as indicated in specifications, drawings & schematics or higher as required.
- c. Butterfly valves shall be slim seal, wafer type with standard finish. Valves shall be suitable for mounting between flanges drilled to ANSI 125.
- d. Valve shall consist of disc pivot and driving stem shall be in one piece centrally located. Disc shall move in bearings on both ends with 'O' ring to prevent leakage.
- e. Seat shall be stainless steel/ductile iron based on working pressure classification and molded with EPDM and shall line the whole body. Spindle shall be AISI 41 steel.
- f. Valve for normal application shall be suitable for a working pressure to suit the application and service and shall be complete with flow control lever and notches, factory machined companion flanges and bolts and nuts.
- g. Valves shall conform to BS 5155/ ASTM F1098 - 87(2015) with electro steel nickel coated SG Iron (N) and seat material EPDM.
- h. The disc shall be of bronze alloy and shaft from SS 316 Grade stainless steel.
- i. All valves shall be enclosed in suitable size valve boxes with openable lid if fixed in earth.
 - _ Excellent flow control in quarter turn operation.
 - _ compact, space saving design.
 - _ Bi-directional 100% tight shut off.
 - _ Low weight, low maintenance, long service life,
 - _ Easy automation / retrofit possible.
 - _ Stream lined valve disc for lower pressure drop.
 - _ Both seats mounted in bearing supports for easy operating torques.
 - _ Suitable for mounting between all standard flanges.
 - _ Gasket packing not required to install between flanges.

6.9.1 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 115mm diameter dial, dial range of two times system operating pressure and bottom outlet.
- C. Underground Warning Tape:
 1. Warning tape shall be laid above the irrigation main and sub-main pipes. Tapes shall be of laminated polyethylene, durable and flexible with at least 15cm wide and 250 microns thick and shall have the phrase "CAUTION – IRRIGATION PRESSURE MAIN BELOW" stamped in black letters and repeated at maximum intervals of 1.0m
 2. The text of tape shall be made using a permanent ink bonded to resist prolonged chemical attack by corrosive acids and alkaline. The text shall be in Hindi and English. The tape shall be laid continuously over pipelines and at joints and there shall be a minimum of 1.0m overlapping. Tape shall be terminated inside valve boxes to allow clipping of detector equipment to the tape

6.9.2 IRRIGATION FIXTURES

General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

A. Bubblers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Hunter
 - b) Toro
 - c) Hit
 - d) Weathermatic
 - e) Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.
2. The bubbler shall be a pressure compensating type capable of providing a consistent flow rate
3. The bubbler shall have a "trickle" pattern or an "umbrella" pattern discharge
4. The bubbler assembly shall have a plastic inlet filter screen to protect the nozzle against clogging
5. The pressure compensating bubbler shall be of a permanently assembled design constructed of durable, UV-resistant plastic with an integral rubber flow washer for regulating the flow rate at an operating pressure range of 1.5 to 6.0 Bars
6. The pressure compensating bubbler shall have a ½" inch female threaded inlet for connection to the piping system riser
7. When used for the irrigation of palms it should be used at a rate of 2 nr. Bubblers for each palm tree with a flow of 1 GPM each

8. Stakes for bubblers shall be constructed from strong temperature resistant polypropylene plastic construction with protective stop collar, length shall be 12 inches each side of inlet with barbed side inlet suitable for class C polyethylene pipes, and outlet shall be ½” inch external male thread
9. Bubbler suppliers have to be pre-qualified and approved by The Engineer-in-charge.

B. Emitters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Hunter
 - b) Toro
 - c) Jain
 - d) Weathermatic
 - e) Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.
2. All emitters shall be pressure compensating with different flow 0.5, 1, 2, 4 and 8 (GPH) gallons per hour or equivalent
3. The capacity and spacing of emitters shall be as follows:
 - a) Palm 22 nr. X 1 GPH in-line drip tube per palm (Only If not Bubbler)
 - b) Trees 15 nr. X 1 GPH in-line drip tube per tree (Only If not Bubbler)
 - c) Shrubs ≥1.0 m spacing 3 nr. X 1 GPH in-line drip tube per plant
 - d) Shrubs 0.75 m spacing 2 nr. X 1 GPH in-line drip tube per plant
 - e) Shrubs ≤0.6 m spacing 4 nr. X 0.5 GPH in-line drip tube per m²
 - f) Groundcover & Seasonal 4 nr. X 0.5 GPH in-line drip tube per m²
 - g) Shrub Hedge 2 nr. X 1 GPH in-line drip tube per L.M.
4. When palms & trees are planted in planting beds, 20% of daily water requirement shall be reduced for both.

C. Pop-up Sprayers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Hunter
 - b) Toro
 - c) Weathermatic
 - d) Contractor to submit any equal alternative proposals for Engineer-in-charges approval.
2. The sprayers shall have a high level impact strength corrosion body, stem and nozzle
3. Pop up height shall be 100mm.
4. The sprayer shall have a heavy-duty stainless steel retraction spring and piston with step clutch to facilitate nozzle positioning
5. Either standard or rotary nozzle could be used and both shall be capable of covering 4.5m radius at 2.0 bar pressure

6. Spacing for the sprayers with standard nozzle shall be 4m. For small areas, sprayers with low flow nozzles shall be used.
7. Sprayers should be installed in such a way that water will not hit stems of the trees or any other structure or the Electric panel. Sprayers shall be installed 150mm from heel/edge of the footpath
8. Sprayer shall have a pressure-activated co-molded wiper seal to clean debris from the pop up stem as it retracts
9. Sprayer shall be provided with built-in seal-a-matic check valve when installed on mounds or slope areas
10. Sprayer shall also have PRS pressure regulator built into the stem and matched precipitation rates nozzles
11. Sprayer suppliers have to be pre-qualified and approved by The Engineer-in-charge.

D. Rotor Sprinklers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Hunter
 - b) Toro
 - c) Weathermatic
 - d) Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.
2. The sprinkler body, stem and nozzle shall be constructed of heavy duty, UV resistant ABS plastic material
3. Rotor shall be a closed water lubricated gear drive, rotary type and capable of covering a radius of 6.7 to 15.9 m (depending on design requirement) at a pressure range of 2.1 to 4.8 bars with discharge rate of 1.9 to 54.5 ltr. Per minute.
4. The sprinkler shall be available with 8-12 standard interchangeable nozzles or 8 built-in different nozzles
5. The sprinkler shall have a strong stainless steel retraction spring and adjustable arc with radius reduction capabilities by means of a stainless steel nozzle retainer/radius adjustment screw or by choosing the appropriate nozzle that is equipped with the sprinkler
6. It is preferable to have a friction-clutch mechanism to allow for 360 degrees + forward or reverse movement of nozzle turret without damage to the internal gear components
7. **It is also preferable to incorporate an “arc recall” feature to allow original arc pattern to be automatically resumed following any disturbance of nozzle setting.**
8. Sprinkler shall be provided with built-in seal-a-matic check valve when installed on mounds or slope areas
9. A screen shall be provided in the pop-up stem to filter inlet water to protect the drive from clogging and simplify its removal for cleaning and flushing of the system
10. The sprinkler shall have minimum 100mm pop-up height and exposed surface diameter of not more than 40mm

11. Shall have a pressure-activated co-molded wiper seal to keep debris out of the rotor and to clean debris from the pop up stem as it retracts. All adjustment shall be made from the top of the sprinkler
12. Sprinkler suppliers have to be pre-qualified and approved by The Engineer-in-charge.

6.9.3 IRRIGATION PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. KIRLOSKAR
 2. KSB
 3. GRUNDFOS
 4. BEAKON WEIR
 5. FLOW MORE
 6. JYOTHI
 7. KISHORE
 8. WPIL
 9. MATHER & PLATT
 10. MBH
 11. TEXMO
 12. Contractor to submit any equal or alternative proposals for Engineer-in-charges approval.

PUMP

1. The packaged pump system shall have 1no. of pumps as indicated on schedule. The maximum duty of pump shall be as indicated on drawings, schematics and schedules.
2. Control panel shall be dust and damp proof steel cabinet supplied by the pump manufacturer and shall include a built-in-anti-condensation heater.
3. Pump head in Equipment schedule and BOQ needs to be verified by contractor based on final shop drawings and final head to be submitted for approval prior to procurement and supply.

B. Filters:

1. Disc Type Filter
 1. JAIN
 2. MAIS
 3. KIMPLASS
 4. FINOLEX
 - a) Disk type shall be made of epoxy coated or stainless steel units with Anodized Aluminum body.
 - b) Work only during the irrigation hours of the system.
 - c) Shall have a maximum operating pressure of 140-150 PSI and a maximum operating temperature of 150-160 F.
 - d) Shall have a minimum back-flushing operating pressure of 45 PSI.

- e) Shall have a flow and size as per the drawings, tender specifications and BOQ.
- f) Shall have a short back flush cycle with regulated volume.
- g) Shall be specially designed for use with organic contaminants.
- h) Shall have isolation valves in the suction as well as delivery side for easy maintenance.

C. Electrical Equipment:

- 1. Electrical equipment shall be in accordance with authority regulations and the Electrical Specification.
- 2. Enclosures shall be protected in accordance with IP55 for equipment installed above ground and IP58 for equipment installed below ground.
- 3. Wiring to and from control panels shall be routed in conduits below floor after getting NOC.
- 4. The size of conduits is dependent on the total wires available.
- 5. All equipment shall be provided with earth leakage circuit breakers in accordance with HUDA regulations.

IRRIGATION CONTROL SYSTEMS

A. Manufacturers:

Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Hunter
- 2. Toro
- 3. Griswold
- 4. Motorola
- 5. K Rain
- 6. Weather Tec
- 7. Weathermatic
- 8. Waterman
- 9. Contractor to submit any equal alternative proposals for Engineer-in-charges approval.

B. Irrigation Controllers:

- 1. The Field Controller shall be a hybrid type that combines electromechanical and microprocessor-based circuitry capable of fully automatic and manual operation.
- 2. Have four fully independent programs and each with separate day cycles and 8 start times.
- 3. Have a 365-day calendar with Event day off option to set any day of the month as a non-watering day for all programs. Programs will run on an ODD/EVEN day cycle, day-of-the-week ON/OFF cycle, or in cycles from 1 to 99 days.
- 4. Capable of running a variable system test program without affecting the normal program and have Cycle + Soak water management software which is capable of operating each station for a maximum cycle time and a minimum soak time to reduce water run-off.

5. Have an internal nonvolatile memory that shall retain the irrigation program and the programmed date and time for a minimum of 100 years without power. A 9-VDC rechargeable batteries and recharging circuit shall also be included for counting down the program-in-progress during a power outage and shall allow programming of the controller when it is disconnected from the main power supply.
6. Shall be pedestal mounted in lockable stainless steel weatherproof cabinets and UL listed and tested.
7. The controllers shall be installed onto concrete basis, control wire shall be color coded and provided with tags.
8. Controller suppliers have to be pre-qualified and approved by The Engineer-in-charge.
- 9.

C. Electric Wiring:

1. All control wires for underground use for Solenoid Valves and Satellites shall be single core; #14 AWG for valve wires and #12 AWG for common cable
2. Power supply cable shall be 6mm² x 3 core armored XLPE/SWA/PVC insulated
3. Power cables and signal cables for satellites shall be laid in separate PVC conduits
4. The cables shall be suitable for direct burial in the earth; however it is required to be installed in ducts or conduits as follows:
 - a) Less than 25mm dia up to 4 wires
 - b) 25mm dia up to 8 wires
 - c) 50mm dia up to 15 wires
 - d) 75mm dia up to 30 wires
 - e) 100mm dia more than 30 wires
5. One spare cable shall be provided for every five cables and it shall run up to the last valve on each main / sub-main

D. Valve Boxes

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Ecorain/Ecoaqua
 - b) APPLIED ENGINEERING
 - c) SUPREME
 - d) AMITEX.
 - e) COSMOPLAST
 - f) Contractor to submit any equal alternative proposals for Engineer-in-charges approval.
2. Air valves (50mm dia or smaller), QCV, Solenoid valves and Wire Pull Boxes shall be installed in an access box of sufficient size to permit readily removal of the valve inner assemblies without removing the box from the ground.

3. Valve name and numbers must be clearly marked inside and outside of the box with permanent plastic tag.
4. Installation of plastic valve boxes in paved areas and Sikkas is not allowed.
5. Valve boxes shall be fabricated from reinforced plastic and recommended size shall be as follows:

Description	Cover	Depth
QCV Round Valve Box	254 mm	260 mm
Pull Box, Air Valve 25mm and Flush Valve	430 x 295 mm	300 mm
Solenoid Valves up to 50mm	650 x 406 mm	380 mm
Solenoid Valves 75mm and above	825 x 495 mm	457 mm

6. Valve box suppliers have to be pre-qualified and approved by The Engineer-in-charge.

6.10 EXECUTION

EARTHWORK

Install warning tape directly above pressure piping, 300mm below finished grades, except 150mm below subgrade under pavement and slabs.

Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 900mm below finished grade, or not less than 450mm below average local frost depth, whichever is deeper.
2. Circuit Piping: 300mm.
3. Drain Piping: 300mm
4. Sleeves: 600mm.

PREPARATION

- Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.
- Protection of existing services: Particular care is to be taken to avoid damage to underground electricity, telephone and water mains, drains, roads and other underground services during the progress of the works. The Contractor shall be responsible for any damage caused to building works supplies or services and shall

fully indemnify. The Client of the services or his representatives shall decide the method of execution of repairs.

- Prior to starting any work at the site, the contractor has to check existing as built services drawings. Copies of these drawings shall be submitted to the Engineer-in-charge before starting the actual work at site.

TRENCH EXCAVATION

- Trench excavation shall be carried out after getting all necessary NOCs (No objection Certificates). Excavation shall be by hand wherever required to ensure the safety of utilities encountered during excavation work. Excavation shall be in accordance with line size as per the following:
 - Main lines: 200mm dia @ 1.2 meter deep, 200mm dia @ 1.0m deep measured from the crown of the pipe to the finish grade. Width shall be pipe diameter +minimum 100mm on each side of pipe
 - Laterals: 600mm deep measured from the crown of the pipe to the finish grade and 400mm wide
 - Storage in streets of excavated material not to be immediately reused in the backfill of trenches will not permitted
 - The selected material for pipe surround and to 300mm above the top of the pipe shall be suitable material selected from the excavated material

- **PIPING INSTALLATION**

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5% down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2" (DN 50) or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2½" (DN 65) or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
- K. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- L. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- M. Install piping in sleeves under parking lots, roadways, and sidewalks.
- N. Install sleeves made of Schedule 80 PVC pipe and socket fittings, and solvent-cemented joints.
- O. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - Underground Piping:

- a) Nominal Pipe Size 1½" (Diameter Nominal 40) and Smaller: Plastic-to-metal transition fittings.
 - b) NPS 2" (DN 50) and Larger: AWWA transition couplings.
- Aboveground Piping:
 - a) NPS 2" (DN 50) and Smaller: Plastic-to-metal transition fittings/unions.
 - b) NPS 2" (DN 50) and Larger: Use dielectric flange kits with one plastic flange.
- Install dielectric fittings for dissimilar-metal pipe connections according to the following:
- Underground Piping:
 - a) NPS 2" (DN 50) and Smaller: Dielectric coupling or dielectric nipple.
 - b) NPS 2½" (DN 65) and Larger: Prohibited except in control-valve box.
- Aboveground Piping:
 - a) NPS 2" (DN 50) and Smaller: Dielectric union.
 - b) NPS 2½" to NPS 4" (DN 65 to DN 100): Dielectric flange.
 - c) NPS 5" (DN 125) and Larger: Dielectric flange kit.
 - d) Piping in Control-Valve Boxes:
 - e) NPS 2" (DN 50) and Smaller: Dielectric union.
 - f) NPS 2½" to NPS 4" (DN 65 to DN 100): Dielectric flange.
 - g) NPS 5" (DN 125) and Larger: Dielectric flange kit.

JOINT CONSTRUCTION

- Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
- Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- Plain-End PE Pipe and Fittings: Use butt fusion.
- Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
- Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

1. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
2. PVC Non-pressure Piping: Join according to ASTM D 2855.

VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
- C. Install valves and PVC pipe with restrained, gasketed joints.
- D. Aboveground Valves: Install as components of connected piping system.
- E. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.
- F. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- G. Drain Valves: Install in underground piping in boxes for automatic control valves.

SPRINKLER INSTALLATION

- A. Install sprinklers at manufacturer's recommended heights.
- B. Locate part-circle sprinklers to maintain a minimum distance of 100mm from walls and 50mm from other boundaries unless otherwise indicated.

AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on either floor, concrete bases or wall as indicated.
 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install control cable in same trench as irrigation piping and at least 50mm below or besides piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

CONNECTIONS

- A. Comply with requirements specified in MEP consultants specification
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

IDENTIFICATION

- A. Identify system components. Comply with requirements specified in MEP consultant's specification.
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches.

SITE QUALITY CONTROL

- A. Manufacturer's Site Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Arrangement for Owners representative to visit assembly/manufacturing facility as required.
- C. Perform tests and inspections.
 - 1. Manufacturer's Site Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Any irrigation product will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

STARTUP SERVICE

- A. Perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
 - 1. Verify that controllers are installed and connected according to the Contract Documents.
 - 2. Verify that electrical wiring installation complies with manufacturer's submittal.

TESTING AND COMMISSIONING

- A. Electrical Tests: Each electrical equipment, cable and complete system shall be thoroughly inspected and tested before finally placing in service under the full responsibility of the Contractor. All tests shall be made in compliance with respective regulations, recommendations and standards. All testing shall be demonstrated to the Engineer-in-charge in a manner to be agreed later.
- B. Irrigation System Auto Run Test.

- C. All pipes shall be pressure tested within two weeks of installation. Pipes shall be tested after center loading with joints exposed. Length of pipe tested at any time shall not exceed 500 meters and the rate at which pipelines are successfully tested shall be of the same order of magnitude as the rate of pipe laying. Center loading shall be sufficient to prevent buckling or deformation due to application of pressure.

CUTTING CHASES IN MASONRY WALLS

Where pipes pass through ROAD or structural walls, subject to the approval of the Structural Consulting Engineer-in-charge, the Contractor shall ensure that sizes and locations of openings required are formed in when the relevant beams or walls are cast.

Automatic Irrigation System Commissioning:

- Commissioning of fieldwork and equipment shall include all works required to bring the system into service and to make sure that the system is operating efficiently and shall include but not be limited to the following:
 - Flushing of system
 - Adjustment of valve pressure $\pm 10\%$ of normal
 - Replacement of all clogged or partially clogged lines
 - Adjustment of sprayers / sprinklers and replacement of clogged / broken sprayers/ sprinklers
 - Replacement of all clogged or partially clogged emitters/ Bubblers
 - Preparation of Irrigation Schedules
 - Adjustment of controllers to give an optimal flow regime
 - Assurances that all valves and sprayers/sprinklers are flushed with finished grade and after all valves' pressures have been adjusted.

ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 13mm above, finish grade.

CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

DEMONSTRATION

- A. Train Client's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

MAINTENANCE OF THE IRRIGATION SYSTEM

Section 7 Technical Specification – Electrical Items

7.1 Electrical Item Specification

SUMMARY

Sr. No.	Description
SECTION - 1	Wiring
SECTION - 2	Distribution Boards
SECTION - 3	Light Fixtures
SECTION - 4	LV Cabling
SECTION - 5	Cable Termination
SECTION - 6	Earthing
SECTION - 7	Technical Specifications

7.2 Internal Wiring

7.2.1 Point wiring

Workmanship

Installation

A) The size of conduit shall be selected in accordance with the number of wires permitted under table given below. The minimum size of the conduit shall be 25 mm. diameter unless otherwise indicated or approved. Size of wires shall not be less than 1.5 sq.mm. copper.

Nominal Diameter of wires (mm)	Nominal Cross sec. Area (mm ²)	20 mm		25 mm		32 mm		38 mm	
		S	B	S	B	S	B	S	B
1/2.40	1.50	4	3	8	6	15	9	--	--
1/1.80	2.50	4	2	6	4	10	8	--	--
1/2.24	4.00	2	2	4	3	8	6	--	--
1/2.80	6.00	1	--	4	3	6	6	--	--
1/3.55	10.00	1	--	3	2	5	4	6	5

S - Runs of conduits which have distance not exceeding 4.25 m. between draw boxes & which do not deflect from the straight by an angle more than 15 degree.

B - Runs of conduits which deflect from the straight by more than 15°.

B) Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 300 mm distance between telephones, TV & Communication piping.

C) Separate conduits/raceways shall be used for:

- i. Normal lights and 6 Amps 3 pin sockets on lighting circuit.
- ii. Separate conduit shall be laid from D.B. to switch board or point.
- iii. Power outlets – 16 Amps 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.
- iv. Emergency lighting if any.

- v. Telephones.
- vi. Fire alarm system.
- vii. Public address system & Music system.
- viii. For all other voltages higher or lower than 230 V.
- ix. Water level guard.
- x. Computer Wiring.

D) Conduits run on surfaces shall be supported on GI 12 mm. thick pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building. Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

E) Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm. intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but final finish will be done by the building contractor.

F) Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the Engineer-in-charge, before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete suitable fish wires shall be drawn in all conduits before they are embedded.

Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.

G) Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal. All junction and switch boxes shall be covered by 6 mm. clear perspex plate truly cut and fixed with cadmium plated brass screws. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the perspex cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.

H) Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in. Conduits should terminate in junction boxes of not less than 32 mm. deep.

H) An insulated earth wire of copper rated capacity shall be run in each conduit.

7.3 Lighting & Power Wiring:

A) All final branch circuits for lighting and appliances shall be flexible copper wire of appropriate size run inside conduits. The conduit shall be properly connected or jointed into sockets, bends and junction boxes.

B) Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.

C) All circuits shall preferably be kept in a separate conduit upto the Distribution Board. No other wiring shall be bunched in the same conduit except those belonging to the same phase. Each lighting branch circuit shall not have more than ten outlets or 800 watts whichever is lower. Each conduit shall not hold more than three branch circuits, of the same phase.

D) Flexible cords for connection to appliances, fans and pendants shall be 650/1100 V grade (three or four cores i.e with insulated neutral wire of same size) with tinned stranded copper wires, insulated, twisted and sheathed with strengthening cord. Colour of sheath shall be subject to the Engineer-in-charge's approval.

E) Looping system of wiring shall be used. Wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors. No such joints shall be made unless the length of the sub-circuit, sub-main or main is more than the length of the standard coil.

F) Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in 3 mm. thick painted or galvanized steel boxes with cover plates as specified. Cadmium plated brass screws shall be used.

G) Power wiring shall be distinctly separate from lighting wiring. Conduits not less than 25 mm. and wires not less than 2.5 sq.mm. copper shall be used.

H) Every conductor shall be provided with identification ferrules at both ends matching the drawings.

7.3.1 Testing

The entire installation shall be tested for:

- a) Insulation resistance.
- b) Earth continuity.
- c) Polarity of single pole switches.

7.3.2 General

All the wiring switch board, outlet points shall be done in a concealed manner in wall & slab in PVC conduit of minimum 25 mm dia. (medium gauge) when laid in ground the PVC pipe will be Heavy gauge & with 650v / 1100v grade PVC insulated flexible copper conductor wire. The

switches should be modular with moulded cover plates, blank plates for outlet boxes. The accessories, connectors, sockets, should be fixed with brass chrome / cadmium plated machine screw. For fan points the rates should be inclusive of 300 W regulators as required to complete the point wiring. The wiring shall be as per IS: 732 and IS: 4648. The wiring shall be done in a looping manner so as to avoid junction boxes at any place. All the looping shall be done only in the switch board and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed. Heavy gauge PVC pipe shall be laid for ground.

The size of wires shall as follow:

10 Amp. Metal clad points:

Phase / Neutral	2.5 mm ²
Earth	1.5 mm ²

6 Amp. out let points:

Phase / Neutral	1.5 mm ²
Earth	1.5 mm ²

Two nos. of 16 Amp. socket out let connected in parallel from DB to first outlet

Phase / Neutral	4.0 mm ²
Earth	2.5 mm ²

Two nos. of 16 Amp. socket out let connected in parallel from first outlet to second outlet.

Phase / Neutral	2.5 mm ²
Earth	1.5 mm ²

Light, fans, exhaust fan, 6 Amp. plug point, two way light point, bell point etc.

Distribution Board to SB

Phase / Neutral	2.5 mm ²
Earth	1.5 mm ²
SB to outlet (P/N/E)	1.5 mm ²

15/20 Amp. Socket outlet for appliances / AC (Single Phase/Three Phase) / Geyser

Phase / Neutral	4.0 mm ²
Earth	2.5 mm ²

Separate pipes shall be laid for off wires and circuit mains.

Circuit mains of same phase shall be drawn in one pipe with prior permission/discussion with the consultant.

Separate phase, neutral and earthing wire of sizes recommended by consultant shall be drawn for each and every circuit mains.

All wires shall have proper size Cu. Lugs when connected to any MCB, Plug etc...

7.4 Conduit Works

CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS:

Outlet boxes shall be of steel with cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaries.

For fixing light fixtures / brackets, outlet boxes complete with knock out for holding conduits shall be used. For lighting fixture suitable for 40/20 watts LED /fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required.

For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

7.5 Draw Out Junction Boxes

Steel draw out boxes at angle dimensions shall be provided at a convenient point on walls / ceilings to facilitate pulling of long runs of cables / wires. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these:

- (a) These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.
- (b) Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.
- (c) If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.
- (d) If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.
- (e) Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling.
- (f) Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.

7.6 Switch Boxes

Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.

Inside each switch box, one bolt shall be welded to receive earthing wire.

7.6.1 Switch and Socket

Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.

The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes

The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.

Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.

The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit

The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

7.7 Cleaning and Protection of Conduit System

The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.

7.7.1 Testing of Installation:

Before a completed installation is put into service, the following tests shall be complied with:

(a) INSULATION RESISTANCE :

The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.

The insulation resistance in gogohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit.

The insulation resistance shall be measured between

- i. Earth to Phase
- ii. Earth to Neutral
- iii. Phase to Neural
- iv. Phase to Phase

(b) EARTH CONTINUITY PATH :

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

(c) POLARITY OF SINGLE POLE SWITCHES :

A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.

(d) COMPLETION CERTIFICATES :

All the above tests shall be carried out in presence of client and the results shall be recorded in a prescribed form. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

7.7.2 Mode of measurement

The unit rate shall include:

- 1) Making zari in the wall & semi finishing the surface.

- 2) Ball and socket joints where ever required
- 3) Earthing of fittings
- 4) Electrical connection to the fixtures from the outlet point/ ceiling rose
- 5) Supply and Installation and interconnection of electronic regulators for ceiling fan
- 6) Circuit Mains shall not be paid extra. Rate for the point shall consist of wiring from the outlet point to the switch board as required with a connector/ plate/ ceiling rose fan box with hook socket with switch. The point rate shall include in addition to phase and neutral wire a PVC insulated earth continuity wire from switch to outlet. The unit rate for the point shall consist of the circuit wiring from LDB to outlet point through switch and/or socket, switch board as required and including the outlet points with connector, fan hook box or sockets. A point shall include in addition to phase and neutral wire a PVC insulated Earth continuity wire from LDB to the final termination at outlet points. No extra rate shall be paid for circuit mains for looping switch board to switch board.

7.7.3 DISTRIBUTION BOARD

Supplying, assembling, grouting, levelling, Connecting & testing D.B of specified make as per Standards IS 8623:

TPN Distribution Board:

Supplying, assembling, grouting, levelling, Connecting & testing various types of Three phase and neutral distribution boards of desired ways of specified make:

Workmanship:

1. All the D.B. should have adequate Capacity three phase busbar with main neutral links.
2. The D.B. should be provided with 2 separate insulated earth links.
3. The D.B. should be concealed type having sheet metal enclosure with double door unless or otherwise specified.
4. The D.B. should be Rust Free Powder coated.
5. The D.B. shall have top and bottom plates openable.
6. The D.B. shall be provided with necessary cable end junction box.

Mode of measurement

The rate shall be for one unit of D.B.

7.8 TPN Distribution Board:

Supplying, assembling, grouting, leveling, Connecting & testing various types of Three phase and neutral distribution boards of desired ways of specified make:

7.8.1 Workmanship:

All the D.B. should have separate neutral link per phase with main neutral link i.e. four neutral links of appropriate nos. of way.

- 1) The D.B. should be provided with 2 separate insulated earth links.
- 2) The D.B. should be concealed type having Thermoplastic enclosure with double door unless or otherwise specified.
- 3) The D.B. shall have top and bottom plates openable with IP 67.
- 4) The D.B. Shall be provided with necessary cable junction box

7.8.2 Mode of measurement

The rate shall be for one unit of D.B.

7.9 M.C.B

Supplying, Assembling, connecting & testing MCBs/ELCBs/Isolators of various rating in boards as specified in 1.1, 1.2, 1.3.

7.9.1 Workmanship

All the MCBs/ELCBs/Isolators and other accessories should mount properly and make necessary terminations with proper lugging in the DB. Should check for any faulty connections and reconnect the same. Also check for the loading once complete installation of fixtures and other equipment's is completed.

7.9.2 Mode of measurement

As per item 2.1 but for MCBs/ELCBs/Isolators and accessories

7.10 Light Fixtures

Supply, Installing, Testing, commissioning of Light fixtures of various types and of specified make

7.10.1 Workmanship

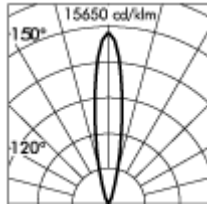
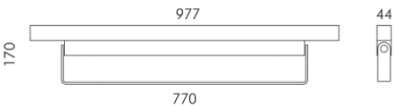
The fixture shall be installed on wall / ceiling as directed and as per manufacturer's instruction, with necessary accessories for surface, concealed, suspended from ceiling, bracket mounting etc. The job also includes connection of fixture with respective outlet point with heat resistant

wires through heat resistance sleeve and PVC connector. The exhaust fan shall be installed complete with M.S. angle iron mounting frame/ ring, G.I. louvers, wire mesh and plug at the end of the cord including wiring & earthing etc. Proper earthing shall be provided to the fixtures

7.10.2 Installation of Lighting Fixtures:

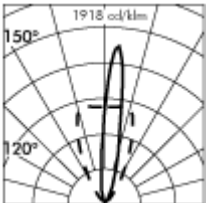
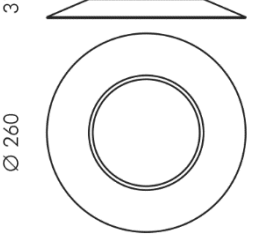
Scope of work under this item shall start from light point, with 3 nos. 1.5 mm.² PVC insulated wires from connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.

7.10.3 Installation of outdoor façade/ surface mount lighting fixtures

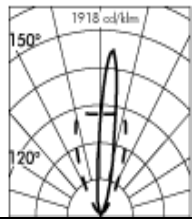
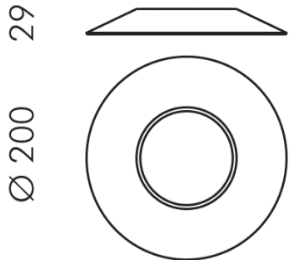
Sr. no	Category	Parameter	Details
1		Product Code	S,1255W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	5235
12		SDCM@50,000 hrs	L70B20
13		Efficacy	71
14	Optics	Beam Angle	12 Degree
15		Tilting/ Fixed	pan and rotatable
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	7
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%

21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	74
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports veryfying IK & IP	YES
26		Country of Origin	ITALY

7.10.4 Installation of outdoor ground/burial fixtures

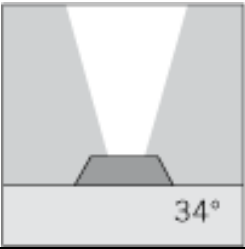
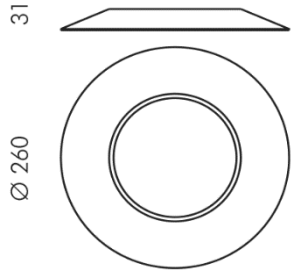
Sr. no	Category	Parameter	Details
1		Product Code	S,1915W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luiminaire luminous flux	1499
12		SDCM@50,000 hrs	L70B20
13		Efficacy	74

14	Optics	Beam Angle	C0-6+6 DEGREE, C90- 54 DEGREE
15		Tilting/ Fixed	Fixed
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	8
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	20
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

Sr. no	Category	Parameter	Details
1		Product Code	S,1905W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	

6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	653
12		SDCM@50,000 hrs	L70B20
13		Efficacy	73
14	Optics	Beam Angle	C0-6+6 DEGREE, C90- 54 DEGREE
15		Tilting/ Fixed	Fixed
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	8
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	9
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verifying IK & IP	YES
26		Country of Origin	ITALY

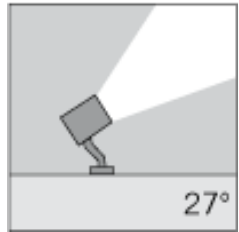
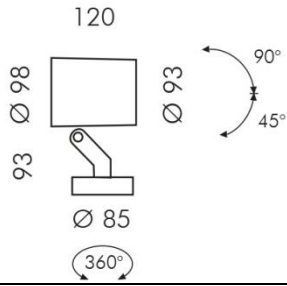
Sr. no	Category	Parameter	Details
1		Product Code	S,1911W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE

4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	1499
12		SDCM@50,000 hrs	L70B20
13		Efficacy	74
14	Optics	Beam Angle	34 Degree
15		Tilting/ Fixed	Fixed
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	8
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	20
23	REPORTS	LM 79 reports	YES

24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

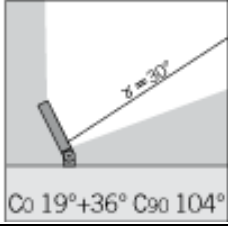
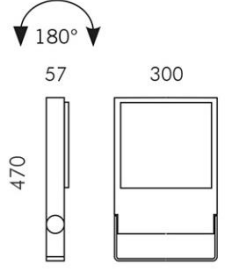
Sr. no	Category	Parameter	Details
1		Product Code	S,1925W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	27 Ø 120
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	164
12		SDCM@50,000 hrs	L70B20
13		Efficacy	75
14	Optics	Beam Angle	C0-6+6 DEGREE, C90- 54 DEGREE
15		Tilting/ Fixed	Fixed

16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	8
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	2.2
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports veryfying IK & IP	YES
26		Country of Origin	ITALY

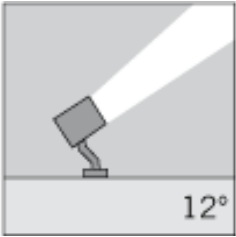
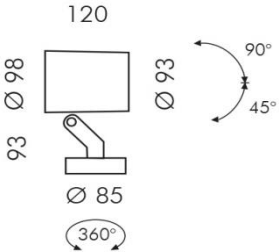
Sr. no	Category	Parameter	Details
1		Product Code	S,1315W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink

7		Fixture finish protection details	IP 66
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luiminaire luminous flux	1040
12		SDCM@50,000 hrs	L70B20
13		Efficacy	93
14	Optics	Beam Angle	27 Degree
15		Tilting/ Fixed	Tilta rotate & pan
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	7
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	11
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports veryfying IK & IP	YES
26		Country of Origin	ITALY

Sr. no	Category	Parameter	Details
1		Product Code	S,1255W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE

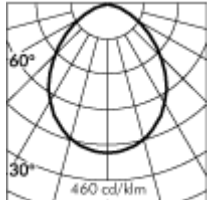
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 66
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	7409
12		SDCM@50,000 hrs	L70B20
13		Efficacy	88
14	Optics	Beam Angle	C0-19+38 DEGREE ; C90-104 DEGREE
15		Tilting/ Fixed	pan and rotatable
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	7
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%

21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	84
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

Sr. no	Category	Parameter	Details
1		Product Code	S,1315W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 66
8		Lamp Source	Lamp Source (LED chip details)
9	Color Temperature		3000K
10	Color Rendering Index		<90
11	Rated luiminaire luminous flux		651

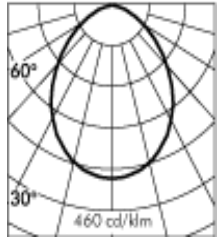
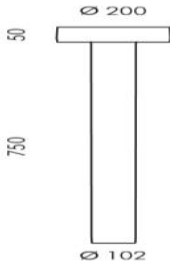
12		SDCM@50,000 hrs	L70B20
13		Efficacy	64
14	Optics	Beam Angle	12 Degree
15		Tilting/ Fixed	Tilta rotate & pan
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	7
19		LM80 report	L70B20
20		Total Harmonic Distortion	<10%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	11
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

7.10.5 Installation of Post top lamp lighting fixtures

Sr. no	Category	Parameter	Details
1		Product Code	S,2131W.14
2	Mounting		On a 2.5-3 mtr pole
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	

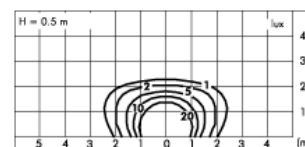
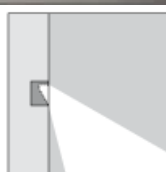
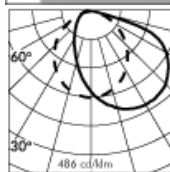
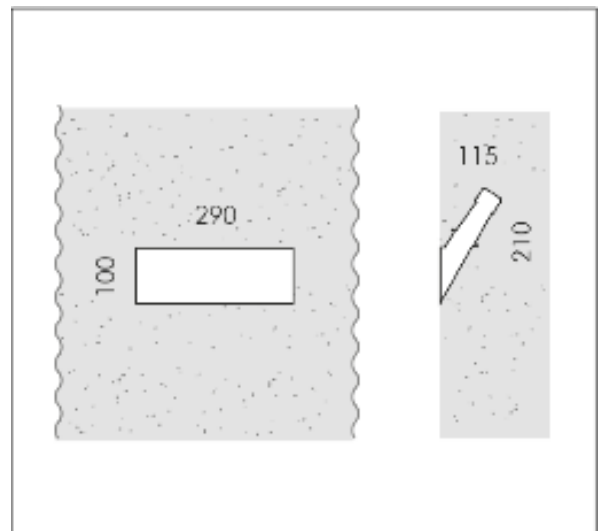
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luiminaire luminous flux	2059
12		SDCM@50,000 hrs	L70B20
13	Efficacy	73	
14	Optics	Beam Angle	Azimuth 30 degree cut off
15		Tilting/ Fixed	Fixed
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	6
19		LM80 report	L70B20
20		Total Harmonic Distortion	<15%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	28
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

7.10.6 Installation of Bollards lighting fixtures

Sr. no	Category	Parameter	Details
1		Product Code	S,2141W.14
2	Mounting		Surface
3	Painting process	Bonderite or equivalent	BONDERITE
4		Illuminance Cone Diagram with lux level and beam diagram	
5	Physical	Dimensions (L X W X H)	
6		Housing Material with Heat Sink type	ENAB 47100.....Body Heat Sink
7		Fixture finish protection details	IP 65
8	Lamp Source	Lamp Source (LED chip details)	
9		Color Temperature	3000K
10		Color Rendering Index	<90
11		Rated luminaire luminous flux	1083
12		SDCM@50,000 hrs	L70B20
13		Efficacy	77
14	Optics	Beam Angle	Azimuth 30 degree cut off
15		Tilting/ Fixed	Fixed
16		L70/ L80 Criteria	L70B20
17		Ingress Protection	65
18		IK Rating	6
19		LM80 report	L70B20

20		Total Harmonic Distortion	<15%
21	Macadam step		3
22	Ballast Details	System Wattage (Precise)	14
23	REPORTS	LM 79 reports	YES
24		LM 80 reports	YES
25		Test certificate reports verfyng IK & IP	YES
26		Country of Origin	ITALY

7.10.7 Installation of fixed light fixtures- TECHNICAL DATA SHEET ART. C.8022W - GHOST HORIZONTAL (the dimension provided in Boq item is of fixture size only, the casting of bollard in RCC/GFRC will be additional size with stone cladding)



MODULES LED 3000K 230V 880lm CRI 80 MacAdam step 3 Rated luminaire luminous flux: 490lm Rated input power: 10W Luminaire efficacy: 49lm/W

Electronic ballast 220÷230V AC 50-60Hz

IP 65

Fixture available with external DALI driver on request with surcharge. LUMINAIRE TYPE Wall mounted luminaire. IP rating IP 65 **MATERIAL CHARACTERISTICS**

Ghost is a lighting void that is obtained from a polypropylene housing anchored to the retaining panels before pouring the concrete. Ghost is composed of two elements: the housing and the lighting element. The housing is in polypropylene and it consists of two

complementary parts: - A jig , which forms the housing, and is extracted together with the retaining panel after completing the casting and removing the anchor screws; - The housing that remains embedded inside the casting and houses the lighting element. (The housing is supplied with bolts, locking system and stickers to be applied on the outside of the retaining panels so to secure a perfect alignment for multiple installations of each housing when pouring the concrete). The lighting element in die cast aluminum is anchored to the casing through proper screws and it remains completely hid into the void. Mechanical resistance IK 10

MAINTENANCE

This luminaire is manufactured on site during the concrete casting of the wall with hand crafted procedures; therefore, small imperfections caused by the low accuracy of the casting, subsidence of the concrete surface, actual and future cracks, colour ripples and variations over time, will be deliberately present and they are a feature of the concrete, proving the hand-made manufacturing procedure. **LIGHTING PERFORMANCE**

Toughened glass diffuser. LOR --

WIRING

Supplied with a pre-wired 0.3m H05RN-F cable. Isolation: CLASS I . Available colours: Cast cement. Weight: 1.3 Kg Glow Wire test: --

L.E.D circuit included. GHOST PATENTED, REGISTERED DESIGN

This luminaire contains built-in LED modules. In case of damage or malfunction please contact the manufacturer to receive additional instructions on how to replace and relative spare parts to order. The LED modules cannot be handled in the luminaire by the end user (Regulation UE 874/2012). LED circuit boards are engineered accordingly to actual Lumen Maintenance regulation (LM80) and Technical Memorandum (TM21) where uniformity and quality of light is 50.000 hours referred to L70 B20 Ta 25°C.

Lifecycle refers to LED circuit boards only, all others components of the luminaire are excluded.

TECHNICAL DATA SHEET ART. C.8022W - GHOST HORIZONTAL ACCESSORIES

S.2498 SURGE PROTECTION DEVICE 10kV CLASS I Compatible with all lighting fixtures classified under electrical Protection Class I Rated voltage 230-277V SPD type 2+3 Max Surge Protection 10kV IP67.

7.10.8 Installation of Led Track Lights

Workmanship:

1. The body of led spot light adopt Aluminium alloy which has excellent mechanical strength, extruded Aluminium for better thermal management.
2. Adopting reflector which is with excellent optics effect and excellent spot light effect.
3. Luminaire integrated with 12W / 20W / 30W LED.
4. Two circuit connector, directionally adjustable, convenient installation and maintenance.
5. 12°, 24°, 36° beam angle
5. Cable entries for through-wiring of mains supply cable.
6. Protection class IP 20
7. Luminaire provided with built-in-constant current driver with advanced circuit design achieves stable performances and long services span. Suitable for operation on 240V, 50Hz single phase ac supply

Mode of measurement

The unit rate shall be considered for Supplying and fixing one fixture. The rate shall include following

- a) All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.
- b) Supplying and fixing Ball and socket joints wherever required.
- c) Earthing of fittings.
- d) Electrical connections to fittings/ from the junction box

Per Unit for Supplying, assembling, installing, connecting, testing and commissioning pole mounted street lights.

7.11 LV cables

Supply, Installation, Testing, Laying, Commissioning of following 1100 volt grade XLPE insulated PVC sheathed Aluminium / Copper conductor armored cables as per specification in trenches, cable trays, ducts, over bed of sand, clamped to wall with suitable clamps

including, saddles fixing bolts, connecting testing and commissioning with identification tags at every 10 mtr. & Both ends. with All the fixing accessories, excavation Back filling & Cable protection with Bricks as per the drawing (If required) as per the Standards IS 1255 (1983).

7.11.1 Installation

Cables can be laid through the pvc pipes throughout the wall as shown in the drawing

- a) Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the contractor shall mark it out on the drawings and also on the site and obtain the approval of the Architect/Consultant before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.
- b) The general arrangement of cable laying is shown on drawings. All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid. cable termination for conductors up to 4 sq.mm. may be insertion type and all higher sizes shall have tinned copper compression lugs. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armoring shall be earthed at both ends.
- c) In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position. So, that no rain water may enter the building. After the cables are tested. The pipes shall be sealed with M. seal & then tarpaulin, shall be wrapped around the cable for making the entry of water light.
- d) All cables shall be provided with stainless steel/Aluminium cable identification tags at a maximum distance of 10 m

7.11.2 Testing of Cables:

- a) Before energizing, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- b) Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.

DC high voltage test shall be made after installation on the following:

- c) All 1100 volts grade cables in which straight through joints have been made.

d) All cables above 1100 V grade.

For record purpose test data shall include the measured values of leakage current versus time.

The DC high voltage test shall be performed as detailed below:

Cables shall be installed in final position with all the straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

7.11.3 Proforma for Testing Cables:

- a) Date of Test
- b) Drum No. from which cable taken.
- c) Cable from to
- d) Length of run of this cable meter

7.11.4 Insulation Resistance Test

- i) between core-1 to earth mega-ohm
- ii) between core-2 to earth mega-ohm
- iii) between core-3 to earth mega-ohm
- iv) between core-1 to core-2 mega-ohm
- v) between core-2 to core-3 mega-ohm
- vi) between core-3 to core-1 mega-ohm
- vii) duration used: 1 kV
- viii) High voltage test

Voltage	Duration
---------	----------

- i) between core an earth.
- ii) between individual cores

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

All test readings shall be recorded and shall form part of the completion documentation.

7.11.5 Mode Of Measurement

The cable shall be measured in per mt. Basis and the rates shall include;

- 1) Cables and clamps
- 2) Installation, Commissioning and testing
- 3) Cable marking and all the accessories for the cable if at all to be installed on walls.

Cable length shall be certified by engineer in charge from Clients side.

7.12 Cable Termination

Supplying & fixing heavy gauge compression type Brass glands & making joint with necessary crimping socket of long neck type connecting the same to various equipment like section pillar, switch, starter, motor etc. sizes of cables specified in BOQ CUPAL washers shall be provided for copper busbars to Aluminium connection as per IS 1255 (1983):

7.12.1 Workmanship

Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool.

7.12.2 Termination And Jointing Of Cables

7.12.3 Use Of Glands

All PVC cables up to 1.1 kV grade, armoured or Unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size single compression type cable glands. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

7.12.4 Use of lugs

All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets

The following is the recommended procedure for crimped joints and the same shall be followed:

- a) Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- b) The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the Aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
 - c) Make the crimped joint by suitable crimping tool.
 - d) If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.

7.12.5 Dressing of Cable Inside The Equipment:

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

7.12.6 Identification of Cables / Wires / Cores

Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self-sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

7.12.7 Mode of Measurement

Rate shall be considered for 1 nos of joint.

7.13 EARTHING

Providing earthing stations for equipment earthing as shown and specified in IS:3043 and drawing for equipment complete with

7.13.1 Workmanship

Following activities shall be carried out for the earthing station

- a) Excavation in hard marram.
- b) laying Watering pipe.
- c) brick masonry with hinged covers.
- d) Charcoal and Salt fill.
- e) Keep minimum 2 mt. distance between two earth pits.
- f) The pit should be minimum 4 mt. deep.
- g) The earth resistance should not exceed 1 ohm.
- h) All earth pits of same category shall be interlinked with strip.

Following points shall be followed strictly.

- A) The plate \ pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.
- B) The plate \ pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall \ column.
- C) The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
- D) 20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber.
- E) Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe.
- F) The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.
- G) The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
- H) Construction of the earthing station shall in general be as shown in the drawing and shall confirm to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.
- K) Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

- L) The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.
- M) The connection between strip and plate shall be through stainless steel bolts and washers.

Following tests shall be carried out:

The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

A) The following earth resistance values shall be measured with an approved earth meager and recorded.

- 1) Each earthing stations
- 2) Earthing system as a whole
- 3) Earth continuity conductor

B) Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 3 Ohm in each case.

C) Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

D) All tests shall be carried out in presence of the Site Engineer-in-charge.

7.13.2 Mode of measurement

Rate shall be considered for one unit of pit.

Section 8 LT OUTDOOR PANEL

8.1.1 SCOPE

This specification covers manufacturing, assembly factory test, supply, delivery, field test and installation of L.T. Switchgear panel of voltage not exceeding 1000 V AC complete in all respect with all equipment fittings and accessories for efficient and trouble free operation as required here in under.

8.1.2 CODES & STANDARDS

The design, construction, manufacture and performance of equipment shall conform to latest applicable standards and comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the BIDDER of this responsibility.

Equipment shall conform to the latest applicable Standards as mentioned. In case of conflict between the Standards and this specification, this specification shall override.

IS:13947 (Part 2&5), 1993 -Low voltage switchgear & control gears

IS:2147, 1966-Degree of protection

IS:13947 (Part 4, Sec.I),1993

BS:60947-4-1, 1992:IEC:158-Contactor for voltage not exceeding 1000V AC.

IS:375, 1993-Marking and arrangement of bus bars

IS:694, 1990 & IS:8130, 1984-PVC Insulated cables and aluminium conductor

IS:1248,1991-Direct acting electrical indicating instruments

IS:13703, 1991 -Low voltage fuses

IS:13118 (All parts), 1991 -Alternating current circuit breakers

IS:2705 (Part 1 to 4), 1992-Current transformers

IS:3156 (Part 1 to 3), 1992-Voltage transformers

8.1.3 POWER SUPPLY SYSTEM

The incomer power supply shall be 415V, 3 phase, 4 wire, 50 Hz, effectively earthed AC system. The fault level for the switchgear shall be as indicated in BOQ and drawings.

Variation of voltage and frequency from their rated values are as below:

Variation of voltage $\pm 10\%$

Variation of frequency $\pm 3\%$

Combined voltage and frequency variation $\pm 10\%$

i. AMBIENT CONDITIONS

The following site conditions shall be considered for the design of panels:

Reference temperature : 45°C

ii. SHEET METAL WORK

The switchgear frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.0 mm.

Frames shall be enclosed by sheet steel of thickness not less than 2 mm cold rolled, smoothly finished, levelled, and free from flaws. Doors and covers shall be made of sheet steel of thickness not less than 1.6mm cold rolled. Stiffeners shall be provided wherever necessary.

All panel edges and door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

Cut-outs shall be true in shape and avoid of sharp edges. The complete structure shall be rigid, self-supporting, free from vibration, twists and bends.

iii. PAINTING

All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with applicable standards

Oil, grease and dust shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and oven drying. A smooth coat of powder coating to be provided of approved colour. Finished painted appearance of equipment shall present an aesthetically pleasing appearance like light grey, free from dents and uneven surfaces.

iv. CONSTRUCTIONAL FEATURES

Switchgear panel shall be:

- a) of the metal enclosed, indoor, floor mounted modular type
- b) made up of the requisite vertical sections
- c) of dust and vermin proof construction
- d) provided with a degree of protection of IP-42
- e) easily extendable on both sides by the addition of vertical sections after removing the ends covers.
- f) provided with a metal sill frame made of structural steel channel section properly drilled for mounting the Switchgear along with necessary mounting hardware. Hardware shall be zinc plated and passivated.
- g) provided with labels on the front indicating the switchgear designation.
- h) of uniform height of not more than 2400mm(nominal). Operating handle, levers etc. of highest unit shall not be higher than 1.70 metres
- i) of single front execution

- j) provided with neoprene gaskets all round the perimeter of adjacent panels, panel and base frame, removable covers and doors.
- k) provided with aluminium bus bars running at the top or bottom, as required, all along the length of the switchgear in a separate sheet steel enclosure.
- l) Feeder pillars/kiosk should be fabricated from 2.5 mm thick CRCA steel and conform to IP:54 degree of protection.

Operating devices shall be incorporated only in the front of the Switchgear.

The switchgear shall be provided in distinct vertical sections each comprising:

- a) A completely metal enclosed bus bar compartment running horizontally.
- b) Individual feeder modules arranged in multi-tier formation. It is essential that the modules are integral multiples of the basic unit size to provide for flexibility in changes, if any, at site.
- c) ACB shall be in single tier formation.
- d) A vertical cable alley covering the entire height. The cable alley shall be minimum 300mm wide for motor control modules and 500 mm wide for circuit breaker controlled modules.
- e) A horizontal separate enclosure for all auxiliary power and control buses, as required, shall be located so as to enable easy identification, maintenance and segregation from the main power buses. Tap-off connections from these buses shall be arranged separately for each vertical section.

Each vertical section shall be equipped with space heaters which may be located in the cable alley.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal bus bar compartment. However, each shipping section shall have metal sheets at both ends.

Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

In breaker compartments, suitable barriers shall be placed between circuit breakers and all control, protective and indication circuit equipment including instrument transformers. External cable connections shall be carried out in separate cable compartments for power and control cables.

After isolation of power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the bus bars and adjacent circuits live.

Cable alleys shall be provided with suitable hinged doors. Adequate number of slotted cable support arms shall be provided for dressing the cables.

All doors shall be provided with concealed type hinges and captive screws with padlocking arrangement & shall be earthed with 2.5 sq.mm copper flexible.

Interchange ability

Switchgear shall be designed in such a way that all component equipment and bus-bars operate satisfactorily without exceeding their respective maximum permissible rise in temperature under ambient temperature conditions prevailing within the switchgear cubicle, with reference ambient temperature outside the switchgear cubicles.

No equipment / devices associated with a particular circuit shall be mounted in any other circuit module.

8.1.4 MAIN BUSES & TAPE

Switchgear shall be provided with three phase bus bars and neutral.

Bus bars shall be of uniform cross section throughout the length of the switchgear

The bus bars shall be made of high conductivity electrolytic Aluminium, suitable to withstand a fault current as specified in BOQ and SLD.

Bus bars shall be provided with at least the minimum clearances in air as per applicable standards for a 500V, 3 phase, 4 wire system.

All bus-bars, bus-taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free plastic insulation of high dielectric strength (450 V/mil) to provide a permanent high dielectric non-ageing and non-tracking protection; impervious to water, tropical conditions and fungi. The insulation shall be non-inflammable and self-extinguishing and in fast colours to indicate phases. The dielectric strength and properties shall hold good for the temperature range of 0°C to 90°C.

Bus bar shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents for the associated switchgear. Bus bar supports shall be made of glass reinforced moulded plastic material (DMC/SMC).

Separate supports shall be provided for each phase of the bus bars. If a common support is provided for all three phases, anti tracking barriers shall be incorporated.

Bus bar joints shall be complete with high tensile steel bolts, washers and nuts. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

8.1.5 AUXILIARY BUSES

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to

suit specific requirements. The material of control power supply buses shall be electrolytic copper. The material for space heater power supply buses shall be same as that for the main power buses. Supply transformer(s), auxiliary bus bars and necessary connections to the supply transformers and associated circuits shall be in the Bidder's scope.

MOULDED CASE CIRCUIT BREAKER

The Moulded case circuit breaker (MCCB) shall conform to latest IEC-60 947-2/ IS13947- 2. The MCCBs should have test certificates for breaking capacities from recognized independent test authorities. The circuit breaker shall comply with the isolation function requirement of IEC 60 947-2 section 7.1.2 to marked as suitable for isolation/ disconnection to facilitate safety of operating personnel while the breaker is in use.

Moulded case circuit breakers shall be fixed type, microprocessor release having adjustable settings with trip-free, manually closing mechanism, accommodated in a Moulded housing of robust and vermin-proof construction matching with switchboards. All MCCBs shall be designed and tested to IS - 13947 Part II to breakers shall be provided with an inverse time delay electronic over current trip device. The trip device shall be direct acting. MCCB shall have inbuilt earth fault protection release at the incomer level.

MCCB shall be provided with Class II insulation between from cover & internal power circuits to avoid any accidental contact with live current carrying path with the front cover open.

The tripping devices shall be ambient temperature compensated type. The insulating case and cover shall be made of high strength heat resistant and flame retardant thermosetting insulating material.

They shall be of the single break type. 3-phase breakers shall be designed to break all the poles simultaneously and they shall have a single mechanism.

They shall have auxiliaries and accessories whenever required for signalling, interlocking, shunt trips, under voltage release, castle lock, etc.

All the circuit breakers used shall have guaranteed breaking capacities sufficient for the maximum short circuit duties that could possibly be imposed on the different breakers. The MCCBs fixed in main switchboard shall have breaking capacity as indicated in BOQ & SLD.

MCCB shall have $I_{cu}=I_{cs}$ for the entire range.

The short circuit breaking capacity and operation of MCCB shall be supported by test certificates. Certificates of neutral independent authority (CPRI/ERDA).

MCCB shall be supplied with spreader links and phase barriers as standard feature.

The MCCB's shall be compatible for reliable protection and accurate measurement. The rated Service breaking capacity (kArms) shall be 100% of Ultimate breaking capacity (kArms). All MCCB's shall be current limiting type with features as per relevant IS codes and CPWD specification.

MCCB's shall be used with terminal spreaders and all terminals shall be shrouded to avoid direct contact.

Where ever MCCB are used as incomer, these shall be provided with earth fault protection. For outgoing MCCB, earth fault protection is not required.

For MCCB,s the rated insulation voltage shall be equal to or greater than 1000 volts and rated operational voltage should be 415 or 690 volts. The rated impulse withstand voltage shall be equal to 8 KV and up to 12 KV.

Electrical/Mechanical Endurance: Should be as per Apendix- V of CPWD General Specifications for Electrical works-2007 (Part – iv Sub- station)

MINIATURE CIRCUIT BREAKERS (MCB)

MCBs shall be hand operated, air break, quick make, quick break type conforming to applicable standards.

MCB shall be provided with overload/short-circuit protective device for protection under overload and short-circuit conditions. The minimum breaking capacity of MCBs shall be 10 kA r.m.s. at 415V AC. It should comply to Class III energy limiting class.

MCBs shall be provided with locking facility.

MEASURING INSTRUMENTS, METERING & PROTECTION

8.1.6 GENERAL

Direct reading electrical instruments shall be in conformity with IS-1248. The accuracy of direct reading shall be 1.0 for voltmeter and ammeters. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

8.1.7 DIGITAL AMMETERS

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

8.1.8 DIGITAL VOLTMETERS

Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

8.1.9 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (part I,II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as

required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring: Class 0.5 to 1.

Protection: Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of the system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

8.1.10 MISCELLANEOUS

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of LED type.

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

8.1.11 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Distribution Boards to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

8.1.12 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Distribution Boards. Labels shall be properly secured with fasteners.

8.1.13 TESTS AT MANUFACTURING FACILITY

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the Department.

8.1.14 TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) Continuity checks of wires, fuses etc. as required.
- d) Insulation test : Testing shall be as per CPWD specification.
- e) Trip tests & protection gear test.

8.1.15 PUSH BUTTONS

Push buttons shall be:

- of the momentary contact, push to actuate type rated to carry 10A at 240V AC and 1A (inductive breaking) at 220V DC.
- fitted with self reset, 2 NO and 2 NC contacts.
- provided with integral escutcheon plates marked with its function.

'Start', 'Open', 'Close' push buttons shall be green in colour.

'Stop' push buttons shall be red in colour.

All other push buttons shall be black in colour.

Emergency stop' push buttons shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.

8.1.16 INTERNAL WIRING

Wiring inside the switchgear shall be carried out with 1.1 kV grade, zero halogen FR insulated, stranded conductor wires. Minimum size of conductor for power circuits is 4 sq mm copper. Control circuits shall be wired with copper conductor of at least 2.5 sq. mm for CT circuits and 1.5 sq.mm for other circuits.

Engraved identification ferrules, marked to correspond with the wiring diagrams shall be fitted to each wire. Ferrules shall be of yellow colour with black lettering.

Wires forming part of a tripping circuit of circuit breaker shall be provided with an additional red ferrule marked 'T'.

Spare auxiliary contacts of all equipment forming part of the switchgear shall be wired up to the terminal blocks.

Spare and unassigned modules shall be complete with internal wiring.

Wiring shall be terminated on preferably stud type terminal blocks such that the wires are connected by cable lugs with nuts and washers/lock-nuts. Not more than two connections shall be made on any one terminal

8.1.17 TERMINAL BLOCKS

Terminal blocks (both for power and control circuit) shall be of reputed make especially for CT and VT circuit. It shall comprise of finely threaded pairs of brass studs of at least 6mm diameter, links between each pair of studs, washers, nuts and locknuts. The studs shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.

Terminals for circuits with voltage exceeding 125 V shall be shrouded. Terminal blocks shall be grouped depending on circuit voltage. Different voltage groups of terminal blocks shall be segregated.

Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block is 10A.

Terminals shall be numbered for identification. Engraved white-on-black labels shall be provided on the terminal blocks, describing the function of the circuit.

Where duplication of a terminal block is necessary it shall be achieved by solid bonding links.

Terminal blocks for CT secondary lead wires shall be provided with shorting and disconnecting/earthing facilities.

Terminal blocks shall be arranged with at least 100mm clearance between two sets of terminal blocks.

Control terminals for external connections shall be suitable for terminating at least two conductors each of 2.5 sq mm size.

8.1.18 EARTHING

Each Panel shall be provided with an earth bus bar running along the entire length of the board. Material and size of the earth bus bar shall be as per IS. At either end of the earth bus, one (1) clamp type terminal with nuts, bolts and washers shall be provided for bolting the Engineer's earthing conductor of size and material indicated in data sheets. In case the earth bus is provided near top of the switchgear, one down comer at either end shall be provided for connection to the Engineer's earthing conductor.

Earth bus bars shall be supported at suitable intervals.

Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wires/bare bus bars of cross section equal to that of the bus bar, or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All instrument and relay cases shall be connected to the earth bus bar using 650 V grade, 2.5 sq. mm stranded, copper, earthing conductor.

8.1.19 TESTS

Switchgear shall be subjected to following tests:

- Temperature rise test on power circuits.

- Short time current tests on power circuits.
- Mechanical operation test.
- High voltage test
- Electrical control interlock and sequential operation tests.
- Verification of wiring as per approved schematic.

All tests shall be carried out on all associated equipment as per relevant standards.

Certified copies of all test certificates shall be submitted for the approval of Engineer-in-Charge before despatch of the switchgear.

Routine test shall be witnessed at the manufacturer's works by the representative of Engineer-in-Charge.

DATA SHEET FOR LT PANELS

A) SWITCHGEAR PARTICULARS

- | | | | |
|----|------------------|---|-------------|
| 1. | DESIGNATION | : | |
| 2. | BUS BAR MATERIAL | : | ALUMINIUM |
| 3. | TP/TPN | : | 4 POLE/TPN |
| 4. | TYPE | : | OUTDOOR |
| 5. | CABLE ENTRY | : | FROM BOTTOM |

B) SWITCHGEAR AND BUS BAR RATING

- | | | | |
|----|-------------------------|---|-----------------------------|
| 1. | SUPPLY SYSTEM | : | 415V, 3-phase, 4W, 50HZ |
| | EFFECTIVELY EARTHED | | |
| 2. | MAX SYSTEM VOLTAGE | : | 433 ± 10% |
| 3. | BUS BAR RATING | : | AS PER SLD |
| 4. | ONE MINUTE POWER | | |
| | FREQUENCY VOLTAGE | | |
| | A) POWER CIRCUITS | : | V |
| | B) CONTROL CIRCUITS | : | V |
| | C) AUX. CIRCUITS | : | V |
| | CONNECTED TO | | |
| | SECONDARY OF CTS | | |
| 5. | REFERENCE AMBIENT | | |
| | TEMPERATURE | : | 45°C |
| 6. | MAX. TEMPERATURE OF | | |
| | BUS BARS AND DROPPERS | : | 85°C |
| 7. | SHORT CIRCUIT WITHSTAND | | |
| | A) SHORT TIME (1 SEC) | : | 65/50 KA (RMS) as required. |

C) SWITCHGEAR CONSTRUCTION REQUIREMENTS

- | | | | |
|----|--|---|------------------|
| 1. | THICKNESS OF SHEET STEEL (COLD ROLLED) | | |
| | A) FRAME | : | 2.0 MM |
| | B) DOORS | : | 1.6 MM |
| | C) COVERS | : | 1.6 MM |
| 2. | DEGREE OF PROTECTION | : | IP-54 OF IS-2147 |

3. COLOUR FINISH AS PER IS-5 :POWDER COATED, SIEMENS GREY
4. CLEARANCES IN AIR OF LIVE PARTS
 - A) PHASE TO PHASE : 25.4 MM
 - B) PHASE TO EARTH : 19.4 MM

Section 9 CCTV & WIFI SYSTEM

9.1.1 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of all indoor and outdoor cameras, DVRs and control panels as specified in the tender and as shown on drawings complete with all inter connection as required. The scope includes supply and laying of Cat-6 cables, power and control wiring. Contractor needs to supply, install and test the computer system to store the data as per given details in tender and the display monitor screen. The entire system must be software based and programmable. All the equipment must be of latest standards and compatible with upgradation software.

9.1.2 General System Description

The CCTV is required to supply the operator with the following information and facilities:

1. Display of images on monitors through commands given by the operators keyboard.
2. Automatic camera selection, positioning and display to preset positions
3. Remote camera, monitor and recording selection
4. Display of single and/or quadruplicated images on any selectable monitor, (optional)
5. Recording driven by Digital Video Recorders

9.1.3 WIFI System

The scope of work includes the supply, installation, testing and commissioning of wifi system capable to cover the entire site area including all outdoor type instruments like antenna, extenders, power supply box, network db, poe switches etc.

Contractor has to test the network with the local area internet service provider with LAN and wifi with computer system and portable devices like mobile, tablet etc. IP rated phone must be installed dedicated for the internet service.

The instruments used in the wifi systems must be as per the specifications given in the tender and must comply with all the government latest standards. Modem/Router/Extender used for the system must be of higher range and capable of handling multiple devices altogether.

All the fibre optic and cat-6 cable connections of the instruments must be in a weather proof junction box. Workmanship as per the site incharge.

Section 10 TRANSFORMER

The scope includes supply, installation, testing & commissioning of 250KVA, 11000/433 volts ONAN Plinth mounted outdoor type transformer with off Load Tap Changer and as per latest IS norms.

1	Make	-
2	KVA Rating	250KV A
3	HV Voltage	11000 Volts
4	LV Voltage	433 Volts
5	No. of Phases	3 (Three)
6	Frequency	50 Hertz
7	Type	Double Copper Wound, Oil Immersed
8	Installation	Outdoor
9	Cooling	Naturally Oil Cooled ONAN
10	HV Connection	Delta
	LV Connection	Star
	Vector Group	Dyn11
11	Tapping (on HV Side)	(+5%) to (-5%) in steps of 2.5%
12	Tap Switch	Off Circuit, Externally Operated
13	No Load Losses at Rated Voltage & Frequency	as per IS 1180
14	Load Loss at Rated Current & 75°C	
15	Impedance at 75°C	
16	(a) Regulation at U.P.F.	

	(b) Regulation at 0.8 P.F.	
17	Efficiency at 100% Load	
	75% Load	
	50% Load	
18	Temperature rise (in Oil)	
	Temperature rise (in Winding)	
19	Terminal Arrangement	
	HV Side	Cable box
	LV Side	Cable box
20	Reference Standard	IS 1180

(a) ERECTION:

Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. All the civil foundation work required shall be in the scope of contractor.

(b) TESTING:

Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary. Check the polarity of terminals and the phase sequence.

(c) PROFORMA FOR TRANSFORMER TEST:

- Transformer name plate.
- Insulation resistance test with 1000 V meagre.
 - a) between primary to earth
 - b) between secondary to earth
 - c) between primary and secondary
- Operation of the tap changer.
 - Operation of the tap at tap No. 1

Operation of the tap at tap No. 2

Operation of the tap at tap No. 3

Operation of the tap at tap No. 4

Operation of the tap at tap No. 5

- Polarity marking and phase sequence.
- Earth resistance: Body as well as Neutral link.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

TEST REPORTS

H.T. CABLE

- | | |
|---|---|
| a) Type of Cable and Make | : |
| b) Voltage Grade | : |
| c) Reference Standards | : |
| d) System Earthing | : |
| e) Conductor | : |
| f) Conductor Screening | : |
| g) Insulation Properties & Process of Application | : |
| h) Nominal thickness of XLPE Insulation | : |
| i) Insulation screening | — |
| i) Non-Metallic Part | : |
| ii) Metallic Part | : |
| j) Inner Sheath | : |
| k) Core Identification | : |
| l) Armouring | : |
| m) Outersheath thickness | : |
| n) Manufacturing Practice | : |

L.T. CABLE

- | | |
|---------------------------|---|
| a) Type of Cable and Make | : |
| b) Voltage Grade | : |
| c) Reference Standards | : |

- d) Nominal cross sectional area of the Conductor :
:_____
- e) Insulation Properties and Process of Application :
:_____
- f) Nominal thickness of the Insulation :
:_____
- g) Inner Sheath :
:_____
- h) Core identification :
:_____
- i) Armouring :
:_____
- j) Outer Sheath thickness :
:_____
- k) Manufacturing Practice :
:_____

CABLE ACCESSORIES

- I Sealing End :
:_____
- a) Bidder's Name :
:_____
- b) Type & Description of material used :
:_____
- c) Size (mm and shape) :
:_____
- d) Rated voltage :
:_____
- e) Rated continuous current (Amps.) :
:_____
- f) Maximum conductor size (Sq. mm.) :
:_____
- g) Rated impulse withstand voltage :
:_____
- h) Impulse wave shape :
:_____
- i) Power Frequency withstand voltage :
:_____
- i) Dry ((KV rms) :
:_____
- ii) Wet (KV rms) :
:_____
- j) Flashover voltage :
:_____
- i) Dry ((KV rms) :
:_____
- ii) Wet (KV rms) :
:_____
- k) Impulse (KV Peak) :
:_____
- l) Mounting details of :
:_____
- i) Sealing end/Switchyard :
:_____
- ii) Link Box :
:_____
- m) Details of terminal connector :
:_____
- n) Other details :
:_____

CABLE ACCESSORIES

II Jointing Termination Kits

- a) Name of Bidder : —
- b) Material of the coffin : —
- c) Details of materials used in : —

CABLE TRAYS :

- 1. Make :
- 2. Code followed :
- 3. NEMA - ASTM - IS. :
- 4. Method of Fabrication (Full details :
required).
- 5. Strength of Tray for concentrated load :
- 6. Load :
- 7. Standard lengths :
- 8. Testing facilities available with the :
manufacture for
 - a. Destruction :
 - b. Deflection :
- 9. Drawings for :
 - a. Trays :
 - b. Fish plates :
 - c. Bends/Tees/Reducers :
- 10. Details of S.S. Bolts, nuts, fixing bolts :
etc.

U.P.S. SYSTEM

1. KVA rating :
2. Technology
3. Inversion Frequency
4. Input Voltage Range
5. Input Frequency
6. Output Voltage
7. Output Frequency
8. Load capacity
9. Total Harmonic Distortion
10. Output Waveform
11. Efficiency
12. Inverter Type
13. Transient response
14. Over load capacity
15. Cooling
16. Noise Level
17. Protections
18. Monitoring / Metering (Digital type)
19. Display
20. Remote Indication
21. Audible Alarm
22. Cooling
23. Switch Gear
24. Temperature
25. D C Voltage
26. Type of Battery
27. Back up
28. Software
29. Testing
30. Backup Time
31. Enclosure

Section 11 List of Approved Brands/Makes

LIST OF APPROVED BRANDS (CIVIL WORK)

Item List With Make (Civil Work)

Sr. No.	Item	Brands
1	Concrete Work: PCC or RCC	
A	Cement	ACC, Ultra Tech, Siddhi, Sanghi Cement, Birla Cement
B	TMT Reinforcement Bar Fe - 415 or Fe - 500	Tata, SAIL, VIZAG, RINL, Jindal Confirming to IS - 1786:1985 (reaffirmed 2004) or IS 432 Part -I & II : 1982)
C	Sand	As per Mix design for concrete work or zone-II. For Masonary and plaster work zone - III
D	Concrete Additive, admixtures	Sika/ STP/CICO/Pidilite/ Fosroc/Fairmate/ MC Bouchemie
E	Precast RCC utility channels	Fuji Silverttech
F	Water Proofing Compounds, Plasticizer, Super Plasticizer, Grouts, Polymers, Polyexpanse, Other construction	ChowguleKoster, Fosroc, Sika, Huntsman (Ciba Geigy), Sunanda Specialty Coating, Shivalik Agro Poly Product Ltd.(Water Proofing liner).
2	Masonary Work	
A	Brick/ bela stone Masonary	Having crushing strength not less than 35 Kg/ Sqcm of Localy Available
3	Structural Steel Work	
A	Structural Rolled Steel sections- beams (all forms of sections including all ISMb, H-section, Universal Column/beam), channels, tee, flats, angles, bars(round, square, hexagonal)	Tata, SAIL, RINL, Jindal
B	Structural Hollow steel sections (Square & Rectangular)	Tata, Asian, Jindal, Surya, Appolo
C	Structural tubular sections	Tata, Asian, Jindal, Surya, Appolo
4	Wood Work (Door, Window & Interior)	
A	Teak Wood	Ghana, Nagpur (Indian Teak)

b	Sal Wood	Indian or Imported (First Class)
b-1	Canadian/Malaysian wood	Imported (First Class)
C	Flush Door (decorative / non decorative)	Green, Duro, Century, Swastik, Kit Ply, Anchor, Uniply, Archid ply, Bhutan Board, Hindustan Board/equivalent.
D	Ply Wood	
	Plywood/Block Board/ Soft Board	Anchor, Duro, Merino, Century, Kitply
	Shuttering plywood	Kitply, Anchor, Green, Pragati, Mayur.
	Water proof/Marine grade plywood as per – IS – 710 (BWP)	Green, Archid, Kitply, Anchor, Uniply
	Commercial Plywood – IS – 303 (BWR)	Green, Archid, Kitply, Anchor, Uniply.
E	Decorative ply (Veneer)	Green, Durian, Century, Archid
F	Natural Veneer	Timex, Durian, Century Ply
G	Laminate sheet	Duro/ Century/ Greenlam/ Formica/ Decolam/ Euro,Sungolss, Sunmica, Bachelite hylem
H	Liquor /Melamine /PU polish	MRF, Asian, ICI, Taralac
I	Wooden Adhesives	Fevicol, Blue coat, Araldite, Pidilite, Dunlop.
5	Aluminum Work (Door, Window & Interior)	
A	Aluminium Sections	Jindal, Indian Aluminium section, Hindalco (Indal), Banco, Royal touch, indal,Hindalco, Bhoruka, Pankaj, Alufit, Gulf extrusion.
B	Aluminium finish	
	Interior works	Super durable powder coated (Akzonobel, Jotun, Fuller AG)
	Façade exteriors	PVDF finish (Valspar, PPG, Akzonobel)
	Non visible surface	Chromatizing
C	Aluminum Window Locks , Handle, Friction Stays	Alualpha, Securestyle, Giessee, Roto, Geze, Savio, Frikstay, Kich, Orbit
D	Oxidised Aluminum Fitting	Dorma, Ebco, Doorline, Classic ,Kich, Orbit
E	Aluminum Operable Louvers	Technal, Domal
F	Anodising	Bhoruka alum, Alufit alum, Ajit India, Alufin

G	Rough ground for Aluminum works	IS 710 ply, 6mm to 8mm thick or Ghana teak.
6	Compact sheet	Alfiaca, Sundek, Vir, Bloom, Formica, Merino
7	Dead Locks/ Mortise locks/ Narrow stile dead locks/ Tubular locks	Kich, Dorma, Dorset, Yale, Godraj, Enerite, Sigma, Opel, Doorset, Europa
8	Tile Work	
A	Ceramic Tiles	Asian, Euro, Bell Ceramic, Johnson, Somani, Nitco, Kajaria, Restiles, Varmora.
B	Glazed Tiles	Asian, Euro, Bell Ceramic, Johnson, Somani, Nitco, Kajaria, Restiles, Varmora.
C	Vitrified Tiles	Asian, Euro, Bell Ceramic, Johnson, Somani, Nitco, Kajaria, Restiles, Varmora, Pavit
D	Tile Adhesives & Grouting material	BAL, Laticrete, Kerakoll
9	Paint Work	
A	Paint, Primer, Putty	Johnson & Nicholson, Asian, Berger, ICI, Birla (putty), JK (Putty) Nerolac
B	Synthetic Enamel Paints	Berger, Asain, Nerolac, Duco
C	Acrylic Distemper	Asian, Berger, Nerolac
D	Cement Paint	Snowcem Plus, Berger, Nerolac
E	Plastic Emulsion Paint/ PU/Epoxy paint	Asian, Nerolac, Berger, ICI, Jotun
F	Low VOC Paint/ Emulsion Paint	Asian, Nerolac, Berger, ICI, Jotun
G	Texture External Plaster	Spectrum, Coral, Terre Palette
H	Heritage Surface Texture	Bakelite Hylam
10	Construction Chemicals (Plasticisers, Bonding agents, , SBR Latex, Micro Concrete)	BASF, Fosroc, Sika India Pvt. Ltd., CICO Tech Ltd., MC Bauchemie , Sunanda chemicals, Pidilite
11	Silicon Sealant/ Silicon Paint	Sika, Wacker, Dowcorning, GE, Soudal, Bostik, Chryso
12	P.U sealant	Sika (Exterior grade - UV resistant)
13	Door Window Hardware	Kich, Dorma, EPPW ,Palladium, Magnum
14	Floor Spring	Dorma, Mab, Hafle, Doorset, Everite, Omega, Hardwyn
15	Hydraulic Door Closer	Dorma, Yale, Hafle, Hardwyn, Trium, Everite, Hyper

16	Anchor Fasteners	Axel, Hilti, Fischer, Kundan, Mungo, Corroshield, Buildex
17	Stainless Steel Railing/ Fittings	D Line, Dorma
18	Rust Remover/Converter	Feovert (Krishna Conchem), Roff Rust Clear (Pidilite Industries)
19	Non-shrink General Purpose Grout	Fosroc, BASF
20	SS clamps for cladding	Hilti, Axel.
21	Lime	Locally/ Outside Available
22	Dhangadhra/ Granite/ Rajula Cobble stone	Rajula /Locally available
23	Internal/ External Paint	Verona vapour lime wash by OIKOS India
24	Golf Car	Yamaha
25	Polycarbonate Sheet	Lexan

LIST OF APPROVED BRANDS (Plumbing)

IN ORDER OF PREFERENCE

S.No.	Description	Makes
1.	BALL VALVES (Brass)	AUDCO/ZOLOTO/ LEADER
2.	BUTTERFLY VALVES	AUDCO/ZOLOTO/ INTERVALVE
3.	NON RETURN VALVES	AUDCO/ZOLOTO/LEADER
4.	PRESSURE REDUCING VALVE	ZOLOTO/ HONEYWELL
5.	WATER FLOW METERS	MEDDALENA/ KRANTI
6.	FOOT VALVE	ZOLOTO/ SANT
7.	LEVEL INDICATOR	TECHNIKA/ MINILEC
8.	PVC/ CPVC/UPVC PIPES/FITTINGS	ASTRAL/ ASHIRVAD/SUPREME
9.	INSULATION MATERIAL	ARMAFLEX/ THERMAFLEX
10.	UNDER GROUND DRAIN PIPE	D-Rex/ Ashirvad(Foam core)/ Astral

11. RCC PIPES	:	ALCOCK/ PRANALI/ JK
12. FRP MANHOLE COVER/ GRATING	:	THERMODRAIN
13. CPVC PIPES AND FITTINGS	:	ASTRAL/ ASHIRVAD/ SUPREME
14. UPVC PIPES	:	ASTRAL/ ASHIRVAD/ SUPREME
15. STRAINER	:	ZOLOTO/ SANT
16. AIR RELEASE VALVES	:	VARIES, HONEYWELL, VB
17. HDPE PIPE	:	DUTRON/ JAIN
18. BALL FLOAT VALVE	:	PRAYAG/ BEE
19. HDPE OVERHEAD TANK	:	SINTEX/ KAKA

NOTES:

Make of various items offered by the tenderer shall clearly be marked in the above list. However the final choice of the selection of particular make solely lies with Client / Consultant which shall mutually be agreed upon before finalization of order.

Approval must be needed for the all material; sample will be submitted to consultant along with detail catalogue.

Make of any other items required but not specifically mentioned shall be got approved by Client / Consultant.

LIST OF APPROVED MAKES (IRRIGATION) IN ORDER OF PREFERENCE

S.No.	Description	Makes
1.	G.I. & M.S. PIPES	JINDAL/TATA/APL APOLLO/SURYA PRAKASH
2.	G.I. FITTINGS (Malleable CAST IRON)	UNIK/ ZOLOTO'M'/ DRP'M'
3.	GUNMETAL VALVE (Full way, check and globe valves)	LEADER/ ENOLGAS/ SANT
4.	CAST IRON NON RETURN VALVES (Swing check type reflux valve)	KIRLOSKAR/ IVC/ ADVANCE/ INTERVALVE/ SANT
5.	IN LINE DRIPPER	HUNTER/ TORO/ K RAIN/ JAIN/ EURO DRIP
6.	SLUICE VALVES	KIRLOSKAR/ IVC/ KSB/ AUDCO
7.	FLOAT VALVE (gunmetal) up to 50mm	LEADER/ SANT
8.	FLOAT VALVE (C.I) 50mm and above	IVC/ LEADER/ DANFOSS
9.	P.V.C. PIPES Class	SUPREME/ FINOLEX/ POLYPACK/ JAIN
10.	ROTORS	HUNTER/ TORO/ NELSON
11.	DUCTILE IRON PIPES & FITTINGS	ELECTRO STEEL/ JINDAL SAW/ KESORAM
12.	POLY PROPYLENE PIPES	JAIN/ SUPREME/ FINOLEX/ AMITEX
13.	HDPE PIPES & FITTINGS	JAIN/ SUPREME/ FINOLEX/ ORIPLAST
14.	BUTTERFLY VALVES	LP,KARTAR/ IVC/ KIRLOSKAR
15.	AIR RELEASE VALVES	BERMAD/ IVC/ ENOLGAS/ ACCUTECH/ AUDCO
16.	PRESSURE RELIEF VALVES	BERMAD/ LEADER/ HONEYWELL/ DANFOSS/ SANT/ ENOLGAS
17.	WATER METERS	BE METERS/ ROCKWIN
18.	VALVE BOXES	ECOAQUA/ECORAIN/ APPLIED ENGG/ SUPREME/ CARSONS

19.	EPDM GASKETS & RUBBER 'O' RINGS	DURABLE/ PRABHAT/ AMALGAMATED/ J.D.Rubber/ APP
20.	R.C.C PIPES	Aggarwal Spun Pipe/ Pragati Concrete Udyog/ Jain Spun Pipe/ Daya Spun
21.	PRECAST MANHOLE COVERS (SFRC)	KK Manhole & Co., Pragati etc.
22.	PLASTIC ENCAPSULATED STEPS	KGM, KK India
23.	DUCTILE IRON MANHOLE COVERS	CRESENT/ RIF/ BIC
24.	SOLENOID VALVE (Nylon Reinforced Plastic)	HUNTER/ TORO/ NELSON
25.	LOW VOLTAGE CABLE (Direct Burial Type)	MACROTHERM
26.	LOW VOLTAGE WIRE CONNECTOR (with grease & closure Cap)	3M, HUNTER
27.	PUMPING UNITS (WITH VFD, PLC etc.)	KIRLOSKAR/ GRUNDFOS/ ITT/ DP HOLLAND/ KSB/ MATHER & PLATT
28.	CHLORINATORS	-
29.	BLEACHING POWDER & PAC	-
30.	IRRIGATION CONTROLLER (with pedestal)	HUNTER/ TORO/ NELSON/ MOTOROLA
31.	PVC SOLVENT CEMENT & PIPE CLEANER	TANGIT/ PARABOND
32.	PE PIPES (LLDPE)	RAIN BIRD/ TORO/ HUNTER/ K RAIN/ JAIN
33.	QUICK COUPLING VALVES (BRASS)	RAIN BIRD/ TORO/ HUNTER/ K RAIN
34.	BUBBLERS & EMITTERS (PC)	HUNTER/ TORO/ NELSON/ K RAIN
35.	CENTRAL CONTROL SYSTEM(with CPU, Monitor, Printer, BMS compatible)	RAIN BIRD/ TORO/ HUNTER/ K RAIN
36.	MANUAL SCREEN FILTERS (SS 316 L)	JAIN/ FINOLEX/ KIMPLASS/ ORIVAL

LIST OF APPROVED BRANDS (ELECTRICAL WORK)

Sl. No.	Item	Approved Makes
1)	Terminal Blocks	PHOENIX CONTACTS/WAGO & CONTROLS / WEIDMULLER / HENSEL
2)	FRLS PVC Insulated Copper Wires	FINOLEX / POLYCAB / KEI / HAVELL'S
3)	Wiring Accessories (Switches, Sockets, Telephone sockets, boxes, etc.)	LEGRAND / SCHNEIDER / HAVELL'S / WIPRO
4)	Transformer	CROMPTON / VOLTAMP / BHEL / AREVA/ ABB/ SIEMENS/ KIRLOSKAR / SCHNEIDER / GE
5)	Contactors	L&T (MNX) / SCHNEIDER-TESYS / SIEMENS (SICOP)/ABB 'A' RANGE/GE
6)	MCCB	SCHNEIDER / HAVELL'S / L&T / SIEMENS / ABB
7)	MCB	SCHNEIDER / HAVELL'S / L&T / SIEMENS / ABB
8)	VCB	SIEMENS / AREVA / ABB / SCHNEIDER / GE
9)	Push Buttons	SIEMENS / ABB / TELEMECANIQUE / L&T / SCHNEIDER
10)	O/L Relays	L&T / SCHNEIDER / SIEMENS /ABB/ GE
11)	Numerical Relays	ABB (RE Series) / SIEMENS (7S Series) / SCHNEIDER (Sepam series)/AREVA (Micom P)/L&T
12)	Timers	L&T / SIEMENS / TELEMECANIQUE / CONZERV / ABB/GE
13)	Indicating Light	L&T / SIEMENS / TELEMECANIQUE / ABB/SCHNEIDER
14)	Indicating Instruments	RISHABH / CONZERV / L&T / YOKINS INSTRUMENT
15)	kWh Meters	CONZERV / YOKINS INSTRUMENT / L&T/SECURE
16)	Light Fittings(Indoor)	PHILIPS / CROMPTON / DECON / WIPRO / BAJAJ / THORN / KESELEC / K-LITE / SPACEAGE / GE /

		PIERLITE / HAVELL'S
17)	HT Cable	FINOLEX / POLYCAB / LAPP / RAVIN / KEI
18)	LT Cable	FINOLEX / POLYCAB / LAPP / RAVIN / KEI
19)	Cable Glands	DOWELS / CROMPTON / COMET / SIEMENS
20)	Termination/Jointing Kit	BIRLA 3M / RAYCHEM / DENSON / CABSEAL
21)	CTs	KAPPA / MAXWELL/ AREVA/L&T/ AE
22)	PTs	KAPPA / AREVA / AE
23)	HT Panels	SIEMENS / SCHNEIDER / ABB / L&T
24)	LT Panels	SIEMENS / SCHNEIDER / ABB / L&T
25)	Cable Trays	OBO / PREFAB / NEEDO / STEELITE / PILCO / VENUS (Sample to be approved by Engineer-in-Charge)
26)	Cable Lugs	DOWEL / LOTUS / JHONSON / WAGO
27)	ACB	SCHNEIDER / SIEMENS / ABB / L&T / GE
28)	Selector Switch	KAYCEE / L&T / SIEMENS / BCH/GE
29)	Battery	EXIDE / STANDARD / AMCO / PANASONIC
30)	Battery Charger	CALDYNE / VOLSTAT / AMARARAJA
31)	Capacitor Banks	EPCOS / ABB / DUCATI / L&T/ GE
32)	Trivector Meter (Digital)	L&T / CONZERV / DUCATI / SECURE
33)	Capacitor Panels	SIEMENS / SCHNEIDER / ABB / L&T
34)	Power Factor Correction Relay	EPCOS / DUCATI / L & T / ABB/SCHNEIDER/GE
35)	Rubber Mat	PREMIER POLYFILM LTD / POLYELECTROSAFE / CHALLENGER
36)	Multi-function Meter	ABB / SIEMENS / L&T / SCHNEIDER/ CONZERV / SECURE
37)	MPCB	SCHNEIDER / L&T / SIEMENS/ABB/GE
38)	Conduit	PRECISION / VRAJ / AKG / STEEL CRAFT/ MKAY

39)	Diesel Engine	CUMMINS / DETROIT / CATERPILLAR / GREAVES / STERLING WILSON / KIRLOSKAR.
40)	Alternators	KIRLOSKAR / STAMFORD / CROMPTON / CATERPILLAR / JYOTI
41)	UPS System	SCHNEIDER / LEGRAND / LABOTEK / LIBERT / MITSUBISHI / SIEMENS
42)	Outdoor Flood Lighting/ High mast fixtures	K Lite/Ligman/Schreder (Sample to be approved from the Electrical Consultant) (all the Tube Lights shall be of 5star rating of BEE)
43)	Outdoor Internatioal Lighting, (Light Pole, Façade Lighting, Surface mount Lighting, Monument Lighting, Ground burial, Bollards	Simes, Erco, Zumtobel (sample to be approved prior to order placement)
44)	All other items not covered above	AS PER SAMPLES APPROVED

Make of various items offered by the tenderer shall clearly be marked in the above list. However the final choice of the selection of particular make solely lies with Client / Consultant which shall mutually be agreed upon before finalization of order. If these brand is not available equivalent brand may be accepted after due approval of authorities.

Section 12 List of Drawings – Appendix 1

“Beautification and Landscaping of Diu Fort”

Sr.No.	Drawing Number	Drawing Tittle	Remarks
1.		Masterplan	
2.	SK 01	Demolition Plan	
3.	SK 02	Flooring Plan	
4.	SK 02A	Jail Plaza Detail	
5.	SK 03	Horticulture Plan	
6.	SK 04	Proposed Pathway Section	
7.	SK 04A	Typical Pathway Detail	
8.	SK 06	Toilet Block Plan	
9.	SK 07	Toilet Block Sections	
10.	SK 08	Information Signage Detail	
11.	SK 09	Directional Signage Detail	
12.	SK 10	Typical Bench Detail	
13.	SK 11	Typical Dustbin Detail	
14.	SK 12	Information Wall	
15.	SK 13	Bell and Statue Plinth	
16.	SWD 01	Column & Footing Detail- Toilet Block	
17.	SWD 02	Ground Beam Details- Toilet Block	
18.	SWD 03	Lintel & Slab Details- Toilet Block	
19.	E-DF-E-LTG-01	Electrical Lighting Layout- Site Plan	
20.	E-DFU-LTG-TB-01	Electrical Layout- Toilet Block	
21.	PL-DF-TD-01	Plumbing Layout- Toilet Block	
22.	PL-DF-TD-02	Plumbing Layout- Site Plan	

Section 13 List of Mandatory Documents

List of Documents to be submitted **(for reference purpose only, however it suggested to the contractor to go through the NIT thoroughly)**

1. Letter of transmittal
2. Form 'A' financial information
3. Form 'B' form of bankers' certificate from a scheduled bank
4. Form 'C' details of all works of similar class completed during the last seven years ending previous day of the last date submission of tenders, if it is a private work TDS certificate shall be furnished.
5. Form 'D' performance report of works and physical requirement table referred to referred to in forms 'c '
6. Form 'E' structure & organization
7. Affidavit as per provision of CPWD-6 for e-Tendering/Information & Instruction for Bidder
8. Form integrity pact, Form acknowledgement by bidder for acceptance of principal of integrity and Form integrity agreement
9. VAT/GST registration or Undertaking
10. Bank Solvency certificate
11. PAN card
12. Tender EMD
13. Tender Processing fee
14. Registration details showing the Class of the Contractor, registration number etc
15. License for electrical works
16. Company details & and its associated information such as Company, registration PoA as applicable
17. Signed NIT
18. Technical & administrative employees and construction equipment for the tendered project
19. Any other documents as specified in the NIT








List of Drawings – Appendix 1

“Beautification and Landscaping of Diu Fort”

Sr.No.	Drawing Number	Drawing Tittle	Remarks
1.		Masterplan	
2.	SK 01	Demolition Plan	
3.	SK 02	Flooring Plan	
4.	SK 02A	Jail Plaza Detail	
5.	SK 03	Horticulture Plan	
6.	SK 04	Proposed Pathway Section	
7.	SK 04A	Typical Pathway Detail	
8.	SK 06	Toilet Block Plan	
9.	SK 07	Toilet Block Sections	
10.	SK 08	Information Signage Detail	
11.	SK 09	Directional Signage Detail	
12.	SK 10	Typical Bench Detail	
13.	SK 11	Typical Dustbin Detail	
14.	SK 12	Information Wall	
15.	SK 13	Bell and Statue Plinth	
16.	SWD 01	Column & Footing Detail- Toilet Block	
17.	SWD 02	Ground Beam Details- Toilet Block	
18.	SWD 03	Lintel & Slab Details- Toilet Block	
19.	E-DF-E-LTG-01	Electrical Lighting Layout- Site Plan	
20.	E-DFU-LTG-TB-01	Electrical Layout- Toilet Block	
21.	PL-DF-TD-01	Plumbing Layout- Toilet Block	
22.	PL-DF-TD-02	Plumbing Layout- Site Plan	



LEGEND

-  NEW PATHWAY FROM LOCAL STONE
-  NEW PLAZA HARDCAPE AREA FROM LOCAL STONE
-  RESTORATION OF EXISTING PATHWAY
-  POINTING WORK OF EXISTING FLOORING
-  LANDSCAPE AREA
-  LANDSCAPE AREA OF CENTRAL UPPER PLINTHS
-  EXISTING TREES

1. ALL DIMENSIONS ARE IN METERS & ARE TO BE READ NOT MEASURED.
2. DISCREPANCY FOUND IN DRG SHOULD BE BROUGHT TO ARCHITECT'S NOTICE BEFORE COMMENCEMENT OF WORK
3. ARCH. DWGS. TO HAVE PRECEDENCE OVER STRL. DWGS. FOR LVLS & DIMENSIONS.
4. FINISHED GROUND FLOOR IS AT 10000.
5. LARGE SCALE DRGS TO HAVE PRECEDENCE OVER SMALL SCALE DRGS
6. ALL DIMENSIONS ARE TO THE FINISHED SURFACE DIMENSIONS.
7. ALL LEVELS ARE TO THE FINISHED FLOOR LEVELS.

APPROVALS
CONSULTANT
ARCHITECT
SITE COORDINATOR
NOTES

ABBREVIATIONS	TBC TO BE CONFIRMED	OT DETAIL
CHK	CHECK ON SITE	OTS OPEN TO SKY
R	RESIDUE	DU DUCT
LVL	FINISHED FLOOR LEVEL	TBA TO BE APPROVED
FTL	FINISHED TOP LEVEL	15MM DROP IN FLOOR
BBLVL	BEAM BOTTOM LEVEL	
UFLVL	UNFINISHED FLOOR LEVEL	
LLVL	LINTEL LEVEL	
SLVL	SILL LEVEL	
T.O.P.LV	TOP OF PARAPET LEVEL	

REVISIONS	SN	DATE	REVISION

BEAUTIFICATION OF DIU FORT, DIU		1806_FORT
MASTER PLAN		DRG.NO:
TENDER PURPOSE ONLY		
ARCHITECTS: KISHORE TRIVEDI ARCHITECT		DATE:
605 - SHUPATH APARTMENTS, NEAR VIJAY CROSS ROAD, NAVRANGPURA AHMEDABAD - 380009		DEALT:
MOBILE : HARDIK +91 9898349415, GEETA +91 9409200660		CHECKED:
EMAIL : studioerur@gmail.com		

APPROVALS	
CONSULTANT	
ARCHITECT	
SITE COORDINATOR	

NOTES	
1.	ALL DIMENSIONS ARE IN METERS & ARE TO BE READ NOT MEASURED.
2.	DISCREPANCY FOUND IN DRG SHOULD BE BROUGHT TO ARCHITECT'S NOTICE BEFORE COMMENCEMENT OF WORK
3.	ARCH. DWGS. TO HAVE PRECEDENCE OVER STRL. DWGS. FOR LVLS & DIMENSIONS.
4.	FINISHED GROUND FLOOR IS AT 10000.
5.	LARGE SCALE DRGS TO HAVE PRECEDENCE OVER SMALL SCALE DRGS
6.	ALL DIMENSIONS ARE TO THE FINISHED SURFACE DIMENSIONS.
7.	ALL LEVELS ARE TO THE FINISHED FLOOR LEVELS.

ABBREVIATIONS	
TBC	TO BE CONFIRMED
CHK	CHECK ON SITE
R	RESIDUE
LVL	FINISHED FLOOR LEVEL
FTL	FINISHED TOP LEVEL
BBLVL	BEAM BOTTOM LEVEL
UFLVL	UNFINISHED FLOOR LEVEL
LVL	LINTEL LEVEL
SLVL	SILL LEVEL
TOP LVL	TOP OF PARAPET LEVEL
DT	DETAIL
O/S	OPEN TO SKY
DU	DUCH
TBA	TO BE APPROVED
15MM	15MM DROP IN FLOOR

REVISIONS		
SN	DATE	REVISION

BEAUTIFICATION OF DIU FORT, DIU		1807 POST
DEMOLITION PLAN		DWG. NO: SK_01
TENDER PURPOSE ONLY		DATE: 10/09/2020
ARCHITECTS: KISHORE TRIVEDI ARCHITECT		DEALT: MAULIK
650/5011, 1ST FLOOR, ANANDAPUR CROSS ROAD, NAGARPUR, AHMEDABAD - 380009		CHECKED: GEETIA
MOBILE: +91 988349415, GEETIA +91 940200060		
EMAIL: shubham@gmail.com		



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APPROVALS	
CONSULTANT	
ARCHITECT	
SITE COORDINATOR	
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LVL	LINTEL LEVEL
SLVL	SILL LEVEL
TOP LVL	TOP OF PARAPET LEVEL
DT	DETAIL
OTS	OPEN TO SKY
DU	DUCT
TBA	TO BE APPROVED
	15MM DROP IN FLOOR

REVISIONS		
SN	DATE	REVISION

BEAUTIFICATION OF DIU FORT, DIU	
MASTER PLAN/ FLOORING PLAN	1806_FORT
ARCHITECTS: KISHORE TRIVEDI ARCHITECT	DWG. NO: SK_02
DATE: 11/09/2020	DATE: 11/09/2020
CHECKED: GEETIA	DEALT: MAULIK



- 2842 SQ.MT. PRIMARY COBBLE PATHWAYS
- 2156 SQ.MT. SECONDARY COBBLE PATHWAYS
- 3378 SQ.MT. POINTING WORKS
- 332 SQ.MT. DHANGADHRAJLETTY AREA
- 5317 SQ.MT. LANDSCAPING AREA
- 12342 SQ.MT. WILD GRASS AREA
- 53 SQ.MT. PLAZA 01
- 107 SQ.MT. PLAZA 02
- 447 SQ.MT. PLAZA 03
- 2544 SQ.MT. PLAZA 04
- 1918 SQ.MT. PLAZA 05
- 363 SQ.MT. PLAZA 06
- 345 SQ.MT. PLAZA 07
- 252.56 SQ.MT. PLAZA 08
- 28 SQ.MT. PLAZA 09
- 45 SQ.MT. PLAZA 10
- 184 SQ.MT. PLAZA 11
- 60 SQ.MT. PLAZA 12

- LEGEND**
- RAJULA COBBLE PRIMARY
 - RAJULA COBBLE SECONDARY
 - RAJULA FLAME FINISH
 - RAJULA FLAME FINISH GREY
 - DHANGADHRA STONE
 - POINTING WORK
 - KERBING
 - TACTILE
 - LAWN
 - SHRUBS
 - WILD GRASS
 - EXISTING TREE
 - PARAPET WALL
 - UNDERGROUND TANK
 - DUSTBIN
 - DIRECTIONAL SIGNAGE
 - INFORMATION SIGNAGE
 - BENCH TYPE 01
 - BENCH TYPE 02
 - PROPOSED BELL AND STATUE

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PC:- USER \\\ FILE :- \\arsurserver\dva R R U R1806_DIUFORT04.CAD\4.1 CONCEPT STAGE\01 UDI200403_TENDER DRAWINGS\SK_03_FORT_HORTICULTURE.dwg \\\ SIZE:-285.98 KB . \\\ PRINT DATE:- 05 October 2020 14:03:53

APPROVALS	
CONSULTANT	
ARCHITECT	
SITE COORDINATOR	

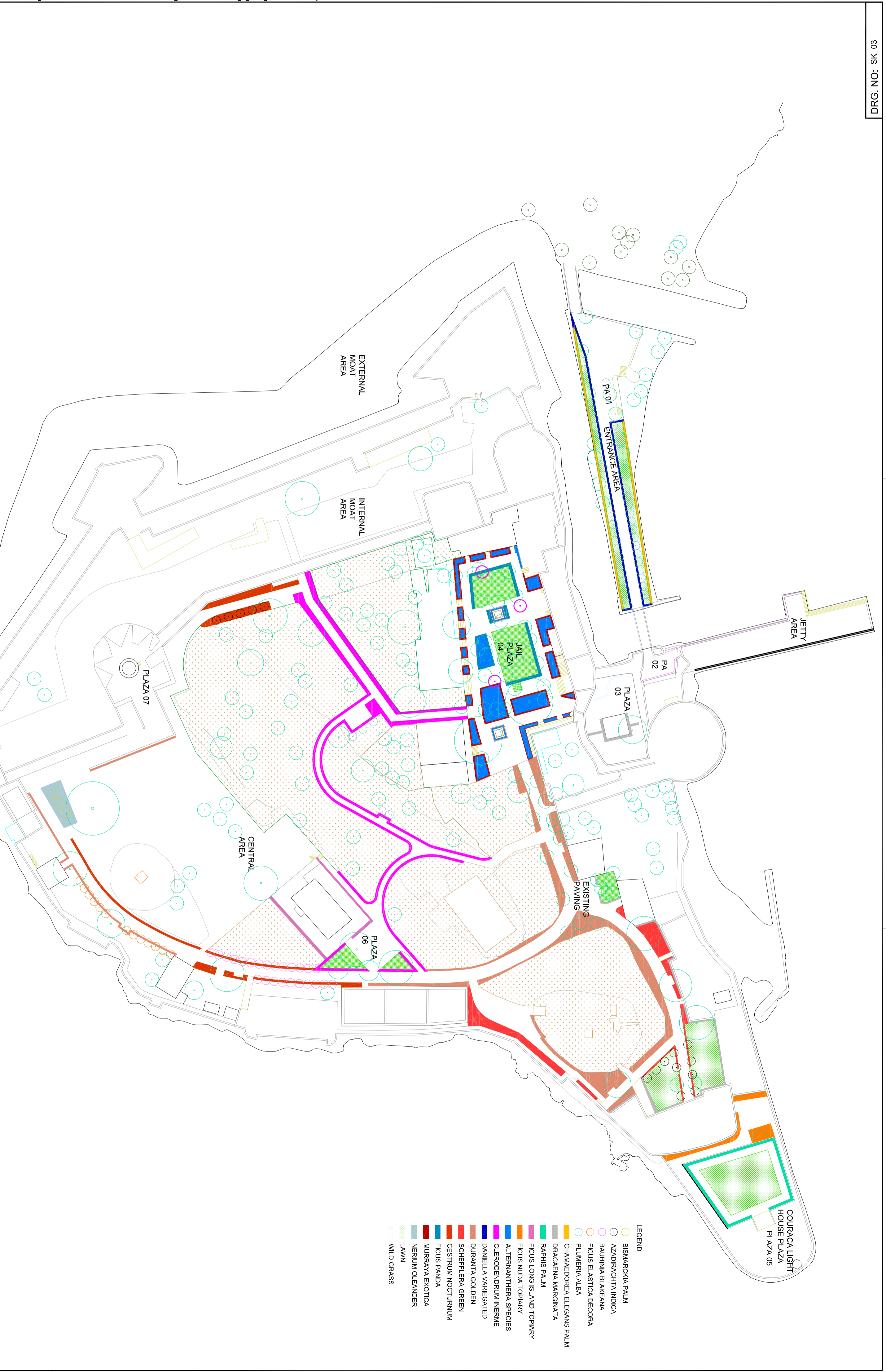
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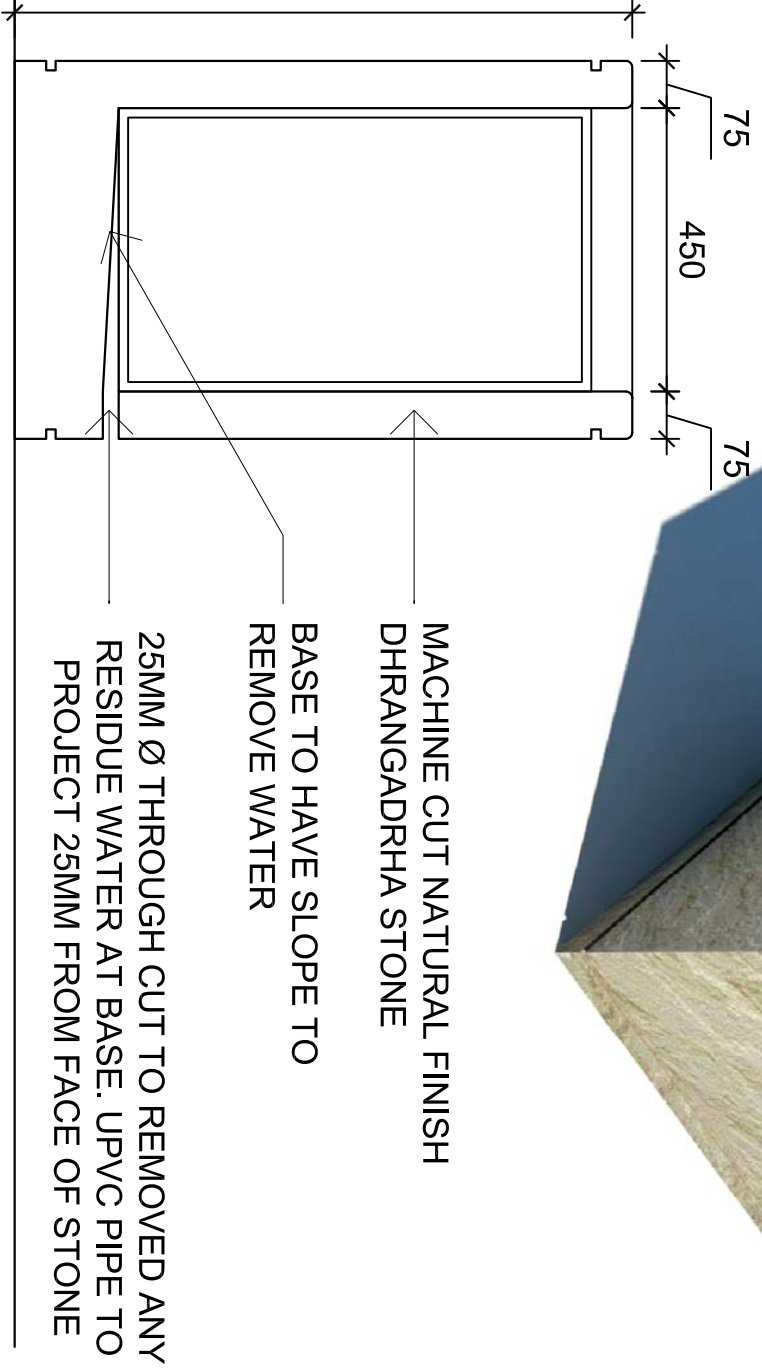
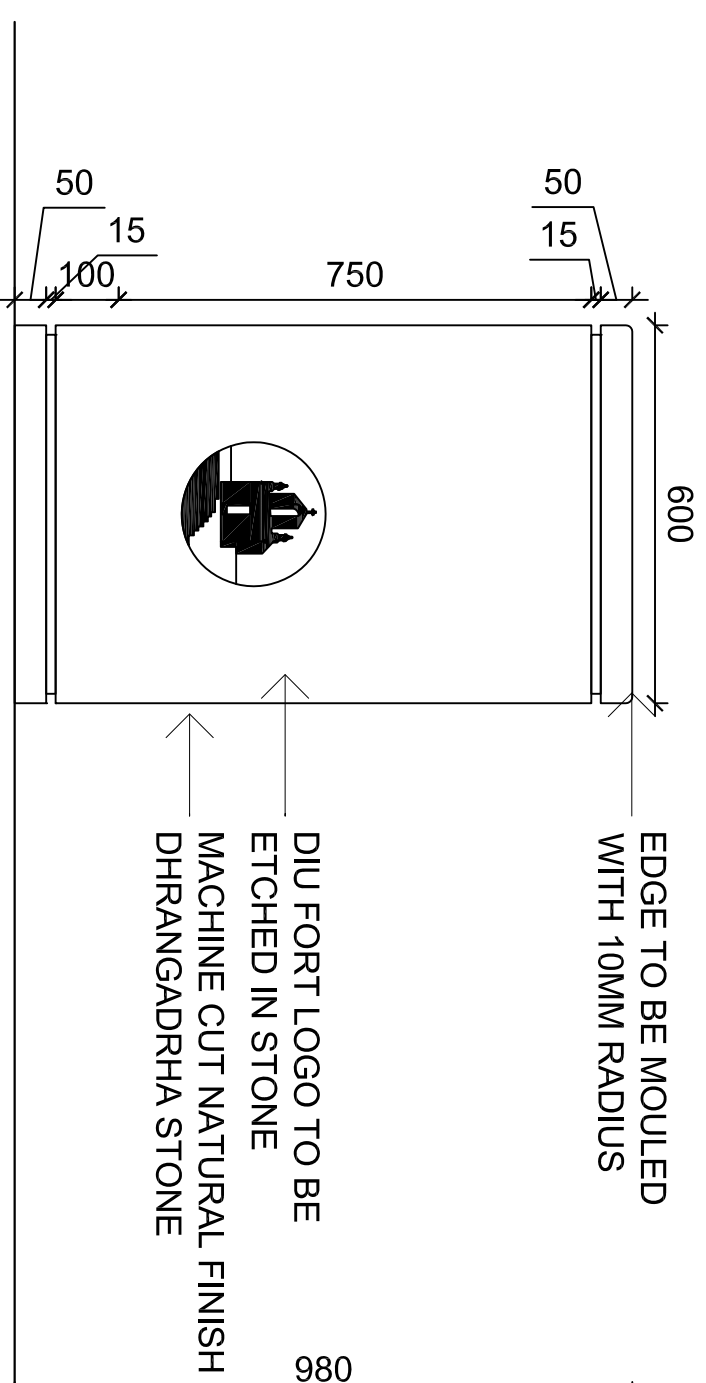
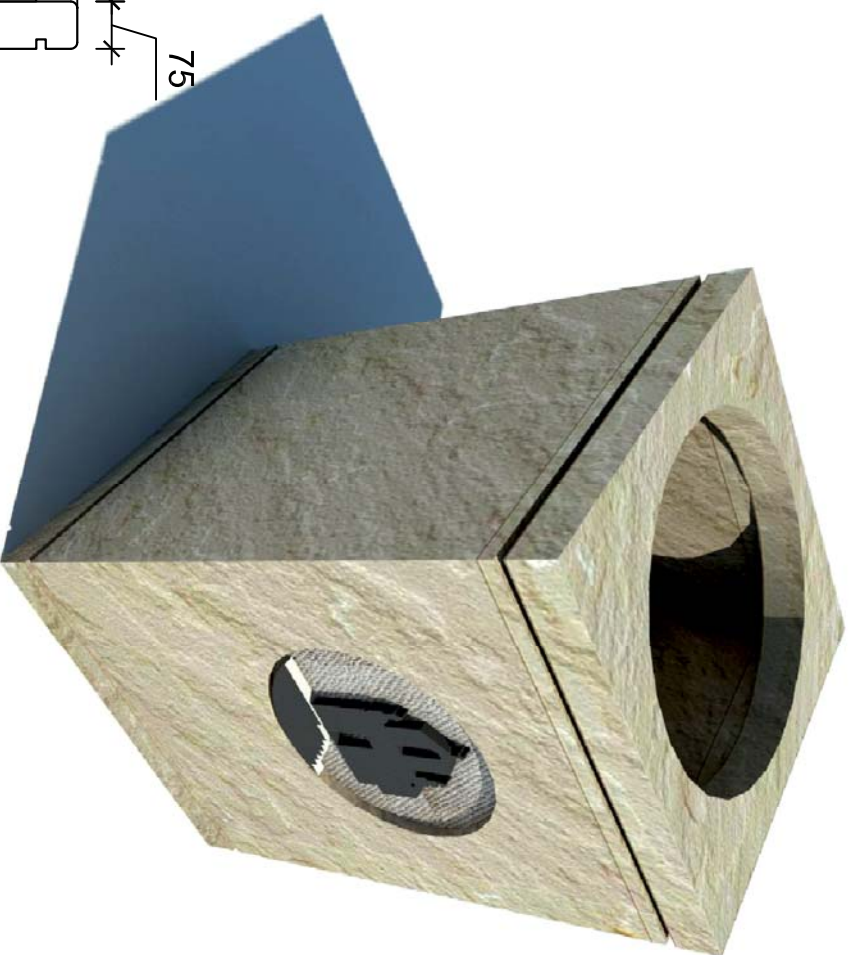
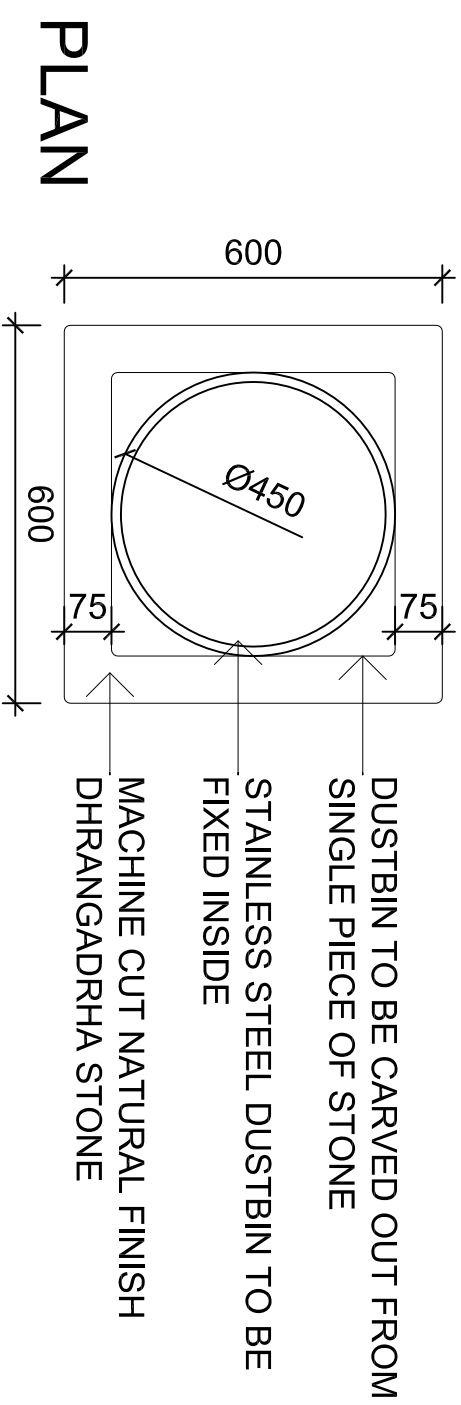
REVISIONS		
SN	DATE	REVISION

BEAUTIFICATION OF DIU FORT, DIU	
HORTICULTURE PLAN	
TENDER PURPOSE ONLY	
ARCHITECTS: KISHORE TRIVEDI ARCHITECT	
650/50111, ANANDAPURAM CROSS ROAD, MADANAPURAM, CHENNAI 600029	
MOBIL: E - HARSH K +91 9885349415, GEETA +91 9492000860	
EMAIL: shubham@gmail.com	

1806_FORT	DWG. NO:	SK_03
	DATE:	10/09/2020
	DEALT:	MAULIK
	CHECKED:	GEETA



DUSTBIN



ELEVATION

SECTION

APPROVALS	
CONSULTANT	
ARCHITECT	
SITE COORDINATOR	
NOTES	
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5.	ALL LEVELS ARE TO THE FINISHED FLOOR LEVELS.
6.	WALL DIMENSIONS WITHOUT FINISHES. THICKNESS TO BE DEDUCTED OR ADDED IF REQUIRED

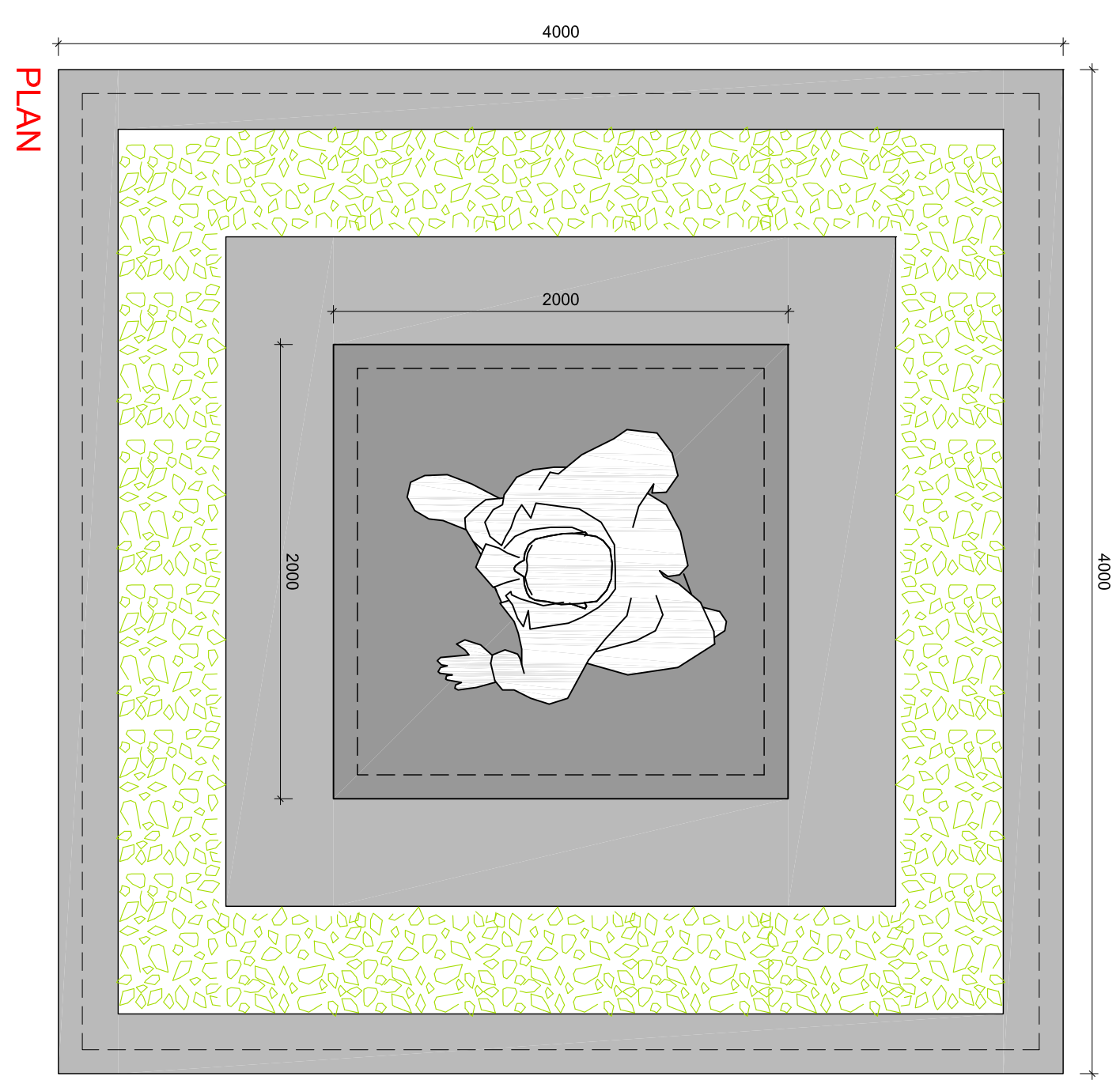
ABBREVIATIONS	
REVISIONS	

SN	DATE	REVISION

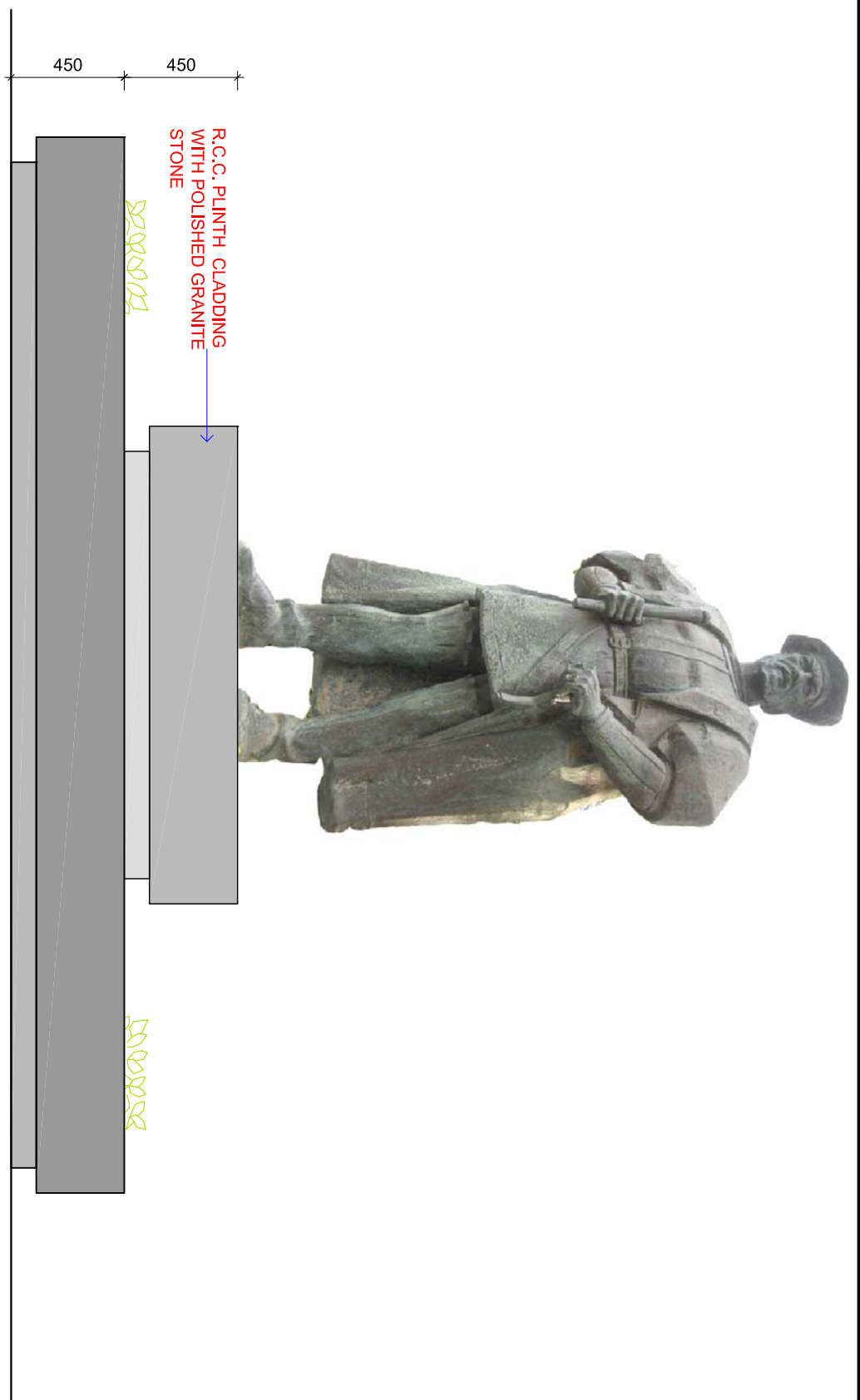
1806_FORT	DRG. NO:	SK_11	NORTH
BEAUTIFICATION OF DIU FORT, DIU	DATE:04/03/2020	DEALT: MAULIK	NTS
TYPICAL DUSTBIN DETAILS	CHECKED: GEETA		
TENDER PURPOSE ONLY			
ARCHITECT: KISHORE TRIVEDI ARCHITECT			
605 SUPRATHI APARTMENTS, OPPOSITE YASH AQUA, VIJAY CROSS			
ROAD, NAVRANGPURA, AHMEDABAD - 380009.			
MOBILE: HARDIK +919898349415 GEETA +91 9409200660			
EMAIL: studioarun@gmail.com			

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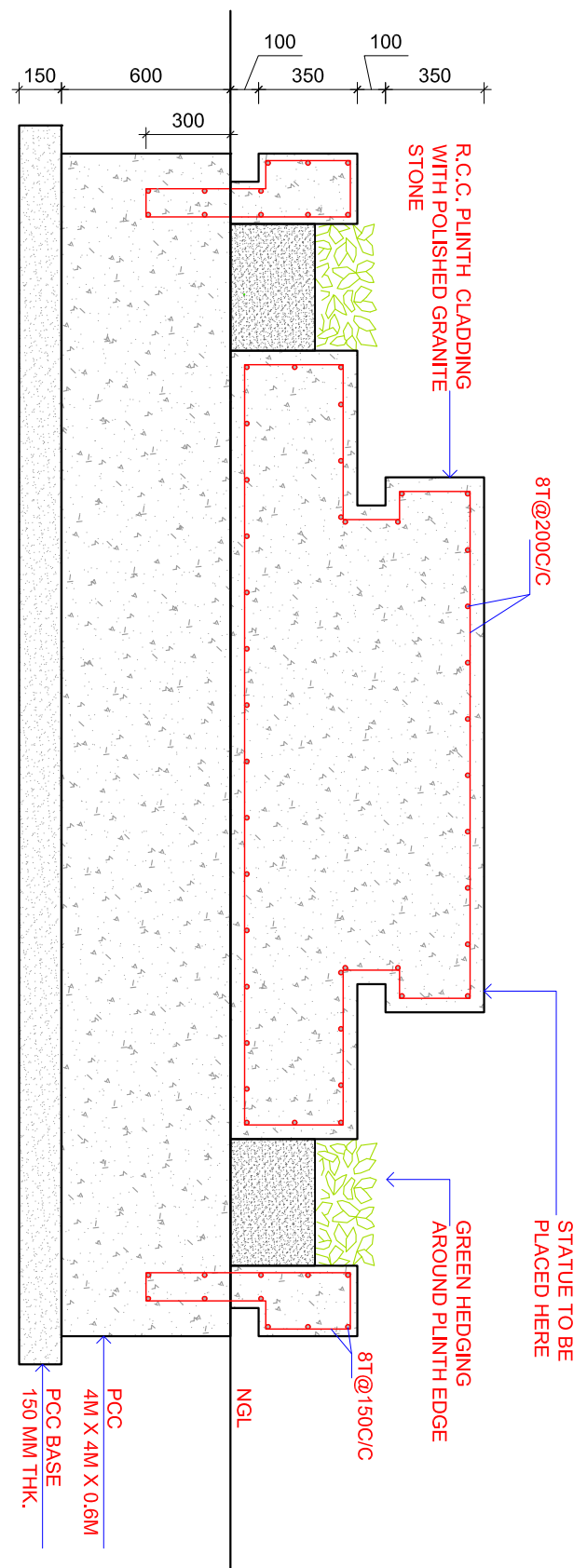
BELL & STATUE PLINTH AT JAIL PLAZA



PLAN



FRONT ELEVATION



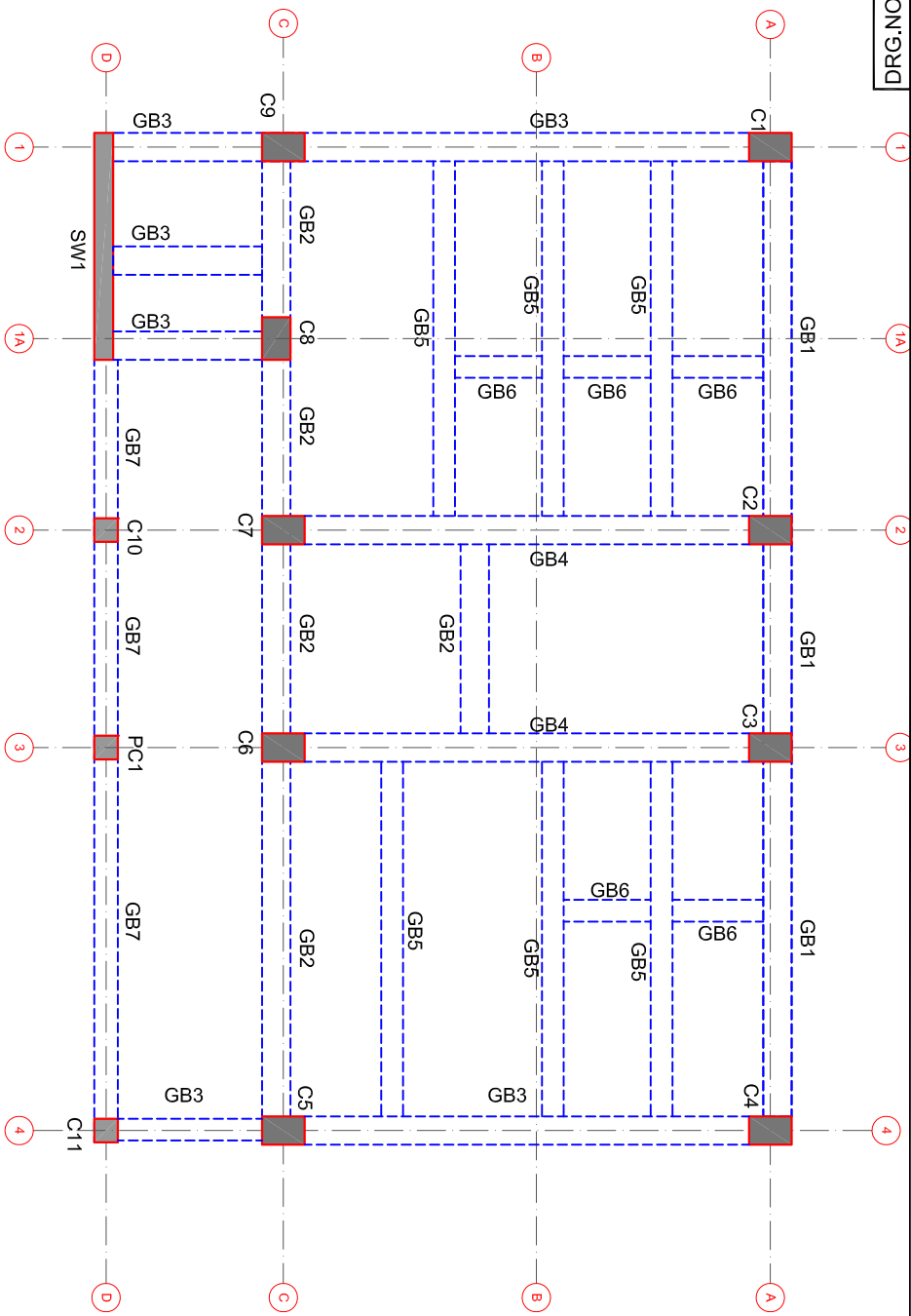
SECTION

APPROVALS	
CONSULTANT	
ARCHITECT	
SITE COORDINATOR	
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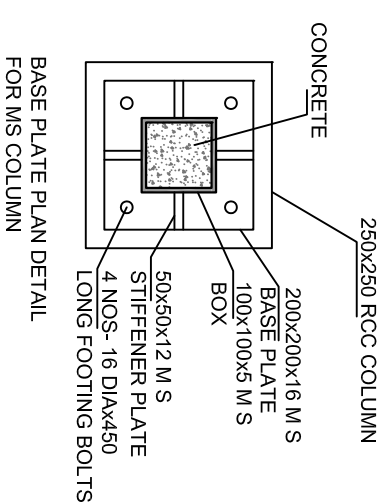
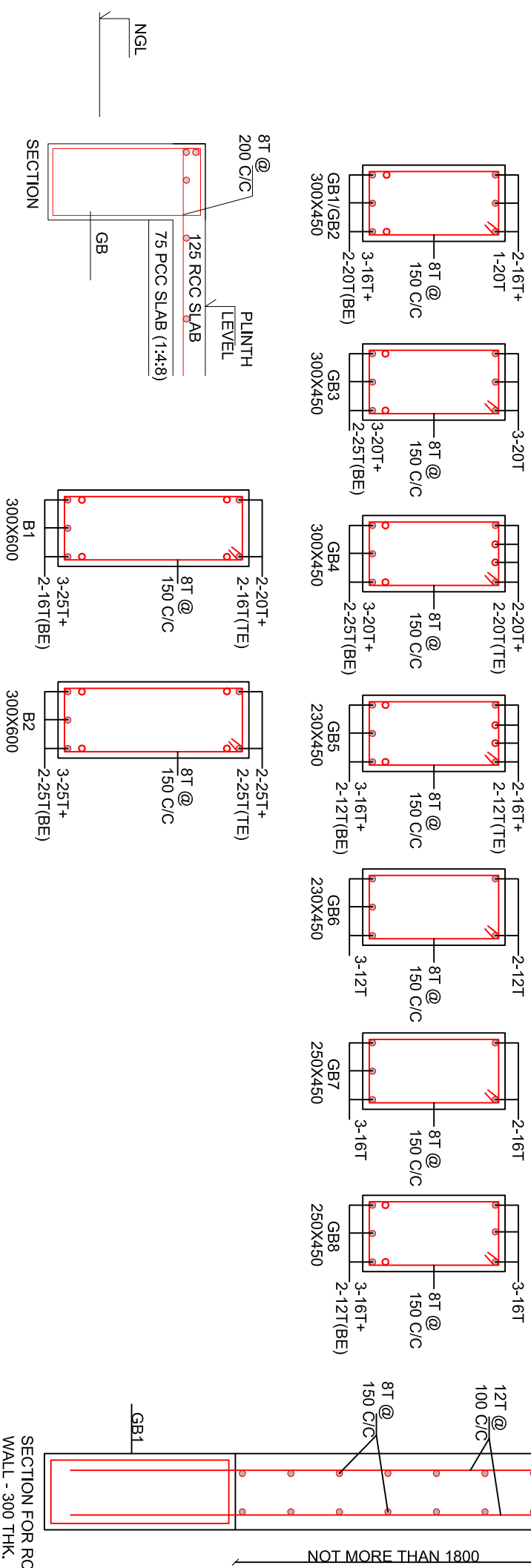
REVISIONS		
SN	DATE	REVISION

PROJECT: BEAUTIFICATION OF DIU FORT, DIU	1806_FORT
TENDER PURPOSE ONLY	DRG. NO: SK_12
ARCHITECT: KISHORE TRIVEDI ARCHITECT	DATE: 23.03.19
605 SUPRATHI APARTMENTS, OPPOSITE YASH AQUA, VIJAY CROSS ROAD, NAVRANGPURA, AHMEDABAD - 380009.	DEALT: MAULIK
MOBILE: HARDIK +919898349415 GEETA +91 9409200660	CHECKED: GEETA
EMAIL: studiotvr@gmail.com	

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BE = BOTTOM EXTRA L/2 AT CENTER OF CLEAR SPAN.
TE = TOP EXTRA L/4 AT SUPPORT OF CLEAR SPAN.



APPROVALS

CONSULTANT
ARCHITECT
SITE COORDINATOR

1. BASIC REFERENCE CODE:- 456:2000

2. DESHUTTERING PERIOD SHALL NOT BE LESS THAN SPECIFIED BELOW:

A) VERTICAL FORCES OF COLUMN, BEAMS & WALL - 24 HRS	M20	M25	M30	M35
B) SLABS (I) SPANNING UP TO 4.5M - 7DAYS (II) SPANNING OVER 4.5M - 14DAYS	20	25	30	40
C) BEAMS (I) SPANNING UP TO 6.0M - 14DAYS (II) SPANNING OVER 6.0M - 21DAYS	20	25	30	45

3. DUE CARE SHOULD BE TAKEN TO ASCERTAIN THAT REQUISITE STRENGTH OF CONCRETE IS GAINED BEFORE COMMENCEMENT OF DESHUTTERING.

4. FOR CANTILEVERS, TOP BARS TO BE ANCHORED BEHIND FOR -

5. DESIGN IS VALID FOR NO. OF FLOORS AS INDICATED IN SCHEDULE ONLY.

6. ALL LAPs SHALL BE STAGGERED & NOT MORE THAN 10% NOMINAL COVERS

50% BARS TO BE LAPPED AT ANY GIVEN SECTION.	MILD	MODERATE	SEVERE
I) FOOTINGS	50	50	50
II) COLUMNS (TO LINKS OF COLUMN)	40	40	45
III) SLABS	20	25	40
IV) BEAMS (TO STIRRUPS OF BEAM)	20	30	45
V) LIFT WALLS/SHEAR WALL	40	40	45
VI) IN CASE OF SLAB IF MAIN REIN. DIAMETER EXCEEDS 12MM THEN COVER FOR MODERATE AND SEVERE EXPOSURE CONDITION BE INCREASED BY 5MM.			

7. ALL STEEL TOR-Fa 500

REVISIONS

SN	DATE	REVISION
01		

PROJECT : BEAUTIFICATION OF DIU FORT, DIU

STRUCTURAL DWG- TENDER PURPOSE ONLY

GROUND BEAM DETAILS - TOILET BLOCK

STRUCTURE DESIGN: RATHI CONSORTIUM

SF- 3A, JBR ARCADE, OPPOSITE SATYAM COMPLEX, SCIENCE CITY ROAD, SOLA, AHMEDABAD

PH. NO: +9198252719029, E-Mail: rathiconsortium.com

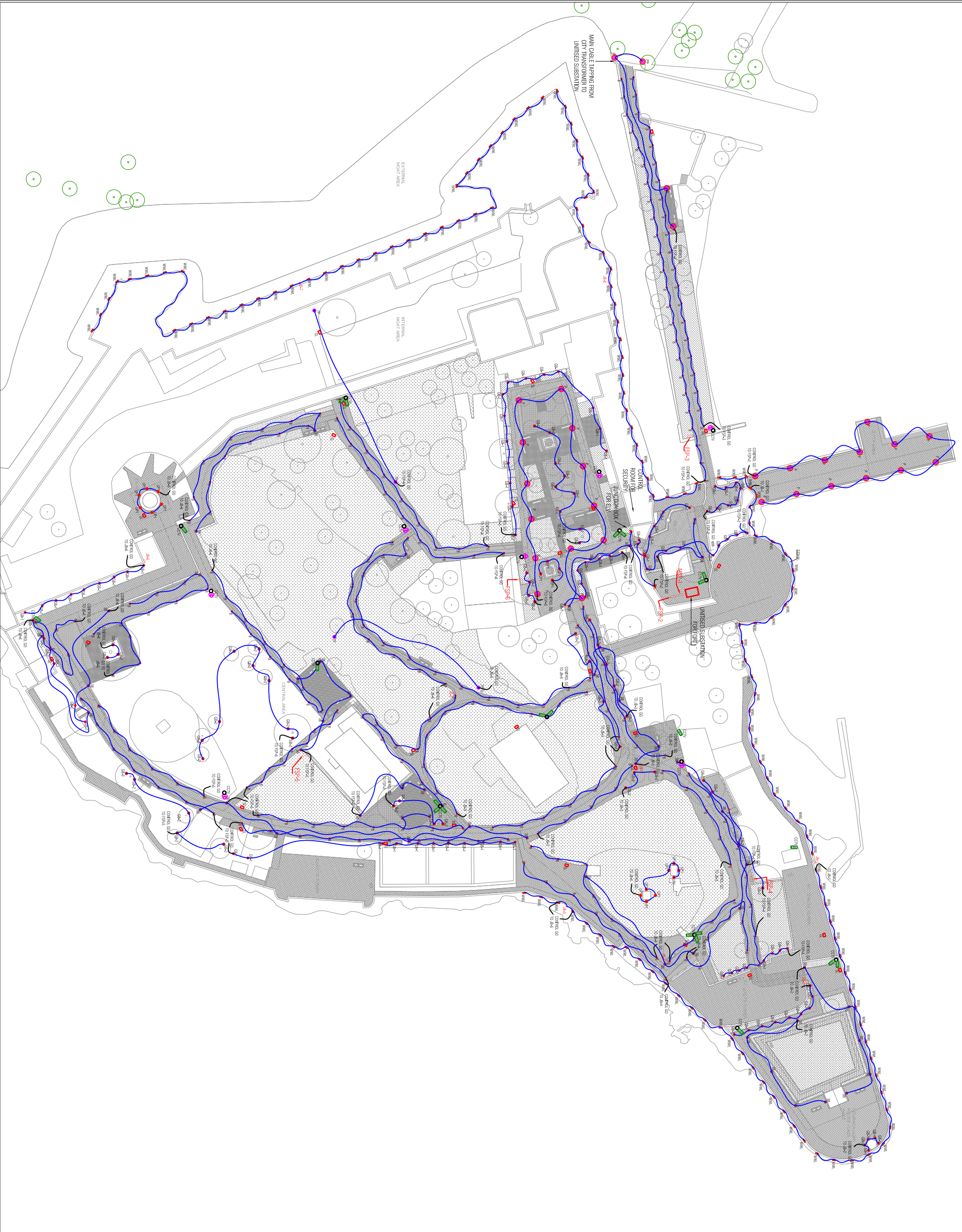
PROJECT NO. RC-1811

SWD NO : 02

SCALE = NTS

DRAWN: HITESH

DATE: 04/03/2020



ELECTRICAL LEGENDS

1.		B - 1FT. BOLLARD-10W
2.		GB-1 GROUND BURIAL-9W ASYM.
3.		GB-2 GROUND BURIAL-20W SYM.
4.		UP-1 UPLIGHTER BRACKET TYPE-11W
5.		3B - 3 FT. BOLLARD
6.		P - 2.5 MTR. POLE
7.		7P - 7 MTR. POLE- 4NOS. 45W EACH
8.		WWL -WALL WASHER LIGHT- 74W
9.		FLD - FLOOD LIGHT - 84W
10.		SIGNAGE LIGHT - UPLIGHTER- 2W
11.		CCTV- BULLET OUTDOOR CAMERA
12.		CCTV- 360 DEGREE CAMERA
13.		3MTR. POLE FOR CCTV CAMERA

1. PLEASE DO NOT CHANGE ANYTHING WITHOUT PRIOR PERMISSION OF THE CONSULTANT.
 2. CONTACT CONSULTANT IMMEDIATELY IN CASE OF ANY CHANGE FOUND AT SITE.

ISSUED FOR: **TENDER PURPOSE ONLY**

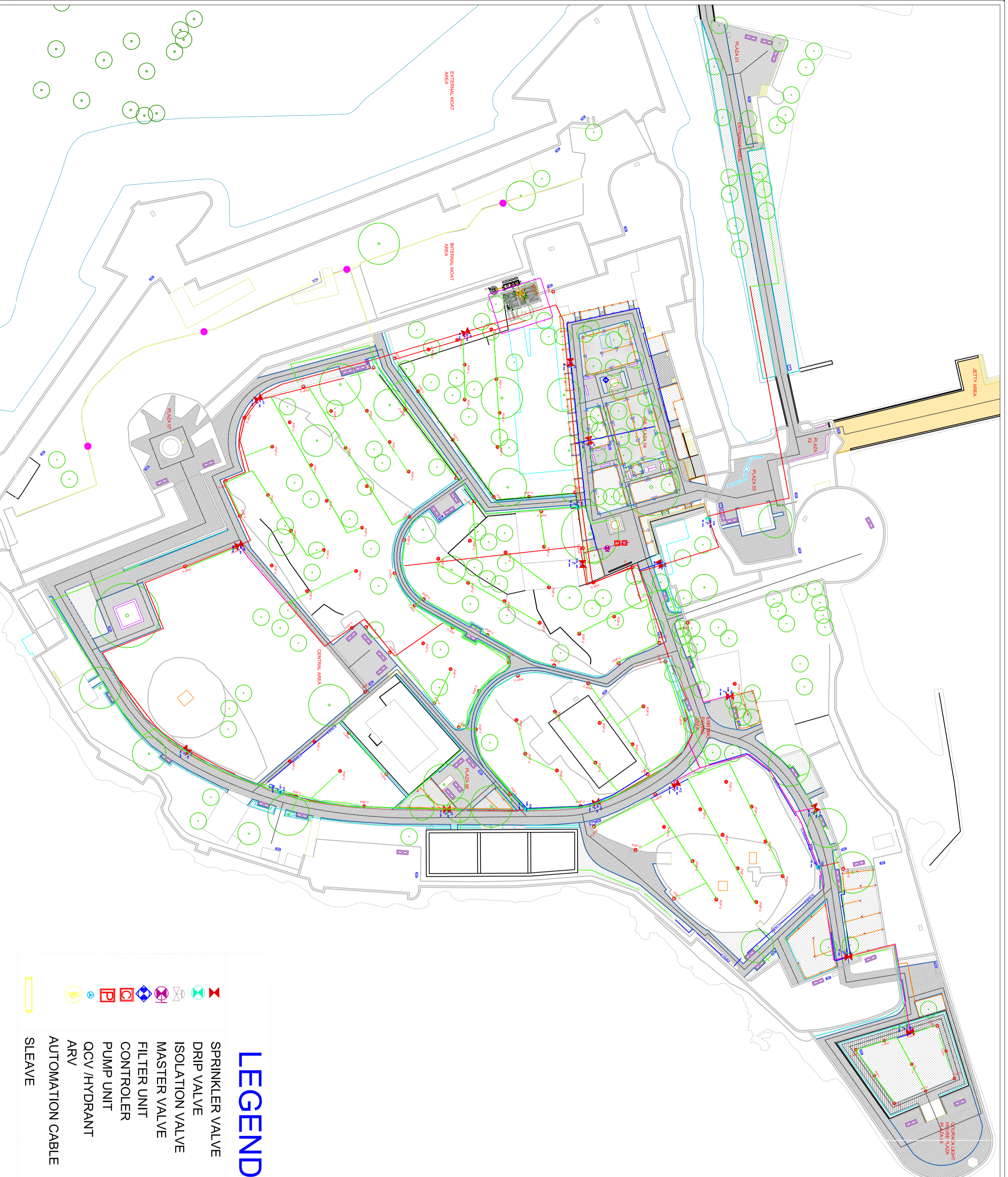
DATE: 21.03.2020
 DRAWN BY: JAV
 CHECKED BY: JAV

SCALE: N.T.S.
 PROJECT: DUJ FORT
 CLIENT NAME: ELECTRONIC LIGHTING LAYOUT FOR DUJ FORT

DESIGNED BY: MSJ
 PROJECT: MSJ
 DRAWN BY: MSJ
 CHECKED BY: MSJ

PROJECT: MSJ
 DESIGNED BY: MSJ
 DRAWN BY: MSJ
 CHECKED BY: MSJ





LEGENDS FOR IRRIGATION :

	SPRINKLER VALVE		PVC PIPE 32 MM/ 6KG/CM2
	DRIP VALVE		PVC PIPE 40 MM/ 6KG/CM2
	ISOLATION VALVE		PVC PIPE 50 MM/ 6KG/CM2
	MASTER VALVE		PVC PIPE 63 MM/ 6KG/CM2
	FILTER UNIT		PVC PIPE 75 MM/ 6KG/CM2
	CONTROLLER		PVC PIPE 90 MM/ 6KG/CM2
	PUMP UNIT		PVC PIPE 110 MM/ 6KG/CM2
	QCV /HYDRANT		PVC PIPE 140 MM/ 6KG/CM2
	ARV		PVC PIPE 160 MM/ 6KG/CM2
	AUTOMATION CABLE		DRIPLINE 16 MM
	SLEAVE		

NOTE:
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 3. PATHWAY SIDE COVER WITH DRIP IRRIGATION SYSTEM CONSIDERED.

ISSUED FOR:
TENDER
PURPOSE ONLY

DRG NO.:
 PL-DF-ID-02
 DETAIL BY:
 MAGN
 CHECKED BY:
 RP

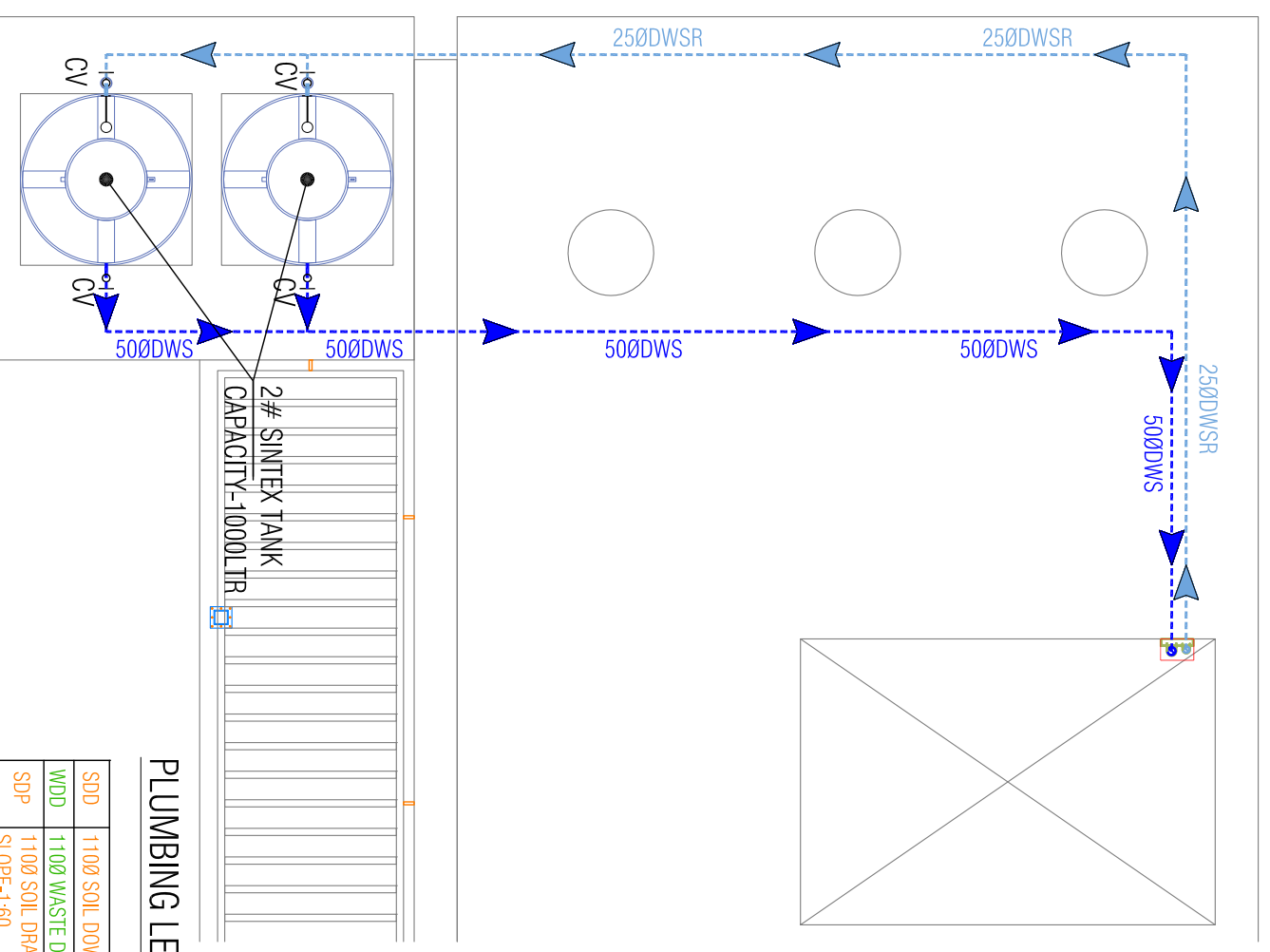
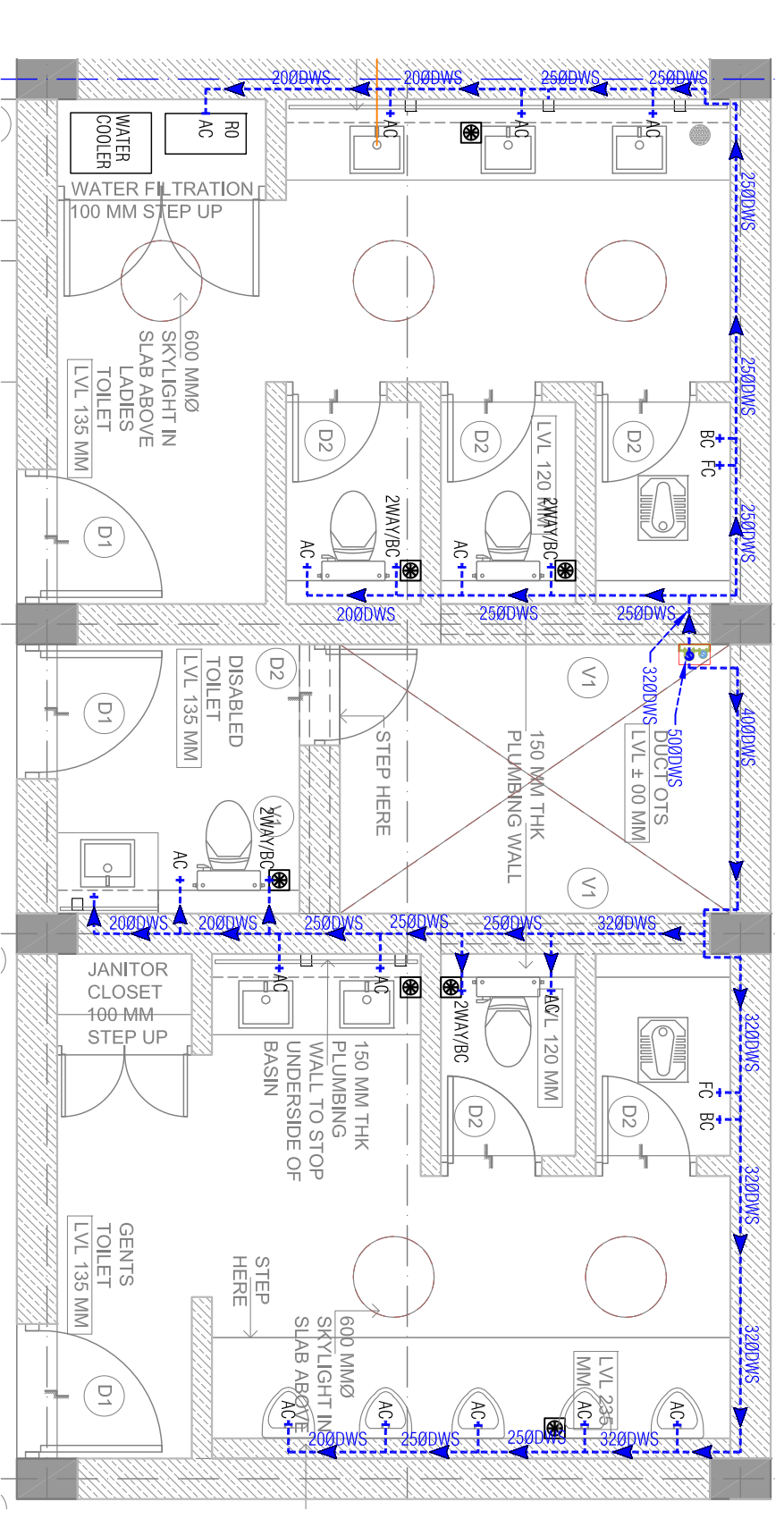
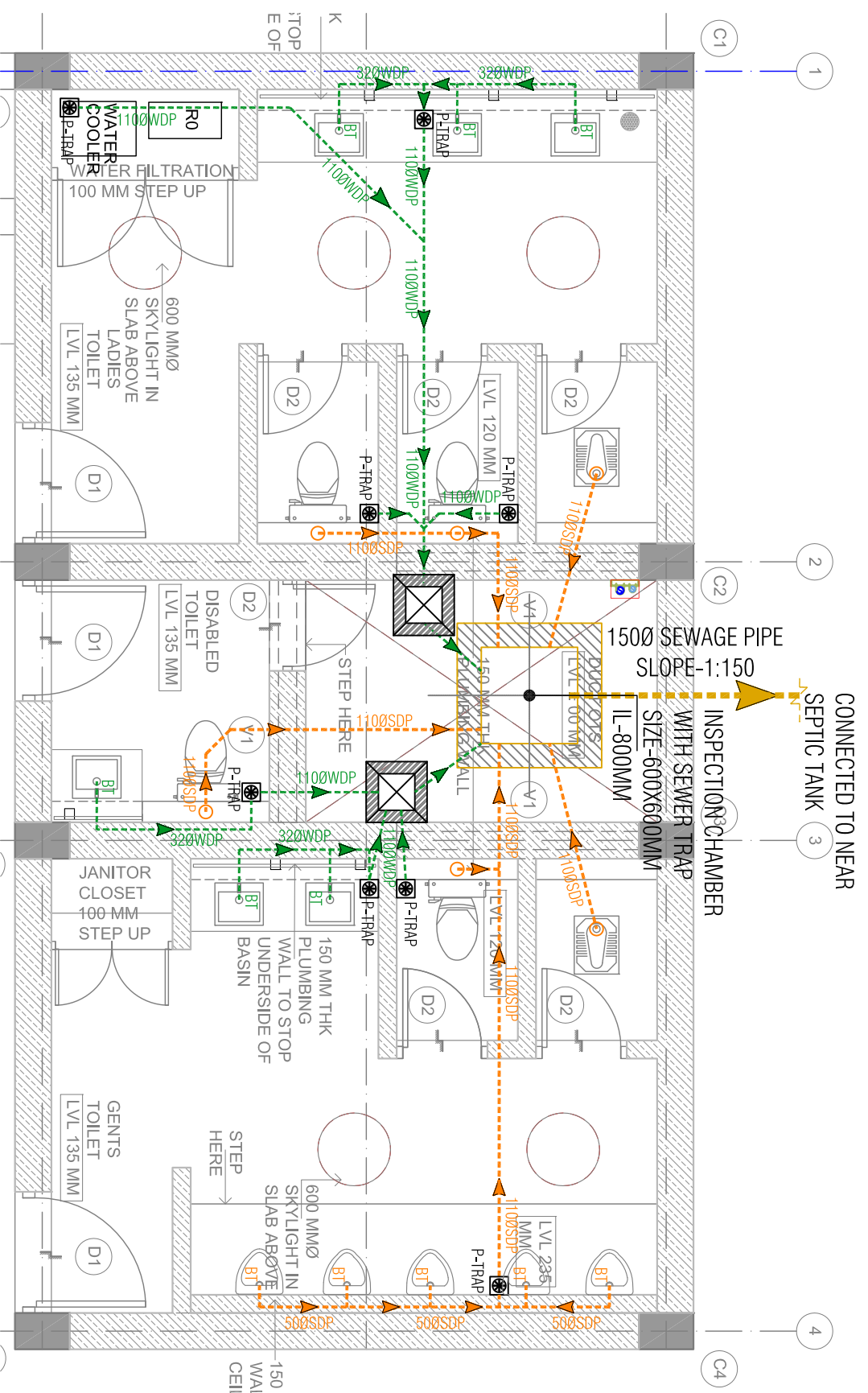
SCALE:
 NTS
 DATE:
 09-08-2020
 REVISION NO.:

PROJECT:
 DIU FORT AT DIU
 CLIENT:
 DIU MUNICIPAL CORPORATION
 DRAWING TITLE:
 TOILET DETAILS FOR PLUMBING LAYOUT

ARCHITECT:
 KISHOR TRIVEDI ARCHITECTS
 RAJKOT, GUJARAT.
 EMAIL: studioartur@gmail.com
 (M) +91 9898349415

MEPF CONSULTANT:

Greenbulb Designs
 B/4, ANAND COMPLEX, NR. SOLA OVER BRIDGE, S.G. HIGHWAY,
 THALTEL, AHMEDABAD-54, GUJARAT, INDIA.
 EMAIL: globeleon@gmail.com (M) +91 8141538333
 Greenbulb Designs



PLUMBING LEGENDS

SDD	1100 SOIL DOWNTAKE PIPE
WDD	1100 WASTE DOWNTAKE PIPE
SDP	1100 SOIL DRAIN PIPE
SDP	500 SOIL DRAIN PIPE
SDP	1100 WASTE DRAIN PIPE
WDP	750 WASTE DRAIN PIPE
WDP	400 WASTE DRAIN PIPE
VP	750 VENT PIPE
RWD	750 RAIN WATER DOWNTAKE PIPE
DWS	DOMESTIC WATER SUPPLY
DWSR	DOMESTIC WATER SUPPLY RISER
MFT	MULTI FLOOR TRAP
FT	FLOOR TRAP
2W/B	2-WAY BIB COCK
AC	ANGLE COCK
FC	FLUSH COCK
BT	BOTTLE TRAP

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ISSUED FOR:
TENDER
 PURPOSE ONLY

DRG NO.: PL-DT-01
 DETAIL BY: MAGN
 CHECKED BY: RP

SCALE: NTS
 DATE: 09-08-2020
 REVISION NO.: R0

PROJECT: DIU FORT AT DIU
 CLIENT: DIU MUNICIPAL CORPORATION
 DRAWING TITLE: TOILET DETAILS FOR PLUMBING LAYOUT

ARCHITECT: KISHOR TRIVEDI ARCHITECTS
 RAJKOT, GUJARAT.
 EMAIL: studiorai@gmail.com
 (M) +91 9898349415



MEPE CONSULTANT:
 B/A ANAND COMPLEX, NR. SOLA OVER BRIDGE, S.G.HIGHWAY,
 THALTEL, AHMEDABAD-54, GUJARAT, INDIA.
 EMAIL: gbd@greenbulbdesigns.com (M) +91 8141533633