**NAME OF WORK: -** DESIGN, BUILD, OPERATE AND MAINTAIN FOR 5 YEARS INCLUDING 1 YEAR DLP MECHANIZED AUTOMATIC CAR PARKING FACILITY FOR MINIMUM 150 CARS IN MAURYA LOK COMPLEX ON EPC MODE UNDER PATNA SMART CITY MISSION.

**(VOL – II)**

**SCOPE OF WORK**

**&**

**TECHNICAL SPECIFICATIONS**

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# 1. SCOPE OF SERVICES

**Preamble**

The Overall objective of the Construction of Automated Multi level Car Parking Facility on Maurya Lok Complex, Patna is decongestion of traffic in the adjoining area of city by reducing on street parking. This will not only help in providing safe, secure and efficient vehicular circulation/ passage but will also enhance public safety & security. The proposed car parking facility is to be constructed under Smart City Mission for Patna . The bidder has to quote for Design, Build, Operate And Maintain for 5 Years Including 1 Year DLP Mechanized Automatic Car Parking Facility for Minimum 150 Cars in Maurya Lok Complex on EPC Mode Under Patna Smart City Mission The broader Scope of Services to be provided by the Contractor under this Contract is as follows:

All statuary approvals such as building approval/fire approval, etc. shall be obtained by bidder before commencement of work. However, BUIDCO will support the bidder in coordination with approving agencies.

Works requiring survey, investigation, design, supply, construction,commissioning of complete Automated Multi Level Car Parking with Electro-Mechanical 6 level overground Puzzle Parking system including other alits services like civil foundation, underground water tank of required capacity as per fire norms with pump room, necessary firefighting system, with overhead tank of 10 thousand ltr capacity, façade with ACP sheet, DG of required capacity including LT panel with AMF panel and necessary electrical cabling & external lighting. CCTV Camera, ticket dispenser, Boom barrier on Engineering, Procurement and Construction basis with defect liability period of 1 years, for which lump sum rate for complete work is to be quoted. Apart from this the work also includes design, supply, construction,commissioning of complete SITC of 20m long FOB connecting two sites of parking area along with necessary road infrastructure improvement as required for car parking approach and connecting roads.

**Operation & Maintenance** of whole Facility for five (5) years after the date of commissioning including the defect liability period of one year. (Operational manpower namely operators, watch and ward, traffic regulators, health and safety, fuel and lubricants for DG sets, or any other requirement to Operate the system 2 shifts shall be borne by the selected bidder/agency).

**Conducting Training Program** during 6 months of last year of Operation & Maintenance for the staff of BUIDCO/MCF/ Authorized agency specified by BUIDCO.

**Collection of User Charges & Advertising rights** will be with the selected bidder wherein parking charges & Advertising locations will be approved in discussion with client.

All equipment's service/maintenance manuals /upkeep procedure/as build drawings/operation manuals shall be submitted by the bidders.

The general Scope of Services described here under is neither exhaustive nor complete and is indicative only. The Contractor shall undertake its own detailed investigations regarding the to-be-built Facility to determine the complete Scope of Services for performance of all obligations as stipulated in various clauses of this Bid Document.

The Scope of Services shall include all technical, managerial, administrative, commercial, environmental, and social interventions as required in accordance with all the provisions of this Bid Document and good engineering and management practices ensuring safe and secure parking solutions to the end users.

Proposed Multi level Car Parking at site 1 (Inside maurya lok) is located at vacant land of about 450 sqm and with additional removal of non-usable spaces by PMC, the parking can be made with Provision of 50 Cars. The proposed structure would be of 2 modules with 50 car capacity in puzzle parking system.

► Maximum height of the structure would be 15 mt above ground and it will be G+5 storied.

► Approach available from Buddh Marg, Accessibility available from both sides.

► Proposed Multi level Car Parking site 2 Vacant land of about 1150 sqm with few encroachments opposite to Maurya Lok wherein Area to be utilized for parking will be with 4 Modules (50 x 3 =150 Cars). The Corner plot is to be developed as green zone.

► The second Module of parking is to be linked with Maurya Lok through Foot Over Bridge of 20m length. The foot over bridge will be steel structure with 2 Nos. lifts and staircase.

► The internal roads of mauryalok complex will be improved with mastic asphalt all around the internal roads & PQC will be done wherever required.

► There will be security bollards on roads for restricting entry points.

► Decorative pole for street lights all along the internal roads have to be provided.

**Definitions**

The words, terms and expressions beginning with capital letters and defined under this Section 7, Clause 1.2 including those in Section 8 - General Conditions of Contract and those in Section 9 – Particular Conditions of Contract shall, unless the context otherwise requires, have the meanings ascribed thereto / herein:

"**BIS**" means Bureau of Indian Standard Specification; "**BOQ**" means Bill of Quantity;
**"Contract Commencement Date"** shall mean the date on which the Contract Agreement is signed and Design Services shall be commenced by the Contractor.
**"Commissioning Date"** shall mean the date on which the created Facility is commissioned for the purpose of use. "**Construction Completion Date**" shall mean the date on which the Construction of Facility is complete in all respects and the Facility is commissioned.

"**Construction Period**" shall mean the period commencing from the Site Takeover Date and up to the Construction Completion Date;
"**Contract Completion Date**" shall mean the date on which all the Contractual obligations (including Operation & Maintenance Period) will be completed by the Contractor and the Contract expires. **"Contract Period or Total Contract Period"** means the period of Contract spread over 5 years and 9 months from the Commencement Date up to the Contract Completion Date;
"**Contractor Personnel**" means those personnel hired and deployed by the Contractor for the purpose of fulfilling his contractual obligations.

"**CPHEEO**" means the Central Public Health and Environmental Engineering Organization under the Ministry of Urban Development, Government of India;

"**Design Period**" is the period of Contract commencing on the Commencement Date and up to a maximum of 30 days, during which time the Contractor will prepare and get approved his Planning, Design and Drawings of all components of work necessary for construction of the Facility under this contract.

"**Project Management consultant**" means the agency appointed by the Employer to provide design and construction supervision services under a separate Contract;
"**DLP**" means Defects Liability Period, which for this contract is 1 (one) year after the date of issue of completion certificate.

"**Electricity Department**" means the local service provider supplying electrical energy for Operation Services of the Car Parking Facility;
"BUIDCO" means Patna Smart City Limited.

"**Existing Assets**" means those infrastructure components, plant, machinery, equipment and any other units existing at the Site of construction as on Commencement Date;

"**FAS**" means Fire Alarm Systems; "**FFS**" means Fire Fighting Systems; "**FPS**" means Fire Prevention Systems;

"**Government Agencies**" means all those agencies comprising of local, state and Central Government authorities directly or indirectly connected to provision of Multi Level Car Parking Facility at Maurya Lok Complex, Patna
"**MCF**" means the Municipal Corporation Patna including all its successors, assignees;

"**Major Maintenance**" means large capital maintenance works requiring replacement of any part, component, machinery with their allied accessories and civil works constructed under this Contract.

"**Mandatory Works**" means those works which are listed in the Activity Schedule/Bill of Quantities and are required to be constructed, installed, or erected as the case may be and commissioned in line with the provisions of this Contract unless such works may require change of scope or design as agreed by the Parties.

"**Milestones**" means the targets to be achieved during the concurrency of the Contract and at the end of the Contract Completion Period.

"**Minor Maintenance**" means routine preventive or corrective maintenance works such as minor repair, reconditioning, or replacement of spare parts to ensure serviceability of the created assets under this contract.

"**Non-Performance Adjustment**" means the adjustment in Payments made by the Employer from the Contractor Payment due to failure of the Contractor to perform as per contract stipulations to the satisfaction of the Engineer/Employer.

"**Operation & Maintenance Service Period**" is the period of contract commencing from the next date of Commissioning of the Facility and spreading over a period of 5 years.

"**PCC**" means Plain Cement Concrete

"**Parking Charge**" shall mean the charge per car parked in the created Facility for a specified time as decided by BUIDCO.

"**Planned Maintenance**" means activities required to undertake preventive maintenance of all assetscreated under the Contract;

"**Project Management Consultant**" means the agency appointed by the Employer to provide project management advisory services to the Employer.

"**QA**" means Quality Assurance; "QC" means Quality Control; "**RCC**" means Reinforced Cement Concrete

"**RCCS**" means Reinforced Cement Concrete Specifications; "**SEP**" means Site Environmental Plan

"**Schedules or Schedule**" means the schedules forming part of this contract, or any one of them, as thecontext requires;

"**Scope of Services**" shall mean all those services to be provided by the Contractor in accordance tothe obligations, activities, responsibilities and tasks in implementing the Project.

"**Services**" means all those activities, interventions, actions and tasks required as part of creating the Facility under this Contract including all planning, design, detailed engineering, procurement, construction,Operations, maintenance, and management in providing best possible car parking facility to the end users.

# 2. GEOTECH SURVEY INVESTIGATIONS

***Introduction***

Geotechnical Surveys and Soil Surveys are to be done by selected bidder/agency at site and in laboratory. It depicts the nature of sub soil strata and evaluates the various soil properties required for the computation of Safe/Allowable bearing capacity required for design of the foundations for a Multi-Level Car Parking.

Note:- Below mentioned report is indicative and for tender purpose only, contractor has to carry out necessary soil tests as per Indian standards for design of structure.

**Summary of Contractual Key Obligations**

The key obligations of the Contractor under the Contract are summarized as follows: –

i. Topographical Survey of the Site area
ii. Geo-tech Investigation of the Site area.
iii. Demolition of existing structures if required.
iv. Dismantling, relocation & installation of existing substation/DG Set to identified location if required.
v. Planning & Design of the Civil Works, Drainage & Sewage Works, Road Works, Landscaping Works, Mechanical Works, Fire Protection & Fire Fighting Systems, Car Parking System Works, Electrical Works. Car Parking Management System and Instrumentation Works, for Parking Facility as per Employer's Requirement.
vi. Operation & Maintenance of whole Facility for five (5) years after the date of commissioning including the defect liability period of one (1) year. (Operational manpower namely operators, watch and ward, traffic regulators, health and safety, fuel and lubricants for DG sets, or any other requirement to Operate the system 2 shift shall be borne by the department). The electricity and water supply charges shall be paid by the BUIDCO/Patna Municipal Corporation during Operation and maintenance period.
vii. Training Program for BUIDCO/Authorized agency from BUIDCO staff during last six (6) months of O&M period.

**Phasing of Contract**

The total contract period is 72 **calendar months** which includes Phase I- Design and construction period of 12 months and Phase II - 60 months Operation and maintenance period including 12 months of defect liability period.

i. **Design and Construction Period of (12 months)**: It shall be counted from the Contract Commencement Date and will be spread over for 12 months or as extended by the Employer on mutual agreement. The Contractor shall submit all the design related documents, as specified under this Section, within 30 days from the Contract Commencement Date to allow the Engineer/ Employer to undertake a thorough review of the documents and suggest amendments if any. The Employer and the Contractor shall sign off the approved documents within 45 days from the Commencement Date or by such date permitted by the Employer and under no circumstances should it be more than 60 days from the Commencement Date.
ii. **Operation & Maintenance Service Period (60 months)**: This phase is spread over 5years or 60 months including 12 months of defect liability period, commencing from the date of issue of completion certificate. During defect liability period the cost of Operation (Operational manpower namely operators, watch and ward, traffic regulators, health and safety, fuel and lubricants for DG sets, or any other requirement to Operate the system 2 shift shall be borne by the selected bidder)

**The electricity and water supply charges shall be borne by the Agency/Selected Bidder during Operation and maintenance period. The Selected agency is liable to collect user charges from parking and advertising based on rates finalized in consultation with client**

**Contract Key Dates**

The following key dates govern the term of the Contract:

(a) The Contract Commencement Date shall be the date on which the Contract Agreement is signed by the Parties;
(b) The Construction Completion Date or Date of Commissioning shall be the date on completion of 9 calendar months from the Contract Commencement Date;
(c) Defect liability period is 12 months from the date of issue of completion certificate.

(d) Operation and maintenance period start from the date issue of completion certificate.
(e) The Contract Completion Date shall be the final date on which the Contract expires.

**Contractor to Inspect Site:**

The Contractor should visit and examine the site of work and satisfy himself as to the nature of existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of the work. No extra charge made in consequence if any misunderstanding or incorrect information on any of these points or on grounds of insufficient description will be allowed.

**Costs for Mobilization and Temporary Works**

No payment above the prices quoted shall be made to the Contractor for mobilization costs, i.e. for providing transportation, light, power, tools, and equipment, or for furnishing building and maintaining construction plant, access roads, sanitary conveniences, disposal, work, water supply, fire protection, guards, trestles, telephone system and other temporary structures, plant and materials, orfor medical attention or health protection, or for watchmen or guards, or for any other services, facilities, or materials necessary or required to execute the work in accordance with the provisions of the Contract as these shall be considered as having been included in the prices stipulated for the various items of the Bill of Quantities containing lump sum price.

**Contractor's Offices, Stores and Equipment**

The Contractor shall make his own arrangements for renting or acquiring sufficient land for the erection of his offices and stores plus parking / maintenance area for vehicles and equipment to be used on the Works at his own expense. The contractor shall establish and maintain these utilities at his own cost and no additional payment shall be made.

**Contractor's Water and Power Supply:**

The Contractor shall make his own arrangements for a hygienically clean and potable water supply forlabor and construction work during Construction Period.

The Contractor shall make his own arrangements at his own expense for the supply of electricity services either using a metered connection from local mainsor by providing his own generating plant to meet the requirements during Construction Period.

**Staff**

The Contractor will also provide Key-Personnel expert resources as given in below mentioned table.

| No. | Position |
|---|---|
| 1 | Project Manager – 1 B. E. Civil / Mechanical / Electrical |
| 2 | Installation Engineer – 1; B.E (Mech./Elect./Electronics)(Having 5 yrsexperience in car parking systems) |
| 3 | Supervisors – 2; Diploma (Mech./Elect./Electronics/Civil) |

**Sign Board**

The Contractor shall provide a sign board at the site of the Works of approved size and design which provides (i) the name of the Project and the source of its finance; (ii) the names and addresses of the Employer, the Contractor, and the Consultant; (iii) the name and short description of the Project, (iv) the amount of the Contract Price; and (v) the starting and completion dates. It shall be deemed to be part of contract and no extra payment shall be madefor the same.

**Other Contracts and Contractors**

The Contractor must ascertain to his own satisfaction the scope of the sub – project and the nature of other contracts that have been or may be awarded by the Employer in the execution of the project to the end that the Contractor may perform the Contract in the light of such othercontracts.

Nothing herein contained shall be interpreted as granting to the Contractor exclusive occupancy of the sites in the project area. The Contractor shall not cause any unnecessary hindrance or delay to any other contractor working in the project area. If the performance of any contract for the project is likely to be interfered with by the simultaneous execution of some other contract or contracts, the Employer shall decide which contractor may proceed.

The Employer shall not be responsible for any damages suffered or extra costs incurred by the Contractor resulting directly, or indirectly, from the award or performance or attempted performance of any other contracts or line departments related to the project, or caused by any decision or omissionof the Employer respecting the order of precedence in the performance of the contracts awarded for completion of the project.

**Transportation and Storage of Materials**

Transportation of any material by the Contractor shall be by suitable vehicle which when loaded does not cause spillage and all loads shall be suitably secured. Any vehicle which does not comply withthis requirement or local traffic regulation and law shall be removed from the Site. All heavy materials which are not permitted to transport by traffic and police department during day time shall betransported at night time with required permissions from local authorities. All materials when brought to site by the Contractor shall be stacked and stored in a manner suitable to protect against, spillage, damage, breakage, pilferage etc., and readily available for checking by the Engineer at any time. The Contractor shall arrange for watch and ward of the materials at all times in a suitable manner satisfactory to the Engineer, all at his own expense.

**Documents and Drawings**

(a) For the purpose of bidding only, a few basic drawings of proposed Facility have been provided in this document.

(b) However, the contractor will prepare the detailed design and drawings for execution at site. These designs and drawings shall be got approved from the Engineer/Employer before execution of work.

(c) The Contractor shall assume all responsibilities for the making of estimates of the sizes, kind sand quantities of materials and equipment included in the work to be done under the Contract.

(d) He shall not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer/Employer if any such errors or omissions be discovered.

**Works Program**

The Contractor should note that the work should be executed and completed within the stipulated timeframe. The Contractor will accordingly submit a comprehensive Period -wise works program and Implementation Schedule of works at site along with Job Safety Analysis for approval of the Engineer/Employer within 15 days after Commencement date. The works program shall be in the form of the Bar Chart/ PERT chart/ Microsoft Project office along with S-curve.

To monitor the progress of work, weekly review meetings will be held with the Contractor.

**Setting Out of the Works**

The setting out of the works should avoid unnecessary disturbance or removal of plants and trees. Only the removal of plants and trees that is absolutely necessary for the construction of the works will be permitted following the approval of the competent authority.

The Contractor shall at his own expense establish working or construction lines and grades as required and shall furnish and maintain stakes and other such materials and give such assistance including qualified staff as may be required by the Employer for checking setting out lines and grade marks. The Contractor shall be solely responsible for the accuracy thereof.

The Contractor shall safeguard all points, stakes, grade marks and bench marks made or established for the work, bear the cost of re-establishing them if disturbed, and bear the entire expense of rectifying work improperly done due to not maintaining or protecting, or removing without authorization, such established points, stakes and marks.

Any work done beyond the lines, levels and limits shown on the drawings or not agreed by the Engineer shall not be paid for and the Contractor shall make good any extra excavation as directed by the Engineer, at his own expense.

**Site Order Book**

Site order Book shall be kept by the Contractor at the project site. Orders entered in this Book by the Engineer/ Employer or their authorized representative shall be held to have been formally communicated to the contractor. The Engineer/ Employer or their authorized representative shall sign each order as it is entered and will hand over the duplicate to the contractor or his agent, who shall sign the original in acknowledgment of having received the order.

**Protection of Works and Public**

The contractor shall exercise precautions at all times for the protection of labor employed and public life and property at and around the sites of work. The safety provisions of applicable laws, building and construction codes shall be observed. Machinery, equipment and all hazards shall be guarded or eliminated in accordance with safety provisions.

During the execution of the work, the contractor shall put up and maintain during the night time such barriers and lights as will effectively prevent accidents. The contractor shall providesuitable barricades, red light "Danger" or "Caution" signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public.

**Environmental Protection**

The contractor will ensure that all actions are taken to ensure that the local environment of thesite is protected and that surface and groundwater, soil and air are kept free from pollution (including noise) due to the works being undertaken.

**Protection of Environment & Natural Habitat**

**(a) Site Environmental Plan (SEP)**

The contractor shall carry out the work for fulfilling the requirement of environmental impact assessment and management plan as related to construction of work as per the EMP provided in the document.

The Contractor shall prepare a detailed Site Environmental Plan (SEP) for the work site, base camp, etc., showing arrangements for disposal of sanitary and other waste, location of fuel, oiland lubricant depots, sheds for equipment, labour and housing facilities, etc., prior to the construction for approval of the Engineer.

**(b) Safety, Security and Protection of the Environment**

The Contractor shall take all necessary precautions against pollution or interference with the supply or obstruction of the flow of, surface or underground water. These precautions shall include but not be limited to physical measures such as earth bunds of adequate capacity around fuel, oil and solvent storage tanks and stores, oil and grease traps in drainage systems from workshops, vehicle and plant washing facilities and service and fueling areas and kitchens, the establishment of sanitary solid and liquid waste disposal systems, the maintenance in effective condition of these measures, the establishment of emergency response procedures for pollution events, and dust suppression, all in accordance with normal good practice and to the satisfaction of the Engineer. Should any pollution arise from the Contractor's activities he shall clean up the affected area immediately at his own cost and to the satisfaction of the Engineer, and shall pay full compensation to the affected parties.

**(c) Protection of Trees and Vegetation**

The Contractor shall ensure that no trees or shrubs are felled or harmed except for those required to be cleared for execution of the Works. No tree shall be removed without the prior approval of the Engineer and any competent authorities.

**(d) Use of Wood as Fuel**

The Contractor shall not use wood as a fuel for the execution of any part of the Works, including but not limited to the heating of bitumen and bitumen mixtures and the manufacture of bricks for use in the

Works, and to the extent practicable shall ensure that fuels other than wood are used for cooking, and water heating in all his camps and living accommodations.

**(e) Water Supply**

The Contractor shall make his own arrangements at his own expense for water supply for construction and other purposes. Only clean water free from deleterious materials and of appropriate quality for its intended use shall be used. In providing water the Contractor shall ensure that the rights of and supply to existing users are not affected either in quality, quantity or timing. In the event of a dispute over the effect of the Contractor's arrangements on the water supply of others, the Engineer shall be informed immediately and shall instruct the Contractor as to appropriate remedial actions to be undertaken at the Contractor's expense.

**(f) Relations with Local Communities and Authorities**

In sitting and Operating his plant and facilities and in executing the Works the Contractor shall a t all time bear in mind and to the extent practicable minimize the impact of his activities on existing communities. Where communities are likely to be affected by major activities such as road wideningor the establishment of a camp, large borrow pit or haul road, he shall liaise closely with the

concerned communities and their representatives and if so directed, shall attend meetings arranged by the Engineer or Employer to resolve issues and minimize impacts on local communities.

**(g) Fire Prevention**

The Contractor shall take all precautions necessary to ensure that no vegetation along the line of the road outside the area of the permanent works is affected by fires arising from the execution of the Works. The Contractor shall obtain and follow any instructions of the competent authorities with respect to fire hazard when working in the vicinity of gas installations. Should a fire occur in the natural vegetation or plantations adjacent to the road for any reason the Contractor shall immediately suppress it. In the event of any other fire emergency in the vicinity of the Works the Contractor shall render assistance to the civil authorities to the best of his ability. Areas of forest, scrub or plantation damaged by fire considered by the Engineer to have been initiated by the Contractor's staff or labor shall be replanted and otherwise restored to the satisfaction of the Engineer at the Contractor's expense.

**Protection of Utilities**

The Contractor is required to carefully examine the location of the Works and their alignmentsand to make special enquiries with all authorities or service suppliers concerning all utility lines such as water supply, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead), cable TV lines, etc.; and to determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authenticrecords. The Contractor shall be wholly responsible for the protection of such utilities as may be required. If any major shifting or realignment of water supply, sewers, drains, electric and telephone lines are necessary due to their interference with the proposed Works, the same will be arranged through the line agencies. The cost of such relocations will be paid by the Contractor which will be reimbursed under the Provisional Sum provided in the Contract on basis on Haryana SOR, following approval by the Engineer.

**Maintaining Utility Services**

The Contractor may be required to carry out the removal or shifting of certain services/utilitieson specific orders from the Engineer for which payment shall be made to him. Such works shall be taken up by the Contractor only after obtaining clearance from the Engineer and ensuring adequate safety measures.

No clearance or alterations to the utility shall be carried out unless specially ordered by the Engineer. Any services affected by the Works must be temporarily supported by the Contractor who must also take all measures reasonably required by the various bodies to protect their services and property during the progress of the Works.

The Contractor may be required to carry out certain Works for and on behalf of the various bodies andhe shall also provide, with the prior approval of the Engineer, such assistance to thevarious bodies as may be authorized by the Engineer.

The work of temporarily supporting and protecting the public utility services during executionof the Works

shall be deemed to be part of the Contract and no extra payment shall be made for the same. Adequate arrangements shall be made by Contractor to protect and support other services during all phases of the work. If the Contractor fails to protect the other services/utilities and any damage occurs to any services/material, Contractor shall reinstate such utilities to existing conditions at his own cost or pay for the rectification of damages so caused.

**Arrangement for Traffic during Construction**

The Contractor shall at all-time carry out work in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. The Contractor shall, in accordance with the directions of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway, or along a temporary diversion. The cost of temporary diversion shall be deemed to be included in the quoted rates. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

On road sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. The signs shall be of approved design and ofreflectors type, if so, directed by the Engineer.

**Cooperation at Site**

Construction may be carried out in areas of restricted circulation. The Contractor's attention isparticularly drawn to;

The need to maintain existing services and reasonable access for local residents and traders during the construction period; and

The probable presence of other contractors on site is to be coordinated by the main Contractor. Heavy Materials shall preferably be transported to site during night time with necessary permissions from all concerned authorities.

All works shall be carried out in such a way as to allow access and afford all reasonable facilities for any other contractor and his workmen and for workmen of the Employer and any other person who may be employed in the execution and / or Operation at or near the site of any work in connection with the Contract or otherwise.

In the preparation of his program of work, the Contractor shall at all times take full accountof and co

– Operate with the programming of the work of other contractors so as to cause theminimum interference to them and to the public.

**Access to Abutting Properties**

For the duration of the Works the Contractor shall at all times provide convenient access to paths, steps, bridges or drives for all entrances to properties abutting the site and maintain them clear, tidy, and free from mud and objectionable matter.

In addition to the above, in order to ensure uninterrupted traffic flow, the Contractor has toprovide and maintain suitable arrangement for the existing traffic to move across the

construction work during the entire period of construction or till such time that alternative arrangements for the traffic are made.

**Access for Inspection:**

The Contractor shall provide at all times during the progress of the works and the maintenance period, proper facilities and necessary attendance for inspection or measurement of the work by the Engineer/ Employer or their representatives.

**Use of Equipment on Works**

The following conditions regarding use of equipment on works shall be followed:

(a) The Contractor shall be required to give a trial run of the equipment(s) to be deployed at site or establishing their capability to achieve the required Specifications and tolerance tothe satisfaction of the Engineer before commencement of the work.

(b) All equipment(s) provided shall be of proven efficiency and shall be Operated and maintained atall times in a manner acceptable to the Engineer.

(c) No equipment or personnel will be removed from the site without permission of Engineer.

**Surveying and measuring equipment**

Equipment for surveying and measurement of the work shall be procured by the Contractor for his useat the Site. The same shall also be made available to the Engineer at site for any work connected with the Contract without any additional charge.

**Site Photographs and Videos**

The contractor shall arrange to take color photographs and videos at locations of the works to demonstrate conditions of the site before work commences / progresses during the construction period and after completion of the works. The photographs / videos may be required as evidence in defense of claims against the contractor for damage to buildings and property due to the execution of the works. Contractor will take all necessary work photographs and videos as per directions of Engineer. All site photographs and videos shall besubmitted to the Engineer in three sets each which will become property of the Employer.

Nothing extra shall be paid to the Contractor on account of above requirements.

**Record Drawings**

The contractor shall prepare reproducible drawings of the whole works "as built". The drawings shall be produced to a standard similar to that of the Approved Drawings for execution.

Record drawings shall be prepared to the Engineer's approval as the work proceeds and shall be handed over to the Engineer as and when asked for. The completion drawing for individual component of works shall be updated periodically during the contract period as the work progresses.

On completion of work, Contractor shall submit to the Engineer Six sets along with soft copies in three CDs of as built drawings indicating all works with complete information as may be required for reference. The Record Drawings shall then become the property of the Employer.

The cost of all above shall be borne by the Contractor and nothing extra shall be paid on this account.

**Periodic Reports**

The Contractor shall prepare and submit periodic reports on different plans, progress of Works, etc., The Contractor shall develop the required formats for the periodic reports and
also identify any critical reporting requirements in order to enable timely decision making by the Engineer/Employer.

**Final Clearance of the Site**

On completion of work, wherever applicable, the contractor shall clear away and remove from the siteall constructional plant, surplus materials, rubbish, scaffolding and temporary works of every kind and leave the whole of the site and works in a clean condition. Final contract payment shall be withheld until this has been done, to the satisfaction of the Engineer.

# 3. TECHNICAL REQUIREMENTS

**Specification Standards and Codes**

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national or related to a particular country or region other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the Bid Document.

The design criteria like loading standards, permissible stresses and quality standards, to be followedfor the preparation of design and drawings will be as per the latest standards, codes and recommendations of the Indian Bureau of Standards. The design shall not only satisfy the functional requirements but also consider the service condition and provision is to be made forfuture expansion.

In case of absence of suitable IS specifications and code of practice, reference may be made to other recognized international standards and codes such as International Standards' Organization (ISO), Euro Norm (EN), British Standards Institution (BSI), ASTM or AASHTO, Deutsche Industries Norm (DIN), ANSI, AFNOR or equivalent standards. Where even these are silent, the construction and completion of the works shall conform to sound Engineering practice as approved by the Engineer andin case of any dispute arising out of the interpretation of the above, the decision of the Engineer shall be final and binding on the Contractor

**Samples and Tests during Construction**

For ensuring the requisite quality of construction, the Materials and Works shall be subject to the quality control tests as per IS codes as applicable. The testing frequencies set forth are desirable e minimum and the Engineer shall have full authority to get the additional tests carried out by the Contractor as frequently as he may deem necessary, to satisfy himself that the Materials and Works comply with the appropriate Specifications.

Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted Engineering practice to the satisfaction of the Engineer.

The Contractor shall be responsible to develop a quality control program and to provide all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the works under the Contract. Without limiting the generality of the foregoing, the Contractor shall establish either (i) establish a testing laboratory at the site of Workswhich is adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the General Specifications and / or these Specifications and provide all field equipment and apparatus as necessary to conduct all specified in-situ tests and/ or any Tests on Completion, or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent testinglaboratory acceptable to the Engineer. The Engineer may also direct the Contractor to arrangeadditional independent sampling and laboratory testing under the supervision of the Engineer, the cost of which shall be borne by the contractor. The Contractor shall furnish certified copies of all test reports to the Engineer within 3 days of completion of the specified tests.

The Contractor shall, within 14 days after the Site taking over date, submit to the Engineer for his consent, a detailed description of the arrangements for conducting the quality control program during execution of the Works, including details of his testing laboratory, equipment,staff and general procedures. If following submission, or at any time during the progress of Works, it appears to the Engineer that the Contractor's quality control program is not adequateto ensure the quality of the Works, the Contractor shall produce a revised program which will be adequate to ensure satisfactory quality control.

**Workmanship**

All workmanship shall be in conformance with the best trade practices. Particular attention shall be given to the appearance of exposed work without compromising on the Quality Standards.

All defective works shall be demolished, rebuilt and defective materials replaced by the Contractor at his own cost. In the event of such Works being accepted by carrying out repairs/rectification etc. as specified by the Engineer, the cost of repairs/rectification shall be borne by the Contractor. Contractor shall depute competent Engineers for supervision of works from his end and ensure that the quality of work is carried out as per the specifications and quality standards specified in the tender.

**Approval of Materials**

Approval of all sources of material for Works shall be obtained in writing from the Engineerbefore their use on the project.

Quality assurance plan shall be submitted before the dispatch of the material from the worksfor the approval of the Engineer.

Samples of cement, sand, aggregate, bricks, steel, and any other material to be used inpermanent works of the contract shall be submitted for the approval of the Engineer.

**Quality Control on Works and Materials**

(a) The Contractor shall be responsible for the quality of the work for all the works carried out by him for this contract. He shall, therefore, have his own independent and adequate set-up for ensuring the same.

(b) The Engineer shall inspect the work from time to time during and after construction and ascertain the quality of the work after testing (by himself, by his Testing and Quality Control Units or by any other agency deemed fit by him). All the procedures and tests as directed by the Engineer shall be followed.

(c) The Contractor shall provide necessary cooperation and assistance in conducting the tests and obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labor, attendance, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.

(d) The Contractor shall carry out modification in procedure of work, if any, as directed by the Engineer during inspection.

(e) Works falling short of quality as per test standards shall be rectified by the Contractor as directed by the Engineer at his own cost.

(f) Where the Engineer considers that in the interest of the control of the quality on materials or workmanship, modifications, if any, are necessary, such modifications shall be carried out by the Contractor at no extra cost

(g) The lump sum price quoted as Contract rate in the Bill of Quantities shall be deemed to be inclusive of all costs of the provisions indicated in the above-mentioned clauses.

**Quality Assurance and Quality Control**

The contractor shall execute all the works and perform tests as per QA & QC Manual (to be submittedby Contractor as per approved work plan), as approved by the Engineer / Employer.

**General responsibilities**

Contractor shall be responsible for providing:

(a) All necessary plant, labour, equipment and construction materials to be used in the works;
(b) All plant, equipment, materials and labour for temporary and auxiliary works;
(c) All equipment and components to be installed or incorporated in the works;
(d) Transportation and storage facilities for all materials and equipment;
(e) Office and accommodation for staff and labour; and
(f) for consultants and Employer's staff Sanitation facilities at the site; and
(g) All necessary staff and equipment for testing and quality control including site office laboratories.

Contractor shall also be responsible for executing and completing the works in accordance with the specified standards and specifications, within the contractual time allowed, and within the agreed price for these works. The contractor shall be responsible for preparing detail design/drawings/documents and obtaining their approval.

**Quality Assurance/Quality Control Duties**

The contractor's QA/QC duties are summarized below in the Table. Other duties shall be performed as stipulated in the contract and as per IS codes or as directed by the Engineer/Employer.

**Table for List of Contractor's QA/QC Duties**

| Activity / Item | Contractor's QA/QC Duties |
|---|---|
| Designs & Drawings | Maintain design register at site<br>Use only approved drawings for construction |
| Material register | Enter receipts in material register. |
| Materials testing | Prepare mix designs as required by contract and submit test results to BUIDCO;<br>Take test samples in presence of PMC/BUIDCO when requested;<br>Perform materials tests, submit test reports to BUIDCO with monthly reports; Maintain test log |

| | |
|---|---|
| Rejected materials | Enter in material register at site<br>Intimate BUIDCO in writing the proposed date of removal fromsite and confirm after removal |
| Material consumption | Enter daily consumption of materials in material register andindicate balance quantity |

| | |
|---|---|
| Construction equipment | Intimate BUIDCO the details, date of mobilization along with requisiteinsurance certificate Maintain equipment in good working condition |
| Construction | Intimate BUIDCO in writing when construction is going to commence andwhat activities are proposed to be undertaken.<br>Intimate BUIDCO in advance when critical works, such as concreting,embankment, paving, pipeline laying and jointing, testing, etc., would be undertaken, along with the test certificates of the materials proposed to beused in these works. No critical activity shall start unless the material testcertificates are verified and approved by the Engineer.<br>Provide necessary QA/QC manuals. |
| Daily work progress | Maintain in daily log |
| Testing of works in progress | Perform tests as per contract requirements Submit test reports toBUIDCO.<br>Maintain test log |
| Rejected work items | Intimate BUIDCO in writing the proposed date of removal fromsite and confirm after removal, or (if so, agreed by BUIDCO)<br>Rectify defective work and invite BUIDCO for re- inspection. |
| Instructions from Engineer | Enter change orders, site instructions, letters and minutes of meetings issued by the Engineer and Consultants in the InstructionLog |
| Inspection of Engineer | Take instructions in Site Order Book. |
| Progress scheduling and control | Prepare and maintain project schedules and undertake work in accordance with approved schedule |

# 4. DETAILED SCOPE OF SERVICES

**Design Period**

Design Period shall be reckoned from Date of Contract Commencement. During this period, the Contractor shall prepare a holistic and comprehensive Parking Plan, minimum of specified capacity. The Contractor will also get the Topographical Survey & Geo-tech investigation. Accordingly, the Contractor will prepare the Planning and Design of all the components of the Car Parking Facility for required Car Parking Spaces. All the designs and drawings shall be submitted to the Engineer / Employer for approval. Contractor will get the complete structural design of automated MLCP vetted from any of the following Indian Institute of Technology or as approved by the Employer. The Contractor will incorporate all the necessary corrections in his Planning, design and drawings in compliance to the observations

made by the Engineer / Employer and it will remain the responsibility of the Contractor to obtain the necessary approval of the Planning, design and drawings, submitted by him, from the Engineer/ Employer / Competent Authority within this Preparatory Period.

The fee, if any, for approval of drawings by Competent Authority shall be borne by the Contractor.

**General**

(a) The Contractor shall establish contact with all relevant stakeholders, including the designated consultants under Bihar Urban Infrastructure Development Corporation Limited (BUIDCo), Patna and become familiar with the place, site and type of the work required for creating the Automated Multi Level Car Parking Facility. The Contractor shall also be in know-how of the applicable standards and guidelines for providing Automated Car Parking Facility.

(b) The Contractor shall satisfy himself about the nature and scope of work and the prevailing site Conditions.

(c) In order to undertake studies and construction activities under this Contract, the Contractor shall keep liaison with Bihar Urban Infrastructure Development Corporation Limited (BUIDCo), (BUIDCO), Municipal Corporation Patna(MCP), Traffic Police Department and other government agencies regarding governing Laws and regulations such as:

i. Environmental and social impact assessments and prevention, mitigation and monitoring of impacts during construction;
ii. Compensation for damages to nearby properties;
iii. Occupational health and safety including workers' compensation;
iv. Prevailing Labour Laws and
v. Building / Construction Bye-laws
vi. Signage for construction works

**Preparatory Surveys**

(a) The Contractor shall undertake a detailed topographical survey covering the entire Site Area. The survey data shall depict all the physical features like adjoining structures, roads, drains, existing utilities and other relevant features which would influence the constructional activities of the Facility.

(b) The Survey Plan drawing and Contour Plan of the site at 0.25 m interval shall be prepared and submitted to the Engineer/Employer in three sets of hard copies along with the soft copy. The Survey levels should be taken with reference to GTS Bench Mark.

(c) The Contractor shall fix 2 No. Temporary Bench Marks at selected locations on the site withtheir levels encrypted. The Contractor shall be responsible for keeping these TBMs undisturbed till the completion of defects liability period.

(d) The Contractor shall carry out geo-tech investigation Parking area site at the required depth as per IS specifications.

(e) The findings of geo-tech investigation shall be submitted to the Engineer of the PMC/BUIDCO in the form of a complete report along with the recommendation for adopting SBC of the soil. The submission shall be in three sets of hard copies along with a soft copy.

**Documents to be submitted by the Contractor for approval:**

The following documents along with inception report are required to be submitted by the Contractor for approval of the Engineer / Employer:

**Part I – Baseline Reports:**

(a) The Topographical survey data.
(b) The Geo-tech investigation report.

**Part II – Constructional Plan:**

(a) Planning of Multi-level Automated Car Parking System for the required No. of Car Parking
(b) Detailed designs, drawings and cost estimates of all the components of the Facility including the proposed Car Parking Management Systems.
(c) Layout Plan and area allocation for each facility such as:
    i. Layout and Flow Diagram for Cars
    ii. Architectural design
    iii. Structural drawings
    iv. Entry and Exit Area for Parking Structure
    v. Pedestrian paths and landscaping areas as applicable to the project
    vi. Other facilities
(d) Methodology and timelines for implementation;
(e) Contractor Personnel deployment plan;
(f) Investments required for the Complete Development of the Facility.
(g) Detailed methodology for continuous monitoring of the performance of the Contractor in achieving and maintaining the Performance Standards for release of the eligible Payments.

**Part III – Operating and Management Procedures and Policies:**

(a) Annual Operating Plan (AOP) covering all Operations, maintenance and management requirements with watch & ward;
(b) Operation and Maintenance Manuals.
(c) Emergency Response Plan (ERP);
(d) Customer Management and Public Relations Plan;
(e) Standard Operating Procedures (SOPs) for routine Operations and emergency responses;

IMP.: The Contractor shall submit the above documents, at the maximum, within 30 days from the Contract Commencement Date to allow the Engineer / Employer to undertake a thorough review of the documents and suggest amendments if any. The Employer and the Contractor shall sign off the approved documents within 45 days from the Commencement Date or by such date permitted by the Employer and under no circumstances should it be more than 60 days from the Commencement Date.

**Construction Period**

(a) The Scope of Services during the Construction Period shall essentially comprise of implementing the procurement, supply, construction, and installation activities of all the components of the Facility as per approved design and drawings.

(b) The implementation of these activities shall be in accordance to international best practice and industry standards and sufficient care shall be taken by the Contractor in minimizing supply interruptions, traffic disruptions and ensuring good and timely communications with the Engineer/Employer. All the Works and interventions proposed in the approved design and drawings shall be in conformity with the Specifications as set out in the Employer's Requirements. The components relating to this Construction period essentially comprise of but are not limited to the following mandatory works.

# 5. OPERATION AND MAINTENANCE PERIOD:

### 5.1 OPERATION AND MAINTENANCE OBLIGATIONS

The contractor has to operate and maintain the constructed facility for the entire contract period. The cost of Operation & Maintenance during this period shall be borne by the contractor.

### 6.1 TRAINING

The Contractor shall plan and develop the course content, and implement on-the- job and classroom-based training, for BUIDCO/MCP deputed staff of at least 15 personnel in 3 batches of 5 personnel each, during last 6 months of the Operation & Maintenance period. The Contractor shall organize training for identified managers from amongst the BUIDCO/MCP deputed staff in technical aspects of automatic car parking systems to enable BUIDCO/MCP to build sufficient capacity and skills to manage the said car parking systems at a later date, if required.

**Clearances/NOCs**

The Proposed Automated Multi-Level Car Parking shall be planned in accordance with the Development Control Regulations applicable on the site in Walled city zone and all relevant permissions or no objection certificate to build MLCP needs to be obtained.

**Fire & Safety**: No objection Certificate from Fire Department shall be obtained after taking care of disaster management measures as per NBC-2016 and provision of sufficient Fire tank on site. The design of the Building proposed by the Bidder shall be compliant with the latest Haryana Municipal Building Bye- Laws, 2018.

# 6. AUTOMATED MULTI LEVEL PARKING SYSTEM:

The design criteria like loading standards, permissible stresses and quality standards, to be followed for the preparation of design and drawings will be as per the latest standards, codes and recommendations of the Indian Bureau of Standards. The facilities will include but not limited to the followings:

- Automated Parking Facility
- Toll Booths adequately computerized
- All spaces (like motor rooms, service /utility areas etc) as permissible under the bye-laws
- Fully automatic scanning including living beings.
- Design shall include all reasonable precautions and provisions for thesafety of operating and

maintenance personnel

- DG sets, Firefighting facility, security should be provided

**CAPACITY**: The design shall meet the Multilevel Parking with a capacity of minimum 150 cars parking (and any additional capacity will be preferred)

**STANDARDS**: The parking system shall be designed for permitting cars with the following characteristics: Length 5.20 M, Height for SUV 2.1 M, Height for Sedan: 1.7 M, Width 2.10 M, Weight 2500 kg. at ground floor & 2000kg on above level Capacity (at least 2 floors with SUVs & Luxury cars provision).

**RETREIVAL TIME**: The system proposed must not allow more than 300 Sec actual time of retrieval.

**MECHANIZED PARKING TICKETS/RFID**: Issuing Machine shall be designed for computation and collection of tolls. The toll shall be collected from the vehicles at the exit point. A mechanized barrier gate shall be designed and synchronized with the toll collection system for regulating entry/exit of vehicles into and out of the parking area. The Ticketing Station or access system shall be located outside the Entry and Exit Areas on the right side of the inbound traffic.

The entry/exit point shall be located away from the traffic junctions and exit locations. The entry/exit of vehicles shall be provided in a way that it does not hinder any Vehicular or human movement. The minimum clear width of Entry Area shall be designed according to the respective needs and leaving adequate space to the left and right of the car for passengers to leave/enter the car. Adequate area for queuing of the inbound and out bound vehicles shall be provided.

**SECURITY AND SAFETY**: The Entry areas shall be equipped with sensors to ensure the right positioning of the vehicle to be transported as well as to determine the presence of oversized vehicles, protruding mirrors or racks, which exceed the size limitations of the system.

Motion detectors and CCTV cameras or similar devices shall be installed inside the Entry and Exit areas to ensure that no person or animals are inside the Entry and Exit Areas or the vehicle when the machine starts moving. Cameras shall be installed to record digital photos of the physical condition of the car entering and exiting the premises. The images are also helpful to locate cars for drivers with a lost ticket and to validate damage claims. All Entry and Exit Areas must comply with disability requirements.

**DROP OFF & HOP IN ISLANDS**

Separate areas/islands are to be provided at the entry and exit of vehicles so that it does not hinder vehicular movements and shall under no circumstances be unsafe for passenger movement apart from pedestrian movement.

**TOLL PLAZA**

'Closed' system of toll collection shall be required to be adopted for the Project. Toll collection is proposed to be fully automatic/semi-Multi-level tolling system comprising registering of vehicle classification, ticket issuing, data processing etc. The multiple numbers of toll lanes shall be provided so that no more than 3 vehicles per lane queue up during the peak hours. The design for toll plaza shall confirm to the standards. The toll plaza/booths layout shall be prepared by Developer and approved from the Development Authority.

**SERVICES AND FACILITIES**

separate underground storage of 150000 Ltr and overhead tank of 10000 Ltr with necessary pumps shall be provided exclusively for firefighting purposes.

Adequate public convenience and drinking water facility should be provided for the support staff as well as the drivers. Drainage facilities shall be constructed and designed in such a manner that there is no stagnation of water in the Project Site. The internal drainage system shall be connected to main common drain at an appropriate location in accordance with the existing network. Worker/ employee amenities shall be provided in accordance with Good Industry Practice.

Safety barriers, at appropriate locations, shall be provided to effectively manage pedestrian and vehicular traffic. Illuminated signage in accordance with National Building Code (NBC)/ Indian Road Congress (IRC) Norms shall be provided at suitable locations within the Parking Facility.

**FIRE FIGHTING FACILITIES**

The developer shall provide the required firefighting equipment and facilities conforming to relevant standards and the applicable rules and regulations. Fire safety measures as recommended in applicable codes (Indian as well as international) listed in Point 3 shall be implemented. Specifically, the fire fighting system shall be adequate to control petroleum fires. Construct the Parking Facilities structure with non-combustible material without a specified fire resistance. In addition, those portions of the facility used for the transport or storage shall have a finish of non- absorbent, non-combustible material. Specifically, the firefighting system shall be adequate to control petroleum fires. Provisions shall be made in a Mechanized Parking Facility that leakage of gasoline tanks or other flammable fluids are collected during transportation and storage of the vehicle.

Where the Mechanized Parking Facility is located below a building, a 2-hour fire resistance rated separation shall be provided between the Mechanized Parking Facility and the adjacent space use.

As the nature of a Mechanized Parking Facility provides the means to transport a vehicle without human interference, provisions shall be provided to detect a vehicle on fire and to transport it to a fire extinguishing cell at a space on ground floor, easily accessible for fire-fighters.

**LIGHT**

Adequate lighting system in parking facility area will have to be provided to achieve a minimum lux level of 70 for parking and pedestrian movement area and a minimum lux level of 100 for stairways, entrance and exit areas of parking.

The Entry Areas for Parking shall be provided with auxiliary emergency lighting system such that in the event of failure in general power supply the auxiliary emergency lighting system is activated immediately.

Power back-up adequate for 100% of the designed power load of the Parking Facility (except Walkways) shall be provided. The generator shall be equipped to have a switch-over mechanism so as to be activated automatically in the event of power failure. The generator shall be installed in a separate sound-proof enclosure well available throughout the year.

**AUTOMATION AND PROCESS CONTROL**

The automation system shall be suitable for acquiring data / information from various systems / sub-systems and process them to execute the functions as required for the operations.

The level of automation shall satisfy the requirements of the promised specification for the Parking system like human interface, ticketing, tracking of the car, choice of least time critical path for parking, retrieval and metering etc. A computer CPU with appropriate software will act through the PLC. The software will be based on the state-of-the art operating system and will be time tested for the type of parking installed.

The required UPS (Uninterrupted Power Supply) will be provided. The equipment and component parts shall conform to the relevant standards by Bureau of Indian Standards wherever available. They shall further conform to the latest Indian standards.

## MAINTENANCE AND PERFORMANCE STANDARD

During the period of operation, the Developer would be required to maintain all the Facilities in accordance with performance standards and maintenance requirements, as mentioned below:

- Perform maintenance on a routine and periodic basis. Identify potential problems early within the context of the planned maintenance system so that corrective action may be planned and completed in a timely manner.
- Establish a maintenance list for planned operation and maintenance. Follow an orderly program so that maximum operational efficiency is attained.

The Parking Facility may have an installed and real time, on-line connection to themanufacturer/ technical operator which allows for resolution of most errors remotely with a short response time in reaction to any trouble alarms generated bythe system.

The Parking Facility shall be capable of reporting alarms in different classes according to their severity for the System functionality. Preferably, a hotline support line shall be implemented to enablea remote system support.

## MAINTENANCE / OPERATOR

Adequate steps shall be taken for regular maintenance of the equipment's. In order to avoid System interruptions as much as possible and to remedy such interruptions in a reasonable time.

Under all circumstances without any exception, trained personnel must be available round the clock at short notice. A contract with manufacturer shall be entered into to provide a trained technician for the prevention and remedy of interruptions during the all hours of operation of the Parking Facility. Explicit provisions relating to training and know- how transfer, including sharing of manuals and procedures would have to be reflected in the agreement that may be entered into with the manufacturer.

The system shall be required to be designed such, that maintenance personnel has access to all Parking Facility, machinery and electrical and electronic components in a safe manner.

The Developer shall perform routine and periodic maintenance activities for the project infrastructure viz, civil, mechanical, and electrical works and equipment, furniture for meeting the specified performance standards.

### Design Standards

The design shall not only satisfy the functional requirements but also consider the service condition and provision is to be made for future expansion. The developer would be required to design, finance, construct, maintain and operate the proposedMultilevel Parking strictly conforming to the relevant Indian Standards, the best Industry practices and internationally acceptable norms.

### Design Basis

All equipment should be rated for and ambient temperature of 45°C for indoor and 50°C for outdoor. Maximum relative humidity to be considered is 90% or as specified. Continuity of power supply is the first consideration. The design shall besuch as to provide facilities to simplify inspection, testing, maintenance, cleaning, and general repairs at site.

Special care to be taken to make the enclosed equipment proof against entry of rats, lizards and other creeping reptiles, which may create electrical, short- circuit. All ventilation opening shall have suitable screen protection. All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions. Design shall include all reasonable precautions and provisions for the safety of operating and maintenancepersonnel.

### Multi- level Parking

Multilevel Parking with a required capacity and additional parking space to accommodate the parking requirements for permissible commercial space as per the building bye-laws. The Multi-level Parking would be required to be planned inaccordance with the Development Control Regulations applicable on the site.

Retrieval Time: Not more than 180 seconds.

**Equivalent Car Space (ECS) Detail MLCP on Maurya Lok Complex, Patna**

| S. No | ECS as per calculation |
|---|---|
| 1 | 150 nos (5 x 2.5 m) |

**MONTHLY PROGRESS SUBMISSION**

The Operator shall submit the Monthly progress report containing the Expenditure for O&M, Revenue sheet and any incident happened at site in MPR on monthly basis every 1st week of every month. Non submission of MPR will lead to Penalty as decided by Authority.

**ADVERTISING STANDARDS**

a) Advertisement rights should be with client where in client would have rights to reject Advertisement.
b) Advertisement shall only be placed at locations in accordance with Approved Designs submitted by Successful Bidder and approved by client.
c) The provision for Outdoor Advertisement Panels cannot be done on any of the key public utility or signages.
d) The advertisement panel shall not dominate any of the existing buildings or public spaces in and around the site.
e) The Successful Bidder shall not display or exhibit any picture, poster, statue, or other articles in any part of the premises that are repugnant to the general standards of morality. The Authorize expressly agrees that the decision of the client in this regard shall be conclusive and binding on the Successful Bidder.
f) The advertisement should not be of any illegal or obscene components which is objectionable for general public and should not be against govt. bodies.

# 7. CIVIL AND STRUCTURAL REQUIREMENTS FOR MLCP

### A. During Design Phase:

The building shall be designed in accordance with the latest Indian Standard Codes and shall be designed to resist wind and seismic forces. RCC Structures shall be designed as per **IS 456: 2000, IS- 13920:1993, IS-1893: Part 1** & other relevant codes. Steel Structures shall be designed in accordance with the provision of **IS 800-1984** & other relevant codes. Structural steel shall conform to IS 20627& other relevant Codes. Tubular section shall conform to **IS 4923** & other relevant Codes. Architectural design norms as per NBC **(National Building Code – 2005)** & other relevant Codes. Structural Design norms as per NBC and **BIS (Bureau of Indian Standards).** The said project comes in Seismic zone IV and the same has to be analysed and designed for earthquake by both Static and Response spectrum method as stated in IS:1893-2002. Structure is to be analyzed as space frames and design of beams and columns has to be carried out using standard software STAAD PRO, ETABS etc.

### B. During Construction Phase & Maintenance Phase:

It needs to ensure that casting of RCC foundation is in accordance with different Indian Standard Code Provision. Fabrication & Erection of Steel

Structure are to be in compliance with specified codes of Indian Standards. Periodic maintenance of steel structure, as mandated by IS and BIS standard needs to be undertaken for safety and upkeep of steel structure. The construction is carriedout in following phases:

i. **Excavation:** Earth is to be excavated to a depth upto bottom of footing. In order to retain the soil, sheet piling if necessary. Excavation will be carried out both manually as well as mechanically. Excavation will be carried out providing adequate side slopes and dressing of excavation bottom.

ii. **Laying of the Plain Cement Concrete:** After the process of excavation, laying of plain cement concrete (PCC) is done. A layer of 4 inches was made in such a manner that it was not mixed with the soil. It provides a solid base for the raft foundation and a mix of 1:3:6 that is, 1 part of cementto 3 parts of fine aggregates and 6 parts of coarse aggregates by volume were used in it. Plain concrete is vibrated to achieve full compaction. Concrete placed below ground should be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances should be kept free from contact with such a ground and with water draining there from during placing and for a period of seven days. When joint in a layer of concrete are unavoidable, and end is sloped at an angle of 30 and junctions of different layers break joint in laying upper layer of concrete.

iii. **Foundation:** Foundation provides support for structures, transferring their load to layers of soil or rock that have sufficient bearing capacity and suitable settlement characteristics.

iv. **Concrete& Steel:** M25 grade of concrete& Fe 500D TMT grade of steel will be used for the construction.

v. **Insulation Concrete to Roofs**: The Contractor is responsible for the Insulation Concrete to roofs top with required grade will be used for the construction as per approved design & drawing and as directed by the Engineer-In- Charge and his satisfaction.

vi. **Roof truss:** Roof truss will be provided to cover the entire area of the building selected for car parking. Over which GI sheet will be used for the covering of roof truss. To provide safety to GI sheet, 50 mm M20 special insulating screening will be done.

vii. **Paver Blocks** as per approval of desired colors, shapes and texture are to be laid on footpaths and traffic islands with kerbstones.

viii. Cement concrete pavement in 6 Mtr wide driveway along the periphery of the MLCP building.

**Project Layouts Plans & Drawings:**

This section deals with the Architectural, Structural and Other drawings for MLCP in Maurya Lok commercial complex for referral purpose only. The Bidder will submit his own proposal for approval meeting the desired requirement.

## INDICATTIVE CONCEPT PLANS

Site Plan


*Figure 7-1: Location of Site 1 inside Maurya Lok Complex*

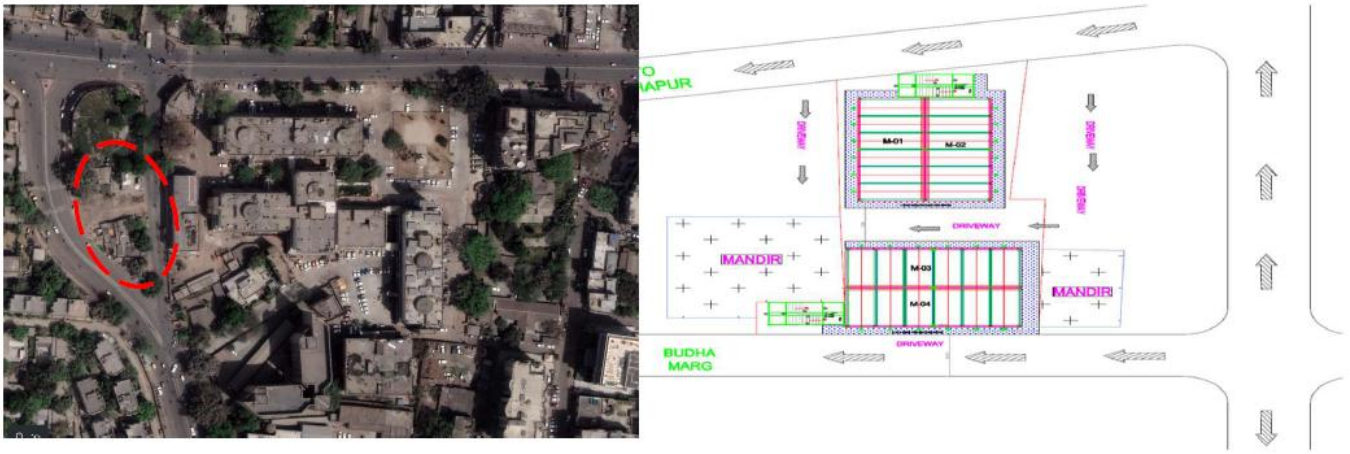
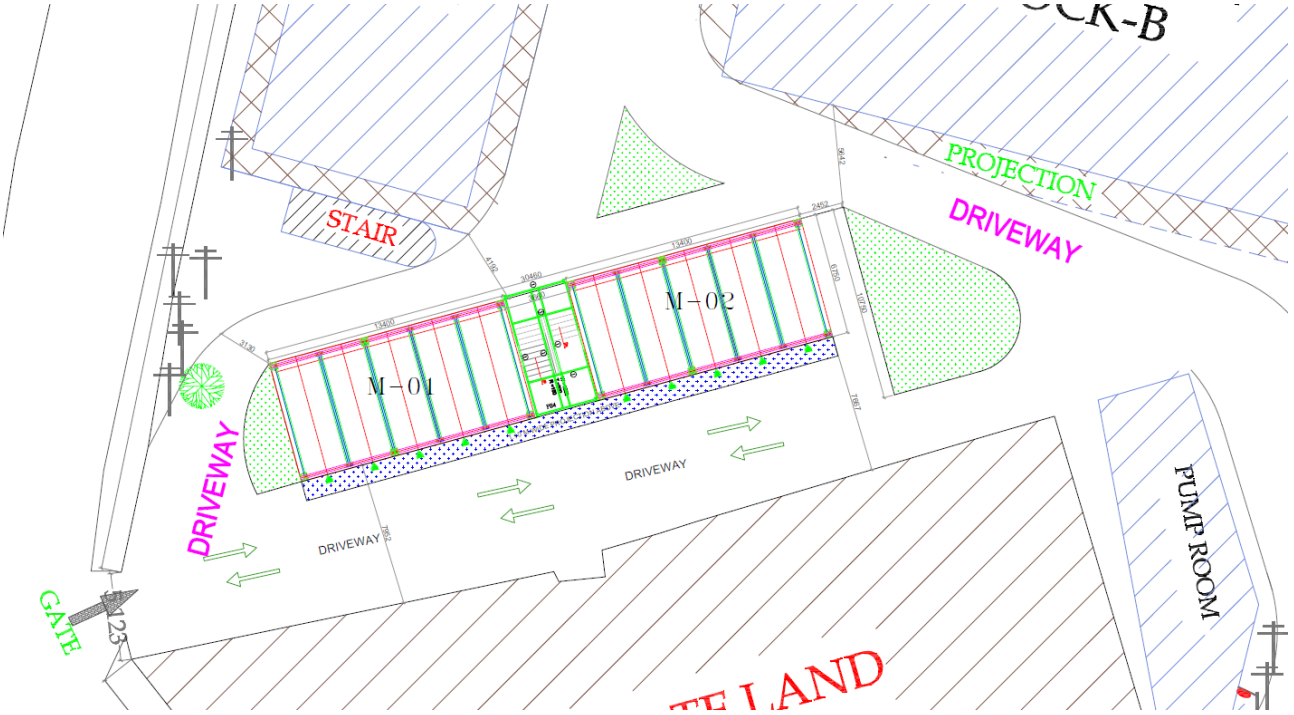
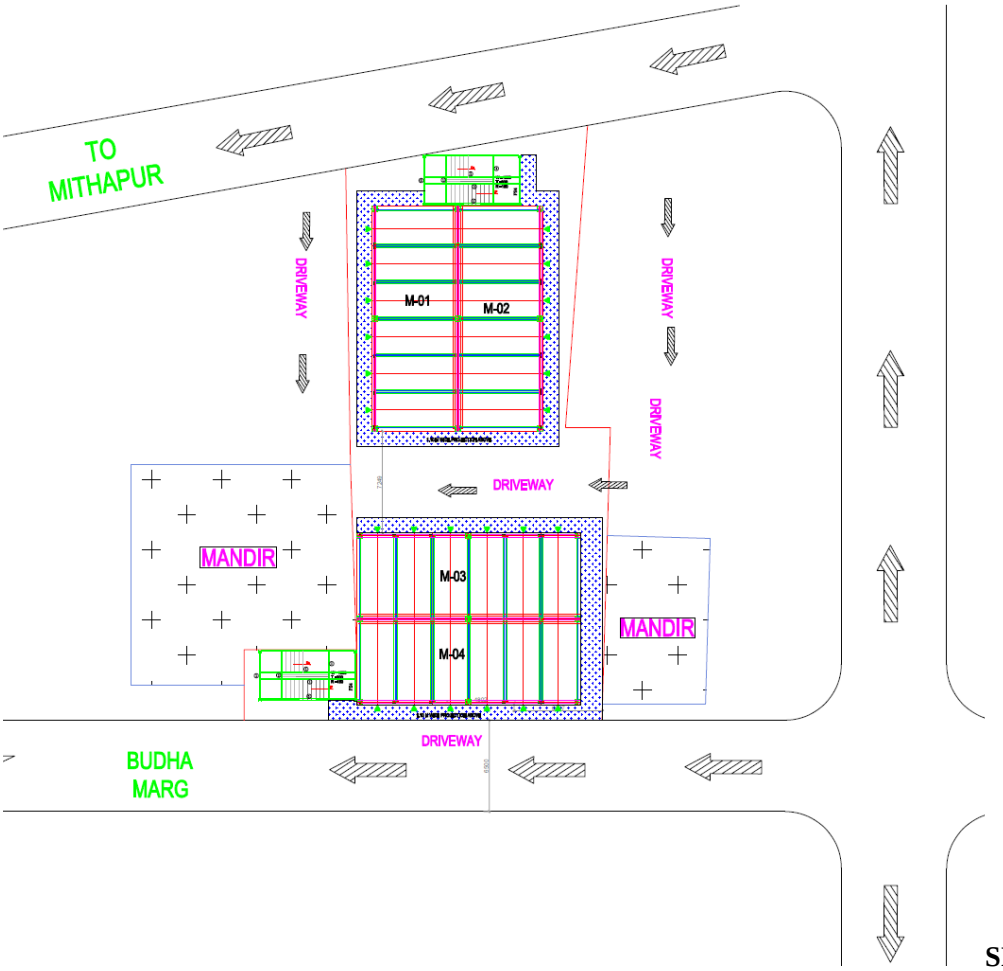



*Figure 7-2: Location of Site 2 outside Maurya lok complex*

**Proposed Layout MLCP Building**

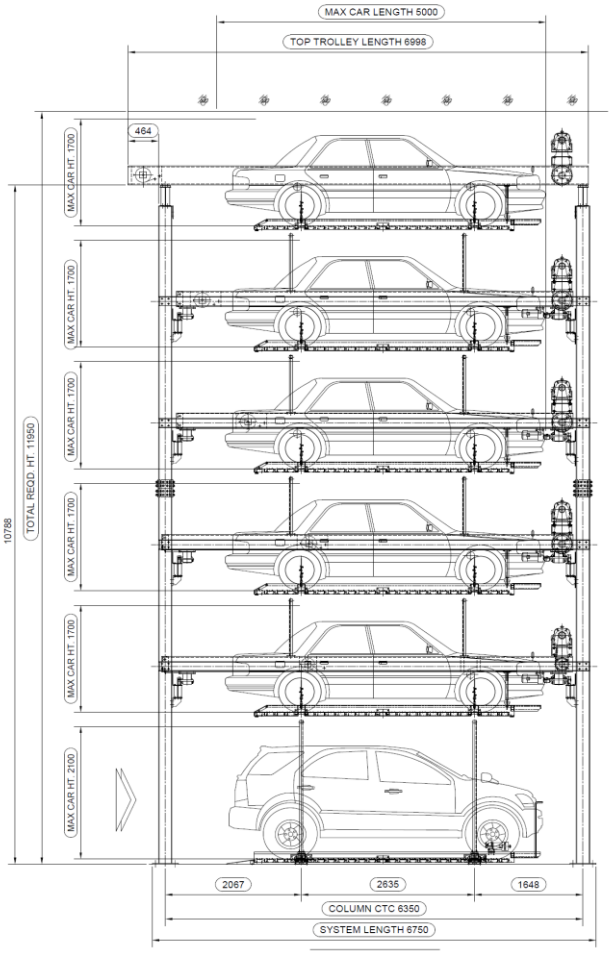



**SITE - 1**

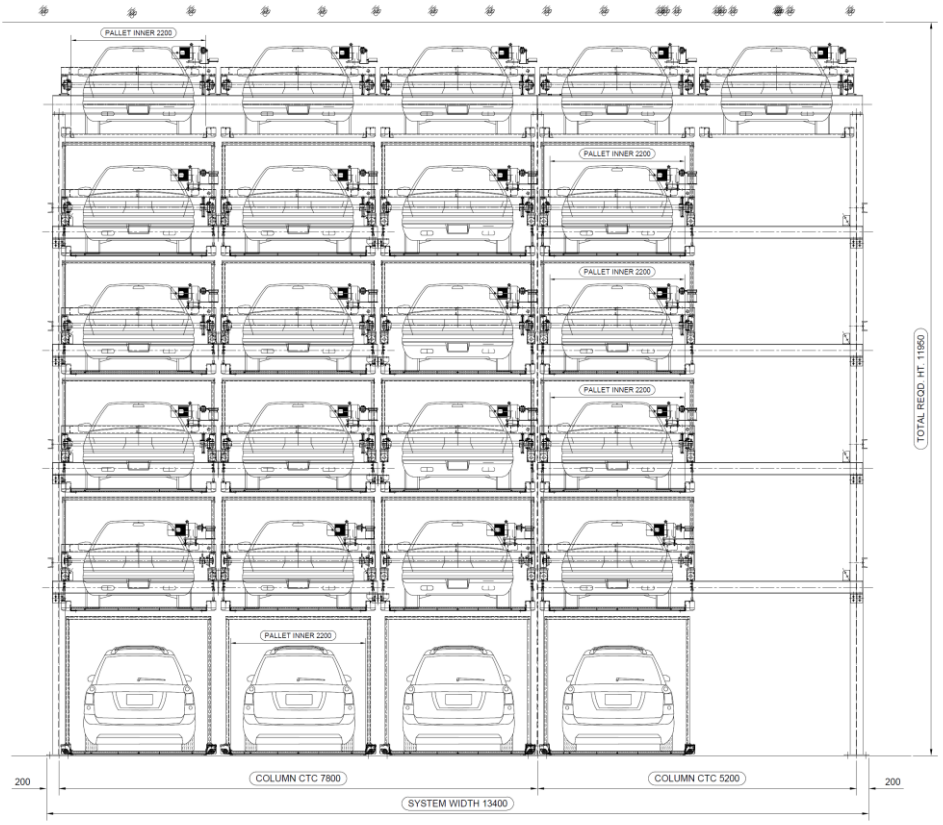



**SITE 2**

# Proposed Section of MLCP Building

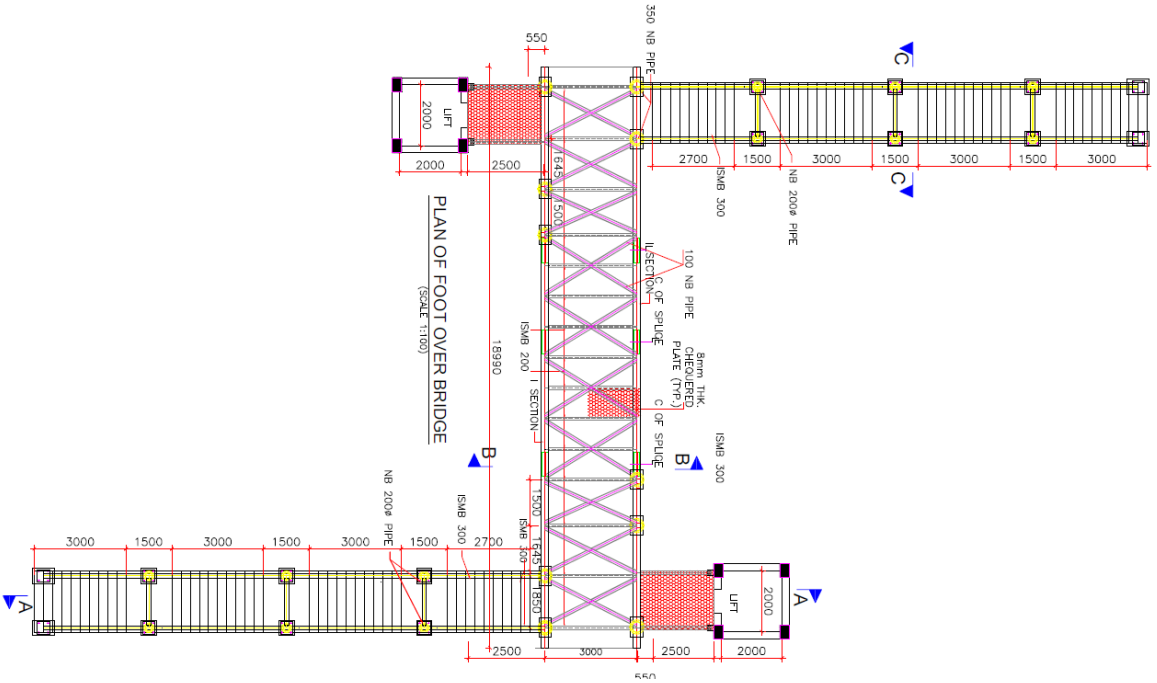



SIDE VIEW

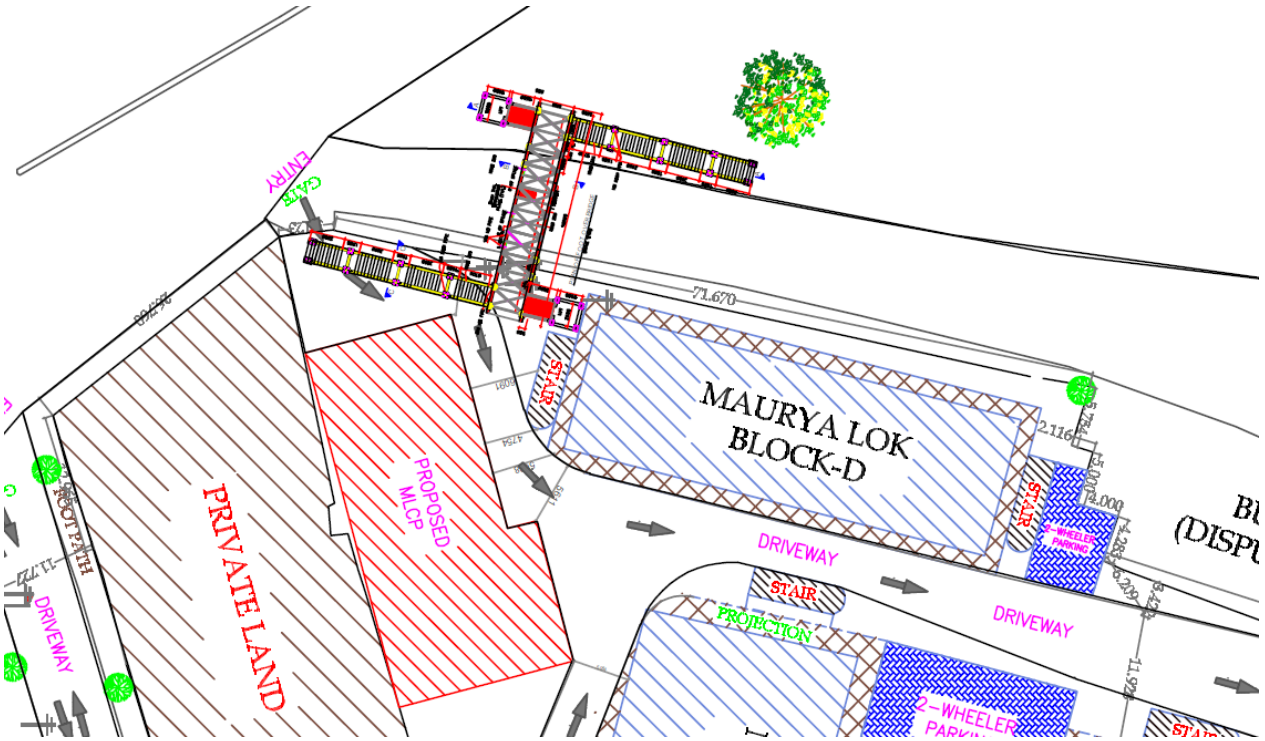



REAR VIEW

## Proposed FOB




## Proposed Layout of FOB



## Annexure – A:

## Scope of Works for Civil and Steel Components including Facade, Drainage Works, Internal Road Works

**General**

Based on surveys and investigations conducted by the Contractor, the Contractorwill plan and frame a comprehensive proposal for providing the desired Car Parking Facility.

The broader scope of civil work will be as offered by the Contractor including the modification and additions accepted. However, a brief description of scope for civil works along with few fixed parameters is detailed here under:

**(a) Car Parking Systems and General Works:**

a. The Automatic Multi Level Car Parking Building will be constructed in the Maurya Lok Complex, Patna will house Minimum 100 ECS parking spaces.
b. The Parking System will have a height up to 15 meters above finished plinth level.
c. The bay on the Ground Floor of the Parking facility shall be utilized for getting the cars parked in the system (for entry, exit, and vehicle movements). However, all the Service Rooms, Control Rooms, Waiting Rooms, Collection Booths and other related facilities shall be provided at the Ground Floor level.
d. Proper space must be kept aside on the ground floor for Car Parking Management Systems, DG Sets and other services.
e. Server Rooms and Control Rooms of appropriate size along with approved finishing as per specifications shall be provided at groundfloor level of the Premises.
f. Service/Fire Stair case as per standard norms of adequate size along with approved finishing, for Maintenance & Service purpose shall be provided incorporated in the design.

**(b) Other Civil Works**

a. Collection/ Dispensing/ Security Booths of appropriate size, properly finished as per directions of the Engineer/ Employer shall be constructed at each Exit/ Entry as per approved plan and shall be furnished with standard approved furniture along with boom barriers.
b. Construction of all approach Roads including Footpaths Drive in Lanes with proper turning from carriageway within and outside the building from the adjoining Main Roads along with necessary traffic signs, markings & other road appurtenances shall be in the scope of the Contract.
c. All the sleeves required for the underground and Over Head Tanks shallbe provided by the Contractor at no extra cost.
d. The Contractor shall provide all inlets, outlets, washouts, vents, overflow and all such other piping connections for Water Storage Tanks.
e. All Drainage & Sewage works if required for successful completion of the sub - project shall be in the scope of the Contractor.
f. The Contractor will have to obtain necessary drainage approvals, layout scheme approval, water connection, etc. & all other approvals and compliances from various statutory departments as required and noextra amount would be paid.

g. The elevation in the entire area –shall be provided with semi (grid) unitized system of structural glazing (with open joints) for linear as wellas curvilinear portions of the building for all heights and all levels, client logo is to be fixed on front elevation of the building.Dimension and design of logo will be as per approval of EIC.

a) Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminum cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)- cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation &drainage and protection against fire hazard including:

(b) serrated M.S. hot dip galvanised /Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.

Two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.

(c) flashings of solid aluminium sheet1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.

(d) provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete.

## Annexure – B

## Scope of Works for Mechanical Components, Car Parking System and Fire Fighting System

**Scope of Mechanical Works:**

(a) The Contractor has to provide two boosting pumps (one stand by and one working) of required capacity with suitable piping and fitting for overhead water tank (10000 Ltr capacity) at the top of the parking systems on a civil structure in the corner and provide two separate pumps of required capacity (one stand by and one working) for Fire Fighting Operations with a separate plumbing system in the UG Tank(150000 Ltr Capacity) of required capacity at ground floor along with pumps of required capacity. Any additional pumps, if required, for efficient functioning of the system as a whole shall also be provided by the Contractor at no extra cost.

(b) All necessary valves and fittings for efficient pumping system are to be provided by the Contractor.

(c) The Contractor shall test the respective system as described to establish whether the installation has been carried out to facilitate efficient Operation.

**Scope of Car Parking System:**

(a) Based on surveys and investigations conducted by the Contractor, the Contractor will Plan a comprehensive proposal for providing the Automated Multi level Car Parking Facility for car spaces of Minimum 100 cars on Ambedkar Marg near Old Sabzi Mandi.

**Scope of Fire Fighting System:**

Firefighting system is provided to minimize danger to life from fire, smoke, fumes or panic before the building can be evacuated. The safety of life is more than a matter of means of exits. Fire protection techniques are based on fire behavior characteristics of different material and structural elements of building. There are three different methods to get rid of danger of fire.

(a) Fire Prevention - Design and construction of building on passive fire protection measures, also describing the various types of building material and their fire rating.

(b) Life safety – Covering life safety provisions in the event of fire and similar emergencies, also addressing construction and occupancy features that are necessary to minimize danger to life from fire, smoke, fumes and panic.

(c) Fire protection – Covering the significant appurtenances and their related components and guidelines for selecting the correct type of equipment and installation meant for fire protection of the building depending upon the classification and type of building.

**Automatic sprinkler system**: A system of water pipes fitted with sprinkler heads at suitable intervals and heights and designed to actuate automatically, control andextinguish a fire by the discharge of water.
**Emergency lighting system**: A complete but discrete emergency lighting installation from standby power source to the emergency lighting lamps. This ensures escape routes is illuminated all the time.

**Fire Door**: A fire resistive door approved for opening in fire separation. Fire exits and Fire lifts alsoto be provided.

**Wet riser**: An arrangement of firefighting within building by means of vertical rising mains not less than 100mm nominal diameter with landing valves on each

floor/landing for firefighting purposes and permanently charged with water from apressurized supply. underground tank capacity required is 150000 litre and an overhead tank ofcapacity 10000 litre.

1. The scope of work covers Fire Fighting (Combination of Wet Riser & Sprinkler System), Necessary Fire staircase as per norms for Proposed Car Parking Facility. It shall be the Contractor's responsibility to plan, design andprovide complete Fire Fighting System as per the applicable codes.

2. The Contractor should provide all fire related pumps like fire sprinkler pump, Smoke detector, fire extinguishers, fire hydrant, fire address system, fire prevention, fire alarm system etc
3. Fire Detection & Fire Fighting systems are to be provided by the Contractor at each level of the car parking facility or at the top level only of the Car parking system as prescribed by the CFO.

4. The Addressable Fire Alarm system planned for this project must in general cover the Design, Quality Control of all The Detectors/ Call Points/ Annunciation system hooked up to main panel.

5. The Fire Protection System must consist of external & internal Hydrant system as required for different areas within all the levels of car parking system as prescribed by the CFO.

6. Foam Cylinders must be provided at the ground level of Car parking systemsto extinguish fire caused due to any kind of fuel.

7. The Contractor shall set out the drainage, soil, waste and water pipe lines andother fittings and fixtures in accordance with the approved plans and designs.

8. The Contractor should note that this work should be executed and completed before the completion of the general work and the Contractor shall take care to see that no damage or breakage is done to work once it is constructed and finished. The sanitary and water supply work shall be programmed in such a way that it does not hold up the general construction or works of other trades.

9. Contractor shall prepare Site drawings indicating the layout, Specification of pipes fittings and all other information required for execution of work. The Shop drawings shall be got approved before carrying out any section of work. The Shop drawings shall be submitted 7 days in advancefor approval from the Engineer / Employer.

10. On completion of work, Contractor shall submit to the Engineer 6 copies of as built drawings indicating all works with complete information as regards to sizes, Operational valves, chambers etc. including levels and other such information as may be required for reference.

11. Contractor shall ensure that all the sleeves required at the time of casting of water tank, overhead tank and any other sleeves required for Plumbing purpose shall be provided as per the drawings.
12. Contractor has to submit his activity schedule in accordance with the civil activity bar chart (especially water proofing, tiling etc.) and ensure proper coordination with the various agenciesto whom these specialized works have been assigned.

13. Contractor will have to obtain necessary approvals for the Fire Fighting works including all approvals and compliances from various statutory departments as required and no extra would be paid.

14. If so directed, materials shall be tested in an approved testing laboratory and the Contractor shall produce the test certificate in original to the Engineer/ Employer and the entire charges for original as well as repeated tests shall beborne by the Contractor.

15. For the purpose of testing of the Sprinkler system after its completion, the Contractor shall provide free of cost Sprinkler heads to be checked by the Engineer/ Employer. The test shall be carried out on the sprinklers separatelyfor each zone.

16. The Contractor shall provide all materials, tools, testing, materials, scaffolding, labour and electric power, necessary for the perfect completion of the whole work at his own cost.

17. The Contractor shall obtain from time-to-time various permissions and the completion certificates as per rules of all local and statutory authorities.

18. The Contractor shall be required at his own expense to test the installation with water.

19. The Contractor shall be responsible for any repairs or replacement of any defective Part and shall rectify the installation free of cost to the owner.

# Annexure – C

## Scope of Works for Electrical Components

### 1. SCOPE OF ELECTRICAL WORKS: GENERAL

**Electrical Systems:**

Electricity is the life line of any project. Electrical system is to be designed considering all safety factors, byelaws, controlling equipment and requirements of various loads. load has to be calculated as per DHVBN norms.

VCB panel, DG set will be installed at ground floor. 11 kV VCB will be fed through 3C X 95 sqm Aluminum armored HT cable. This DG Set will feed Main LT panel at same location. All electrical equipment's are outdoor type. DG set are with AMF panel. During power off, DG set will start automatically. There are double neutral and double body chemical type earthing for DG Set. For other panels double body earthing's are provided. Light and Power sockets will be provided as per requirement. Two no. 6A sockets will be provided for one PC point. The load on 6A socket should not be more than 200W. All power loads should have 6/16A multi socket. Size for point wiring will be 1.5sqmm and power point will be 4sqm. Secondary 6/16A socket (unused) will be wired with 1.5sqmm. Size of earth wire for 1.5sqmm will be 1sqmm and for 2.5sqmm will be 1.5sqmm and for 4sqmm will be 2.5sqmm. Single earthing will be provided for single phase circuit and double earthing will be provided for three phase circuit. TPN DB's will be used for internal distribution to ensure load balancing on each phase. It is ensuredat LT Panel level also. Sub main and circuit wiring will be of copper only. Modular sockets of reputed makes will be used. Cables and Panels switchgears will be of reputed make. Capacity of DG Set should be taken in sucha way that it take complete load of MLCP in Auto-Mode. The provision for Auto-transfer of load from LT supply to DG Set should be taken in LT Panel also. All necessary inter-locks should be considered in LT Panel.

**Illumination:** LED lights with efficacy more than 100 lumens per watt of reputed make. The respective illumination or Lux level of different areas are as follows:

- External areas (Pathways etc.) - 20 Lux
- Pallet space – 250 Lux
- Remaining areas like offices etc. – 500 Lux
- Illumination can be calculated as
- I = L * C* LF / A where
- I = illumination (Lux, lumen/m2)
- L = luminance per lamp (lumen) (as provided by manufacturer)
- C = coefficient of utilization (generally 0.6)
- LF = light loss factor (generally 0.8)
- A = area per lamp (m2)
- Efficacy chosen for LED lamps (minimum) = 100 lumens per watt
- 1 Lux = 1 lumen per sqm

Listed below are the Electrification works to be carried out by the Contractor for Internal and External areas of the Car Parking Area along with all necessary described systems and equipment as per technical specifications, drawings, scope of work and to complete the installation in all respects and make it ready to use and ultimately commission it to the satisfaction of the Engineer / Employer.

**(a)** LT Panels will be at ground floor. Dismantled material will be deposited at BUIDCO store at Patnaas instructed by BUIDCO.

**(b)** All material including D.G Set etc. shall be as approved by BUIDCO.

**(c)** There should be provision for replacement of faulty DG set by additionalarrangement in alley.

**(d)** DT meters of all DG Set shall be in Contractor's scope.

**(e)** Required Earthing's and all safety measures shall be given by Contractor.

**(f)** Testing of all installed equipment will be done by contractor in presence ofPMC/BUIDCO.

**(g) Employers Requirements of Electrical Work**

(a) The entire scope of work of the contractor for electrical works must be completed as per the scope mentioned in this document after thoroughly adhering to the specifications of the related electrical works mentioned separately in the Specifications' section.

(b) The DG Set of adequate capacity with HT/LT Panel as required would be provided by the Contractor complete as per specifications of DHVBN.

(c) The contractor must do a detail study and find out the exact electrical load requirements for this entire project and accordingly recommend to the Engineer/ Employer, the details of the capacityof the DG Set required so that the same can be installed.

(d) The contractor's scope of work with regard to electrical works will comprise of:

a. Supply, Installation, Testing & Commissioning of substation equipment such as 1 Nos. DG set for 100 % backup with AMF Panels,HT / LT Panels etc.,
b. Cabling,
c. Internal electrification,
d. Lighting fixtures,
e. Street lighting,
f. CCTV system wiring etc., Access control wiring etc. with all its alliedElectrical equipment
g. The contractor should provide all applicable standards, codes, etc.
h. Earthing system,
i. Lightning arrestor, etc. with all allied equipment.

(e) The Contractor shall carry out and complete the said work under this contract in every respectin conformity with the bid documents and with the directions of and to the satisfaction of the Engineer / Employer.

(f) Unless stated elsewhere in these documents, all equipment like pipes, cables, DG Set, generators, panels, poles, lighting fixtures etc. are to be factory tested either in this country or abroad by third parties & same shall be intimated to the Engineer / Employer in advance. All incidental expenses for the said third party inspection incurred for factory tests shall be borne by the contractor and later will be reimbursed by the Employer from the Provisional Sum.

(g) The contractor shall furnish all labour, materials and equipment including transportation and other incidental activities necessary for supply, installation, testing and commissioning of the complete electrical system as described in the Specifications. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or in the Specifications section but which are necessary and customary to be performed for the successful completion of the project. The brief scope of electrical system to be provided by the contractor shall be as below but not limited to:

a. Contractor shall carry out all necessary tests required to establish the guarantee performance as per IS codes.
b. Contractor shall carry out testing and commissioning of the D.G. set as per required capacity with AMF panel supplied by him.
c. Contractor shall also carry out all necessary tests at site required to be sure of the performance of the items used in these Electrical Works, before installing the same.
d. Contractor shall provide all necessary literature for erection andcommissioning works to the Engineer / Employer.
e. The detailed design arrangement of the equipment shall be the responsibility of the Contractor subject to the approval of the Engineer /Employer.
f. All conduits should be concealed wherever applicable
g. The Contractor shall provide the following:
i. All the necessary junction boxes, outlet boxes Switches, plug sockets, cover plates wiring for lighting and power circuits andall other wiring accessories
ii. LT Cables, Mains and Sub-Mains, Rising Mains / Bus Ducts, GI raceways and

junction boxes, HT/LT panel, Main Distribution / Sub Distribution panels, Final Distribution panels & Capacitor Panels as per their required sizes & thickness (IS Standards) Cables on cable trays and / or within suspended ceiling spaces including installation, cable trays, hangers, supports, cable terminations and all fixing accessories.

iii. Earthing (Grounding) System.
iv. Lightning Protection System.
v. Supply and installation of Lighting Fixtures for Street Lighting areas.
vi. Installation of Internal Lighting fixtures.
vii. HT switchgear as per required sizes.
viii. Substation Earthing.
ix. Supply and installation of conducting & cabling for CCTV.
x. Supply & Installation of separate cable system for firedetection, fire prevention /fighting.

(h) DG set provided as a back-up for this car parking system must be connected with the entire parking systems and must be equipped with automatic switch over mechanism.

(i) The contractor shall carry out the work in accordance with the Specifications, and other documents specified in the bid documents. The contractor shall be fully responsible for the performance of all the equipment at the specified parameters in electrical works and for the efficiency of the installation to deliver the required end result.

(j) The contractor shall guarantee that the Electrical system as installed shall perform to complete satisfaction of the Engineer / Employer. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also, actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

(k) After completion and successful commissioning of the Electrical works, it shall be responsibility of the Contractor to obtain the necessary NOC fromconcerned Line Department

(l) At the close of the work and before issue of final certificate of virtual completion, the contractor shall furnish written performance guarantee against the replaced materials. The Contractor shall hold himself fullyresponsible for reinstallation or replacement, free of cost for the following:

a. Any defective work or material supplied by the Contractor.
b. Any material or equipment damaged or destroyed as a result of defective workmanship by the Contractor.

(m) The work shall be carried out to the satisfaction of the Engineer / Employer and in accordance with the Specifications, Regulations of the Electrical Supply Authority, Indian Electricity Rules and Regulations and latest Indian Standards.

**(n)** The Contractor shall ensure the sufficiency of the size of electrical shaft openings, clearances inwall and suspended ceilings for proper installation of his conduits, cables, cable trays, panels etc**.**

(o) The Contractor shall locate all equipment which must be serviced, Operatedor maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized with the Engineer within sufficient time. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense.

(p) All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design.

(q) Makes shall be strictly in conformity with list of approved manufacturers as per IEC/IS Codes as mentioned in the makes list or as suggested by Engineer in charge.

(r) Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, and where nothing has been specifically mentioned in these documents, the manufacturer's instructions shall be followed in that case.

(s) The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Engineer / Employer

(t) Upon completion of the work and before issuance of certificate of virtual completion the contractor shall submit to the Engineer of the Employer four sets of layout drawings in progressive manner for individual systems drawn at approved scale, indicating the complete wiring system as installed.

(u) Drawings shall be prepared on AUTO-CAD (latest version). Along withthe hard copies, the contractor shall submit copies of all drawings on a CD. These drawings must provide:

a. Substation equipment layout & all power distribution panel layout.
b. Single line power distribution diagram including control wiring for DG sets.
c. Cable Trays with number and size of cables installed
d. Run and size of conduits, junction and pull boxes.
e. Raceways and Junction Boxes.
f. Number and size of conductors in each conduit with phase identification
g. Location and rating of sockets and switches controlling the lighting and poweroutlets.
h. Location and details of distribution boards/panels, mains, switches along with phasebalancing details
i. A complete wiring diagram as installed and single line diagrams showing all connectionsin the complete electrical system.
j. Location of all earthing stations, route and size of all earthing conductor's manhole
k. Layout and particulars of all HT/LT cables
l. Instruction, maintenance and Operation manuals including maintenance schedule for allequipment. Testing & commissioningreports of all electrical equipment

(v) The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, all transport for labour and materials and plants necessary for the proper execution and completion of the work to the satisfaction of the Engineer / Employer.

(w) The cost of constructing pillars, platforms for temporary works is also to be borne by the Contractor.

# Annexure – D

## Scope of Works for Car Parking Management System and Instrumentation

### 1. ICT Intervention in MLCP

The objective of Smart Parking is to provide a seamless, efficient, citizen - friendly, cost-effective parking operation for Patna City. The proposed SmartParking Management system will involve:

- Installation of Parking sensors as required for the MLCP parking system
- Installation of CCTV, ANPR cameras ad 24X7 monitoring for entire parking area.
- Display of parking availability on entry.
- Real time update of entry & exit of vehicle in the local & centralized system.
- Real time update of parking violations.
- Data for analysing and understanding the demand of parking at different hours of the day.
- Indicative KPIs for Smart Parking.
- Payment collection reconciliation and analysis.
- Trend analysis which shall facilitate better urban planning.
- Integration with BUIDCO Integrated Command and Control Centre and Real timemonitoring.
- Parking Management System software shall be customized taking into account the daily payment received and compilation of data as per requirement of BUIDCO / MCF.
- Provision of Data back-up for 5 years, agency shall make arrangement for the said dataand provide it to BUIDCO / MCF.

- Bidder provide the parking management system along with the required hardware in terms of server and POS machines. Server along with requisite software including operating system, anti-virus etc., to be deployed on premises (on site). The application tobe integrated with BUIDCO – ICCC to get real time information. All the connectivity parameters to be taken care by bidder.

### 2. Components for Mechanized Smart Parking Management Systems

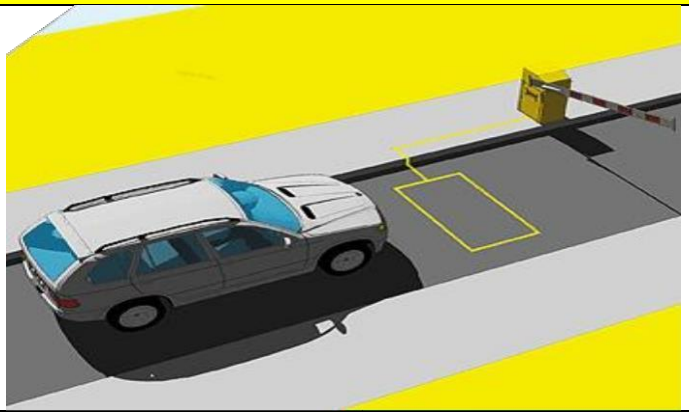
Various components of the project, including the expected usage and description are discussed in this section like Automatic Boom Barriers, parking columns, security cameras, handheld ticketing devices, advance booking feature of parking facility, map-based guidance system and LED signage.

Below are detailed descriptions of the components involved in Smart Parking Management System selected for mechanized parking lots.

**Entry / Exit boom Barrier Gate** - Entry/Exit Boom barrier gate with loop detection shall be used for entry and exit to the Parking Lot. These allow entry / exit based upon the information loggedin the scanner installed in the Parking Column nearby.

| **Automated Boom Barriers** | |
|---|---|
| Boom barriers have 10 million open/close cycles<br>These come along with loop detectors for safety and security<br>No. of open/close events, loop trigger time etc. are available for analysis and auditing The open/close times are configurable forthe barriers (0.9 sec, 1.5 sec or 3 sec etc.)<br>Completely maintenance free, No AMC required |  |

**Loop Detectors:** These magnetic loops are used to detect presence of vehicles and safely operate boom barriers.

| **Loop Detector** | |
|---|---|
| Connected to a ground induction coil with two relay outputs, a loop detector is used to detect the presence of vehicles to safely operate boom barriers |  |

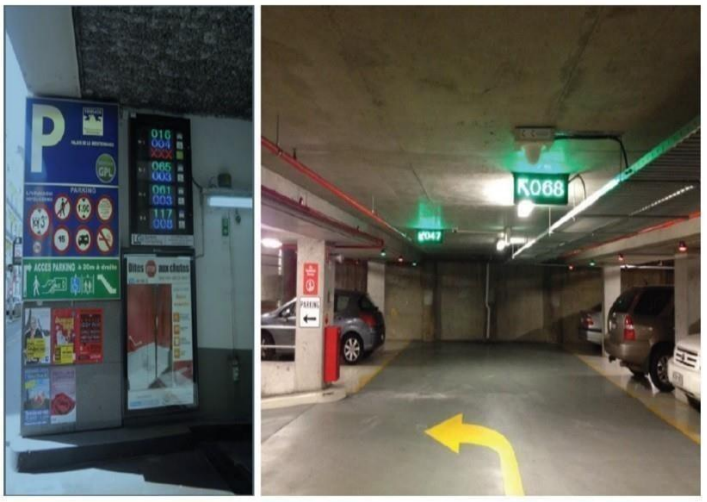
**Data Collector:** This device shall integrate with the Parking Availability LED Displays and Programmable Logic Controllers (PLC's) of the mechanized parking solution and collect the availability information and push it to the LED Displays which will be installed at each and every entrance and intersection of the parking lot. The data collector system is also connected to internet and synchronizes data with a web-based Parking management application server.

**Parking Column based Ticket dispenser and QR/Barcode reader & writer –** This system is used for scanning mobile booked tickets, generating on-spot parking tickets and special passes for frequent/staff persons. It is also integrated with the parking boom barriers for automated operation after verification of tickets.

| **ENTRY / EXIT Parking Column** | |
|---|---|
| The parking columns can dispense parking tickets to gain access to the parking lots. These also have option for contactless card readers, or option to enter/leave without stopping if the window shield tag is read by the external long-range reader. Typically, the Entry/Exit Station is coupled with a Barrier Gate, Loop Detector, and optional devices, depending on the site requirements. |  |

**Handheld Ticket Dispenser**-The Handheld devices are used for issuance of spot tickets, validation and also for monitoring the online pre-booked transaction with printer and scanner. The Machine shall also be able to access Debit/Credit/Smart Card transactions.

**Parking Availability Displays –** These displays are used for displaying the parking occupancy level and navigational aids at entry points to a mechanized parking lot.

| Parking Inventory | |
|---|---|
| **LED Display System** That Real Time Vehicle Inventory system calculates the parking bays automatically at the time of Vehicle Entry and Exit andshow the number of parking slots that are free at the entry for allowing vehicles inside. |  |

**CCTV Cameras –** CCTV cameras along with ANPR functionality shall be there at the entry /exit points

**Centralized web-based Parking Management Software:**

Helps to provide real-time information to operators along with historical and analytical reports on parking lot and provides web-based administration and management of functions like pricing, policies etc. related to the parking lot.

**On Premise Software Platform**

- Gives real-time vehicle count, number of transactions and revenue generated
- Allows the operator to change the parking tariff at any time (Dynamic pricing)
- Provides a Map View, which shows the entire parking lot's floor plan mapped with real timeparking status
- The software also lets the operator control the LEDs. The LEDs can be shut selective during non-peak hours thereby reducing power consumption.
- Key analytics with regards to revenue (wherever applicable) and traffic could be generated basedon data stored on the cloud server

**General Obligation and Requirements of ICT**

(a) The Contractor shall supply, install, configure, test, commission, provide training for all required ICT hardware such as boom barriers, handheld ticketing device devices, parking columns, IP surveillance cameras, parking availability displays, computer, printer network equipment, Data collection units etc. as per Bill of Material at the parking lots.

(b) The Contractor shall supply, install, configure, test, commission, and provide training for web- based parking management software. The web-based parking management software shall providereal time operations management including pricing management and availability information, payment gateway integration, provide mobile application API and analytics of different trends based on specific time, specific area, vehicle, usage and parking demand etc. for the purpose of better management of parking lots.

(c) The Contractor shall ensure complete integration of the ICT solution components with the mechanized parking solutions like Car parking, parking system etc. to display parking availability information, revenue management and optimization functions of the parking lot.

(d) The Contractor shall enable unique identification of each vehicle entering any of the parking lots through bar coded tickets/ QR Coded entry etc. as applicable and ensure collection of parking revenue meets all policies and guidelines of Bihar Urban Infrastructure Development Corporation Limited (BUIDCo)

(e) The Contractor shall provide training and capacity building along with complete training documentation, copies of the original licences/make product licences /hardware licences/ software licences to parking operator/BUIDCO and MCF staff as required.

(f) The Contractor shall provide AMC and Support for period of 5 years from date of Go Live of the complete system including hardware, software, network and other related subsystems.

(g) Deliverables to be completed as part of ICT Solution

| S.No. | Milestone | Deliverables |
|---|---|---|
| **1** | Team Mobilization | Team shall be mobilized as per the contract |
| **2** | Project Initiation | Detailed Survey Report including infrastructure assessment, hardware deployment plans etc.<br><br>Detailed Project Plan including Operations management, Contract management, Risk management, Information Security and Business Continuity |
| **3** | Supply, installation, Configuration, testing and commissioning of Smart Parking | Delivery Report, inspection reports Site Completion/readiness Report Software Licenses<br>Acceptance /Go Live Certificate from purchaser/authorized entity |
| **4** | Training and CapacityBuilding | Transfer of Training Documentation and Imparting training for operation of equipment and software installed at the Parking Lots to Parking Operators, BUIDCO and MCP |
| **5** | Annual Maintenance Contracts & Support | AMC and Support shall be provided annually for period of 5 years for all equipment's supplied out of which two years shall be defect liability period where cost of replacement of hardware and software shall be completely borne by Contractor. |

# Annexure – E

## Scope of Works for Operation & Maintenance

**1. General:**

i. Operation & Maintenance of whole Facility for Five (5) years after the date of issue of completion certificate including the defect liability period of one year. However, during defect liability period, the cost of Operation (Operational manpower namely operators, watch and ward, traffic regulators,health and safety, lubricants for DG sets, or any other requirement to Operatethe system 24x7 shall be borne by the contractor.

ii. The necessary fixtures and furniture required for Contractor's office during O&M period shall be provided by the Contractor at no extra cost and shall remain property of the BUIDCO.

iii. Operation and Maintenance of the Car Parking Systems and maintenance for all the assets and mechanism installed for Electrical Systems, Plumbing, Fire Prevention Systems, Fire Fighting Systems, and the Civil Building (Office block) will bein the scope of work of the contractor.

iv. **The Cost of Operation & Maintenance for five (5) years** shall be borne bythe contractor.

v. All the defective parts will have to be replaced, to an extent, whereby they cannot be repaired during the whole O&M Period.

vi. The maintenance for all the equipment's 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 O&M Period.

vii. Operation and Maintenance instruction manuals must be provided by the contractor in 6 sets of hard copy and a soft copy to the Engineer / Employer along with the list of all spare parts to be stored at site for effective maintenance of the entire systems during the defect liability period and during the maintenance contract.

viii. The contractor must ensure that he also submits a separate list of the spare parts to be imported and these spare parts must be stored at site immediately after the commissioning of the parking systems.

ix. The contractor must maintain at least 5 sets of spare parts for those equipment's which are utilized for safety in fully automatic car parking systems.

x. The contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufactures. Adequate stock of such spares is to be maintained by the contractor. Test certificate of the manufacturer for all major equipment including bearings will be submitted by the Contractor to BUIDCO/MCF.

xi. If any material brought upon the site of works or to the places where Operations have been or are being carried out in connection with or for the purpose of the works, be in the judgment of the BUIDCO/MCF, of an inferior or improper description or improper be used in the works, the said materials or workmanship shall where required by the said officer be removed or amended by the contractor forthwith or within such period for every breach by the contractor in this clause, the BUIDCO/MCF is authorized to remove or cause to be removed the materials and workmanship so objected to or any part thereof and replace the same with such other materials and workmanshipas shall be satisfactory to BUIDCO/MCF.

xii. The Contractor should make sure that all the equipment to be replaced at site during the defect liability period and during the comprehensive maintenance period reach the site in proper packaging, without any mishandling and the details of which must be given to the BUIDCO/MCF every month in his report.

xiii. The Electricity, Water charges and SIM recurring charges (if any) during O&M period shall be borne by BUIDCO/MCF. In case of power failure, the DG sets shall be operated and cost on account of fuel for these DG sets shall be borne by Contractor.

xiv. The contractor must provide adequate labour, materials, tools and equipment during Operation and maintenance period.

xv. The car parking systems and equipment covered under the above contract shall be promptly attended by the contractor including any 'Trouble Shooting'to ensure smooth and trouble-free Operation.

xvi. Regular drills (at least once in a month) will be carried out by the contractor to check the quality of all the equipment during Operation and maintenance period. The report of the same shall be given to the BUIDCO/MCF after every quarter.

xvii. The contractor has to make sure that proper fire extinguishers are used to cover any kind of fire during any mishap within the total boundary area including machineries. The expiry period of refills of various fire extinguishers should be watched and maintained during the period of contract.

xviii. The Contractor must be responsible for the regular maintenance of the created facility as described in the supplied manual.

xix. The Contractor will provide the technical support if required after the completion of O & M period also even in case of obsoletion of technology minimum for 10 years.

xx. During O&M period, the Contractor will also regularly maintain all constructed structures. During this period, the daily cleaning and maintenance of site premises shall be arranged by the Contractor at no additional cost.

xxi. In case of battery-Operated auto system panels and also system alarm etc., batteries are required to be maintained and replaced as and when needed by the contractor at no extra cost.

xxii. POL (Petrol/Diesel Oil & Lubricants) has to be arranged by the contractor as and when needed as per manufactures recommendations for periodical maintenance of entire system.

xxiii. The Contractor shall program inspection/monitoring of the project facility for its good upkeepand smooth Operations.

The inspection/monitoring shall be covering all the elements of Project facility including buildingstructure, electrical and mechanical systems, signboards, service standards etc.

xxiv. In case of major repair due to normal wear and tear/break down, the contractor should bring the same to the notice of the BUIDCO/MCF immediately and necessary measures for its repair should be taken simultaneously. Breakdown, all repairs of any kind are to be attended by the contractor.

xxv. The Contractor shall also take care for the on-site personal training of its employees for the emergency Operations.

xxvi. The Contractor shall maintain log book of planned and reactive maintenance.

xxvii. Any loss or theft to the equipment in the store room will be totally theresponsibility of the contractor.

xxviii. The contractor shall not remove/shift any equipment/machinery even temporarily without written permission of the BUIDCO/MCF or authorized representative.

xxix. The Contractor shall attend immediately to all the complaints with reference to O&M of the entire system.

xxx. BUIDCO/MCF will be at liberty to post its staff for surveillance/ inspection atthe Facility along with access to all units, control room and records, log books, MIS (Management Information system), data etc. round the clock as required. The logbooks and other records shall be properly maintained and any cutting should be attested by the staff from authorized employer officials and this record shall be open for further inspection / checking by BUIDCO/MCFfor further action/improvements/rectifications. All the equipment, building land etc., shall remain the property of BUIDCO/MCF.

**2. Staffing**

i. The contractor in each shift of Operation must provide minimum number of qualified employees as mentioned in the indicative list of Personnel Requirements for Operation and Maintenance. However, a tentative list of actual number of employees required for O&M services shall be provided by the Contractor during the preparatory period. The list of actual number of employees required for O&M services shall be

finalized after submission of O&M Manuals.

ii. In addition, the contractor will provide unskilled personnel during O&M of the facilities as per requirements.

iii. The O&M shall be carried out on a 24x7 basis, without intermission and the staff deployed by thecontractor shall be in accordance with this contract.

iv. The staff in each shift shall record their attendance electronically operated biometric system. The contractor shall provide to his staff all necessary superintendence during the O&M.

v. Such superintendence shall be given by a competent person having adequate knowledge of the Operation and Maintenance to be carried out (including themethods and techniques required), the hazards likely to be encountered and

methods of preventing accident as may be required for the satisfactoryworking of the entire Facility.

vi. The contractor shall ensure that the staff employed takes all necessary precautions while carrying out the work either in shift duties or any general shift.

vii. The staff engaged shall wear common uniform with name plate indicating name and designation during duty hours.

viii. Any dispute among the contractor's staff shall be resolved by the Contractor and in no way shall BUIDCO/MCF be responsible for the disputes between them.

ix. The contractor shall follow the rules and regulations as per Labour Act / Factory Act, as applicable.

x. The contractor shall give his telephone no., contact addresses, etc. to the BUIDCO/MCF as well as shift duty staff to contact him during emergency/odd hours etc.

**Indicative list of staffs for Operation and Maintenance**

| S.No. | Position | No |
|---|---|---|
| 1 | Technician / Maintenance Engineer / Supervisor (per shift) | 1 |
| 2 | Operator (per shift) | 2 |
| 3 | Multi-purpose (Revenue / Data Handler) (per Shift) | 1 |
| 4 | Guards (For night shift only) | 1 |

xi. This list is indicative only; The contractor may increase the manpower as per the requirement/situation at the parking facility without charging anything extra to the BUIDCO/MCF.

xii. MLCP will be operational for 24x7.

xiii. Cleaning of MLCP area is also under the O & M scope of bidder including consumables for the same.

**3. Safety/Security**

i. The contractor shall take all safety precautions under various Acts/Rules, under central/State Govt.

ii. The contractor shall from time to time ensure compliance with all safety precautions underlined under various Acts/ Rules and he shall be responsible for safety of its staff and the consequences thereof.

iii. The contractor shall deploy round the clock Watch and ward staff - security personnel at entranceof the premises and in the compound for the safety of the Facility during the O&M period.

iv. The contractor shall be completely responsible for the safety of the entire car parking area, all its equipment and all other electrical, Ventilation and mechanical components and all his personnel during this period.

v. The care of the whole of the car parking area shall remain with the contractor who shall be responsible for all accidents or damages due to causes attributable to him.

vi. Adequate safety precautions against fire, flooding, lightening, electrical shocks, accident due to moving/non- moving heavy/light equipment shall be strictly observed by the contractor at his own cost.

vii. Suitable safety measures like gumboots, gloves, safety belts, ladders, safety lamps, gas masks, insulated tools, alarms etc. shall be provided by the contractor.

viii. Necessary medical first aid kit shall be made available at all times.

ix. In absence of observance of above safety precautions, the contractor shall be responsible for any unforeseen loss of the equipment or persons dealing with it.

x. In case of any injury / loss to the workmen / plant and equipment, the contractor shall inform employer immediately within 12 hrs of the occurrence of the event. The facilities will be open to local/ state/ central agencies for verification of safety/ emission/ acts compliance.

xi. During night hours, the main entrance should be closed. However, shift duty staff should be alert and open the road during surprise checking of BUIDCO/ MCF staff or any other Government Authorities or its nominees

xii. Only bonafide persons will be allowed in the premises, being a prohibited area. Smoking and drinking are strictly prohibited in the premises.

**4. Reporting**

i. The Contractor will prepare monthly reports and quarterly reports and submit the same to the BUIDCO/MCF. The reports shall contain, inter-alia, the following:

i. A description of the maintenance work carried out in the reporting period. A report on major failures, if any, their causes and remedial actions taken.

ii. List of spare parts consumed in the reporting period from the store room.

iii. Any change in inventory of the material in the store room with additions and subtractions shown at the end of the reporting period.

iv. O&M staff deployed by the contractor during the reporting period.

v. Any major repair works, if any.

ii. BUIDCO/ MCF will be at liberty to post its staff for surveillance/ inspection at the Facility along with access to all units, control room and records, log books, MIS (Management Information system), data etc. round the clock as required. The logbooks and other records shall be properly maintained and any cutting should be attested by the staff from authorized employer Officials and this record shall be open for further inspection/checking by BUIDCO/ MCP for further action/improvements/rectifications.

iii. The BUIDCO/ MCP reserves the right to carry out any work including capital works in the created Facility for improvement of the performance of the system. The contractor shall not obstruct/ create hindrance to any such work/works by BUIDCO/ MCP or its authorized agencies.

iv. All the equipment, building land etc. shall remain the property of BUIDCO/ MCF

**5. Facility Visits**

i. At any time or at the end of each twelve-month period, or at the initiative of the BUIDCO/MCF, a Visit shall be organized so that both parties can check the condition of the installations at the facility.

ii. A report shall be drawn up to record the opinions of the both parties. The BUIDCO/MCP reserves the right to call the equipment manufacturers or specialized technicians for these visits. All expenses are to be borne by the contractor for these purposes.

## 6. Training

The Contractor shall plan and develop the course content, and implement on-the-job and classroom based training, for BUIDCO/ MCP deputed staff of at least

15personnel in 3 batches of 5 personnel each, during last 6 months of the Operation & Maintenance period. The Contractor shall organize training for identified managers from amongst the BUIDCO/ MCP deputed staff in technical aspects of fully automatic car parking systems to enable BUIDCO/ MCP to build sufficient capacity and skills to manage **t**he said car parking systems at a later date if required.

This training would include training in overhauling and replacement of various components of Automatic Car Parking Systems, Electrical Systems, Plumbing, Ventilation, Fire Prevention Systems, Fire Fighting Systems, and expertise in Maintenance of the entire Office block.

| **Indicative Parking Maintenance Schedule** | | | |
|---|---|---|---|
| **SL No** | **Description** | **Process** | **Frequency** |
| 1 | Sensor Check | General Check | Every day |
| 2 | Software Status Check | General Check | Every day |
| 3 | Gear Motors | Oil Level inspection and oil top up if required | Every 6 month |
| | | Oil Change | Every 10,000 Working Hours |
| | | Bearing Inspection / Electrical Terminal inspection | Every 2 Years |
| 4 | Bearings | General Inspection | Every Week |
| | | Bearing Change | Every 2 Years |
| 5 | Drives | General Inspection | Every 6 month |
| 6 | MCBS / Electrical Equipment | General Inspection | Every 6 month |
| | | Replacement | If required in general inspection |
| 7 | Hydraulic Equipment | General Inspection | Every month |
| | | Replacement of Oil seals | Every 5 year |
| 8 | Flexible Electrical/control Cables | General Inspection | Every month |
| | | Replacement | Every year |
| 9 | Static (fixed) Electrical/control Cables | General Inspection | Every 6 month |
| | | Replacement | Every 10 years |
| 10 | Wire ropes / Chain | General Inspection | Every month |
| | | Replacement | Every 3 years |
| | | General (Visual) Inspection | Every 6 month |

| | | | |
|---|---|---|---|
| 11 | Steel Platforms | Painting / Maintenance | If required in general inspection |
| 12 | HMI Device | General (Visual) Inspection | Every 6 month |
| | | Replacement | Every 10 Year |
| 13 | Smart Cards | General Inspection | Every Six Months |
| 14 | Rubberised wheels | General Inspection | Every week |
| | | Resoling | Every Year |

**Note:** This is an indicative preventive maintenance schedule however, contractor will get approved the preventive maintenance schedule from BUIDCO before commencement of O & M.

## SPECIFICATIONS

**Civil and Steel Components including Sanitary & Plumbing works, Drainage & Sewage Works.**

i. All Civil Works, including Sanitary & Plumbing, Drainage & Sewage shall be executed as per CPWD Specifications and relevant latest IS codes.
ii. The building block shall be designed as in Seismic Zone – IV.
iii. The RCC Work shall be executed as per approved Drawings and Designs. The loading willconform to the standards as follows:
    **a.** Dead load for all permanent structures: IS 875 (Part 1) Live load: IS 875 (All 5 Parts)
    **b.** Seismic load: IS 1893
    **c.** Floor load other than car parking levels (unless required higher otherwise): 200kg/m2
    **d.** Staircase load: 400 kg/m2
    **e.** Floor load for car parking areas: 400 kg/m2 (or at actual with safety factor,whichever is higher)
iv. Due to nature of application, the structure will be subjected to dynamic loading. The structures shall be designed for adequate rigidity and stability in all directions apart from dead and superimposed loads.
v. Road Work shall be executed as per MORTH Specifications.

**Finishing Items of buildings:**

**A. INTERIOR FINISHES:**

**(b) Ceiling and Walls:**

The walls of the Ground floor and all the walls of other floors shall be plastered in Cement MortarMix 1:4 and the ceiling of G.F. shall be finished in Cement Mortar 1:3 finished with neat cement punning both on walls as well as on ceiling.

The interior (walls & ceiling) of all Car Parking levels except Ground Floor Level of Car Parking Building shall be provided with a coat of grey cement wash.

The interior of Ground Floor Level including Control Room, Server Room, D.G. Set / Battery Room (Area excluding Tiled Portion) and Machine Rooms of Car Parking Building shall be finished with Oil Bound Washable Distemper of approved Shade & Make with Cement Primer over two coats of Cement based putty.

**(c) Flooring:**

The flooring of Ground Level and Approach Roads shall be of Cement Concrete Pavement whichshall be designed to carry out the impact load of the vehicles.

The flooring for Control Room, Server Room, etc. shall be finished with 600 x 600 mm Vitrified Tiles of approved Shade & Make over 20 mm thick Cement Mortar of Mix 1:4 as per IS: 15622.

The flooring of D.G. Set/ Battery Room shall be finished with 10 mm thick Acid Resistant Tiles of approved Shade and Make as per IS: 4457. The Side walls shall also be finished with Acid Resistant Tiles of approved Shade & Make up to 1.50 m height as per IS: 13753.

The Footpaths/ Pathways shall be finished with Cement Concrete Inter-locking tiles, minimum 65 mmthick, of approved Shade & Make over a bed of 150 mm thick sand.

## A. EXTERIOR FINISHES:

The elevation in the entire area –, The elevation in the entire area –shall be provided with semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels,

BUIDCO logo of is to be fixed on front elevation of the building. Dimension and design of logo will be as per approval of EIC.

The Exterior of Control Room, Server Room, D.G. Set/ Battery Room, etc. shall plastered with Cement Mortar Mix 1:4. The exterior walls of this office block shall be finished with exterior Weather Coat Paint of approved Shade & Make overexterior cement primer as per relevant specifications.

### (a) Doors & Windows:

The required No. of Doors & Windows of Control Room, Server Room, etc. shall be of Powder Coated Aluminum Sections of 3 mm thickness as per relevant specifications and as approved by the Engineer/ Employer. The door shutters shall be partly paneled and partly glazed with toughened glass of minimum 6 mm thickness. The paneling shall be provided with both sides pre- laminated board of 12 mm thickness. All hardware fixtures shall be of approved make.

Fully paneled PVC doors with frames shall be fixed in Bathrooms. The windows/ ventilators shall be of Powder Coated Aluminum Sections of 3 mm thickness as per relevant specifications and as approved by the Engineer/ Employer. The glass panes of windows/ ventilators shall be provided with toughened glass of minimum 6 mm thickness.

M.S. Rolling Shutter shall be provided in D.G. Set/ Battery Room. The windows/ ventilators in these rooms shall be of shall be Powder Coated Aluminum Sections of 3 mm thickness as per relevant specifications and as approved by the Engineer / Employer.

### (b) Water Proofing:

Top Floor Roof Slabs of all the Buildings shall be finished with proper treatment of Water Proofing of approved specifications with either of the brands namely FOSROC/ CICO/ TEXAS through their authorized applicators only.

### (c) Pipes and Specials:

Water pipe lines with clamps and specials etc. shall be described by their diameter and length measured in running **m** inclusive of joints.

If the joints, special and fittings etc. are required to be separated, it shall be so stated and enumerated. Transporting of useful material such as pipes, valves, steel items to the Stores of respective departments or as directed by the Engineer/ Employer.

## CARRIAGE OF MATERIALS:

**(a) Scope**

This Specification covers the general requirements for carriage of materials.

**(b) General**

The carriage and stacking of materials shall be done as directed by the Engineer. Any tools and plants required for the work shall be arranged by the Contractor. The pipes and specials shall be carried from manufacturer works/ agency/ supplier to the site of work.

**(c) Responsibility for Loss or Damage**

Loading, carriage, unloading and stacking shall be done carefully to avoid loss or damage to the materials.

**(d) Mode of Carriage**

Depending upon the feasibility and economy, the Engineer shall determine the mode of carriage viz. whether by mechanical or manual labor.

**(e) Stacking, Covering and Protection**

Material shall be stacked in such a manner as to ensure the preservation of their quality and fineness for the work.

Different types of materials shall be stacked separately and in such a way that counting and measurements can be done without disturbing the stacks. Any material that is liable to be affected by rain or other adverse weather conditions shall be covered and protected properly against the same.

Earth, dismantled materials, malba and other similar materials shall be stacked as directed by the Engineer.

Cement bags, steel bars, structural steel sections, bricks and timber and other similar materials shall bestacked in proper manner.

Pipes of, D.I., / D.I. Fittings, HDPE pipes, valves etc. Shall be stacked as permanufacturers/suppliers ‘instructions or as directed by the Engineer.

Stone metal, sand and such similar materials shall be stacked as directed by the Engineer.

## SHORING:

Earthwork in cutting shall be retained by designed Steel Shoring as per relevant code.

If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope. Removal of the slipped earth will not be paid for if the slips are due to the negligence of Contractor. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the excavated area subsequently, such slides shall be removed.

## PRESERVATION OF PROPERTY:

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction Operations and which, in theopinion of the Engineer, shall be continued in use without any changes. Safety measures taken by the Contractor in this respect, shall be got approved from the Engineer. However, if any of these objects is damaged by reason of the Contractor’s

negligence, it shall be replaced or restored to the original condition at his expense. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the Contractor to replace / restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement / restoration directly through any other agency at the risk and cost of the Contractor after issuing a prior notice to the effect.

**WORKS TO BE KEPT FREE OF WATER:**

The Contractor shall arrange for the rapid dispersal of water collected / accumulated on the earthwork or completed formation during construction or on the existing roadway or which enters the earthwork or any other item of work from any source, and where practicable, the water shall be discharged into the permanent outfall of the drainage system. The arrangement shall be made in respect of all earth work including excavation for pipe trenches, foundations or cuttings.

The Contractor shall provide, where necessary, temporary water courses, ditches, drains, pumping or other means for maintaining the earthwork free from water. Such provisions shall include carrying out the work of forming the cut sections and embankments in such manner that their surfaces have at all times a sufficient minimum cross-fall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

The works involved in keeping the earthwork or any other item of works free of water shall be deemed as incidental to the respective item of work.

**MATERIALS:**

**(a) Scope**

Materials to be used in the work shall conform to the specifications mentioned on the drawings, the requirements laid down in this section and specifications for relevant items of work covered under these specifications.

If any material, not covered in these specifications, is required to be used in the work, it shall conform to relevant Indian Standards or international standards (in the absence of Indian standards) or to the requirements specified by the Engineer.

**(b) Sources of Material**

The contractor shall notify the Engineer of his proposed sources of materials prior to delivery. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any other source proves unacceptable at any time, the contractor shall furnish acceptable material from other sources at his own expense.

**(c) Bricks**

Burnt clay bricks shall conform to the requirement of IS: 1077, except that the minimum compressive strength when tested flat shall not be less than 7.5 MPa for individual brick. They shall be free from cracks and flaws and nodules of free lime. The brick shall have smooth rectangular faces with sharp corners and emit a clear ringing sound when struck. The size may be according to local practice with atolerance of ± 5 per cent.

**(d) Cement**

Cement to be used in the works shall be any of the following types with the prior approval of the Engineer. These have to be procured from reputed ISO: 9000 organizations: Ordinary Portland Cement, 43 Grade, conforming to IS: 12269

Rapid Hardening Portland Cement,

conforming to IS: 8041.Portland slag

cement, 53 Grade conforming to IS:

455.

Pozzolana Portland Cement (PCC) conforming to IS: 1489.

Cement conforming to IS: 8041 shall be used only for precast concrete products after specificapproval of the Engineer.

**(e) Coarse Aggregates**

For plain and reinforced cement concrete (PCC and RCC) or works, coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or granite or other approved inert material. They shall not consist pieces of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the steel reinforcement. Coarse aggregate having positive alkali silica reaction shall not be used. All coarse aggregates shall conform to IS:383 and tests for conformity shall be carried out as per IS: 2386 Parts I to VIII.

The contractor shall submit for the approval of the Engineer, the entire information indicated in appendix-A of IS: 383.

Nominal size of coarse aggregate for various components in PCC & RCC is mentioned in BOQ. In case of discrepancy the decision of the Engineer is final.
The maximum value for flakiness index for coarse aggregate shall not exceed 35 percent. The coarse aggregate shall satisfy the following requirements of grading:

| **IS Sieve Size** | **Percent by Weight Passing the Sieve** | | |
|---|---|---|---|
| | **40 mm** | **20 mm** | **12.5 mm** |
| 63 mm | 100 | - | - |
| 40 mm | 95-100 | 100 | - |
| 20 mm | 30-70 | 95-100 | 100 |
| 12.5 mm | - | - | 90-100 |
| 10 mm | 10-35 | 25-55 | 40-85 |
| 4.75 mm | 0-5 | 0-10 | 0-10 |

**(f) Sand/Fine Aggregates**

For masonry work, sand shall conform to the requirements of IS: 2116.

For plain and reinforced cement concrete (PCC and RCC) works, fine aggregate shall consist of a suitable combination of natural sand. They shall not contain dust, lumps, soft or flaky, materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of theconcrete, or to attack the embedded steel. Sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregate shall conform to IS: 383 and test for conformity shall be carried out as per IS: 2386 (Part I to VIII). The contractor shall submit to the Engineer the entire information indicated in Appendix A ofIS: 383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor than 3.5.

Sand/fine aggregate for structural concrete shall conform to the following grading requirement

| **IS Sieve Size** | **Percent by Weight Passing the Sieve** | | |
|---|---|---|---|
| | **Zone I** | **Zone II** | **Zone III** |
| 10 mm | 100 | 100 | 100 |

| | | | |
|---|---|---|---|
| 4.75 mm | 90-100 | 90-100 | 90-100 |
| 2.36 mm | 60-95 | 75-100 | 85-100 |
| 1.18 mm | 30-70 | 55-90 | 75-100 |
| 600 micron | 15-34 | 35-59 | 60-79 |
| 300 micron | 5-20 | 8-10 | 12-40 |
| 150 micron | 0-10 | 0-10 | 0-10 |

**(g) Steel Reinforcement:**

For reinforced cement concrete (RCC) works, the reinforcement / un tensioned steel as the case may be shall consist of the following grades of reinforcing bars:

| **Grade Designation** | **Bar type conforming to governing IS specification** | **Characteristic strength MPa** | **Elastic Modulus** |
|---|---|---|---|
| Fe 500 D | IS: 1786 High Yield Strength Deformed Bars | 500 | 200 |

All steel shall be procured from original producers, or their authorized re-rollers.

Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

Utmost care should be taken so that bars are not damaged during handling and transportation. Structural Steel:
Unless otherwise permitted herein, all structural steel shall before fabrication comply with the requirement of the following Indian Standards:

| | |
|---|---|
| IS: 226 | Structural Steel (Standard Quality) |
| IS: 2062 | Wieldable Structural Steel |
| IS: 1730 | Dimension for Steel Plate, sheet and strip for structural and general engineering purposes |
| IS: 1731 | Dimension for Steel flats for structural and general engineering purposes |

IS: 1731 Dimension for Steel flats for structural and general engineering purposes

The use of structural steel not covered by the above standards may be permitted with the specific approval of the Engineer.

**(h) Bitumen**

The bitumen shall be paving bitumen of Viscosity Grade VG-30 (60/70) as per Indian Standard Specifications for "Paving Bitumen" IS: 73. Guidance to selection of the grade of bitumen may be taken from Appendix 4 of MORTH Specifications for Roads and Bridge Works (IV Revision).

**(i) Water**

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete.

**(j) Concrete Admixtures**

General:

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more of the properties of concrete in the plastic or hardened state.

Concrete admixtures are proprietary items of manufacture and shall be obtained only from established manufacturers with proven track record, quality assurance and full-fledged laboratory facilities for the manufacture and testing of concrete.

The Contractor shall provide the following information concerning each admixture after obtaining the same from the manufacturer:

i. Normal dosage and detrimental effects, it any, of under dosage and over dosage.
ii. The chemical names of the main ingredients in the admixtures.
iii. The chloride content, if any, expressed as a percentage by weight of the admixture.
iv. Values of dry material content, ash content and relative density of the admixture which can be used for Uniformity Tests.
v. Whether or not the admixture leads to the entertainment of air when used as per the manufacturer's recommended dosage and it so to whatextent.
vi. Where two or more admixtures are proposed to be used in any one mix, confirmation as to their compatibility.
vii. There would be no increase in risk of corrosion of the reinforcement or other embedment's as result of using the admixture.

Physical and Chemical Requirements:

Admixtures shall conform to the requirements of IS: 9103. In addition, the following conditions shall be satisfied:

i. Synthetic fiber (Polyester 12mm Recrown 3S) triangular; admixtures shall be added in all concrete works.
ii. "Plasticizers", "Super - Plasticizers" shall meet the requirements indicated for "Water reducing Admixture".
iii. Except where resistance to freezing and thawing and to disruptive action of deicing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS: 1199 shall not be more than 2 per cent higher than that of the corresponding control mix and in any case not more than 3 per cent of the test mix.
iv. The chloride content of the admixture shall not exceed 0.2 per cent when tested in accordance with IS: 6925. In addition, the maximum permissible limit of chloride content of all the constituents (not to exceed 1.5% of the weight of cement in each batch of concrete) shall also be observed.
v. Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch at different times.

The tests that shall be performed along with permissible variations in the same are indicated below: Dry Material Content: to be within 3 per cent and 5 per cent of liquid and solid admixturesrespectively of the value stated by the manufacturer.

Ash content: to be within 1 per cent of the value stated by the manufacturer.

Relative density (for liquid admixtures): to be within 2 percent of the value stated by the manufacturer.

All tests relating to the concrete admixtures shall be conducted periodically at an independent laboratory and compared with the date given by the manufacturer.

**Storage of Materials:**

**(a) General**

All materials may be stored at proper places so as to prevent their deterioration or intrusion by foreign matter and to ensure their satisfactory quality and fitness for the work. The storage space must also permit easy inspection, removal and re-storage of the materials. All such materials even though stored in approved good-owns /places, must be subjected to acceptance test prior to their immediate use.

**(b) Bricks**

Bricks shall not be dumped at site. They shall be stacked in regular tiers as they are unloaded, to minimize breakage and defacement. The supply of bricks shall be available at site at any time. Bricks selected for use in different situations shall be stacked separately.

**(c) Aggregates**

Aggregate stockpiles may be made on ground that is denuded of vegetation, is hard and well drainedIf necessary, the ground shall be covered with 50 mm plank or brick flat soling. Coarse aggregates shall be delivered to the site in separate sizes agreed by the Engineer in writing.

In the case of fine aggregates, these shall be deposited at the mixing site not less than 8 hours before use and shall have been tested and approved by the Engineer.

**(d) Cement**

Cement shall be transported, handled and stored on the site in such a manner as to avoid deterioration or contamination. Cement shall be stored above ground level in perfectly dry and water-tight sheds and shall be stacked not more than eight bags high. Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirement at site and should be cleaned at least once every 3 to 4 months.

Each consignment shall be stored separately so that, it may be readily identified and inspected and cement shall be used in the sequence in which it is delivered at site. Any consignment or part of a consignment of cement which had deteriorated in any way, during storage, shall not be used in the works and shall be removed from the site by the Contractor without charge to the Employer.

The Contractor shall prepare and maintain proper records on site in respect of delivery, handling, storage and use of cement and these records shall be available for inspection by the Engineer at all times.

The Contractor shall make a monthly return to the Engineer on the date corresponding to the interim certificate date, showing the quantities of cement received and issued during the month and in stock atthe end of the month.

**(e) Reinforcement Steel**

The reinforcement bars, when delivered on the job, shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected from mechanical injury and from deterioration by exposure.

**(f) Pipes**

The pipes shall be transported and handled as per IS: 12288. All precaution set out shall be taken outto prevent damage to the protective coating, damage of the jointing surfaces or the ends of the pipes.

The pipes shall be stacked in layers on dry surface preferably on the projected bench/ surface.

All the pipe specials, rubber rings / joints, nut, bolts including valves etc. shall be stored in closed room or shed.

**(g) Mechanical Items**

All the items of mechanical required shall be stored in closed room or shed with original packing.

**(h) Mild steel (M.S) appurtenances**

Special fittings such as bends of odd size angle, flanged and socket tees, gap pieces, tail pieces, tapered flanged pipe nipple and other fittings required as per the site requirement shall be fabricated from MS pipe and steel. The special so fabricated shall be having protection coat and paint against corrosion.

**(i) Fittings and Fixtures**

All the fittings and fixtures shall be supplied and fixed as per relevant standards or as directed by the Engineer.

**(j) Water**

Water shall be stored in containers / tanks covered at top and cleaned at regular intervals in order to prevent intrusion by foreign matter or growth of organic matter. Water from shallow, muddy or marshy surface shall not be permitted. The intake pipe shall be enclosed to exclude silt, mud, grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake atall times.

**TESTS AND STANDARDS OF ACCEPTANCE:**

All materials, even though stored in an approved manner shall be subjected to an acceptance test prior to their immediate use. Independent testing of cement for every consignment shall be done by the Contractor at site or in a laboratory approved by the Engineer before use. Any cement with lower quality than those shown in manufacturer's certificate shall be debarred from use. In case of imported cement, the same series of tests shall be carried out before acceptance.

**(a) Testing and Approval of Material**

The Contractor shall furnish test certificates from the manufacturer/supplier of materials along with each batch of material(s) delivered to site. Tests shall be as specified in QA/QC Manual.

The Contractor shall set up a field laboratory as per MORTH Standard with necessary equipment for testing materials, finished products used in the construction as per requirements of conditions of contract and the relevant specifications. The testing of all the materials shall be carried out in the presence of the Engineer or his representative for whom the contractor shall make all the necessary arrangements bear the entire cost.

Tests which cannot be carried out in this field laboratory have to be got done at the contractor's cost at any recognized reputed laboratory/testing establishments approved by the Engineer.

**(b) Sampling of Materials**

Samples provided to the Engineer or his representatives for their retention are to be in labeled boxes suitable for storage. Samples required for approval and testing must be supplied well in advance by at least 48 hours or minimum period required for carrying out relevant tests to allow for testing and approval. Delay to works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the works.

If materials are brought from abroad, the cost of sampling/testing whether in India or abroad shall be borne by the Contractor.

**(c) Rejection of Materials not conforming to the Specifications**

Any stock or batch of material(s) of which sample(s) does not conform to the prescribed tests and quality shall be rejected by the Engineer and such materials shall be removed from site by the Contractor at his own cost. Such rejected materials shall not be made acceptable by any modifications.

**(d) Testing and Approval of Plant and Equipment**

All Plants and equipment used for preparing, testing and production of materials for incorporation into the permanent works shall be in accordance with manufacturer's Specifications and shall be got approved by the Engineer before use.

**OTHER SPECIFICATIONS:**

(a) Minimum one week before the actual commencement of construction, the contractor shall supply to the Architects/Structural Consultant drawings showing the general detailed arrangement for concreting (e.g. - formwork, staging, centering, bar-bending schedules, actual placing arrangement at site, sequence of concreting etc.) for approval.

(b) All materials which have been damaged, contaminated or have deteriorated or do not comply in any way with the requirements of this specification shall be removed from the site at the Contractor's own expense.

(c) The concrete mix shall be designed by recognized methods. The proportions chosen shall be such that the concrete is cohesive and of adequate workability and durability for the conditions prevailing on the work in question and can be properly compacted without segregation.

**SAFETY CODE:**

(a) First aid appliance shall be maintained in a readily accessible place including adequate supply of sterilized dressings and cotton wool.

(b) An injured person shall be taken to a public hospital without loss of time, in cases where the injury necessitates hospitalization.

(c) Suitable and strong scaffolds should be provided for work men for all works that cannot safely bedone from ground.

(d) No portable single ladder shall be over 8 meters in length. The width between the side rails shall not be less than 30 cm. (Clear) and the distance between two adjacent rung shall not be more than30 cms. When a ladder is used an extra mazdoor shall be engaged for holding the ladder.

(e) The excavated materials shall not be placed within 1.5 meters of the edge of the trench or half of the depth of trench whichever is more. All trenches and excavations shall be provided with necessary fencing and lighting.

(f) Every opening in the floor of a building or in working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.

(g) No floor, roof or other part of the structure shall be so overloaded with debris or materials as to render it unsafe.

(h) Workers employed on mixing and handling material such as asphalt, cement mortar or concrete and lime mortar shall be provided with protective footwear and rubber hand gloves.

(i) Those engaged in welding works shall be provided with welder's protective eye-shields and gloves.

(j) No point containing lead or lead products shall be used except in the form of paste or ready made paints.

(k) Suitable face marks should be supplied for use by the workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scraped.

(l) Overenrolls shall be supplied by the Contractor to the painter and

adequate facilities shall be provided to enable the working painters to wash during the periods of sensation of work.

(m) Hoisting machines and tackle used in the works, including their attachments, anchorage and supports shall be in perfect condition.

(n) The ropes used in hoisting or lowering material or as a means of suspension shall be of durable quality and adequate strength and free fromdefects.

**SPECIFICATIONS TO BE FOLLOWED BY THE CONTRACTOR FOR CAR PARKING SYSTEMS OF STEEL STRUCTURE FOR LEVELS ABOVE THE GROUND.**

**ANCHORAGE TO HARDENED CONCRETE**

a. Anchorage to hardened concrete shall include mechanical and adhesive anchors of size, number, and spacing as shown on the drawings.
b. Holes shall be drilled and cleaned and anchors shall be installed in strict accordance with the manufacturer's published instructions. Inspection and testing shall be provided in accordance with the general notes.
c. Where a specific type of anchorage is specified on the drawings, substitution for a different type of anchorage (including substituting for cast-in-place anchorage) shall not be permitted without prior written approval.

**MECHANICAL ANCHORS**

a. Acceptable mechanical anchors shall be as follows: hilti "kwik bolt tz" carbon and stainless steel expansion anchor or approved alternative.
b. Unless noted otherwise on the drawings, minimum effective anchor embedment depth shall be 6.5 anchor diameters, minimum distance to the nearest concrete edge shall be 12 anchor diameters and minimum anchor spacing shall be 8 anchor diameters.
c. Stainless steel anchors shall be used at all exterior locations and where specifically indicated on the drawings.
d. No steel Reinforcement shall be cut to install anchors. Defective or abandoned holes shall be filled with non-shrink grout or an injectable adhesive matching the adjacent concrete compressive strength.
e. Notify the structural engineer of defective or abandoned holes in walls and columns. These elements may require non- shrink grout with a compressive modulus of elasticity matching that of the adjacent concrete.

**ADHESIVE ANCHORS**

a. Acceptable adhesive (epoxy) anchors shall be as follows: Hilti "Hilte RE 500" Adhesive anchor or approved alternative. Unless noted otherwise, anchors shall be fe500d reinforcing dowels.
b. Unless noted otherwise on the drawings, minimum effective anchor embedment depth shall be 7.5 anchor diameters, minimum distance to the nearest concrete edge shall be 6 anchor diameters, and minimum anchor spacing shall be 6 anchor diameters.
c. Holes shall be drilled with rotary impact hammer or equivalent method to produce a hole with a rough inside surface. Core drilling holes is not permitted. No reinforcing shall be cut to install adhesive anchors. The adhesive shall be mixed, applied, and cured in strict accordance with the manufacturer's published installation instructions.

d. All placement and curing shall be conducted with concrete.
e. Adhesive shall be applied only to clean, dry concrete. Positive protection shall be provided so that anchors are not disturbed during the curing period.
f. Defective or abandoned holes shall be filled with non-shrink grout or an injectable adhesive matching the adjacent concrete compressive strength. Notify the structure engineer of defective or abandoned holes in walls and columns. These elements may require non-shrink grout with a compressive modulus of elasticity matching that of the adjacent concrete.

**NONSHRINK GROUT FOR BASE PLATES, SLEEVES, EMBEDDED STEEL, ANDANCHOR PLATES**

a. Grout shall be an approved non-shrink expandable cementitious grout delivered to the jobsite in factory pre-packaged containers requiring only the addition of water.
b. The minimum 28day compressive strength shall be at least 2 grades higher (m10 higher)than the supporting concrete strength, unless noted otherwise.
c. Grout shall be mixed, applied, and cured strictly in accordance with the Manufacturer's printed instructions.
d. For grouting under base plates and behind anchor plates, grout shall be proportioned as a flow able mix.
e. When a flow able mix does not provide the required strength or when a minimum strength ofM70 is required, an epoxy grout shall be used.

**TOLERANCES**

a. Standard tolerances shall be based on IS 7215 and IS 486.

**SEQUENCING CONSTRUCTION AND LATERAL STABILITY**

a. The structural components by themselves are a non-self-supporting structure.
b. Lateral forces due to wind, earthquake, or soil are carried by the roof and floor diaphragms to the lateral system. Certain elements shown on the structural drawings (such as bracing, roof and floor slabs) are required for overall or local stability of other elements (such as beams, columns, and walls).
c. If, due to sequencing of construction, these stability elements are not in place, the contractor shall investigate where temporary shoring/bracing is required and shall design this temporary shoring/bracing.
d. The contractor shall provide this shoring/bracing until the required structural elements and their connections have been installed and reach their final design strengths.

**STRUCTURAL STEEL**

a. I-sections, UBS, UCS, etc IS: 2062, E350 (Fe490)
b. All angles and channels unless noted otherwise IS: 2062, E350 (Fe490)
c. All other steel unless noted otherwise IS: 2062, E350 (Fe490)
d. Base plate/gusset plate IS: 2062, E250 (Fe410w)
e. The ratio of fy/fu <= 0.8 preferably, but in any case, fy/fu <= 0.85.
f. General notes for steel connections shall apply to all steel connections unless noted otherwise.

g. All work shall be in accordance with the Indian standards. Shop drawings shall be submitted and reviewed by the architect/engineerbefore commencing fabrication.
h. All steel anchors and ties and other members embedded in concrete or masonry shall be left unpainted.
i. Dimensional tolerance for built up members shall be as per IS 7215.
j. Gas cutting of steel is not allowed.
k. Steel beams are equally spaced between dimension points at the maximum deck span location unless noted otherwise. Minimum camber should be provided in steel beams as shown in structural drawings.
l. Shoring shall be provided to beams, where indicated in structural drawings, to support the weight of wet concrete coming from the slabs. This shoring shall be removed only after the concrete has attained about 80% of the compressive strength. The props shall be spaced at a maximum spacing of 1.2m c/c.
m. The contractor shall be responsible for the design, detailing, and fabrication of all steel framing connections unless specifically detailed on the structural drawings. The contractor shall retain a structural engineer to perform the work, who shall design the connections and submit stamped calculations to the architect / structural engineer for review and approval prior to starting fabrication.
n. Connection design shall meet the requirements of the Indian standards and BS 5950.
o. Connections shall be capable of resisting vertical and horizontal loads listed. The connections should be designed to resist 60% of shear capacity and 90% of moment capacityfor beam members, and 100% of member capacity of axially loaded members. Columns should always be spliced using complete joint penetration (CJP) welds.
p. Connection design shall provide an adequate load path to transfer the loads from each member, through the connection, into the supporting member, and shall consider the effects of the forces on each member. Provide stiffener plates, web doublet plates, flange continuity plates, etc, as required. Members shown on the drawings have not been sized for local effects at connections.
q. Steel connection details submitted by the structural engineer show general criteria for design and detailing and are not intended to show complete connection configurations or other specific information that are the responsibility of the connection design engineer/ contractor/ fabricator. If any connection distances, edge distances, pitch, weld lengths etc. On connection sketches do not match with the minimum or maximum specifications of IS 800:2007, structural engineer should be notified, and revised connection sketch should be taken in writing by contractor.
r. Alternative connection configurations may be submitted to the structural engineer for review and approval.
s. Connections specifically detailed on the structural drawings are to be fabricated as shown.
t. The contractor shall be responsible for all erection aids that include, but are not limited to, erection angles, lift holes, and other aids.

**BOLTED CONNECTIONS**

a. All bolts, nuts and washers shall confirm to section 2.4 of IS 800: 2007.
b. All bolts shall be of grade 8.8 unless noted otherwise
c. All bolt holes shall be of standard clearance bolt holes. Unless noted otherwise, oversize and slotted holes should not be provided.

d. Connections shall be a minimum of two-bolt connection using M20 bolts in single shear.
e. All high-strength bolts shall be installed, tightened, and inspected in accordance with IS 3757, IS 4000, IS 6623, and IS 6649. The criteria for slip-critical connections shall apply to all connections unless noted otherwise as snug-tight.
f. Bolts in connections of beam-to-beam/girder/column may be snug tight, unless specifically called out as slip critical (SC).
g. Where connections are noted as snug-tight, the contractor may install per the criteria for snug- tight bolts.
h. All shear type connections in columns, and connections in bracing shall be slip- critical. Slip-critical connections shall use load indicator washers or tension control bolts.
i. All bolts shall be provided with lock washers under nuts or self-locking nuts.

**STRUCTURAL STEEL WELDING**

a. All welding electrodes shall be of type E70XX unless noted otherwise.
b. Structural steel shop drawings shall show all welding with is 813/AWS A2.4 symbols.
c. All welding shall be done by certified welders and in accordance with AWS D1.1 or is 822.
d. Welds shown on the drawings are the minimum sizes. Increase weld size to IS: 800 minimum sizes, based on plate thickness. The minimum weld size shall be 6 mm.
e. Field welding symbols have been indicated on the drawings. Where shown, proper field welding per IS: 814 and IS: 822 shall be used.
f. Where no field welding symbols are shown, it is the contractor's responsibility to use shop welds or clarify with the structural engineer.
g. Unless noted otherwise, all groove welds should be CJP welds.
h. All fillet weld sizes shown on drawings refer to weld size and not effective throat thickness.
i. All partial joint penetration groove weld sizes shown on the drawings refer to effective throat thickness.
j. All welds shall be made using low hydrogen electrodes with minimum tensile strength per IS: 814 (minimum 480 MPa).
k. Low hydrogen swam electrodes shall be used within 4 hours of opening their sealed containers. Electrodes shall be re-dried no more than one time, and electrodes that have been wet shall not be used.
l. All welding shall be performed in strict adherence to a written welding procedure specification (WPS) submitted by the contractor. All welding parameters shall be within the electrode manufacturer's recommendations.
m. Welding procedures shall be submitted to the owner's testing agency for review before starting fabrication or erection. Copies of the WPS shall be on site and available to all welders and the special inspector.
n. Unless noted otherwise, all welding procedures (WPS) shall be pre-qualified as per AWS D1.1. Annex q of the code gives a sample of a pre-qualified WPS.
o. If non pre-qualified procedures are to be adopted, testing shall be carried out as per AWS D1.1 and the same shall be reported in the WPS.
p. All complete joint penetration welds shall be ultrasonically tested upon completion of the connection, except plate less than or equal to 6 mm thick shall be magnetic particle tested. Testing of welds shall be carried out as per AWS D1.1.
q. Reduction in testing may be made in accordance with the building code with approval of the engineer.

r. The contractor shall be responsible for the joint preparations and welding procedures that include, but are not limited to: required root openings, root face dimensions, groove angles, backing bars, copes, surface roughness values, and tapers and transitions of unequal parts.

**FIREPROOFING STRUCTURAL STEEL**

a. All members of the structural frame shall be compliant with the Haryana Municipal Building Bye-Laws, 2018, National Building Code and any other relevant and prevalent laws, with respect to Fire and structural safety.
b. The structural frame consists of columns and girders, beams, trusses, and spandrels having direct connections to the columns or beams and bracing members designed to carry gravity loads.

**ANCHOR RODS**

a. Anchor rods not specified as adhesive anchors shall be of Grade 8.8, unless noted otherwise.
b. Furnish anchor rods prefabricated with matching double heavy hex nuts jammed at the end embedded in concrete.
c. Furnish hardened plate washers, lock washers, and matching heavy hex nuts for securing the base plate to the anchor rods. Hooked anchor rods shall not be used except where noted.
d. A rigid steel template shall be used to locate anchor rods while placing concrete.
e. Anchor rods shall have sufficient length to provide the minimum embedment shown on the drawings, measured from the face of the concrete to the near face of the double nut, with adequate extension as required to receive the base plate with full thread projection for nut installation.
f. Anchor rod installation shall be coordinated with reinforcing and formwork.
g. Levelling nuts shall not be used except after evaluation by the contractor's erection engineer.
h. After base installation, anchor rod nuts shall be installed to a snug tight condition. No heating or bending of the anchor rods is permitted.
i. Holes in the base material shall not be enlarged by burning.
j. Anchor rod shall follow the following dimensional criteria as far as base plates are concerned:

| ANCHOR ROD | HOLE DIA. | MIN. EDGE/ END DIST. | MIN.SPACING/ PITCH | EMBEDMENT LENGTH (UNO.) |
|---|---|---|---|---|
| M20 | 28 | 50 | 75 | 500 |
| M24 | 32 | 60 | 85 | 600 |
| M30 | 40 | 75 | 100 | 750 |
| M36 | 48 | 85 | 125 | 900 |
| M40 | 52 | 100 | 150 | 1000 |

**COMPOSITE FLOOR SYSTEM**

a. Floor slabs shall be constructed to the elevations shown on the structural drawings.
b. The contractor shall include the quantities of the added concrete due to the steel deck deflection.
c. Design camber shown for the steel beams has been calculated based on the deflection of the beam due to the weight of the steel and concrete slab.
d. Minimum slab reinforcing is type T8 - 150 c/c or A252 mesh, unless noted

otherwise.

e. Decking sheets shall be continuous over supports

**SHEAR CONNECTOR STUDS**

a. All shear connector studs shall be 19 mm in diameter unless noted otherwise.
b. Shear connector studs shall be automatically end welded in shop or field with equipment recommended by manufacturer of studs. The shear studs shall be able to develop the shear strength as per AISC manual of steel construction.
c. Steel stud material, welding, and inspection shall be in accordance with IS 814 and IS 822.
d. Shear studs shall be placed at a maximum spacing of 300 mm on center for all beams supporting a steel deck with concrete fill or a cast-in-place concrete slab.
e. This spacing shall also apply when the number of studs is not indicated on the plans.
f. Shear connector layouts are provided in the general detail drawings.
g. Steel deck shop drawings detailing the shear stud placement shall be submitted to the engineer for review before installation.

**STEEL COMPOSITE DECK / METAL DECKING**

a. The steel deck shall be of depth shown on the structural drawings.
b. Unless noted otherwise, gage of deck shall be determined by the contractor based on the span conditions, shoring requirements, construction loads, deflection requirements, and the superimposed loads shown on the drawings, load diagrams, and notes.
c. Minimum sheet thickness is 1 mm.
d. Maximum dead load deflection is 20 mm or L/180.
e. Written verification of conformance for all conditions in the structure shall be submitted for acceptance prior to fabrication.
f. The capacities of the deck shall be certified by the manufacturer.
g. Shop drawings shall be submitted showing deck gage, layout, fastening, stud layout, and closures.
h. If any shoring is to be used, it shall be approved by the general contractor and shall be shown on the shop drawings.
i. Units shall span over four supports, continuous over three or more spans, except where framing does not permit.
j. BS 5950 shall govern the design of all deck units. Steel deck and all of its flashings shall conform to IS 811.
k. The steel shall have received, before being formed, a metal protective coating of zinc conforming to Z185.
l. All welding shall be in accordance with AWS D1.3.
m. Concrete bonding-type units shall be formed with deformations to provide an interlock between the concrete and steel.
n. Unless shown otherwise, units shall be fastened to the steel supports at the ends of the units and at intermediate supports at 300 mm (maximum) on center with 20-mm-diameter puddle welds; where two units abut, each unit shall be so fastened to the steel supports.
o. The side laps of adjacent units shall be fastened between supports by 40-mm top seam weldsat 600 mm on centre or button punched at 600 mm on centre.
p. Deck units shall be fastened to the steel supports at the side boundaries by 20-mm- diameter puddle welds at 300 mm (maximum) on centre. 20>mm-diameter shear studs welded through deck may be used in place of 20>mm- diameter puddle welds.
q. Design and provide flashing and closure plates at wall ends of all units, around columns, andat all perimeter locations requiring closure.

r. Coordinate all closures with elevator, stair, escalator and other architectural details. The deck installation, when complete, shall be ready to receive concrete.
s. Steel deck types shall be Corus Comflor 60 and Comflor 80 or approved equal.
t. Steel decks shall be continuous over supporting beams.

**STEEL ROOF DECK**

a. The steel deck shall be of depth shown on the structural drawings.
b. The gage of deck and its connections to the structure shall be determined by the contractor based on the span conditions, deflection requirements, construction loads, diaphragm shears, and the superimposed gravity loads and wind loads shown on the drawings, load diagrams, and notes.
c. Minimum sheet thickness is 1 mm. Maximum deflection under superimposed loads is 12mm or L/240.
d. The deck and its connections shall provide a minimum allowable diaphragm shear capacity of 7 KN/m unless noted otherwise on the drawings.
e. Written verification of conformance for all conditions in the structure shall be submitted for acceptance prior to fabrication.
f. The capacities of the deck shall be certified by the manufacturer. Shop drawings shall be submitted showing deck gage, layout, connections, and closures. Roof deck and all of its flashings shall conform to IS 811.
g. The steel shall have received, before being formed, a metal protective coating of zinc conforming to Z185.
h. All welding shall be in accordance with AWS D1.3.
i. Units shall span over four supports, continuous over three or more spans, except where the framing does not permit.
j. Non composite units shall be fastened to the steel supports at the ends of the units and at intermediate supports by a minimum of four connections per 1 meter of width.
k. Where two units abut, each unit shall be so fastened to the steel framing. The side laps of adjacent units shall be fastened between supports by connections at a maximum spacing of 600 mm on centre unless noted otherwise.
l. Deck units shall be connected to the steel supports at the side boundaries at a maximum spacing of 600 mm on center. Connections shall be made with welds, powder actuated fasteners, or pneumatic pins, screws, or mechanical crimping, provided that the contractor presents calculations with current manufacturer test reports demonstrating equivalent values of shear capacity, deck capacity, and deck flexibility.
m. Where steel members are parallel to the deck flutes and at the same elevation of the bottom of the deck, adjust deck layout and weld deck to steel with same welding as required for sideboundaries.
n. Steel deck that is to be covered with insulating concrete shall be slotted or perforated to provide a minimum of 1.5 percent uniformly distributed venting.
o. Provide flashing and closure plates at all perimeter locations requiring closure. The deck installation, when complete, shall be ready to receive insulating concrete.

**STEEL STAIRS, ELEVATORS, AND MISCELLANEOUS METALS**

a. The contractor shall design and supply all additional miscellaneous metals that are indicated in the architectural drawings or those metals which are found to be necessary to support the architectural finishes or other building systems.
b. All framing and connections designed by the contractor shall not result

in eccentric loads being applied to the primary structure nor lateral loads being applied to the bottom flange of steel beams.

c. The contractor's design shall verify that the connections do not result in adverse local connection stresses occurring within the primary structure.

**PERMANENT PRESTRESSED ROCK ANCHORS**

a. Drilling for anchors will be completed by rotary or pneumatic methods, as per installation pattern, sizes and lengths provided in drawings.
b. Borehole sides shall be adequately protected against side collapse by use of PVC or MS casing.
c. The anchor hole should be perpendicular to the anchor bearing plate. The deviation of the anchor hole entry angle from its inclination as specified the contract documents shall be no than + 3 degrees.
d. Water tightness test shall be conducted in anchor holes as per IS 12070. If rock permeability is observed to be more than 5 Lugeons, the anchor hole shall be consolidation grouted, redrilled and retested. This procedure shall be repeated until the permeability is less than 5 Lugeons.
e. Ht strands of 12.7mm dia. Or equivalent Tata SSL conforming to LRPC class ii as per IS: 14268 will be cut to length of anchor including that required for stressing purpose.
f. Working loads on strands shall not exceed 50% of the characteristic strength of the strands.
g. The strands shall be pre-treated to remove rust/oil, scaling, grease, etc. Two coats of epoxy formulation shall be applied on the strands. The 2nd coat shall be applied only after allowingthe 1st coat to dry for 2-3 hours. Quartz and shall be sprinkled to roughen the surface. Following epoxy formulation will be used: Araldite: Gy257 (2 parts), Aradur -140 (1 part).
h. For the strands in free length, a coat of primer (Berger Epilux 610) shall be brush applied. Also, a flexible PVC sheath of HDPE, 2mm thick shall be provided over each individual strand. The top and bottom of the HDPE sheathing shall be taped at top and bottom.
i. Prepared strands will be grouped together. Spacers shall be used to separate the strands or bars individually or into small groups at regular intervals of 1.5m in fixed length. The strands will be tied with the help of binding wires at the centre of two spacers. A ms guide shoe shall be welded to the bottom of the strands by brazing for lowering the anchor in the bore.
j. Centralizer shall be utilized to support the tendon in the drill hole and position. The tendons so a minimum grout cover of 12mm is achieved. All centralizers shall be designed to permit grout to flow freely around the tendon and up the drill hole. The contractor shall determine the number of centralizers required; however, a minimum of one unit shall be placed within 1m of the bottom of the hole and another at the bond length and free stressing length interface.
k. A PVC grout tube of 25mm diameter will be inserted through all the cable spacers to facilitate grouting. Care shall be taken to ensure that the sheathing, corrosion protection and grout tubes are not damaged during installation.
l. The fixed length of the anchor should be placed in a HDPE corrugated PVC pipe with minimum wall thickness of 0.8mm.
m. The grout shall entirely fill the annular space between the strands and the bore hole wall in the bond length.
n. Grouting will be done with minimum 53 grade OPC cement neat cement grout with non- shrink compound Cebex 100 or equivalent, or with GP2 compound in fixed length, by providing a packer at the top of

fixed length or by ensuring with physical measurements that grout does not intrude the free length portion.

o. Three (3) grout cubes (7.5cm x 7.5cm x 7.5cm) will be cast for each day of grouting. One cube will be tested at 7 days while the remaining cubes will be tested at 28 days.
p. Stressing shall not commence until the grout has reached its 28 –day strength.
q. The anchors shall be proof tested to 1.1 times the design load in 5 increments. A Multi-standjack system should be utilized for stressing of anchors. The initial increment of 10% of design load will be applied.
r. Elongation should be measured at each of the 5 load increments. The load will be held at the final test load for at least 15 minutes.
s. The anchor can be deemed acceptable upon proof testing if both the below conditions are satisfied:
    i. Total elongation exceeds 80% of theoretical elongation of free length.
    ii. Total elongation is less than the theoretical elongation of free length + 50% theoretical elongation of the fixed length.
t. The load shall then be released and the anchor locked off at desired lock off load with wedges. Wedge holes and wedges shall be free of rust, grout, and dirt. The free length will then be grouted.
u. After cutting off the extra portion of the strand, the anchor head shall be protected with epoxy formulation mentioned above applied uniformly over the thrust plate, bearing plate, and anchor wedges by a concrete block with minimum reinforcement of T8-150 (developed 300mm into walled beam or raft) in either direction.

**CORROSION PROTECTION OF STRUCTURAL STEEL**

a. The environmental exposure condition of all structural steel (uncladded or cladded) exposed to atmosphere (except steel encased in concrete) shall be taken as very severe as per IS 800:2007.
b. The environmental exposure condition of all structural steel within interior of building not exposed to atmosphere shall be taken as moderate as per IS 800:2007.
c. Coating system shall be provided by the contractor based on the above atmospheric conditions and should have a minimum life of 15 years.

**CAUTION**

i. Structural drawings shall be executed on site subject to necessary permission from competent authority.
ii. It shall be ensured on site that the construction activity is according to the latest revision of the structural drawings. In case of any confusion or discrepancy, the structural consultant shall be promptly contacted.
iii. The responsibility of the structural consultant is limited only to the accuracy of design calculations and structural drawings, and periodic general checking construction activity andtest results. The design is be based on the data provided by the Employer. The Employer shall engage an independent supervision agency to ensure quality control on site.
iv. Continuous supervision is not part of the scope of the structural engineer and his inspection cannot guarantee that the work is carried out strictly as per his drawings and general detail drawings.
v. We shall not guarantee the work of the contractor; we shall not be responsible for the damage to life and property whatsoever resulting from any act by Employer, contractor, suppliers or any other agencies during the execution of work.

vi. The Employer shall also ensure that: no addition and alteration shall be carried out without consulting the structural engineer.
vii. Structural members shall not be damaged / tampered with for any reason whatsoever during and after construction.
viii. Overloading the structure, changes in the structural system, lack of maintenance, or any act that is detrimental to the safety and stability of the structure as a whole shall be avoided during the lifetime of the structure.

## DESIGN LOADS

a. Dead loads shall be calculated as per IS 875 latest - part 1.
b. Live loads shall be calculated as per IS 875 latest - part 2.
c. Wind loads shall be calculated as per IS 875 latest - part 3.
d. Earthquake loads shall be calculated as per IS 1893 latest.
e. Load combinations shall be as per IS 875 latest - part 5 and IS 456:2000 latest.

## Definitions/ Terminology for using Steel Structure Bead:

A single run of weld metal deposited on surface.

**Butt Weld:**

A weld in which the weld metal lies substantially within the extension of the planes arc the surfaces on the parts joined.

**Crater:**
A depression left in weld metal where the arc was broken or the flame was removed.

**End Crater:**

A crater at the end of a weld or at the end of a joint.

**Fillet Weld:**

A weld of approximately triangular cross-section joining two surfaces approximately at the right angles to each other in a lap joint, tee joint or corner joint. It is of two types:
(1) Continuous
(2) Intermittent.

**Fusion Welding:**
Any welding process in which the weld is made between metals in a state of fusion without Hammering or pressure.

**Non- fusion welding:**

A term applied to the deposition, by the Oxy-Acetylene process of filler metal on parent metal without fusion of the latter.

**Oxy-Acetylene Pressure Welding:**
Pressure welding in which any Oxy-Acetylene flame is used to make the surface to be united plastic. No filler metal is used.

**Run:**
The metal deposited during one passage of the electrode or blow pipe in the making of a joint.

**Weld:**
A union between two pieces of metal at faces rendered plastic or liquid by heat or pressure, or both, Filler metal may be used to affect the union.

## STEEL WORK IN SINGLE SECTION FIXED INDEPENDENTLY WITHCONNECTING PLATE

The steel work in single section of R.S. joists, flats, Tees Angles fixed independently with or without connecting plate, is described in these clauses.

**Fabrication:**

The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. 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. All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

**Erection:**

Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary mechanical appliances such as lifting tackle winch etc. shall be used. The suitability and capacity of all plant and equipment used for erection shallbe up to the satisfaction of the Engineer -in-charge.

## STEEL WORK IN BUILT UP SECTIONS (RIVETED AND BOLTED)

The steel work in built up section (Riveted and bolted) such as trusses, framed work etc. is specifiedin this clause.

**Laying Out:**
A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts, as shown on drawings or as directed by the Engineer-in- Charge. Steel tape shall be used for measurements.

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

Great accuracy shall be observed in the fabrication of various members, 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, kinks, buckles or open joints. Wooden or metal sheet templates shall be madeto correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No two pieces shall be welded or joined to make up for the required length of member.

**Making Holes:**

Holes through more than one thickness of materials for members, such as compound stanchion andgirder flanges shall, where possible, be drilled after the members are

**Steel Work:**

Assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not than 16 mm.

**Rivet Holes:**

The diameter for rivets and black bolts holes shall be taken as the nominal diameter of a rivet/black bolts plus 1.5 mm for rivets/ bolts of nominal diameter less than or equal to 25 mm and 2.0 mm for rivets of nominal diameter exceeding 25 mm, unless specified otherwise. Holes for turned and fitted bolts shall be drilled or reamed large by 0.2 to 8 mm depending upon the dia. of bolts. Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes shall be clean and accurate. Holes for rivets and bolts shall not be formed by gas cutting process. Holes for counter sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

**Assembly:**

Before making holes in individual members, for fabrication and steel work intended to be riveted or bolted together shall be assembled and clamped properly and tightly so as to ensure close abutting, or lapping of the surfaces of the different members. All stiffeners shall be fixed (or placed) tightly bothat top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together.

Web plates of girders, which have no cover flange plates, shall have their ends flush with the tops of angles unless otherwise required. The web plate when spliced, shall have clearance of not more than 5mm. The erection clearance of cleated ends of members connecting steel to steel shall preferably be not than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm at each end but where for practical reasons, clearance is

necessary, seating designed suitably shall be provided. Column splices and butt joints of struts and compression members requiring contact for stress transmission shall be accurately, machined and close butted over the whole section. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc. after riveting together shall be accurately machined 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 great accuracy so that they are not unduly reduced in thickness by machining. The ends of all bearing stiffeners shall be machined or grounded to fit tightly both attop and bottom.

**Riveting:** Rivets shall be used, where slip under load has to be avoided.

Preliminaries before Riveting: - Members to be riveted shall have all parts firmly placed and held together before and during riveting, and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

**Process of Riveting:**

The riveting shall be carried out by using machines of the steady pressure type. However, where suchfacilities are not available hand riveting may be permitted by the Engineer-in-charge. The rivets shallbe heated red hot, care being taken to control the temperature of heating so as not to burn the steel.Rivets of diameter less than10mm may be driven cold. Rivets shall be finished neat with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly. All loose, burnt, or badly formed rivets with eccentric or deficient heads shall be cut out and replaced.In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking andrecapping shall not be permitted. For testing rivets, a hammer weighing approx. 0.25 kg shall be usedand both heads of the rivet (Specially the machine head) shall be tapped. When so tested, the rivetsshall not give a hollow sound and a jar where so specified, other tests shall be carried out to ensure thesoundness of rivets. All rivets heads shall be painted with approved steel primer paint within a weekof their fixing.

**Bolting:**

The nominal length of the bolt shall be the distance from the underside of the head to the further endof the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads. Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil,before use. All bolts heads and nuts shall be hexagonal unless specified otherwise. The screwed threads shall conform to IS 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project at least two clear threads beyond the nuts when fixed in position, and these shall fit in the holes without any shake. The nuts shall fit in the threaded ends of bolts properly. Wherenecessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least two thread.In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nuts to avoid any threaded portion of the bolt being within thethickness of the parts bolted together. Where there is a risk of the nuts being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use oflock nut, spring washers as directed by the Engineer-in-charge.

**Erection:**

Steel members shall be hoisted and erected in position carefully, without any damage to itself, other structures and equipment and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Engineer-in-charge in advance. The contractor however shall be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members and proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

The work of erection may be done in suitable units as may be directed by the Engineer -in charge. Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against over-turning or collapse by suitable means. During execution, the steel members shall be securely bolted or otherwise fastened when necessary temporarily braced to provide for all loads including those due to erection equipment and its Operation to be carried safely by structure during erection. The steel members shall be placed in proper position as per approved drawing, final riveting or permanent bolting shall bedone only after proper alignment has been checked and confirmed.

Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be lifted by slinging at two mid points of rafters, which shall be temporary braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible.

The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans up to 10m the free end of the truss shall be laidon lead sheet or steel plate as per design, and the holes for holding down bolts shall be made in the form of oblong slots so as to permit the free movements of the truss end. For larger spans the truss shall be provided with proper bearing as per design.

Columns and stanchions shall be erected truly vertical with the necessary cross bracing etc. and the base shall be properly fixed with the foundation concrete by means of anchor bolts etc. as perdrawing.

Anchor bolts to be placed in the concrete foundation should be held in position with a wooden template. At the time of concreting anchor bolt locations shall be provided with suitable timber mould or pipe sleeve to allow for adjustment which shall be removed after initial setting of concrete. The spaces left around anchor bolts shall be linked to a stopping channel in the concrete leading to the sideof the pedestal and on the underside of the base plate to allow the spaces being grouted up after the base plate is fixed in the position along with the column footing. Grouting shall be of cement mortar 1:3 (1 cement: 3 coarse sand) or as specified.

**Bedding of Column, Stanchions etc.:**

Bedding shall not be carried out until the steel work has been finally leveled, plumbed and connected together. The stanchion shall be supported on steel wedges and adjusted to make the column plumb. For multistoried buildings, the bedding shall not be done until sufficient number of bottom lengths of stanchions have been properly lined, leveled and plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the bases by M.S. wedges and adjusted where necessary to plumb the columns. The gaps under the base plate may be made up to 25 mm which shallbe pressure grouted with cement grouts. With small columns, if permitted by the Engineer-in-charge, the column

base shall be floated on a thick cement grout on the concrete pedestal. The anchor bolt holes in the base plate may be made about 10 to 15 mm larger than the bolts. In such cases suitable washers shall be provided.

## SPECIFICATIONS FOR STRUCTURAL FABRICATION AND ERECTION: GENERAL

All dimensions are in mm and levels in meters. Written dimensions shall be followed. No dimension shall be scaled from the drawing. If in doubt, please ask the concerned project in charge for clarifications.

Structures are fabricated in accordance with relevant Indian/ International standard codes of practice.

**Material:**

i. Structural steel and other related materials for construction shall confirm to Annexure-A.
ii. All test certificates confirming to IS Codes which is going to be used for the construction ofbuilding structure has to be submitted to Employer for every consignment.
iii. Due to non-availability of specified materials, suitable substitutions may be provided withconsent of the Employer. Such substitution shall be incorporated in the "As-built" drawings.
iv. Rolling and cutting tolerances shall be as per IS: 1852-1985.
v. Cover electrodes for arc welding shall conform to IS: 814 - 2004/ Equivalent Internationalstandard.
vi. Raw materials shall be straightened before marking and cutting if required.
vii. All hexagonal bolts & nuts should be Chromium Coated and it should be rotate freely and shall confirm to IS: 1363-2002 and IS 1364-2004 (for precision and Fully precision hexagonal bolts). Washer shall confirm to IS 2016-1967.
viii. Crane Rails shall confirm to IS: 3443-1980.

**Connections:**

a. In general, all welding shall conform to IS:9595-1991/Equivalent standard and welding design toIS:816-1969/Equivalent International standard.
b. All fillet welds shall be 6 mm continuous unless otherwise specified.
c. Minimum size of fillet welds based on thickness of connected members shall be as given below ifdetails are not given in the drawing

| **S.** | **Description** | | | | |
|---|---|---|---|---|---|
| 1 | Thickness of Plate in mm | 6-20 | 21-30 | 31-50 | 51 & above |
| 2 | Minimum size of Fillet weld | 6-8 | 8-10 | 10-12 | 12-16 |

d. Bolts shall be provided with washer plates of thickness equal to half the thickness of base plate or 10 mm whichever is more. Washer plates on the column base plate shall be site welded after alignment of column. Holes for bolted connection should match well to permit easy entry ofbolts. Gross mismatch of holes shall be avoided.

e. Fillet weld terminating at the sides or ends of parts shall be returned around the corners for a distance of not less than 25 mm.
f. All shop splices shall be made by means of full-strength full penetration butt welds unless otherwise specified. Not more than one splice shall be permitted per member.
g. Shop butt joints in flanges and webs shall be staggered type in assembly.
h. on account of inaccessibility. Ends of butt welds are to be continued beyond the limits on run-on and run-off plates.
i. Butt joints are to be welded from both sides irrespective of edge preparation except when back strips are used. Back-gouging shall be done pneumatically or by proper grinding method.
j. Machining of contact surfaces of column base, end of column shaft, cap plates and bearing stiffeners shall be done wherever specified in the drawing. At other places maximum surface unevenness on contact surface of base plate, cap plate shall not exceed 0.5 mm. Maximum gap between bearing end of column shaft and base plate at any place shall not exceed 1 mm. If this is achieved by cold sawing and grinding, machining of column end need not be done.
k. Chequered plate platforms exposed to weather shall have 25 mm diameter holes drilled at450mm C/C to drain rain water.
l. Drain holes shall be provided in the stiffeners of base plates of columns to drain off rain.
m. Water, wherever the stiffeners form an enclosed space in the column base. Members fabricated inpieces due to limitations of transport shall be control assembled at shop in order to ensure true length, fitment and alignment. Where control assembly is not possible matching details and holes shall be marked with template. Control assembly part assemblies shall be given matching identity marks. In column wherever such type of joints is reqd. it should be provided 1000 mm above the floor level.
n. Shop splices shall not be spaced less than 6 mtrs.
o. Prior approval shall be taken for any splice not indicated in the drawing.
p. Full scale layout is recommended, before cutting of material. Size and length specified indrawing BOM are tentative and are basically released for raw material indenting purpose.
q. All inclined dimensions and gusset sizes shall be checked during actual shop layout as per drawing.
r. Fabricated structures shall conform to tolerance as specified in IS: 7215 - 1974/ Equivalent International standard.

**Inspection of connections:**

All butt welds in structural members like columns, floor and framing beams, crane girders and bases shall be tested as follows:

a. 10 % Dye Penetration test on root run and wherever in doubt during the process.
b. 100 % Visual examination.
c. 100% Ultrasonic test (For important Butt Welds Only).

**FABRICATION OF STEEL STRUCTURES: General:**

This specification shall apply to fabrication and supply of all building structures pertaining to structural steel works complete in all respect as per specification.

**Fabrication and Painting:**

The Contractor shall carry out, under fabrication and shop painting Connection design, Preparation of drawings, Getting Approval, Procurement of Steel (Grade E250/E350), Primer, Paint, Permanent fasteners, Anchor Bolts and hardware along with all accessories. Fabrication of Structural Steel including Surface preparation with Shot blasting & painting, Packing, loading, transportation and supply at site.

i. Preparation of Connection drawing mentioning the bolted joints, arrangement of bolts and specification of bolts, nuts etc. (Specifying Clearly shop and site bolts).
ii. Procurement and supply of all erectable consumables like bolts, nuts, washers, shims and packs etc., including allowance for spares and wastages.
iii. Cold straightening of sections and plates, whenever they are bent and kinks.
iv. Carry out the controlled assembly of steel structural components at site, wherever required or as directed by the Employer.
v. Re-fabrication of parts, damaged beyond repair during transport & handling or incorrectly fabricated, and fabrication of parts omitted during fabrication by oversight or subsequently found necessary.
vi. Making arrangements for and providing all facilities wherever applicable for conducting ultrasonic testing on butt welds, getting the test conducted by reputed testing laboratories, making available test films/ graphs, reports and interpretation at site or erection site.
vii. Preparation of steel structural surfaces with shot blasting for painting at fabrication yard asspecified in the design drawings/specification.

**FABRICATION:**

a. Fabrication will be done only as per fabrication drawings/sketches etc. supplied by The Employer.
b. All edge preparation for welding shall conform to IS: 9595-1980.
c. All the items are to be cut as per requirements of the drawing. If joints are to be provided in any item, in order to meet requirements of size and shape, cutting plan showing locations of joints shall be prepared for consideration of Employer. Joints provided shall be incorporated in "As - built" drawings.
d. Fabrication of all structural steelwork shall be in accordance with IS: 800-1984 and in conformitywith various clauses of specification.
e. Fabrication of structures shall be preferably be taken as per the sequence of erection.
f. Surface, wherever machining is specified, shall be either planed or milled or ground to ensure maximum contact. Standard of acceptance for machined surfaces, wherever specified by designer, (e.g. In column cap plates, base plates, and columns shafts etc.) Shall be given as per relevant IS codes. Maximum surface unevenness on bearing surface of cap/base plates shall notbe exceeding 0.5 mm.
g. Wherever perfect matching of parts is required at site, member shall be shop assembled before dispatch. Parts not completely assembled in the fabrication yard shall be secured, to the extent possible, to prevent damage during dispatch.
h. No hole shall be made by gas cutting process.
i. The fabricator shall carry out the controlled assembly of the following structures and units at site before dispatch to erection site.
j. The welding and welded work shall conform to IS: 816-1969. The extent of quality control in respect of welds in important structural elements such as crane girders, girders, floor and framing beams, column shafts including traverses and bases etc., shall be as follows: -
    i. 100 % Dye Penetration test on root run and wherever in doubt during the process.

ii. 100% visual examination.
iii. 100% ultrasonic test (for important butt welds only).

k. Employer / Employer's engineer reserves the right to demand X-ray or other tests of welds wherever he considers necessary and the Contractor shall be prepared to carry out tests as directed by Employer / Employer's engineer. The Cost of NDT of welds as per the specification shall be included in quoted price.

l. For other structures in addition to 100% visual check and measurement of external dimension by appropriate gauges, selective examination of welds by drilling, ultrasonic / radiographic / magnetic particles tests shall be done if necessary.

m. Standard of acceptance for weld defects is indicated below:
   i. For metal thickness up to 10mm under cuts shall not be more than 0.5mm. For metal thickness more than 10mm, under cuts shall not be more than 1mm.
   ii. Incomplete weld, molten metal flow, pits and cracks shall not be allowed.

n. Following weld defects detected by ultrasonic method of tests are permissible:
   i. For joints welded from both sides, incomplete penetration shall neither be more than 50mm in length in one stretch nor the aggregate length be more than 200mm per meter length of joint. Thickness of incomplete penetration shall not be more than 5% of the thickness of the parent metal or 2mm, whichever is
   ii. Where joint welding from one side without backing strip is permitted, thickness of incomplete penetration shall neither exceed 15% of the thickness of parent metal nor 3mm at the root.

o. Slag inclusion located along the length of the weld and measured in a chain or separately shall not exceed 200mm per meter length of the weld, subjected to the following: -

At any cross-section, aggregate thickness of incomplete penetration, slag inclusion and pores located separately as a chain shall not exceed:

- 10% of the metal thickness or 2mm whichever is when welding is done from both sides.
- 15% of the metal thickness or 3mm whichever is when welding is permitted from one side and without backing strip. In case any weld is found defective by radiographic examination further equivalent adjacent lengths or welds shall be tested by radiographic examination.

p. In case of detection of defects in welds, the rectification of the same shall be done as follows: -
   i. All craters in the weld and breaks in the weld and breaks in the weld run shall be thoroughly filled with the weld.
   ii. Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth penetration. Porosity, slag inclusion etc. exceeding permissible limits shall be rectified by removing the lengths of weld at the location of such defects plus 10mm from both ends of defective welds, and shall be re-welded.

q. The Contractor shall make all necessary arrangements for stage inspection by Employer's engineer/inspector during the fabrication at site and incorporate all on-the-spot instructions/changes conveyed in writing to the Contractor. Members wrongly fabricated shall be reported to inspector and shall be made good as directed. Minor misfits which can be remediedby a moderate use of drift pins, and moderate amount of reaming and slight chipping may be corrected in that manner, if in the opinion of the Employer's engineer/inspector the strength or the appearance of the structure will not be affected adversely. In the event, Employer's engineer/inspector directs otherwise, the items will be rejected and completely new piece shall be

fabricated. The cost of correcting errors shall be to the account of the Contractor. No field torch repairs shall be carried out unless approved by the engineer/inspector.

**Tolerance of Workmanship:**

The permissible tolerance in workmanship shall be as per IS: 7215-1974.

**Programme:**

(a) All program on fabrication and dispatch shall match with the sequence of erection of different structural components and different buildings/units, of the projects as per planning or mutual agreement between Employer and the Contractor.
(b) Employer may change or alter the detailed working program for the sequence of work and for the fabrication of components of structures, within the framework of the agreed schedule, which will be binding on the Contractor.
(c) If due to design or other stipulations in the bid or requirements at site, a particular sequence of overall construction has to be followed due to which certain interruptions to any one or more items of work are inherent, no claims for such interruption will be admissible.

**Drawings:**

(a) Three (3) sets of drawings and soft copy in Auto Cad will be supplied to Contractor by the Employer.
(b) Correctness of all details like cutting length of individual items, gusset/cleat size, matching holes,dimension of individual items, matching of marking, bill of materials, bolt lists etc, shall be the responsibility of the Contractor.

**Contractor's Responsibility:**

The Contractor shall take the prior approval from Employer regarding subletting the work fully orpartly.

**Shifting of Fabricated Materials:**

The Contractor is solely responsible for any loss or damage during transit of any of the fabricatedmembers, and as such proper precautions shall be taken to guard against such mishaps. For all such important structures, match marking shall be given at the control assembly stage in the shop floor and such match marking shall be made clearly visible while assembling the structures at site. Centre lines of column flanges and both sides of web shall be punched, preferably at top and bottom to facilitate alignment after erection. As built drawing shall be prepared after fabrication is complete to indicate additions/alternations made during the process of fabrication. Each dispatchable structure shall bear mark no. along with reference drawing number at two locations. (e.g. On flange and bottom of base plate of column).

**Setting Out:**

(a) The Contractor shall be responsible for checking the alignment and levels of foundations, correctness of foundations, centers of anchor bolts etc., well in advance of starting erection work and shall be responsible for any consequence for non-compliance thereof. Discrepancies, if any shall immediately be brought to the notice of Employer. Any mistake subsequently found in alignment and levels of the structural steel work due to non-verification of foundation shall be rectified at Contractor's expense.

(b) One set of reference axes and one bench mark level will be furnished to the Contractor. These shall be used for setting out of structures. Maintenance of such bench mark level shall be the responsibility of the Contractor.

(c) The Contractor at his own expenses shall provide measuring instruments (Total Station, Dumpy Level) for setting out, leveling and alignment steel work.

**Staging:**

Any staging necessary for the preassembly work of structures shall be provided by the Contractor athis own expense.

**Rules & Regulations of Safety, Electricity Boards, Factory etc.:**

The Contractor shall at all times comply with all relevant factory acts, electricity rules, safetyregulations etc. as per statutory requirement of Central/State Government.

**Deviations:**

Should the Contractor wish to deviate from any specification or details showed on Employer's approved drawings and/or Technical Specifications, he shall obtain Employer's written permission before proceeding with the deviations in proper format.

**Measurement:**

(a) Measurement for structural steel work shall be made on the calculated weights of steel work as determined from the dimensions given on the approved drawings or any approved amendments there to. In the case of mild steel plates, the calculated weight shall be based on 78.5 kg per sq-m of metal 1 cm thick and in the case of mild steel standard sections and rods, the weights shall be calculated on the basis of weight per meter run specified in the relevant Indian standards.

(b) The weights of all plates and sheets shall be calculated using the actual dimensions shown in the drawings with deductions for skew units and openings irrespective of their size. However, no deductions shall be made for skew cuts for gussets, rolled sections and holes for bolts. Theweight for gusset shall be calculated from its overall dimensions.

(c) No additional weight for weld metal deposited, bolts (permanent or erection bolt), nuts, washers, etc. shall be allowed in measurements. Cost of bolts, washers, nuts electrodes, gases, etc. as required for the work shall be deemed to be included in the quoted rates.

(d) Oiling, painting, temporary cleats, marking, packing and delivering to site shall be included inthe scope of work.

(e) The weights to which the rates shall be applicable shall be as shown on the approved drawings/ material lists and no allowance for wastage shall be permitted. Suitable cutting diagrams of components shall be prepared in order to minimize consumption of steel.

**Surface Preparation and Painting of Steel: General**

(a) This specification is intended to cover the general requirements for surface preparation and painting of steel structural work. Reference may also be made to IS: 8629-1977 (parts I to III).
(b) Code of Practice for Protection of Iron and Steel Structures from atmospheric corrosion.
(c) While this gives a general indication of the surface preparation and painting requirements, specialcases may arise which have to be dealt with individually on the merits of each case.
(d) The Contractor shall carry out the painting of structures fabricated by them with suitable paints. The schedule of painting shall be 1 coats of red oxide and 2 coats of enamel paint. Blast cleaning shall be done by shot blasting as per Swedish standard. Grade Sa-2 ½-- this involves very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that theonly traces remaining are slight stains in the form of spots or strips. Finally, the surface is cleanedwith a vacuum cleaner, clean dry compressed air or a clean brush. It shall then correspond in appearance to the prints designated as Sa-2 ½.

**PAINTS AND PAINTING: General:**

(a) Areas which become inaccessible after assembly shall be painted before assembly after cleaning the surfaces as specified.
(b) Portion of structures to be encased or embedded in concrete shall not be painted, but shall be coated with cement slurry, on completion of fabrication.
(c) Wherever shop primer is damaged, the surface shall be thoroughly cleaned and the damaged portion shall be painted with the same primer.
(d) Application of paint shall be by spraying as per IS: 486-1983 and IS: 487-1985. Painting shall not be done when the temperature is less than 5°C or more than 45°C and relative humidity is more than 85% unless manufacturer's recommendations permit. Also painting shall not be done in frosty or foggy weather. During application, paint agitation must be provided where such agitation is recommended by the manufacturer.

**Painting of steel structures**

(a) If more than 50% of the painted surface of an item requires repair, the entire item shall be mechanically cleaned and new primer coats shall be applied followed by finishing coats as per painting specification.
(b) Primer paint shall be applied not later than 2-3 hours after preparation of surface, unless specifiedotherwise.
(c) The finishing paint as specified shall be of approved colour and quality.
(d) Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of the required thickness.
(e) Surfaces which cannot be painted but require protection shall be given a coat of rust-inhibitive grease according to IS: 958-1975.

**Erection of Steel: General**

In addition to provision of erection, transport and handling of equipment, the specification of work in this scenario shall include supply of tools and tackles, consumables, materials, labour and supervision,and shall cover the following: -

(a) Storing and stacking at site all fabricated structural components/ units/ assemblies till the time oferection.
(b) Transporting structures from storage yard to site including multiple handling if required.
(c) All minor rectification/ modifications such as:

i. Removal of bends, kinks and twists etc. for parts damaged during transport and handling.
ii. Other rectification works such as Plugs welding and re-drilling of holes which do not registerand which cannot be reamed or used for next higher size bolt.
iii. Drilling of holes, which are either not, drilled at all or are drilled in incorrect position during fabrication
iv. Fabrication of minor items/ missing items or such important items as directed by the engineer.
v. Verification in the field of the position of the embedded anchor bolts and inserts with respect to line and level, installed by others based on bench mark/ reference co-ordinates to be furnished by the engineer.
vi. Assembly at site of steel structural components wherever required including temporary supports and staging. viii. Rectification at site damaged portions of shop paint by cleaning andtouch up paints.
vii. Erection of structures including connections by bolts/welding (Rail works).
viii. Alignment of all structures true to line, level, plumb and dimensions within specified limits of tolerances as per drawing and specifications.
ix. Supply of labour in sufficient numbers, where necessary, as directed by Employer.
x. Conducting preliminary acceptance & final acceptance tests and rectification of structures wherever required as per preliminary & final acceptance report.
xi. Preparation of sketches/ drawings to suit availability of material, convenience of fabrication, transportation and erection and changes during fabrication and erection. All such works are subject to approval of Employer.
xii. The members of the structures which are received under knock-down condition shall be assembled and welded on ground at site prior to erection.

**Erection Drawings:**

The approved erection drawings and any approved arrangement drawings, specifications or instructions accompanying them shall be followed in erecting the structures.

**Storing and Handling:**

i. Before starting erection, the program and sequence of work shall be followed as approved or mutually agreed by Employer.
ii. The fabricated materials on receipt at site shall be carefully unloaded, examined for defects, checked, sorted out for each building and stacked securely on skids above level ground which shall be kept clean and properly drained. Girders and beams shall be placed upright and stored. Long members such as columns and chord members shall be supported on skids placed close enough to prevent damage from deflections.
iii. The fabricated material shall be verified with respect to markings on the marking plan orshipping list which shall be supplied by the Contractor.
iv. Any material found damaged or defective shall be stacked separately and the damaged or defective portions shall be painted in distinct color for identification. Such materials shall bedealt with as instructed by Employer.
v. The handling and storing of component parts of a structure shall involve the use of methods and appliances not likely to produce injury by twisting, bending or otherwise deforming the structures. No member slightly bent or twisted shall be put in place until the defects are corrected.Members severely damaged in handling shall be rejected.

**Defects in Materials and Rectification:**

All members shall be straight unless required to be curvilinear for and

shall be free from twists.Only cold straightening shall be permitted.

During assembly and before erecting the units to position, the Contractor shall compare the structures with the drawings to ensure that there are no fabrication errors or omissions. Should any defects or omissions be found, the same shall be brought to the notice of Employer, who will issue necessary instructions for its rectification.

**Assembly and Erection:**

i. Before starting erection, the Contractor shall submit to follow and number and types of equipment and temporary work proposed to use for erection.
ii. The approval of Employer shall not be considered as relieving the Contractor for the loads for which the erection equipment and temporary work will be called upon to carry and support. Adequate allowances and provision shall be made for lateral forces and wind forces.
iii. If in the opinion of Employer, the tools, tackles, plant and equipment, instruments, apparatus, etc. arranged by the Contractor are not sufficient or are inadequate for the fulfilment of contractual obligations of the Contractor within the stipulated period, Employer shall have the right to order the Contractor and the Contractor shall comply with order to bring/ arrange such additional tools, tackles, plant and equipment, instruments, apparatus etc. to the site and arrange the same to complete the work in time. All charges in connection thereof shall be borne by the Contractor.

**Proper consideration shall be given to the following items during erection:**

(a) Frames of the building to be true to plumb.
(b) Temporary guying and bracing shall be used to align the frames during erection, if required. All temporary guying and bracing shall be in Contractor Scope.
(c) Temporary bracing may be required to sustain forces due to erection load and equipment. Erectedparts of the structures shall be stable during all stages of erection. The stability of the structure subjected to action of wind, dead weight and erection forces shall be achieved by installing permanent and temporary bracing.
(d) Erection member shall be held securely in place by bolts to take care of dead loads, erection loads, wind loads.
(e) Provision of free expansion and contraction wherever provided.
(f) No final bolting of joints shall be done until the structures are fully aligned.
(g) Erection tools and machinery shall be of suitable capacity for handling the materials furnishedand must be in safe Operating conditions at all times to avoid dangers to materials and personnel.
(h) In positioning beams, columns and other steel members, the use of steel sledge shall not bepermitted.
(i) The Contractor shall report all failures of the fabricated steel to fit together properly to Employerand shall obtain approval prior to taking corrective measures.
(j) Steel members shall not be allowed to fall or be subjected to shock or impact due to othermembers being swung into position or for any other causes.
(k) Contractor should provide Cherry Packer /Man Lifter for Fixing and

Tightening the Bolts &Nuts.

(l) Torque Value for tightening of Bolts & Nuts should be incorporated.

**Other vital points to be taken care off during erection**

(a) The erection shall be carried out according to the best modern practices and as laid down in IS: 800-1984 and other relevant standards referred to therein and this erection specification together with erection drawings.

(b) The Contractor shall be carrying out Connection design, manufacture, erection and provide false work, staging, temporary supports etc. wherever required for safe and accurate erection of structural steelwork and shall be fully responsible for the adequacy of the same.

(c) The Contractor shall provide adequate supervision by competent personal at all stages of the work and examine each portion of the work for accuracy before commencing the erection of the next structural members.

(d) The Contractor shall also provide facilities such as adequate temporary access ladders, gangways,tools and tackles, instruments etc., for inspection at any stage during erection.

(e) Instrumental checking for correctness of initial setting out of structures, and adjustment of alignment shall be carried out in sequence and at different stages as determined by design.

The final leveling and alignment shall be carried out immediately after completion of each

section of a building or when called for by Employer.

(f) All structural members shall be erected with erection mark in the same relative position as shownin the appropriate erection and shop drawings.

**Field Connection:**

(a) The number of washers on permanent bolts shall not be more than two (and not less than one) forthe nuts and one for bolt head.

(b) Wooden rams or mallets shall be used in forcing members into position, in order to protect themetal from injury and shock.

(c) The permanent bolts shall be tightened to the maximum limit. The threaded portion of each boltshall project through the nut by at least 4-5 thread.

(d) Spring washers or locknuts shall be provided as specified in the design/ shop drawings.

(e) All field assembly and bolting shall be executed in accordance with the requirement of shopfabrication.

**BEDDING AND GROUTING**

(a) Base plates shall be set to elevations shown on the drawings, supported and aligned using steel wedges and shims or other approved methods. The supply of wedges and shims and materials for alignment shall be the responsibility of the Contractor as part of this work at no extra cost. Plates shall be leveled, properly positioned and anchor bolts tightened. The Contractor shall provide the packing plate at least four corners of the base plate.

(b) The bedding/ grouting shall not be carried out until a sufficient number of columns have been aligned, leveled, plumbed and sufficient girders, beams, trusses and bracings are in position tothe satisfaction of Employer.

(c) The Contractor shall inform Employer when the base plates are ready for grouting and shall co- ordinate with others regarding grouting schedule. The Contractor is responsible for the final vertical and horizontal alignment of all base plates.

**Erection of Miscellaneous Structures:**

(a) Unless otherwise specified, the crane rail joints shall be butt-jointed (either by Thermite or fusionwelding) or by fish plate as per specification/ drawings.
(b) The joint shall be free from kinks, twists etc. and shall be ground properly after bolting.
(c) Method of securing the crane rail to the crane gantry, alignment and expansion joints, if any,shall be as indicated in the approved drawings.

**Preliminary Acceptance:**

After completing the erection of a unit or portion thereof, the Contractor shall give a notice in writing stating that the job is complete in all respects and ready for preliminary acceptance. The job shall be jointly inspected visually by representatives of Contractor and Employer. All observed defects and omissions as per drawings and specifications shall be noted down. If the defects are not major in the opinion of Employer/ Employer's representatives, the Contractor will be issued a preliminary acceptance certificate mentioning the defects, deficiencies and omissions which shall be made goodby the Contractor within a period of 2 weeks.

**Final Acceptance:**

(a) Before commencement of inspection for final acceptance of the unit, the Contractor shall make available two complete sets of all modification drawings, sketches (if any) prepared by himduring execution of work.
(b) The Contractor shall make good all defects, deficiencies and omissions noted down during preliminary acceptance and shall inform in advance Employer/ Employer's representatives for conducting inspection for final acceptance. Final acceptance certificates will be issued by Employer/ Employer's representative only after all defects / deficiencies / omissions noted under preliminary acceptance have been certified.

**Acceptance of Work:**

(a) Acceptance of erected steel structures shall be either after completion of erection of the wholebuilding or in blocks.

(b) Intermediate acceptance certificates will be given in the following areas: -
   a. Any steel work or part thereof embedded in concrete.
   b. Steel structures, which are to be covered in the process of carrying further work.

(c) The following documents shall be prepared and produced by the Contractor at the time ofacceptance of erected steel structures: -
   a. Documents showing approved deviations made during execution of erection work.
   b. Documents showing acceptance of embedded structural steel work.
   c. Certificates / documents on control checking and testing of materials (if any) and welds.
   d. Data and results of geodetic measurements while checking the erection of structures.

**FUSION-BONDED EPOXY COATING**
**MATERIAL:**

To protect reinforcing steel against corrosion, the coating shall be providing a continuous film that will resist penetration by salt ions, resist the action of osmosis, adhere to and expand / contract with the steel substrate, resist breakdown from weathering and exposure and be flexible and durable enough for handling. Once the coating is cured, the coating shall not tend to soften with higher temperatures.

The FBE coating shall be done confirming to IS code 13620:1993. Patch up materials shall be procured in sealed containers. PVC coated 18G binding wire shall be used for tying reinforcement steel.

The epoxy coating shall achieve its beneficial properties as a result of a heat catalyzed chemical reaction. The dry powder shall be produced by combining organic epoxy resins with appropriate curing agents, fillers, pigments flow control agents. When heated, the powder shall melt and its constituent shall react to form complex cross-linked polymers.

The fusion-bonded epoxy coatings used for steel reinforcement shall not contain appreciable solvents or other environmentally hazardous substances. Also, systems used to apply the coating shall be very efficient resulting in very little material loss to the atmosphere or waste disposal.

**MANUFACTURING PROCESS:**

The application of fusion-bonded epoxy coating to steel reinforcement involves four major process steps:

**(a) Surface preparation**
**(b) Heating**
**(c) Powder application**
**(d) Cure**

In coating plants, rebar shall be first coated in straight lengths and then fabricated (i.e., cut to length and bent to shape).

**(a) SURFACE PREPARATION:** The objective of surface preparation shall be to assure thatmaximum adhesion will develop at the interface between the steel and the coating. Rebars shallbe blast-cleaned using abrasive grit to a near white metal finish. The process shall clean the steel of contaminants, mill scale and rust. It shall also roughen the surface to give it a textured anchor profile. The surface roughness shall key the coating to the steel and shall provide mechanical anchorage. Texturing the surface shall also facilitate adhesion by increasing the exposed surface area of the steel and shall provide more opportunity for chemical bonding of the coating. Chemical pre-treatments shall be used to supplement last cleaning and facilitate surface preparation.

**(b) HEATING:** After the bars have been blast-cleaned, they shall be heated to approximately 450 degrees F. This shall be usually accomplished using electrical induction heaters. The gas-fired heating shall be used in some cases.

**(c) POWDER APPLICATION:** The heated steel shall be passed through a

powder spray booth where the dry epoxy powder shall be emitted from a number of spray nozzles. As the powder leaves the spray gun, an electrical charge shall be imparted to the particles. These electrically charged particles should be attracted to the grounded steel surface providing even coating coverage. The dry powder shall hit the hot steel & shall melt and flow into the anchor profile (i.e., the microscopic peaks and the valleys on the surface) and shall conform to the ribs and deformations of the bar. The heat shall initiate a chemical reaction that causes the powder molecules to form complex cross-linked polymers that shall give the material its beneficial properties.

**(d) CURE:** Following powder application, the coating shall be allowed to cure a short period (approximately 30 seconds) during which time it shall harden to a solid. The curing period shall be followed by an air or water quench to reduce the bar temperature to facilitate handling.

Fusion-bonded epoxy coating shall protect against corrosion by isolating the steel from oxygen and chloride. Epoxy coating shall have high electrical resistance, which shall block the flow of electrons that make up the electrochemical process of corrosion. In addition to serving as an electrical circuit breaker, the coating shall protect in another way that is less obvious. Coating a steel surface shall reduce the size and number of potential cathode sites, which limits the rate of any corrosion reaction. in order for macro cell corrosion to take place, a large area of steelsurface shall be needed to act as a cathode where oxygen reduction can occur. Thickness for FBE coating shall not be less than 200 to 250 microns.

**STACKING & HANDLING:**

The epoxy-coated bars shall be stacked & handled carefully in steel yard during laying. The coated bars shall be carefully handled in order not to drop them, not to rub them on hard surface or against another coated bar while conveying, stacking, placing or stacking of fabricated bars & that for this purpose, wooden packing batons shall be used at spacing of not more than 60 cm. The coated barsshall be tied to make bundles with PVC binding material to avoid damages to coating. The cut ends of bars shall be touched up with special touch up materials of specifications as provided by coating agency. There shall be minimum time gap to repair the cut ends and damaged portions with touch up materials and that failure to do so may cause complete rejection of the coated bars the cut ends and damaged portions shall be touched up with repair patch- up material within four hours' time gap. All damages to coating in handling etc. shall be repaired irrespective of their size. This stipulation supersedes provision of I.S. Code.

**MEASUREMENT:**

The coating shall be done as per manufacture's specification & as directed by consultant. The measurement of reinforcement bars shall be taken in accordance with IS code & as specified in description.

**CEMENT POLYMER COMPOSITE COATING**

The application of the cement polymer composite coating system comprises the following sequence:

**SURFACE PREPARATION:**

The surface of the steel reinforcing bars to be coated shall be cleaned by abrasive (dry sand) blast cleaning to the near-white metal in accordance with SSPC - SP10/NACE No. 2-1994. It includes the following procedures:

(a) Prior to blast cleaning visible deposits of oil or grease shall be removed by suitable cleaningmethod.
(b) Clean dry compressed air shall be used for nozzle blasting.
(c) Dry uniformly graded silica sand shall be used for blast cleaning.
(d) Suitable arrangement shall be made in the sandblasting unit to suit automation.
(e) The pressure at the nozzle shall be regulated as per the supplier's specifications.
(f) Dust and residues shall be removed from prepared surface by brushing, blowing off with dry air.
(g) The surface shall meet the visual standards of comparisons as in SSPC- VIS1 or SSPC-VIS2.

**APPLICATION OF THE COATING:**

(a) The coating shall be applied as soon after cleaning and before oxidation of the surface. However,the application of the coating shall not be delayed more than 4 hrs after cleaning.
(b) A rapid setting primer shall be applied over the prepared surface either by brushing or dipping.
(c) After 30 minutes of application of the primer a cement polymer-sealing coat shall be appliedeither by brushing or dipping.
(d) The coated rods shall be handled after 6 hrs.

**REQUIREMENT OF THE COATED BARS:**

(a) Thickness of The Coating: After curing, the minimum average the dry film thickness of thecoated bars shall not be less than 150 + or - 25 microns.
(b) Continuities of The Coating: The coated rod when visually examined should be fairly uniform in thickness and should be devoid of any defects as cracks, peeling, bulging etc. No surface area should be left uncoated. No rust spot should be visible with the unaided eye.

**SPECIFICATION FOR PATCH REPAIRING OF COATING DAMAGES:**

Coating repair is required when peeling off and other damages exist. Prior to repairs, loose or deleterious material from the damaged area shall be cleaned. In case where rust is present it shall also be mechanically removed prior to repair.

After this, primer coat shall be brush applied. After curing (15-30 minutes) sealing shall be appliedand it is desirable to ensure a thickness of 150 microns.

**SPECIFICATIONS FOR CUTTING, BENDING AND WELDING OF COATED REBARS AT FIELD:**

(a) It is desirable that the coated rods shall be bend gradually.
(b) In the field, the cut and weld portion of the coated rebars shall be repaired by the sameformulation.
(c) It is advisable that the binding wires shall also be coated by the same formulation.

**THE COATING SYSTEM OF A PRIMER AND A SEALING COAT:**

(a) The primer shall have rapid Setting property as per Indian Pat. No. 481/DEL/93. Dated 13.05.93. The specification of primer shall be as under:
    I) Percentage of Solids: 30%

II) Coverage: 160 cc/m2
III) Colour: Strawberry

(b) The Sealing product shall be formulated with Resin mixed with a pigment. Indian Pat. No.259/DEL/92. Dated 25.03.92. The specification of Sealing product shall be as under:

a. Percentage of Solids: 30%
b. Coverage: 300 cc/m2
c. Colour: Olive Green

(c) A Passivating-cum-barrier type of coating and the product shall be formulated in such a way thatdue to elasticity and flexibility of the coating, the treated bars can be cut and bend afterwards.

**Applicable Codes and Specifications:**

The following specifications, standards and codes of practice (Latest edition) apart of these specifications and which are referred to herein shall be applicable all official amendments and revisions.

| | | |
|---|---|---|
| I | 383 | Specification for coarse and fine aggregates from natural sources for concrete |
| I | 432 | (All 2 Parts)– Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement. Part 1 - Mild steel and medium tensile steel bars, Part 2 - Hard drawn steel wires |
| I | 45 | Plain and reinforced concrete - Code of Practice |
| I | 875 | (All 5 Parts)– Code of Practice for design loads (other than earthquake) forbuildings and structures |
| I | 10 | Specification for steel doors, windows and ventilators |
| | 10 | Common burnt clay building bricks - Specification |
| | 1200 | (Relevant Parts) – Method of measurement of building and civil engineering works |
| | 1239 | (All 2 Parts)– Mild steel tubes, tubular and other wrought steel fittings,<br>Part 1 - Mild steel tubes, Part 2 - Mild steel tubular and other wrought steel pipe fittings |
| | 13 | Code of Practice for prestressed concrete. |
| | 1443 | Code of Practice for laying and finishing of cement concrete floor tiles. |
| | 1542 | – Specification for sand for plaster |
| | 1566 | – Specification for hard-drawn steel wire fabric for concrete reinforcement |
| | 17 | – Code of Practice for building drainage |
| | 1786 | – Specification for high strength deformed steel bars and wires for concrete reinforcement |
| | 18 | – Criteria for Earthquake resistant design of structures |
| | 1904 | – Code of Practice for design and construction of foundations in soils; general requirements |
| | 22 | – Code of Practice for brickwork |
| | 25 | – Code of Practice for bending and fixing of bars for concrete reinforcement |

| | | |
|---|---|---|
| | 2751 | – Code of Practice for welding of mild steel plain and deformed bars for reinforced concrete construction. |
| | 29 | (All 4 Parts)– Code of Practice for design and construction of pile foundations |
| | 29 | (All 5 Parts)– Code of Practice for design and construction of machine foundations |
| | 33 | (All 4 Parts)– Code of Practice for concrete structures for storage of liquids |
| | 37 | – Code of safety for excavation work. |

| | | |
|---|---|---|
| | 4014 | – (All 2 Parts) Code of Practice for steel tubular scaffolding |
| | 4081 | – Safety code for blasting and related drilling Operations |
| | 4138 | – Safety code for working in compressed air |
| | 6248 | – Specification for metal rolling shutters and rolling grills |
| | 9103 | – Concrete Admixtures - Specification |
| | 1026 | – Recommended guidelines for concrete mix design |
| | 1468 | – False work for concrete structures – Guidelines |

**SPECIFICATIONS OF PLUMBING, DRAINAGE & WATER SUPPLY**

**Materials**:

G.I. (B-Class) / CPVC pipes shall be used for all External Water Supply Pipe works.uPVC pipes shall be used for all SoilWaste, Rain Water and Drainage works. CPVC pipes shall be used for all internal Water Supply Pipe works.

uPVC Pipes for Soil, Waste and Rainwater, Planter and AC drains shall conform to I.S.13592-

1992 (type - B, SWR quality) for concealed pipe within the toilet sunk portion. The jointing of the pipes shall be in solvent cement joints. All the shaft piping shall conform to I.S.13592- 1992 (type - B, SWR quality). Vent Piping shall conform to I.S.13592- 1992 (type - A, SWR quality). All jointing in the shaft shall be by rubber ring joints. Rubber rings shall conform to IS 5382 and fittings to BS 4515 DIN 19531 & 19534. All the fittings like tees, bends, couplers cross etc. shall conform to IS 7834- 1975. The joints of uPVC Pipes recommended shall be solvent cement, flanged, or threaded, joints. Pipes and fittings shall be free of any defects like cracks, etc.

**Testing:**

Inspection & Testing Pipes and Fittings before Commencing Work:

All Pipes & Fittings shall be inspected before delivery at the site whether they bear where appropriate, the certification mark of the I.S.I.

**Testing of Service Pipes and Fittings:**
When the service is complete, it shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The Service shall be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipe shall be absolutely water-tight.

**Painting:**

a. All exposed G.I. pipes and fittings shall be painted with 2 coats of approved shade enamel paint over a coat of Zinc Chromatic primer while M.S pipes shall be painted with 2 coats of Zinc Chromatic primer with 2 coats of enamel pint to the satisfaction of Engineer / Employer.
b. All pipes concealed through wall of floor shall be protected with anticorrosive paint and hessian cloth.

**Sanitary Fixtures:**
All glazed Vitreous china sanitary ware shall conform to Indian Standard IS: 2556. The Vitreous China Sanitary ware shall be of first quality only. They shall be non-porous and fully vitreous, with allthe visible portions perfectly glazed and should absolutely be free from hairline cracks, pin-holes and local depressions. They shall be perfectly symmetrical, uniform and smooth. The chromium plated fittings shall match the vitreous china fixtures.

**Valves and Controls:**
All Valves (gate, globe, check, safety) shall be either all brass or gun metal valves suitable for the particular services. All valves shall be of the particular duty and design called for. Valves shall either be of the screw type or flange type, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:778-1971 (Gunmetal gate, globe and check valves for general purposes) and non- return valves to swing check type reflex (non return valves IS:5312 (Part I) 1969.

**Codes & Standards:**

All the applicable codes and standards updated and in force published by the Bureau of Indian Standards (BIS) and its subsequent revision and all other standards which may be published by them before construction work starts, shall govern in respect of design, workmanship, quality and propertiesof materials and method of testing for Plumbing, Drainage and Water Supply etc.

All materials shall conform and bear stamps of the required Indian Standard specifications. The

following is the list of applicable codes:

- IS: 651 - 1980 Specification for salt glazed stoneware pipes and fittings.
- IS: 778 - 1984 Specification for gunmetal gate, globe and check valves for water.
- IS: 780E - 1984 Specification for sluice valve for various purpose.
- IS: 781 - 1978 Specification for sand cast brass screw down bib taps and stop for water services.
- IS: 782 - 1983 Specification for caulking lead
- IS: 1172 - 1971 Basic requirement of water supply drainage and sanitation
- IS: 1239 - 1982 Specification for M.S. or G.I. Pipes.
- IS: 1536 - 1989 Specification for LA class Centrifugal cast (spun) iron pressure pipes for waterand sewage.
- IS: 1538 - 1976 Specification for cast iron fittings for pressure pipes for water and

sewage.

- IS: 1703 - 1977 Specification for ball valves (horizontal plunger type) including floats for watersupply purpose.

**Specifications of Works for Mechanical Components including Fire Fighting & CarParking Systems**
**Applicable Standards:**

Unless specifically mentioned otherwise all the applicable codes and standards updated and in force published by the Bureau of Indian Standards (BIS) and its subsequent revision and all other standards which may be published by them before construction work starts, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of these available standards are listed below:

(All materials shall conform and bear stamps of the required Indian Standard specifications).

- I.S.1239 Specifications for G.I. Pipes
- I.S. 778 Specifications for Gun Metal gate, globe, and check valves for water
- I.S. 800 Specifications for Structural steel.
- I.S. 3589 Specifications for ERW black pipes for water, gas and sewage Class I.
- I.S. 814 Specifications for covered electrodes for metal arc welding purpose of structural steel
- B.S 5155 Specifications for C.I. butterfly valve
- I.S. 4927 Specifications for Canvas Hose pipes
- B.S.1641 Specifications for C.I. Screwed fittings.
- I.S. 903 Specifications for Branch pipes
- I.S. 3844 Code of practice for installation of internal fire hydrant in Multi storied building.
- I.S. 5290 Specifications for landing valves (Courtyard Hydrant)
- I.S. 903 Specifications for coupling double male double female Instantaneous pattern for firefighting
- I.S. 2217 Recommendation for providing first aid firefighting arrangement in public buildings.
- I.S. 1879 Malleable Iron fittings Parts I to X.
- I.S. 1200 Method of measuring of building & civil engineering works (Water Supply, PlumbingDrain and sanitary fittings)
- I.S. 1538 Specifications for cast iron fittings for pressure pipes for water, gas and sewage.
- I.S. 4853 Recommended practice for radiographic inspection of Fusion welded butt joints in steelpipes
- I.S. 636 Synthetic, jacketed hose pipes
- I.S. 1520 Electrically Operated multistage/ multi-outlet pump
- I.S. 2198 Control Panels

**Works to comply with Local Regulations:**

All Fire Fighting works shall confirm to the prevailing local Bye-laws and/or rules and regulations of Local Bodies and the works shall be got inspected and approved by the various authorities having jurisdiction.

The work shall be carried out through a licensed Fire Fighting Agency.

In the interior of the building, all pipes whether of cast iron or G.I. shall be embedded in an approved manner in chase made in walls or floors if required by

the Engineer-in-charge. The Contractor shall make all necessary holes in the walls of masonry and concrete etc. and restore them to the original condition.

All cuttings, chasing and fixing work concealing work, shall be completed before commencement of any plastering tiling or finishing work.

The contractor shall be responsible for the adequacy and efficiency of the entire system.

The materials & equipment to be incorporated for use in construction of the work shall the responsibility of the contractor in totality.

The equipment of the fire-fighting system / fire prevention system shall be tested independently at various intervals and at completion. Where the situation calls for sectional testing (e.g. before embedding any piping within the building structure or before covering up pipes laid in trenches), the contractor shall promptly arrange such testing. All testing shall be done in the presence of Engineer - in- charge's representative and at intervals as desired by him. The contractor shall record all testing done by him in a 'Log Book' of approved form. The test results shall be countersigned by the representatives of both the Contractor and Engineer-in-charge. The contractor shall arrange for all facilities, labour, materials, kit and instruments required for testing. All expenses thereof shall be borne by the contractor.

**Fire Hydrant & Sprinkler System**
**Materials:**

All materials shall conform and bear stamps of the required standard specifications.

Samples of all materials shall be approved before placing order and the approved samples shall be deposited with Engineer-in-charge.

If so directed, materials shall be tested in an approved testing laboratory and the Contractor shall produce the test certificate in original to the Engineer-in-charge and the entire charges for original as well as repeated tests shall be borne by the Contractor. If required by the Engineer - in- charge, the Contractor shall arrange to test portion of the work at his own cost in order to prove their soundness and efficiency. If after any such test, the work or portions of work is found in the opinion of the Engineer-in-charge, to be defective or unsound, the contractor shall pull down and the same at his own cost. Defective Material shall be removed from site.

It shall be obligatory for the Contractor if so, required by the Engineer-in-charge to furnish certificatesfrom manufacturers or materials suppliers, that the work has been carried out using their materials and installed/fixed as per their recommendations/factory manuals.

**Steel Pipes:**

The M.S. pipes of 200 mm dia and above shall conform to IS:3589-1981 Class I Grade 330 with 6mm wall thickness and 150 mm dia and less G.I shall conform to IS: 1239 (Mild Steel Pipes, Tubular and Wrought Steel) heavy class only.

**Galvanizing:**

Galvanizing shall conform to I.S. 2529 (Hot Dip galvanizing of iron and steel). On delivery to site, the pipes and fittings shall be inspected for the galvanized coating and shall have identification for the class of pipes. Pipes with damaged coatings shall be segregated & removed from the site and not be used in the installation.

**Welding of Pipes:**

The welding of M.S or galvanized pipes and fittings shall be in accordance with "Recommendation for metal Arc welding of carbon and carbon manganese steel". IS: 9595 -1980. The electrodes usedfor welding shall comply with I.S 814 (part -1) 1974 and IS: 814 (part-2) 1974.

Preparing pipe faces for welding: Before aligning, assembling and welding the pipe faces shall be cleared by scraping by wire brushes or any other method specified by the construction Manager.

The welding shall show evenness in ripples or waves and well-formed beds with good fusion along the edge of weld. There shall be no unfilled cavities, small pockets of slags or burned metal air or gas pockets.

**Testing of Welded Joints:**

The welded joints shall be tested in accordance with the procedure laid down in I.S.3600, (Part I)1973 suitable means as desired by Engineer-in-charge.

**Welding of Closure Gaps:**

Final welding of closure gaps shall be carried out with in a temperature range of average air temperature +8 Degree C.

**Jointing of Pipes:**

All pipes M.S./G.I. shall be joined by means of arc welding after laying in correct position and shall have flanged joints at every 20 M straight length and at change in direction/change in size/branch connections. M.S. Flanges shall conform to I.S 1538 part IV to part VI table E which shall be cut and drilled out of M.S. Plates. M.S. cut flanges shall be galvanized before welding to G.I. Pipes. All gaskets for flanged joints wherever required shall be of Neoprene 6mm thick with G.I. nuts and bolts. Welded joints shall be covered with a coat of epoxy paint, applied after preparation of surface and appropriate primer. Inspection Before Installation:

M.S and G.I. pipes, fittings and specials shall be inspected before delivering at the site for the brand, quality, etc. The pipe and fittings shall be inspected at the site again before laying and defects noticed, if any, such as protrusion, grooves, dents,

etc. shall be rectified. Care shall be taken that the resulting wall thickness does not become less than the minimum. Any damaged portion shall be cut-out as a cylinder and replaced by an undamaged piece of pipe.

**Handling of Pipes and Specials:**

It is very essential to avoid damage to the pipes, fittings specials etc., at all stages during handling. The pipes & specials shall not be distorted of their circular shape and galvanizing shall not be damaged. Pipes shall not be thrown down while unloading.

**Laying of Pipes:**

The pipes cut to required lengths shall be laid to required gradients and joined by welding or by flanged joints as called for. The laying of welded pipes shall comply to IS:5822-1986, "Code of practice for laying of welded pipes for water supply".

**Testing of Pipe Line:**

**(a) Field Test:**

The field test of pipes shall be carried out as per I.S. 1538.

**(b) Procedure of Test:**

All air shall be expelled from the pipe line through hydrants and air valves. Each valve section ofpipes shall then be slowly and carefully filled with water and allowed to stand full of water for a few hours if time permits. The specified test pressure based on the elevation of lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer-in-charge. Due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been re-calibrated before the test. The test pump having been stopped, the test pressure shall maintain itself without measurable loss for at least Two hours or as directed by Engineer-in-charge. The pipes shall be tested in sections as the work of laying Proceeds, and joints inspected during testing. The open end of the pipe line may be temporarily closed for testing under moderate pressure by fitting a water tight expanding plug. The end of the pipe and the plug shall be secured by struts or other wise to resist the end thrust of the water pressure in the pipes.

**M.S. C.I. Brackets/hangers:**

All M.S. Brackets/Hangers for supports of M.S, G.I. pipes and fittings shall be fabricated out of mild steel section such as channels, Angles, Tees, Flats etc., or shall be cast iron as per site conditions asper drawing or as suitable, as per I.S. Code. The brackets, hangers etc. shall be fabricated to required sizes and shapes and installed in position as shown on drawings or as required as per site conditions. The welding and other Operations involved in fabrication shall be carried out as per relevant specifications and best trade practices.

M.S. Brackets/Hangers shall be thoroughly cleaned by wire brush to make the surface clear from any rust before application of paint. The brackets/Hangers shall be fixed to the ceiling by Anchor fasteners, as directed by the Engineer-in-charge. In case the brackets cannot be fixed by above methoddue to site condition, they shall be grouted in to the slab with the permission and as directed by the Engineer-in-charge.

Sturdy Hanger, Brackets and saddles of approved design shall be installed to support all pipe lengths, which are not embedded over their entire run. The hangers and brackets shall be of adjustable heights and primer coated with zinc chromate primer. Clamps, collars and saddles to hold pipes shall be provided with nuts, bolts and suitable gaskets. The brackets and hangers shall be designed to carry the weight of pipes safely and without any deflections. All pipes and fittings shall be supported at a maximum of 3 M run of pipe and at change of direction or wherever required as per site conditions. Where called for, pipe hangers shall also be supplied with proper sound and vibration dampening devices, to minimize noise and vibration transmission.

Details of piping support both for Horizontal and vertical pipes are shown in the relevant drawingsand shall be strictly followed by the Contractor.

Fire water main pipes or headers shall be supported on M.S. Cradles, fabricated out of M.S. angles of suitable size and verticals made out of M.S. flat of suitable size hooked to reinforcement in slab aboveand pocket grouted properly.

**Painting:**

This painting clause is applicable to all the structural & mechanical items, cabinet housing electrical controls etc. Items manufactured indigenously will follow relevant standards by Bureau of Indian Standards. For items manufactured outside India EN standards may be followed.

Painting shall be applied to all iron and carbon steel surfaces exposed to the atmospheric action after surface preparation. Items made of asbestos, Aluminum, brass, bronze, galvanized steel, stainless steeland other corrosion resistant alloys, rubber, synthetic polymers, fiber reinforced plastics, and buried pipe work (for which separate protection is required) are not required to be painted except for aesthetic purposes and / or for identification.

The painting process will consist of surface preparation, Application of prime coat, application of intermediate coat where required and finally application of the finish coat and touch up.

The paint material shall conform to the relevant standards by Bureau of Indian Standards. The Make & Shade of the paint shall be approved by the Engineer / Employer.

Primer paint shall be applied on dry and clean surfaces. Intermediate paints formulated with micaceous iron oxide (MIO) to be applied over prime coats where required as an intermediate layer to provide weather proof sealing of prime

coat. Finish paint of approved color to IS 5 shall applied over prime and intermediate coats. Proper cleaning and touch up should be done at all level.

The colour scheme for the moving items shall follow the relevant standards by Bureau of Indian Standards.

**Standards for Painting**

| | | |
|---|---|---|
| IS | 5 | Colors for ready mixed paints and enamels |
| IS | 384 | Brushes, Paints and Varnishes, Flat Specification |
| IS | 958 | Temporary corrosion preventive grease. |
| IS | 1153 | Temporary corrosion preventive fluid |
| IS | 2074 | Ready Mixed Paint, Air Drying, Red Oxide Zinc Chrome, Priming - Specification. |
| IS | 9954 | Pictorial Surface Preparation Standards for painting of Steel Surfaces |
| IS | 1094 | Code of Practice for Painting procedure for Machine Tools. |
| IS | 8501 | Preparation of steel substrate before application of paint. |
| SI | 0559 | Pictorial surface preparation standard for painting of steel. |

**C.I. Non Return Valves:**

The non-return valve shall be double flanged cast iron of approved make. Re coil check valve with cast iron body with all internals made of Gun Metal or Wafer Type Check Valve.

**Orifice Plates:**

These shall be specially designed orifice plates wherever required on hydrant outlets of suitable size for adjustment of delivery pressure, where running pressure exceeds 7 kg/cm2.

**Hydrant Valves:**

Hydrant valves shall be as per I.S. 5290. The hydrant valves shall be Gun Metal Morris pattern approved by Fire Brigade with necessary nuts, bolts & gaskets etc. The valve shall be right angled, turn down and other types having instantaneous female plunger type out lets with chained blank cap. Flanged inlets gunmetal or light alloy with C.I. Or brass hand wheels tested to 21 kg/cm2 pressure. The valves shall be either single outlet or Double outlet as required.

**Fire Brigade Connection:**

Fire Brigade inlet connection with 4 (four) connecting points fabricated out of G.I. Pipes and incorporating a C.I. non return valve for fire and sprinkler system.

The fire brigade connection shallbe connected to the 1) Fire storage tank 2) Fire wet riser system 3) Sprinkler system at appropriate locations.

**Sprinklers:**

Sprinklers shall be `GRINNEL/AUTOMATIC' Type F UNDER WRITERS LABORATORY/Factory mutual listed or approved equivalent. The bulb shall be quartzoid bulb with a temperature rating of 68 deg.C. The sprinklers shall be pendant type / Side Wall / Recessed type as called for.

The Orifice size shall be 15 mm with Gun Metal Body, Bronze finish and quartzoid bulb as heat sensitive element and universal deflector. The discharge pattern for pendant sprinklers shall be spheroidal covering an area of 9 sq. meters. Sprinklers shall be mounted up right/ suspended in pendant position.

**Installation Control Valve:**

Installation Control valves shall be wet type, flanged of suitable size with cast iron body, bronze seating Alarm valve clack, Drain and test valve, pressure gauge on upstream and downstream and water motor going to be automatically Operated on loss of pressure in the system. The water motor gong shall be pelton wheel type or electric alarm.

**Court Yard Hydrant:**

The Court Yard Hydrant landing valve shall be as per I.S. 5290. The valve shall be a single outlet oblique type hydrant valve with instantaneous coupling Gun Metal Body and hand wheel to be fixed on a stand pipe of minimum 80mm dia.

**Hose Pipe For Court Yard Hydrant:**

Fire hose shall be synthetic, jacketed type with unified lining and cover of special polymer compound designed to resist impact, abrasion, damage, weathering by ozone, burning oils and chemicals. It shall conform to IS: 636 type B with instantaneous couplings (Male & Female) screwed, with 16 gauge G.I. wire on either end.

**Connection Pipes:**

Connection pipe shall be as per IS-903 long type with copper body with Male inlet and screwed bronze type 20 mm nozzles.

**Pressure Gauge:**

The pressure gauges shall be of 'BOURDEN TYPE' with +/- 1% accuracy. The size or diameter of the dial shall be 150mm with a pressure range from 0 to 16 kg./sq.cm. The measuring element type shall be `BOURDEN' and material shall be SS-316.

**Automatic Sprinkler and Fire Alarm Installation (Wet System):**

Installation Control Valves and shall be wet type, flanged of required size with **C.I.** body, bronze seating alarm valve clack, drain and test valve, pressure gauge on upstream and downstream and watermotor going to be automatically Operated on loss of pressure in piping. The water motor gong shall bePelton wheel type or electric alarm. **Stop Valve:**

The valve shall be of wedge type and be provided with an indicator showing the valve in open or closed position. It shall be secured in the open position by a padlock and strap. This valve controls the water supply to installation and must always remain open.

**Alarm equipment:**

The Alarm equipment to be provided shall give a loud alarm in case of fire. This equipment shall come into Operation when water flows through the installation valves to sprinkler when opened due to fire. The equipment shall consist of simple and positive action main parts namely i) Alarm valve, ii) Alarm Stop Valve, iii) Alarm Motor & Gong

**Alarm Valve:**

Alarm valve shall have a cast iron body & be fitted with a Bronze seating and valve guide clack resting on the bronze seating. The flat circular Bronze plate of the clack shall be faced with a special

composition disc, and shall rest on the seating and prevent access of water to the groove. When water flows into the installation, clack shall lift and water shall flow through groove and open alarm stop valve to the alarm motor.

**Alarm Stop Valve:**

Alarm stop valve shall have an indicator to show whether it is open or closed. Alarm stop valve shall control the flow of water from Alarm valve through annular groove to the alarm motor. It should have a strap to keep the valve in open position to give alarm when the fire takes place.

**Alarm Motor and Gong:**

The Alarm Motor shall be of Pelton wheel type. The whole unit shall be simple and robust construction and shall give a reliable service. Suitable Drain pipe shall be provided to discharge water through drip plug with an orifice to restrict the rate of discharge. This shall not iMPair the Operation of Alarm motor and gong.

**Drain and Test Valve:**

The drain pipe size shall be 50mm dia. The test valve shall have to be in closed position secured by a strap. 15mm dia size test valve shall be provided to test the Alarm when the test valve is opened,water shall flow through Alarm valve, lift alarm valve clack from its seat and allow water to flow to the Alarm Motor. Valve shall be in closed position when not in Operation and shall be secured withthe strap.

**Examination Under Pressure**

Under the test pressure no leak or sweating shall be visible at all section of pipes, fittings, valves, Hydrants & welded joints. Any defective workmanship and defective pipes, fittings, valves or Hydrants discovered in consequence of this pressure test shall be removed and replaced with acceptable material & the test shall be repeated until found satisfactory by the Engineer.

**Testing:**

The contractor shall be required at his own expense to test the installation with water. The minimum test pressure shall be 50% higher than the system pressure. Pressure shall be 50% higher than the system pressure. When the installation is completely carried out, proper stoppers, screws, plugs, hose, etc. must be provided for this purpose. If required, these shall be taken out and re-laid at thecontractor's expense. The required quantity of water for testing will be provided by the owner. The installation shall be guaranteed against faulty material, workmanship and design. The defect liability period is for 12 months and design and the period commence from the date of commissioning of the whole installation along with the approved certificate from the authorities. During this period the contractor shall be responsible for any repairs or replacement of any defective part and shall rectify the installation free of cost to the owner.

The contractor shall train the BUIDCO/MCF personnel for the proper maintenance of the Installation.

**SPECIFICATION FOR INTELLIGENT ANALOG ADDRESSABLE TYPE FIREDETECTION AND ALARM SYSTEMS**

The main / local fire alarm control panel and loop devices including sensors, Manual call points, interface & relay units should be sourced from the same ISO 9002 certified manufacturer to ensure compatibility between hardware and software.

All basic equipment proposed and planned for use shall be formally approved by at least one internationally recognised testing labs and/or approval from all the concerned authority y for the system offered, few or which are listed below

| | | |
|---|---|---|
| a) | UL | - Underwriters Laboratories, USA. |
| b) | FM | - Factory Mutual, USA. |
| c) | B.S. | - British Standards, Great Britain |
| d) | U.L.C. | - Underwriters Laboratories, Canada |

Contractor shall obtain clearance and approval of drawings from the following Authorities

- Local Fire Authorities
- Tariff Advisory Committee

All control equipment's and loop devices including sensors, interface modules, relay units etc. are to be manufactured by a single company to ensure total compatibility and faultless communication of the FAS.

The system shall be capable of connecting signal devices (hooters, horns, flash light etc) & Monitor Devices (sensors, MCP's etc) in the same loop irrespective of difference in the principle of operation and should not require separate loop. This would reduce the no. of cards installed in the system and thus maintenance would be easy.

Sensors should be provided in the ducting used for the air-conditioners in addition to those used below the ceiling.

The system shall be one of the latest generations of INTELLIGENT ANALOG SYSTMS whereby it shall be the FIRE ALARM PANEL that determines that a fire situation really exists and not the device in alarm. This should be possible so as to eliminate the false alarms.

The system should have the optional facility to be connected into a Network in future, by adding the required cards, and thus Operate as a Node of that Network while maintaining its Local Mode Operation.

Monitoring and Control Equipment:
Standard Features

i. The Fire Alarm Control Panel should be manufactured by an ISO 9002 company and be ULlisted for NFPA 71, 72, UL 1076 Security Operation or similar and approved by FM or a similar laboratory in addition to approvals from local authorities.

ii. This should be capable of optional 100% Hot redundant Operation with identical other panel or 100% Redundant Operation with standby processor.

iii. To provide maximum efficiency in performing primary fire alarm functions, the main operator panel should give access only to the indication and interaction keys required in Emergency situation. For increased functionality operator should need to open "Access Door" to access the additional operator keys.

iv. The depth of the Operators interaction with the control panel should be protected by at least 4 software programmable Access levels so that specific functions may be allowed only to designated persons. It should be capable of assigning min 20 discrete passwords to identify individual operator. The user specific code shall be stored in the on line history log to identify the individual responsible for activating the function.

v. The main panel shall have a 2 X 40 character Back-lit Super Twist Alpha Numeric LCD Display screen, which may be visible under any lighting condition. Vacuum fluorescent displays, which may consume high levels of current and are not readily visible in high ambient light conditions, shall not be used. At least 40 character of the LCD display shall be available for customer text to describe the location of a zone or device.

vi. Each loop must be able to support minimum 127 addressable input and/or output devices in any combination.

vii. The memory of the panel shall be non-volatile. Systems requiring a power source to maintain siteprogrammed data are not recommended.

viii. The system shall have self contained (internal) standby battery as a part of the Intelligent power supply with automatic charger. The charger must be capable of Automatically adjusting theBoost or trickle charger according to the requirement of the Battery. The charger must be able to charge the battery backup required for 24 hrs. of normal Operation and 10 minutes of alarm Operations in case of mains failure. There should be complete supervision of the power supply from main panel.

ix. The LCD Display on the main panel shall be capable of displaying all the information about the current status of the power supply, Battery and charger (low/no battery, Battery voltage, peak current, Battery current etc.)

x. The main panel should be able to supervise and monitor supervisor services (water flow switches, tamper switches etc.) in addition to the fire alarm system. There should be a dedicated supervisory service indicator LED & acknowledge on the main panel.

xi. Alarm, Trouble & Supervisory conditions should have separate LED's & acknowledge keys. Operation of the appropriate Acknowledge Button, silences the Tone Alert but the LED remains illuminated until all conditions in that category are restored to normal.

**Software Features**

i. The control panel shall be fully site programmable by Laptop computer i.e. field programmable, configurable and expandable in the field without the need for any material to enable such programming to be undertaken. A down loading facility with suitable hardware and software via a PC shall be provided.

ii. In addition to the above it should have the facility to connect an optional external CRT – keyboard and/or printer through RS – 232 port card. There should be no need to provide anyextra software or compatibility of the printer / CRT keyboard with the main panel.

iii. The CRT should be able to display all the Historical logs and other information that the Main Panel displays. In addition, it should be possible for the CRT/Keyboard to perform all the basic functions that the main panel performs.

iv. The system should have a One Person walk test capability to allow for one person to physically test system devices to reduce further maintenance costs. It should be possible to make a minimum of 8 walk test groups so that even if one group is in walk test the others remain in Normal Working condition.

v. The control panel must be fully field configurable, programmable and editable and should perform programmable functions like changing circuit labels, selective signaling, coding, selective relay control, priorities, cross zoning, 2-stage alarm etc.

vi. The control panel shall allow for cross zoning or looping of sensors i.e. a detector on any loop may be assigned to any zone. This will prevent the need for excessive wiring.

vii. The control panel shall have the facility of field selectable alarm verification by zone, by groupof zones, or by system.

viii. The control panel should contain a non-volatile Historical Event Log with a minimum of 600 events ready for display or printing. Only printing is not acceptable substitute for Display. Trouble events (300) and alarm event s (300) should be stored in a separate Log for easy diagnostics.

ix. The control panel shall have total control over the sensor in all respects. It should allow for sensitivity / alarm level programming for sensor so that the system is tailored to relevant site conditions.

x. The main control panel should be capable of displaying the detailed information about the sensor (current analog value, average analog value, set sensitivity, alarm level, address of sensor, condition of sensor, location of sensor, troubles if any etc.) on the LCD display.

xi. In case of the heat sensor the ambient temperature of the environment in which the sensor is mounted should be displayed on the LCD panel directly in C or F.

xii. A facility shall be provided to give a pre-warning of devices that were almost dirty. If actions not taken at this warning a second should be displayed telling that the sensor is "excessively dirty" and needs immediate maintenance.

xiii. It shall be possible to program a day/night facility with programmable alarm delay to reduce the unnecessary evacuation of the building during working hours.

xiv. Main panel shall have features like:

a. Field selectable signal silence inhibit
b. Software based field programmable (per circuit) selective zoned PNIS coded, temporalcoded, march time coded or master coded Operation
c. Sprinkler flow/gate valve supervisory monitoring
d. Alarm / trouble resound
e. Supervised serial annunciator connection
f. Built-in alarm verification tally for alarm verification zones
g. Optional remote serial (two-wire) alarm and trouble annunciation with optionalacknowledge and reset switch, trouble signal, trouble light and trouble signal silence switch

xv. There should be an optional facility in the main panel to integrate voice communications (oneway communication). For details refer to Annexure –

xvi. The control panel should allow for addition of card for interfacing optional supervised serial annunciators, graphic annunciation modules etc.

**Sensors:**

i. **Intelligent Analog Addressable Photoelectric Smoke Sensor** compatible with a common base and approved by UL, ULC, FM or a similar laboratory. The sensitivity of this sensor should be adjustable from the Main Panel in 7 steps ranging from a minimum of 0.2% (UL Certified) to a maximum of 3.7% per foot of smoke obscuration.

ii. **Intelligent Analog Addressable Heat Sensor** compatible with a common base and with combined Fixed Temperature Element and Rate of rise Element and approved by UL, ULC, FM or a similar laboratory. The Rate of rise Operation should be selectable in either a 15F (8.3C) per Minute or a 20F (11.1C) per Minute Rate of Temperature rise. Fixed Temperature setting should be entirely independent of the Rate of rise Operation and should Operate at 135F (57.2C)

**iii. Other Requirement of Sensors:**

a. All intelligent Addressable Analog Sensors should be manufactured by the same manufacturer as that of the control panel so as to assure complete compatibility and communication with the system.

b. All sensors (both f& heat) shall be similar in appearance so that, when different detectors are required within the same area, a balanced and aesthetically pleasing effect is provided.

c. A full range of detectors shall be available and identical in appearance as follows:

d. Each detector's "hard" Address must be Dip Switch selectable and the switch must be withinthe detector's base only. The Dip-switch shall be below the sensor Head (In Base) to preventthe ingress of dust and other foreign matter.

e. Each detector shall incorporate a LED to for staff identifying the device in alarm. In the alarm condition, the LED shall illuminate continuously until the system is reset. In the normal working condition, the device LED's will flash to a pre- defined time period indicating normal Operation of the unit. If any unit is incorrectly addressed, then the duplicate addressing shall be identified by the panel.

f. All sensors shall be low profile & have an earth bonding point on each sensor base.

g. All sensors shall have 30 mesh insect screens & have completely closed backs to restrict entry of insects, dust & air turbulence which may drastically affect the Operation of the detector.

h. Electronics of the unit shall be completely shielded to protect against False Alarms fromEMI & RFI.

i. The sensors shall contain Locking screw to discourage unauthorized Tampering.

j. The detector should contain a functional test switch (magnetically Operated) that when Operated, will test the electronics of the unit and put it into the alarm.

k. The sensors should have arrangement to connect to optional bases with sounder, Relay driver for Remote Relay & Remote Alarm LED indicator Operation.

l. All sensors must have Automatic self-test feature meeting NFPA 72 sensitivity Test requirements which tests the sensor every minute thus reducing maintenance cost.

m. All smoke sensors shall have the facility for selection of two sensitivities for a dual stage Operation. A system unable to satisfy this requirement is unacceptable.

n. All sensors should have a facility of Automatic Environmental compensation i.e. once set the sensitivity should remain fixed irrespective of the various environmental factors like Temperature, Humidity, Dust, Dirt etc. No Drift in the sensitivity shall be allowed.

o. Wrong device connection must immediately give trouble condition at the panel. However, the device must still Operate at its default setting to protect the premises.

## SPECIFICATIONS FOR CAR PARKING SYSTEMS

### Design & Specifications

The bidder has to provide the complete design, drawings and specification of each component to beused in Car Parking System with reference to following or any other relevant code / specifications:

i. KIS/JIS
ii. American National Standard Institute (ANSI)
iii. Building Officials and Code Administrators of America (BOCA)
iv. International Standards Organization (ISO)
v. Fire Protection for these semi-automatic car parking systems should fulfil - National FireProtection Association of America (NFPAA) as well as NBC (National Building Code) of India.
vi. National Electric Code of America (NEC)
vii. Safety Code for Mechanized Parking Garage Equipment of America (ASA.A113.1)
viii. American Society of testing Materials (ASTM)
ix. International Society for Measurement and Control (ISA) (x) ISO 9000 – as per latest dataavailable
x. American Society of Mechanical Engineers code on Storage Retrieval (S/R) Machines andAssociated Equipment (ASME B30.13)
xi. National Mechanical Code of America (NMC)

In line to the above standards the contractor must take care of the following aspects:

a. The contractor must use structural steel of following grades for semi-automatic parkingsystems
   i. Rolled steel sections: IS 2062 Fe 410W A
   ii. Plates up to 20 mm thickness: IS 2062 Fe 410W A
   iii. Plates above 20 mm thickness: IS 2062 Fe 410W B
   iv. Sections & plates -medium or high tensile steel: IS 8500
   v. Circular steel tubes: IS 1161 Yst 240
   vi. Rectangular or sq hollow steel sections: IS 4923 Yst 240
   vii. Rails or crane rails: IS 3443

b. This steel must be galvanized.
c. No compromise must be made in safety. All the components of the car parking systems mustmatch international safety standards as per the codes mentioned above.
d. Adequate sensors must be provided by the contractor for these semi-automatic car parkingsystems as per the above standards so that the functioning is very smooth.

**Technology**

The bidder will also provide the following details / documents:

i. Certificates from concerned authority of the projects where the proposed parkingtechnology/product has been installed in either India or abroad stating its functionality.
ii. Certificate from the vendor regarding suitability in context of the site.
iii. Technology management & know-how transfer arrangements.

**Concept**

i. Based on surveys and investigations conducted by the Contractor, the Contractor will Plan a comprehensive proposal for providing the Multi Level Automated Car Parking Facility for a total of Minimum 150 car spaces through 6 level structure (G+5 levels).

ii. 4levels shall be proposed to be allocated for Sedans and 2 levels shall be allocated for SUVs / cars
iii. The prevalent mechanism at the entry exit gate for the bomb/ explosive detection must be provided for scanning the vehicles.

iv. The parking capacity must be worked out in terms of no. of Equivalent Car Space (ECS) proposed.

v. While designing, the Contractor shall take care of Integration Arrangement with surrounding traffic flow and street network

**General Specifications for the Car Parking Facility**

i. Once the car enters the premises, it is to be cleared through a bomb detection test.
ii. Before parking the Car, the user has to authorize himself / herself through a swipe card / barcoded ticket/ permanent access card as prescribed in the car parking management system.
iii. The average time taken for the automatic car parking system to park and retrieve cars mustnot exceed 3 minutes on an average.
iv. The noise level of the car parking systems must not exceed 90 db during any given time.
v. DG Sets should be connected to the car parking systems to park and retrieve cars in caseof power failure.

**Standards**

The following BIS Standards are applicable to structural work. However, this list is not exhaustive

| | |
|---|---|
| 5 | Colours for ready mixed paints and enamels |
| 277 | Galvanized steel sheets (plain and corrugated) |
| 800 | Code of Practice for general construction in steel |
| 814 | Covered electrodes for manual metal arc welding of carbon and carbon manganese steel |
| 816 | Code of Practice for use of metal arc welding for general construction in mild steel |
| 822 | Code of Procedure for inspection of welds |
| 875 | (All 5 Parts)– Code of Practice for design loads (other than earthquake) |

| | |
|---|---|
| | for buildings and structures |
| 1024 | Code of Practice for use of welding in bridges and structures subject to dynamic loading |
| 1030 | Carbon steel castings for general engineering purposes |
| 1161 | Steel tubes for structural purposes – Specification |
| 1182 | Recommended Practice for radiographic examination of butt joints insteel plates. |
| 1254 | Corrugated Aluminum sheet |
| 1363 | (All 3 Parts)– Hexagon head bolts, screws and nuts of product grade C |
| 1364 | (All 5 Parts)– Hexagon head bolts, screws and nuts of product grade Aand B |
| 1367 | (All 20 Parts)– Technical supply conditions for threaded steel fasteners |
| 1477 | (All 2 Parts)– Code of Practice for painting of ferrous metals inbuildings |
| 1852 | Rolling and cutting tolerances for hot rolled steel products. |
| 1893 | Criteria for Earthquake resistant design of structures |
| 2016 | Specification for plain washers |
| 2062 | Steel for general structural purposes – Specification |
| 2074 | Ready mixed paint, air drying, red oxide-zinc chrome, priming - Specification |
| 2595 | Code of Practice for radiographic testing |
| 2629 | Recommended Practice for hot-dip galvanizing of iron and steel |
| 3443 | Crane rail sections |
| 3600 | (All 9 Parts)– Method of testing fusion welded joints and weld metal insteel |
| 3657 | Radiographic image quality indicators |
| 3658 | Code of Practice for liquid penetrant flaw detection |

| | |
|---|---|
| 3664 | Code of Practice for ultrasonic pulse echo testings of contact andimmersion methods |
| 3757 | Specification for high strength structural bolts |
| 4000 | Code of Practice for high strength bolts in steel structures |
| 4260 | Recommended Practice for ultrasonic testing of butt welds in ferriticsteel |
| 4759 | Hot Dip Zinc coating on structural steel and other allied products |
| 4923 | Hollow steel sections for structural use |
| 4943 | Assessment of butt and fillet fusion welds in steel sheet, plate and pipe |
| 5334 | Code of Practice for magnetic particle flaw detection of welds |
| 5372 | Taper washers for channels (ISMC) |
| 5374 | Taper washers for I-beams (ISMB) |
| 5624 | Foundation bolts – Specification |
| 6623 | Specification for high strength structural nuts |
| 6649 | Specification for hardened and tempered washers for high strengthstructural bolts and nuts |
| 6755 | Double coil helical spring washers |
| 7215 | Tolerances for fabrication of steel structures |

| | |
|---|---|
| 7280 | Bare wire electrodes for submerged arc welding of structural steel |
| 7293 | Safety code for working with construction machinery. |
| 8500 | Structural steel – Micro alloyed (medium and high strength qualities) – Specification |
| 8062 | (All 3 Parts) Code of Practice for protection of iron and steel structuresform atmospheric corrosion |
| 9595 | Metal arc welding of carbon and carbon manganese steels – Recommendation |
| 12843 | Tolerances for erection of steel structures |

**Car Parking Mechanical Machinery**
**General**

(a) Each machine is a complete unit serving a specific purpose. The selection, design and construction of the machine or any of its elements shall be to suit the specific purpose and satisfy the demands of good engineering practice. These guidelines are provided to maximize the interchangeability and to minimize the maintenance.

(b) In the interest of availability of maintenance spares certain brands may be preferred over others. Regarding choice of machine or machine elements for foreign brands, the brand with presence in India will be preferred, provided the same is technically suitable for the purpose.

(c) Components shall be designed to meet the specified requirements – hardness, strength, rigidity, resistance to wear and fatigue etc. Due care in their detailing is to be taken to avoid stress concentration.

(d) Sub-assemblies and machine elements shall be easily dismantled without disturbing the neighbouring units as far as possible.

(e) All large and or critical rotating parts shall be statically and dynamically balanced.

(f) After selection of the motor, the elements down the line should be designed for the maximum starting torque or break down torque whichever is higher

**Manufacturing Methods**

(a) Carbon steel forgings will be as per IS 2004. Other forgings will be as per relevant IS.

(b) Carbon steel black bars for production of mechanical parts will be as per IS 2073. Bright steel bars as per IS 9550 may also be used as raw material for production of mechanical parts, it the strength and other requirements permit.

(c) Iron Castings will be as per IS 210 and IS 14329.Steel castings will be as per IS 1030, IS 2644, IS 2707, IS 2708, IS 3444Non-ferrous castings will follow the relevant IS.

(d) Selection of electrodes, procedure, testing and any other aspect of welding in steel will be as IS 814, IS 822, IS 1182, IS 3600, IS 4260, IS 5334 and IS 9595. Welding and brazing of other metals will follow national and international practice.

(e) Machining and tolerance of various items like couplings, gears, key and keyways, shafts, splines, sprockets, V-belt pulleys etc will be to relevant IS.

**Mechanical Systems**

(a) Couplings, electric brakes, electric motors, fasteners, gear boxes, roller chains, V-belts, various kinds of ball and roller bearings etc will be bought out items of reputed and approved brands. Appropriate factor of safety shall be used for all these items depending on torque transmitted / resisted.

(b) For ball and roller bearings the expected ISO basic Operating hours L10h will be around 40 000 (forty thousand). The static rating of the bearings must have an appropriate, depending on the type of application, factor of safety over the rated loads.

(c) For structural welded machine frames steps are to be taken to avoid time dependent distortiondue to locked up stress. The seating of motor, gearbox etc is to be machined after fabrication. During assembly shim packs are to be used as required following good engineering practice.

(d) Centralized lubrication is preferred.

**Standard**

The following BIS Standards are applicable to Car Parking Mechanical Machinery. However, this listis not exhaustive:

| | |
|---|---|
| 28 | Phosphor bronze ingots and castings |
| 210 | Grey iron castings – Specification |
| 305 | Specification for aluminum bronze ingots and castings |
| 306 | Tin bronze ingots and castings |
| 318 | Specification for leaded tin bronze ingots and castings |
| 617 | Aluminum and Aluminum alloy ingots and castings for general engineering purposes |
| 814 | Covered electrodes for manual metal arc welding of carbon and carbon manganese steel |
| 816 | Code of Practice for use of metal arc welding for general construction in mild steel |
| 822 | Code of Procedure for inspection of welds |
| 919 | (All 2 Parts) ISO system of limits and fits Part 1 Bases of tolerance, deviations and fits, Part 2 Tables of standard tolerance grades and limit of deviations for holes and shafts |
| 1030 | Carbon steel castings for general engineering purposes |
| 1182 | Recommended Practice for radiographic examination of butt joints insteel plates. |
| 1363 | (All 3 Parts)– Hexagon head bolts, screws and nuts of product grade C |
| 1364 | (All 6 Parts)– Hexagon head bolts, screws and nuts of product grade Aand B |
| 1365 | Specification for slotted countersunk head screws |
| 1366 | Slotted cheese head screws - Product grade A |
| 1367 | (All 20 Parts)– Technical supply conditions for threaded steel fasteners |
| 1368 | Dimension of end parts with external ISO metric threads |
| 1458 | Railway bronze ingots and castings |
| 2004 | Carbon steel forgings for general engineering purposes |
| 2016 | Specification for plain washers |
| 2031 | Driving and driven machines - Shaft heights |

| | |
|---|---|
| 2048 | Specification for parallel keys and keyways |
| 2073 | carbon steel black bars for production of machine parts for general engineering purposes |
| 2102 | (All 2 Parts) General tolerance Part 1 Tolerance for linear and angular dimensions without individual tolerance indications Part 2 Geometrical tolerance for features without individual t tolerance indications |
| 2232 | Specification for slotted castle nuts |
| 2269 | Hexagon socket head cap screws |
| 2291 | Specification Tangential keys and keyways |
| 2292 | Specification for taper keys and keyways |
| 2293 | Specification for gib-head keys and keyways |
| 2294 | Specification for woodruff keys and keyways |
| 2327 | Straight sided splines for cylindrical shafts with internal centering - Dimensions, tolerances and verification |
| 23 | Slotted grub screws |
| 2403 | Short pitch transmission precision roller chains and chain wheels |
| 2494 | (All 2 Parts)– V-Belts - Endless V-belts for industrial purpose – Specification |
| 2501 | Solid drawn copper tubes for general engineering purposes –Specification |

| | |
|---|---|
| 2535 | Basic rack and modules of cylindrical gears for general engineering and heavy engineering |
| 2637 | Steel roller chains type S and C, attachments and chain wheels |
| 2644 | High tensile steel castings |
| 2707 | Carbon steel castings for surface hardening – Specification |
| 2708 | 1.5 Percent manganese steel castings for general engineering purposes |
| 3142 | Pulleys, V-grooved pulleys for endless V-belts section Z, A, B, C, D and E and endless wedge belts section SPZ, SPA, SPB and SPC – Specification |
| 3444 | Corrosion resistant high alloy steel and nickel base castings for general applications – Specification |
| 3542 | Specification for extended pitch transmission precision roller chains and chain wheels |
| 3560 | Specification for short pitch transmission precision bush chains andchain wheels |
| 3600 | Specification for Short pitch transmission precision bush chains and chain wheels |
| 3665 | (All 9 Parts)– Method of testing fusion welded joints and weld metal insteel |
| 3681 | Dimensions for involute sided splines |
| 4206 | Gears - Cylindrical Gears – Accuracies |
| 4218 | Dimensions for nominal lengths and thread lengths for bolts, screws and studs |
| 4260 | (All 6 Parts)– ISO metric screw threads |
| 5037 | Recommended Practice for ultrasonic testing of butt welds in ferroussteel |
| 5334 | Specification for basic rack and modules of straight bevel gears forgeneral engineering and heavy engineering |
| 9550 | Code of Practice for magnetic particle flaw detection of welds |
| 9595 | Bright steel bars – Specifications |
| 14329 | Metal arc welding of carbon and carbon manganese steels – Recommendation |
| 15151 | Malleable iron castings |

| | |
|---|---|
| 28 | Belt drives - Pulleys and V-ribbed belts for industrial applications - PH,PJ, PK, PM and PM profiles: Dimensions |

| | | |
|---|---|---|
| STEEL STRUCTURE PARTS | | |
| 2 | Vertical columns - Sizes | Column H-Beam H-203x203-46Kg/Mtr |
| 3 | Top Beam | H-Beam H-306x165-40Kg/Mtr |
| 4 | Trolley Track Beams | H-Beam H-206x133-25Kg/Mtr |
| 6 | Structure - Finish | Post Shot blasting, epoxy painted Unicoat with around 80 - 100 DFT, |
| | | |
| PLATFORM PARTS | | |

| | | |
|---|---|---|
| 7 | Platform Width –Maximum in mm | 2200 mm Clear Inner Usable |
| 8 | Platform Side Members Profile & Arrangement. | GI Sheet of 3 mm thickness RAL Shade 5000 (Voilet Blue) Epoxy Unicoat - Formed Sheet with bending, |
| 9 | Platforms main Galvanization coating thickness on sheets in microns | IS 277 Spangled GI Sheet of 1.5/2 mm thick with W sections with 120 GSM, |
| | | |
| MOTOR & LIFTTING PARTS | | |
| 12 | Motor | Brake Geared Motor. |
| 13 | Motor Capacity Lifting | 1.5 / 2.2Kw |
| 14 | Motor Capacity Shifting | 0.4Kw for 1F Trollies, 0.2Kw for GF Pallet. |
| 15 | Motor Roller Chain | 1" Duplex for 2F Pallet, 1.25" Simplex for 1F Motor, 0.625" Simplex for GF Motor. |
| 16 | Lifting Roller Chain | 1.5" Simplex for 2F pallet, 1" Simplex for 1F Pallet Lifting. |
| 17 | Lifing Wire Rope | Usha Martin Make, Dia 10mm, 8mm (Double), 8/19 Const, Fiber core, Ungalvanised. |
| | | |
| SAFETY FEATURES | | |
| 18 | Safety Device | UP/DN Overtravel Limit Switches, Emergency Stop Button, On/Off Key switch, Sensor at the entry, |
| 19 | Platform Wheel Stopper type (Square /U) | Square Pipe 40x40 mm |
| | | |
| FUNCTIONAL PARAMTERS | | |
| 20 | Speed of the Movement UP and Down | UP,DN Movement 3.5 Mtr/Min, |
| 21 | Speed of the Movement Sliding | Sliding Movement 5.5 Mtr/Min, |
| 22 | Both Side parking (Y/N) | Yes, |
| | | |
| MANUFACTURING & FINISH | | |

| | | |
|---|---|---|
| 23 | Manufacturing Process | Machined Manufacturing - Cutting, Bending, Drilling all are on fixtures by CNC machine to achieve the required accuracies and repeatabiltiy in mass production cycles. |
| 24 | Overall Paint Scheme | All the Steel parts are of RAL Shade 5000 (Voilet Blue) Epoxy Unicoat, Pallet parts in GI Finish except Side Members & Supports, |
| | | |

**Power Hydraulics**
**General**

(a) Some car parking equipment could be hydraulically Operated. The hydraulic equipment will consist of 3 systems: the hydraulic actuator, thehydraulic power pack and electrical controls.

(b) The hydraulic actuator is either a cylinder or a motor. The actuator will consume the pressurized fluid and transform the same to a linear or rotarymotion.

(c) The hydraulic power pack will generate the pressurized fluid. It will consist of all or some of thefollowing:

Pipe lines, Flexible hose, Pumps and Electric Motors, Direction Control Valves, Gate Valve, Check Valve, Restrictor Valve, Flow Control Valve, Reducing Valve, Relief Valve Reservoir, Accumulator, Air Breather, Filter, Strainer, Cooler, Pressure Gauge, Level Gauge, Thermometer, Pressure Switch, Hydraulic Fluid etc.

(d) For remote actuation generally the valves are electrically controlled. The electrical controls again are actuated by programmable logic controllers (PLC) with computer monitoring.

**Hydraulic Power System**

The hydraulic Power System shall satisfy the following:

i. All hydraulic circuit elements should be generously sized.

ii. Minimize surge pressure using appropriately sized accumulators

iii. The size of all components shall be selected to withstand the highest surge pressure.

iv. With a view to reduced heat generation, the system should be Operating for the required periodonly with a small margin of time during cut-off and also for recharging the accumulators. The temperature of the hydraulic fluid shall not be permitted to rise beyond 500 C. Considering the ambience, if required, coolers may be used.

v. Incorporate necessary connections, valves and appurtenances to facilitate air purging, testing, pickling, flushing, draining, sampling and re-commissioning the system.

vi. Provisions to reduce the risk of ignition of the hydraulic fluid.

vii. The selection of the type of pump will depend on the service condition.

viii. The working volume of the reservoir must be adequate.

ix. The return and suction pipes in the reservoir shall be located as far away as possible with a baffle wall in between.

x. The bottom of the reservoir shall be sloped for easy draining.

xi. The reservoir shall have a suitably protected thermometer. There shall be provisions for high & low temperature alarms.

xii. There shall be a flush mounted fluid level indicator for the reservoir.

xiii. The total flow rate of the pumps should have adequate margin over the design flow rate.

xiv. Provision of stand by pump should be made.

xv. Pumps shall be provided with isolation valves on both suction and delivery side to facilitate maintenance.

xvi. All directional valves shall be sub plate mounted on suitable valve stand or ease of Operation and maintenance.

xvii. Proportional and servo valves shall be provided with electronic card and cardholder. Necessary test kit shall be provided for proportional and servo valves.

xviii. Solenoid Operated valves shall incorporate the following features: Suitably sealed to avoid splashing liquid and airborne contaminant Manual override, which can be Operated without removing the cover but cannot be Operated accidentally. Solenoids shall be continuous duty type, Operating on 24 V DC.

xix. All accumulators shall preferably be bladder type and charged with nitrogen / inert gas. The size of the accumulator should satisfy the functional needs. The design pressure shall at least be 1.5 times the nominal design pressure.

xx. Before removing the accumulator from the system, the gas and fluid shall be released from the same. Arrangement shall be provided in the accumulator for this purpose. Manual bleeding and shut off valve shall be provided. Suitable charging device shall be provided. The accumulator shall be provided with safety relief valve and pressure gauge.

xxi. The cylinder body, heads and flanges shall be of steel. The cushion adjusting screws shall be stainless steel. Bleed valves are to be provided at both ends of the cylinder. Arrangement should be made to make the cylinder and cylinder head joint leak proof.

xxii. The piston shall be bronze or bronze coated steel. In the later case the minimum bronze coating thickness after machining will be 2.5 mm. Piston rods shall be high yield strength steel with hard chrome plating to 40~50 micron thickness, with 0.25 rms surface finish. The piston rod shall have wrench flats for the ease of tightening with the piston.

xxiii. The hydraulic motor selection shall incorporate the following features: The hydraulic motor shall be designed to meet 1.25 times the maximum system pressure at full flow rate. Possibility of over-running and complete stalling of the motor is present, suitable relief arrangement shall be provided to allow the oil to circuit without overheating.

xxiv. Where the hydraulic motor is required to rotate in both directions, arrangement shall be made for smooth change of direction.

xxv. Hydraulic system shall be provided with pressure filter, circulation filter and return line filter of 3 micron, 5 micron and 10 micron respectively. The size shall be chosen to handle at least 100% of the rated capacity of the pumps. The filters shall have differential pressure switch to provide audio-visual signal indicating clogging.

xxvi. The pipelines shall have minimum bursting pressure of 5 times the maximum working pressure. Fluid velocity in the pipeline shall be near about4 m/s.

xxvii. Interlocks shall be provided to keep the system Operating.

xxviii. Positive position stop shall be provided so that the dwell time will not be affected when the position stops are reset.

xxix. The hydraulic power system shall have built in safety in all areas.

**Standards (BIS)**

| | |
|---|---|
| 635 | Specification for oil and solvent resistant hose of rubber |
| 7651 | Wire reinforced rubber covered hydraulic hose- Specification |
| 8208 | Sizes for cylinder bores and piston rod diameter for fluid power systems |
| 9269 | Evaluation of pressure drops versus flow characteristics of hydraulic filter elements and filters - Method of test |
| 10532 | Code of Practice for selection and use of fire resistant hydraulic fluids |
| 10532 | (All of 4 Parts) Specification for fire resistant hydraulic fluidsHydraulic |
| 10660 | Specification for rubber hydraulic hose with textile reinforcement |

| | |
|---|---|
| 11003 | (All of 2 Parts) Recommendations for mounting dimensions forhydraulic fluid<br>power - single rod cylinders, 160 bar medium series - bore -50 to500 mm |
| 11146 | Hydraulic fluid power - Cylinders - Bore and rod area ratios |
| 11147 | Recommendations for parameter definitions and letter symbols for hydraulic fluid power pumps, motors and integral transmissions |
| 11277 | Recommendations for characteristic quantities and designation of hydraulic fluid power gas loaded accumulators with separators |
| 11337 | Purchase specification for hydraulic cylinders |
| 11559 | Hydraulic fluid power - Cylinders - Rod end spherical eyes -mounting dimensions |
| 11560 | Hydraulic fluid power - Cylinders - Rod end plain eyes - mounting dimensions |
| 12092 | Method of hose assembly used in hydraulic fluid power system |

| | |
|---|---|
| 13053 | Hydraulic fluid power system - Commissioning and maintenance of complete hydraulic systems |
| 13102 | Hydraulic fluid power - Single rod cylinders 250 bar (25 MPa) series - Port dimensions<br>Hydraulic fluid power - Single rod cylinders 160 bar (16 MPa) compact series – Port dimensions |
| 13103 | |
| 13614 | (All of 2 Parts) Hydraulic fluid power - Quick action couplings |
| 13614 | Hydraulic couplings quick action |
| 14130 | Hydraulic Lifting table – Specification |
| 14148 | Hydraulic fluid power - Pressure control valves (excluding pressure relief valves), sequence valves, unloading valves, throttle valves and check valves - Mounting surfaces |
| 14645 | Fluid power systems and components - Cylinders - Nominalpressures |
| 14671 | Code of Practice for installation and maintenance of hydraulic lifts |
| 14848 | Hydraulic fluid power - Pumps and motors - Geometric displacements |
| 14849 | (All of 2 Parts) Hydraulic fluid power - Determination of characteristics of motors |
| 15168 | Fluid power systems and components - Cylinders - Identification code for mounting dimension and mounting types |
| 15170 | Hydraulic fluid power - Methods for cleaning and assessing the cleanliness level of components |
| 15178 | Hydraulic fluid power - Fire resistant fluids - Guide lines for use |
| 15179 | Hydraulic fluid power - Compatibility between elastomeric materialand fluids |
| 15181 | (All of 2 Parts) Hydraulic fluid power - Measurement techniques |

**SPECIFICATION OF WORKS FOR ELECTRICAL COMPONENTS**

The Technical Specifications in accordance with which the entire work described hereinafter shall be constructed and completed by the Contractor within the quoted rates are given in this section. Specifications given are in accordance with the specifications / requirements indicated in Indian Electricity Act 2003 and Local Power Authority rules and regulations.

**D.G SET**

This specification covers the requirements of design, manufacture, assembly, testing, packing and forwarding, transportation, erection and commissioning of following DG Set:

- 1Nos. of adequate capacity,
- 440 / 415V D.G. Set (Outdoor) with base frame,
- Battery & battery charger & fuel tank.

(a) D.G control panels with required switchgear & protection. Generator control unit (GCU) shall be included in panel to provide control for AMF & Synchronous Operation.
(b) Acoustics enclosure should be provided to restrict the vibration level to 70db at 1mtr distance from the DG set. HSD day tank of sufficient capacity should be provided with level glass tube.
(c) Flue gas ducting with silencer in IS 2002, 6mm thick. (Or A106 Gr. B., Sch 40) SS 304 below, lightly resin branded mineral wool, 100mm thick with 22g Aluminum cladding and exhaust chimney. Length of chimney shall be as per local regulations.
(d) All statutory approvals such as local supply co. and pollution control board NOC and approval of electrical inspector for installation drawings and installation work from Electricity Department, Pollution Control Board etc.
(e) Earthing grid for DG and panel, earth pits in scope of contract.
(f) All civil work, power cabling etc. shall be in scope of contract.
(g) All piping / hose between Day tank and DG set.
(h) AVM pads (gel filled) for engine and alternator frame mounting.

**Format of Data Sheet for DG Set**

| | **Description** | **To be filled inby contractor** |
|---|---|---|
| | **Diesel Engine** | |
| | Make | ** |
| | Model no. | ** |
| | Bore / Stroke / Mean piston speed /No. of cylinders | ** |
| | Fuel Consumption in Gm/BHP/hr. & liters/hr | |
| | At 100% load in gm/BHP/hr. | ** |
| | At 75% load in gm/BHP/hr. | ** |
| | At 50% load in gm/BHP/hr. | ** |
| | At 100% load in ltrs./ hr. | ** |
| | At 75% load in ltrs./ hr. | ** |
| | At 50% load in ltrs./ hr. | ** |
| | Lube Oil Consumption (liters/hr.) | ** |
| | Frequency of lube oil replacement | ** |
| | Coolant conditioner consumption | ** |
| | Frequency of corrosion resistor replacement | ** |
| | Power availability at Generator terminals (units/liter of HSD) | ** |
| | Specific gravity & calorific value of HSD considered for Fuel | ** |
| | Type of AMF controller and Technical details. | ** |
| | Cooling Water requirement: | ** |
| | Inlet temperature | ** |
| | Outlet temperature o C | ** |
| | Ventilation requirement (water) | ** |
| | **Alternator** | ** |

| | | |
|---|---|---|
| | Make | ** |
| | Model | ** |
| | Enclosure Air cooled IP protection class | ** |
| | Insulation class F/F | ** |
| | Temperature sensor for bearings | ** |
| | Temperature sensor for windings | ** |
| | Anti-condensation standstill heaters – Voltage: 220V AC | ** |
| | Tropical/Humidity Protection | ** |
| | Voltage regulator | ** |
| | **Protection Relays** | ** |
| | **Acoustic Enclosure** | ** |
| | Weatherproof, metallic, sound attenuated | ** |

| | | |
|---|---|---|
| | Noise level to be maintained at a level of less than 72 dB. | ** |
| | Self-supporting structure | ** |
| | Normal regular conversation possible at a distance of 1.0 mtr. from the enclosure | ** |
| | Residential silencer with suitable lagging | ** |
| | Warranty offered for weather proof enclosure | ** |
| | Overall Dimension layout with clearances with respect to DG set shall be provided | ** |
| | **Battery & Battery Chargers** | ** |
| | Battery | ** |
| | Make | ** |
| | Type | ** |
| | Voltage | ** |
| | Battery Charger | ** |
| | - AH capacity | ** |
| | **Maintenance** | ** |
| | Spares/consumables list for one year trouble free Operation after warranty period. | ** |
| | Maintenance schedule incorporating normal/major maintenance & shut down requirements. | ** |

**Note:** ** Data to be filled by contractor

**LT Cable**

**General**

The scope of this specification covers manufacture, supply, inspection, testing at works, packing and forwarding of 1100V grade LT XLPE Power cables & installation including commissioning at site.

Cables shall be Aluminum, XLPE insulated, PVC sheathed and round armored of 3 / 3-½ core and 4 core of sizes specified and suitable for 230 / 415 volts, 1 / 3 phase 50 Hz power supply. The cables shall be suitable for the rated voltage 1100 volts conforming to IS 7098 with latest amendments.

Cables shall be of approved make only. Each drum or coil of cable shall be accompanied by a certificate stating the manufacturer's name, rating of cable, result, and date of tests.

All cables shall be delivered with cable ends effectively sealed. When a cable is cut from a drum both ends shall be immediately sealed to prevent ingress of moisture. Cables shall not be transported to site in loose coils but a number of short lengths of cable may be transported on the same drum. The Contractor shall be wholly responsible for the purchase and/or hire costs of all cable drums and for theremoval of these drums from site after use.

Cables shall be adequately rated for current carrying capacity under normal and short time fault conditions at the specified voltage.

The voltage drop for any circuit from origin of the installation (i.e. supply authority's terminals) and the load under steady state conditions shall not exceed ±6% of the nominal voltage.

The Contractor shall submit cable schedules for approval detailing ratings, sizes, lengths, method of installation and function of all individual cables. Cables shall be laid in uncut/ single lengths from one termination to the other.

All cables will be identified close to their termination point by cable numbers as per cable schedule. Cable numbers will be punched on aluminum straps (2 mm thick) securely fastened to the cable and wrapped around it. Alternatively, cable tags shall be circular in construction to which cable numbers can be conveniently punched. Each underground cable shall be provided with identity tags of lead securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. Unpaved area, cable trenches shall be identified by means of markers as per standards.

**Standards**

The cables offered shall conform to the latest revision of relevant Indian Standard Specifications Some of these standards are list below:

| **Sr No** | **Indian Standard** | **Title** |
|---|---|---|
| 1 | 7098 | XLPE insulated electrical cables for working voltages up to 1100V |
| 2 | 8130 | Conductors for insulated electric cables and flexible cords. |
| 3 | 5831 | PVC insulation & Sheath of electric cables. |
| 4 | 3975 | Mild steel wires, strips and tapes for armouring of cables. |
| 5 | 2633 | Methods of testing weight, uniformity of coating, thickness on hotdip galvanized articles. |
| 6 | 3961 | Recommended current ratings for cables- PVC insulated and PVCsheathed. |
| 7 | 1753 | Aluminum conductors for insulators cables. |

**Termination**

All XLPE cables up to 1.1KV grade shall be terminated at the equipment by means of cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

Cable leads shall be terminated at the equipment terminals, by means of crimped type lugs. When crimping the lug to the cable, proper crimping tool to suit the size of lug / cable is to be used.

**Cable Trays / Raceway & Accessories**

These specifications cover the design, material selection, fabrication, testing at manufacturer's works, insurance, packing, transportation, loading / unloading, supply at site and installation of cable trays, trunking (Raceway) and accessories covered herein.

**Material and construction**

Cable trays and accessories shall be manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturers' Association (NEMA).

Cable trays and accessories shall be fabricated using mild steel sheets and hot dip galvanized in accordance with B.S.729 after fabrication. All bolts, nuts and washers shall also be galvanized. The zinc coating shall be uniform, smooth and free from imperfections such as flux & ash, black spots, blisters etc. Cable trays and accessories shall undergo a process of degreasing, pickling in acid & cold rinsing prior to galvanisation.

Cable trays shall be of the following type:

i. Ladder type with rungs
ii. ii. Perforated type.

Perforated cable trays shall be generally of channel type and the perforations shall be 10x30 mm oval holes.

Perforated cable trays shall also be galvanized. Galvanizing shall be in accordance with that specified above for ladder type cable tray.

Ladder type cable trays shall be made from 2mm thick sheet formed in `C' section of 75mm heightand inward flanges of 15mm as side runners and 30mm wide x 10mm high rungs (`C' shaped) from a 1.5mm thick sheet. Perforations as mentioned above shall be provided in the width of the rungs. Pitch of the rungs shall not exceed 250 mm center to centre. Rungs shall be tack welded to the side members.

The thickness of sheet steel for perforated trays shall be 1.6 mm and they shall be of the formed channel shape.

Cable trays shall be of following dimensions as specified in BOQ.

**Accessories**

Following accessories and hardware, as required, shall be supplied with cable trays:

- Coupler plates
- bends
- Tees
- Reducers
- 4-way cross
- Fasteners (Hardware)

**Testing at manufacturers' work**

The material for cable trays and accessories shall be offered for stage inspection of the Engineer/Employer as follows:

- Prior to fabrication and galvanizing.
- After fabrication but before galvanizing.
- After galvanizing but prior to dispatch.
- During inspection, thickness of sheets, dimensions and weight of zinc coating will bemeasured. Items not conforming to specifications shall be rejected.
- Prior to fabrication, sheets to be used for fabrication of trunking/accessories shall be offeredfor inspection.
- Subsequent to fabrication, but prior to galvanizing, trunking/accessories shall be offered forinspection. Items not conforming to specifications shall be rejected.

**Wiring System**

This section covers providing & commissioning of wiring system for lights, fans, exhaust fans, power sockets etc. The wiring shall generally be carried out using 1.1 KV grade PVC insulated stranded copper conductors FRLS wires in rigid PVC conduit laid on surface or concealed complete with insulated earth wire, flushed modular switches, sockets etc.

**Standards**

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical wiring installation IS:732-1963 and IS:2274-1963. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code and National Building Code, CPWD specifications and requirements of the Local Electric Supply Authority. In general, all materials, equipment and workmanship shall conform to the Indian Standards, specifications and code. Some of the applicable codes/standards are as under:

| | |
|---|---|
| IS 375 | Marking and arrangements for switchgear: Bus bars, main connection andauxiliary wiring |
| IS 2675 | Specifications for enclosed distribution |
| IS 1554 | Specifications for PVC insulated (heavy duty) electric cable Part-I for voltage Upto 1100 volts. |
| IS 694 | Specifications for PVC insulated: Cables for voltage up to 1100V withAluminum conductors. |
| IS 5133 | Boxes for the enclosure of electrical accessories |
| IS 1293 | 3 pin plugs and socket outlets |

| | |
|---|---|
| IS 1913 | General and safety requirements for electric lighting fittings. |
| IS 374 | Electric ceiling fans and regulators. |
| IS 3043 | Code of practice for earthing IS 3043 |
| IS 1646 | Electrical installation. |
| IS 8623 | Factory built assemblies of switch gear & control gear. |

**Distribution**
**Wiring Systems**
**2.17.11.5.1**
**General**

The wiring systems should be suitable for the following systems depending on the requirement.

i. 3 phase, 4 wire, 440V, 50 Hz, AC.
ii. Single phase, 2/3 wire, 240V, 50 Hz, AC

**Wiring systems**

Depending on the requirement, the following systems are covered by this specification.

Concealed / Exposed systems using conduits laid / surface mounted in / on slabs, beams, walls, flooring etc. The conduits should be of heavy duty rigid PVC.

**Installation**

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 20 mm Dia unless otherwise indicated or approved. Size of wires shall be as specified in the schedule of work / SLD:

| Nominal dia of wires | Nominal Cross sec. area | | Mm<br>B | 25<br>S | mm<br>B | 32<br>S | mm<br>B | 38<br>S | mm<br>B |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 1/2.40 | 1.50 | | 3 | 8 | 6 | 1 | 9 | - | - |
| | | | | | | | | | |
| 1/1.80 | 2.50 | | 2 | 6 | 4 | 1 | 8 | - | - |
| | | | | | | | | | |
| 1/2.24 | 4.00 | | 2 | 4 | 3 | 8 | 6 | - | - |
| | | | | | | | | | |
| 1/2.80 | 6.00 | | - | 4 | 3 | 6 | 6 | - | - |
| 1/3.55 | 10.00 | | - | 3 | 2 | 5 | 4 | 6 | 5 |

(a) S- runs of conduits which have distance not exceeding 4.25 m between draw boxes & which donot deflect from the straight by an angle more than 15 degree.
(b) B- runs of conduits, which have, deflect from the straight by more than 15 degree.
(c) Conduits shall be kept at a minimum of 100 mm from the pipes of other non-electrical services.

Separate conduits shall be used for each of the following:

Normal lights and 6A 3 pin
sockets on lighting circuit
Power outlets - 16A 6 pin
socket

Emergency lighting Telephones

Data outlets

Fire alarm system Public address system

Call bell wiring CCTV system Access Control

Conduit layout shall be as approved of the Engineer. Wiring for short extensions to outlets in hung ceiling or to vibrating equipment, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25m.

**Point Wiring**
**Definition**

A point shall include all work necessary in complete wiring to the following outlets from thecontrolling switch or MCB.

(a) Ceiling rose or connector (in the case of points for ceiling / exhaust fan points, prewired lightfittings, and call bells).
(b) Ceiling rose (in case of pendants except stiff pendants).
(c) Back plate (in the case of stiff pendants).
(d) Lamp holder (in the case of goose neck type wall brackets, batten holders and fittings which arenot prewired).

**Point wiring (Other than socket outlet points)**

Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points, call bell points and power point. These shall be measured on unit basis by counting.

**Group Control point wiring:**

(a) In the case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the DB to switch board & the switch to the first point outlet as one point (Primary point) and for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point (Secondary point)
(b) No recovery shall be made for non-provision of more than one switch in such cases.

**Socket Outlets:**

(a) Socket outlets shall be 6A 3 pin, 16 Amp 3 pin or 16/6 Amp 6 pin. 5 pin socket outlets will not be permitted. The third pin shall be connected to earth through protective (loop earthing)conductor, 2 pin or 5 pin sockets shall not be permitted to be used.

(b) Conductors connecting electrical appliances with socket outlets shall be of flexible type with an earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.

(c) Sockets for the power outlets of rating above 1 KW shall be of industrial type with associatedplug top and controlling MCB.

(d) Where specified, shutter type (interlocking type) of sockets shall be used.

(e) Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the `live' side of the line.

(f) 5A/6A and 15A/ 16A socket outlets shall be installed at the following positions, unless otherwise specified.
   a. Non-residential buildings - 23cm above floor level.
   b. Kitchen - 23 cm above working platform and away from the likely positions of stove and sink. Bathroom - No socket outlet is permitted for connecting a portable appliance thereto. MCB/IC switch may be provided above 2 m for fixed appliances, and at least 1 m away from shower.
   c. Rooms in residences - 23 cm above floor level, or any other level in special cases as desired by the Engineer-in- charge.
   d. Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

**Advanced Lightning Protection System**
**General**

The lightning protection system shall be of the enhanced type which is designed to attract lightning to a preferred point and safely convey the lightning energy to ground with minimal risk of side flashing via a pre-determined route. The complete lightning protection system will comprise of the following key components:

(a) Lightning Air Terminal
(b) Mounting support
(c) Dedicated down conductor
(d) Lightning Strike Recorder
(e) Dedicated earthing system

**The Lightning Air Terminal**

(a) The lightning air terminal shall be an Early Streamer Emission terminal which will respond dynamically upon leader activity in the near area.

(b) The lightning air terminal shall be configured as a spheroid which is comprised of separate electrically isolated panels surrounding an earthed central finial.

(c) The insulation material used to electrically isolate the panels shall be comprised of a base polymer which provides high ozone and UV resistance with a dielectric strength of 24 – 38 KV/mm.

(d) The central finial shall be elevated above the spheroid to a length of 90mm.

(e) The upper section of the central finial shall be rated to withstand 200KA.

(f) An air gap shall be provided between the individual electrically isolated panels (4 panels) and thefinial tip of the central rod.

(g) Arcing shall occur between the panel sections of the spheroid and the finial tip only upon the progression of a lightning leader.

(h) The lightning air terminal shall have no moving parts and will have no dependence on external power supply or batteries.

(i) The lightning air terminal shall be tested and certified in accordance with the French National Standard – NF C 17-102. & IEC 60-1:1989

**Mounting Support of Lightning Air Terminal**

The mounting pole used to support the lightning air terminal shall either be a circular insulating fibre glass tube or Aluminum or S.S mast or powder coated mast at a minimum height of 2 metres abovethe area to be protected. The pole will have an outside diameter of 68mm.

The mounting pole and supports shall be securely fixed with brackets and guy wires where required. The down conductor shall pass through the centre of the pole for the entire length of the pole.

**Down Conductor**

(a) Each lightning air terminal should be fixed with one down conductor. The down conductor should have a minimum size of 70mm² and can be an insulated round copper conductor. The down conductor should be fixed securely every half metre. The down conductor shall be routedas directly as possible to the ground avoiding electrical shafts and sharp bends (minimum bending radius of 0,5m). The down conductor shall be of single length, devoid of any joints for the entire vertical run of the conductor.

(b) As an alternative the use of a high voltage shielded cable is acceptable. The high voltage shielded cable shall consist of a core filler, stranded copper conductor, insulation material, outer copper conductor with external conductive sheath.

(c) The main copper conductor within the high voltage shielded cable shall have a minimum cross- sectional area of 75mm².

(d) The outer diameter of the high voltage shielded cable shall be less than 38mm.

(e) The high voltage shielded cable shall have a maximum inductance of 25 nH/m.

(f) The main copper conductor shall allow for direct connection to the lightning rod through the use of a compression lug.

(g) The high voltage shielded cable shall be fixed to the structure through the use of conductive saddles every two metres for the length of the cable route.

(h) The high voltage shielded cable shall be installed as per manufacturer's instructions and shall not be subject to bends of less than 0.6 metres radius.

**Event Recording Device**

(a) All systems shall be installed complete with the lightning strike recorder.
(b) The lightning strike recorder shall contain a mechanical 6 digit display which will register alllightning discharges with a sensitivity of 1500A 8/20 µs peak current impulse.
(c) The lightning strike recorder shall be housed in an IP 65 rated enclosure and will Operate withoutreliance on batteries or an external power source.
(d) The lightning strike recorder shall be installed as per the manufacturer's instructions.

**Grounding**

(a) The grounding system shall incorporate the following individual components or a combination ofthe following – flat copper tape buried to a depth of not more than 800mm or by deep driven copper bonded steel core ground rods10' x 5/8".
(b) All components of the grounding system shall be electrically connected to the central injectionrod which is securely connected to the lower end of the high voltage shielded cable.
(c) The grounding system shall be installed so that the final impedance reading does not exceed 10 Ohms unless otherwise stipulated by the lightning protection manufacturer or consulting engineer.
(d) It is recommended that the grounding system is bonded to all structural reinforcing steel of the building, along with all connecting services.
(e) The use of ground resistance improvement material shall be applied in order to reduce the resistivity levels of the grounding system and maintain a constant low resistivity. The grounding system shall be maintenance free.

**Earthing Specifications**

The earthing shall be done in accordance with requirements given here. Measurement of soil resistivity and earth mat design calculations for switchyard area shall be submitted by contractor for review by Employer. The main earth mat shall be laid in the switchyard area in accordance with the approved design requirements.

Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipment and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.

Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

(a) Code of practice for Earthing IS: 3043
(b) Code of practice for the protection of Building and an allied structure against lightning IS: 2309.

(c) Indian Electricity Rules 1956 with latest amendments.
(d) National Electricity Safety code IEEE publication.

**Earthing Conductor Layout**

Earthing conductors in outdoor areas shall be buried at least 900 mm below finished ground level unless stated otherwise.

Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on the earthing terminals of the equipment/structure as per "Earthing Details".

Earthing conductors or leads along their run on cable trench, ladder, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc., galvanized iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1000 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location. Earthing conductors crossing the road shall be laid 300 mm below road or at depth to suit the site conditions.

Earthing conductors embedded in the concrete shall have approximately 50 mm concrete cover.

**Equipment and Structure Earthing**

Earthing pads shall be provided for the apparatus/equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with Owner.

Whether specifically shown in drawings or not, steel/RCC columns, metallic stairs etc. shall be connected to the nearby earthing grid conductor by two earthing leads. Electrical continuity shall be ensured by bonding different sections of hand-rails and metallic stairs.

Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

Metallic conduits shall not be used as earth continuity conductor.

Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.

**Jointing**

Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti- corrosive paint/compound.

Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type. For rust protections, the welds should be treated with red lead and afterwards coated with two layers bitumen compound to prevent Corrosion.

Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression. Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor. All ground connections shall be made by electric arc welding. All welded joints shall be allowed tocool down gradually toatmospheric temperature before put- ting any load on it. Artificial cooling shall not be allowed.

Bending of earthing rod shall be done preferably by gas heating.

All arc welding with large dia. conductors shall be done with low hydrogen content electrodes. The50x6mm GS flat shall be clamped with the equipment support structures at 1000mm interval.

**Power Cable Earthing**

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear endonly.

**Earthing Conductors**

**General:**
All conductors buried in earth and concrete shall be of galvanized steel. All conductors above ground level and earthing leads shall be of galvanized steel, except for cable trench earthing. Constructional Features of Galvanized Steel

(a) Steel conductors above ground level shall be galvanized according to IS: 2629.

(b) The minimum weight of the zinc coating shall be 610 gm/sq. m. and minimum thickness shall be 85 microns.

(c) The galvanized surfaces shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surfaces of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

**Tests:**

In accordance with stipulations of the specifications galvanized steel shall besubjected to four one

minute dips in copper sulphate solution as per IS: 2633.

Procedure for Soil Resistivity Measurement Soil resistivity measurement should be carried out with the earth tester. Please check the calibration report before performing the measurement. Also check the measurement should be strictly followed as per procedure given in IS 3043 (Wenner method of measurement)

**LT panels, Distribution Boards, Control Panels Erection**

(a) Electrical panels and bus duct shall be delivered in convenient shipping section. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading/unloading during transportation. The contractor shall be responsible for final assembly and inter connection of bus bar / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and leveled on their base channels and bolted or tack welded to them as per the instructions of the Engineer - in-charge. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the Switchgear. The contacts of the draw-out circuit breakers shall be checked for proper alignment and interchangeability.

(b) After erection the switch board shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost.

(c) If the instrument DG Set are supplied separately, they shall be erected as per the direction ofthe Engineer of Employer -. The contractor shall fix the cable glands after drilling the bottom/ topplates of all switch boards with suitable holes at no extra cost.

(d) Range of overload relays/timers etc. shall be checked with requirement of motor actually to be connected at site and shall be provided accordingly.

(e) The bus duct shall be suitably supported between switchgear and DG Set. The opening in the wall where the duct enters the switchgear room shall be sealed to avoid rain water entry. The

foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the bus duct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the bus duct shall be properly connected.

**TESTING:**

Before electrical panel is energized, the insulation resistance of each bus shallbe measured fromphase to ground. Measurement shall be repeated with circuit breakers in Operating positions and contacts open.

Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground. The following tests shall be performed on all circuit breakers during erection.

(a) Contact alignment and wipe shall be checked and adjusted where necessaryin accordance with the breaker manufacturer's instructions.
(b) Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulationresistance measured from phase to phase and phase to ground.
(c) All adjustable direct acting trip devices shall be set using values given by the Engineer of the Employer/ manufacturer.
(d) Close and trip the circuit breaker from its local control switch push button or Operating handle. Switch gear control bus may be energized to permit test Operation of circuit breaker with AC closing with prior permission of the Engineer -in-charge.
(e) Test tripping of the electrically Operated circuit breaker by Operating mechanical trip device.
(f) Test proper Operation of circuit breakers latch, check carriage limit switch if provided.
(g) Test proper Operation of lock-out device in the closing circuit. Wherever provided by simulating conditions which would cause a lock-out to occur.
(h) Trip beaker either manually or by applying current or voltage to each of itsassociated protective relays.
(i) Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
(j) Capacitor banks shall be tested as per IS: 13340 / IPP3 & IS: 13585 (Part – I)
/ IPP4. In addition, test for output and /or capacitance, Insulation resistancetest and test for efficiency of discharge device shall be carried out.
(k) All electrical equipment alarms shall be tested for proper Operation by causing alarms to sound under simulated abnormal conditions.

**Installation of Lighting Fixtures**

Scope of work under this item shall start from light point, with a connector/ ceiling Rose , 3 core 1.5 mm.$^2$ PVC insulated wires from the point to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories including supports, down rods , lamps on wall /roof / steel truss etc. testing the lighting fixture and commissioning.

**(a) Installation of Exhaust Fans**

Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 3core 2.5 mm.$^2$PVC insulated wire from ceiling rose to connector of exhaust fan, connections, including fixing of fan with all accessories and supports complete with testing and commissioning.

**(b) Bracket for Street Light Fittings:**

The brackets shall be made GI pipe with MS galvanized "sleeve" of requiredlength and design, to accommodate type of street light fitting to be fixed.

**(c) Installation of Poles:**

Installation of poles shall be done as approved by the Engineer/ Employer.

**(d) Installation of Street Light Fixtures:**

This specification includes fixing of street light fittings complete with accessories and lamps at theend of the pole/ bracket, connecting it with 3 x 2.5 mm.$^2$ Aluminum conductor, PVC insulated cable from terminal box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of terminal box at the other end.

**Completion Tests**

After supply and installation of complete project or a particular building/ area, tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site- Engineer.

If results are not satisfactory/ as per standards set herewith, the contractor shall identify the defects/ shortcomings and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

**DANGER BOARDS AND SIGNAGES: -**

Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signage shall be provided one each at battery –cum- control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with PEDA/ owner.

**FIRE EXTINGUISHERS: -**

The firefighting system for fire protection shall be consisting of: -

(a) Portable fire extinguishers in the control room for fire caused by electrical short circuits.
(b) Sand buckets in the control room.

The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards.The fire extinguishers shall be provided in the control room housing PCUs as well as on the Roof or site where the PV arrays have been installed.

## SPECIFICATION OF WORKS FOR CAR PARKING MANAGEMENT SYSTEM

### 1. Functional & Technical Requirement Specifications

**Smart Parking System – Functional Requirement Specifications**

**Entry Requirement**

| Sr. No | Indicative Requirement Description |
|---|---|
| ENTR.FR.001 | Entry to any parking space shall have outdoor displays/screens showing overall availability of parking slots in that particular parking space. |
| ENTR.FR.002 | Each entry lane shall be equipped with one Entry Device with the following capabilities: |
| ENTR.FR.003 | The Entry Device shall act as an Automatic Ticket Dispenser |
| ENTR.FR.004 | It shall have touch screen for motorist to enter Unique Booking Number |
| ENTR.FR.005 | The ticket with Barcode/QR Code used by SI shall be capable of capturing data thatis easily retrievable at the exit. |
| ENTR.FR.006 | Every vehicle entering the parking space shall be stopped by barrier. The barrier is raised when the motorist is issued a ticket or has been identified as a legitimate user. |
| ENTR.FR.007 | In case the parking lot is already occupied to its capacity, the ticket issuing shall automatically be blocked and therefore, the barrier shall not open. A message shallalso be displayed on the outdoor screen stating the same. |
| ENTR.FR.008 | The Entry Device shall be able to detect and report: |
| ENTR.FR.009 | Anti-pass back |
| ENTR.FR.0010 | Back-out ticket |
| ENTR.FR.0011 | Low ticket stock |
| ENTR.FR.0012 | The display on Entry Device shall have capability to display messages in English, Punjabi and Hindi languages. The solution shall also include provision to capture the video of vehicle using dedicated cameras. |

**Exit Requirement**

| Sr. No | Indicative Requirement Description |
|---|---|
| EXIR.FR.001 | Any vehicle, before leaving the parking area, shall be stopped by a barrier systemat the point of exit from the parking. |
| EXIR.FR.002 | The solution shall have parking column display with clear instructs easy to use interface |
| EXIR.FR.003 | The solution shall also include provision to capture the video of the vehicle exiting any of the parking spaces and the all the information related to the same shall be stored at a central server. |
| EXIR.FR.004 | The solution should provide option of manual cash payment through handheld payment terminal operated by an attendant |
| EXIR.FR.005 | Exit of every parking shall be equipped with a manned parking pay station (booth). |
| EXIR.FR.006 | The exit booth shall have appropriate space for keeping devices such as a computer with internet connectivity, handheld with QR code reader, credit card reader, printer etc. |
| EXIR.FR.007 | For motorists who enter the parking lot using Smart Parking Card or Monthly pass the exit booth shall also have facility for motorist to tap his/her Smart Parking Card for express exit. The payment can also be linked to the e-Wallet of the motorist with |

| | |
|---|---|
| | auto- debit option and corresponding limits and alerts to the same. |

| | |
|---|---|
| EXIR.FR.008 | The payment for parking shall be collected based on entry time stamp by any personnel stationed at the Pay Station. |
| EXIR.FR.009 | The system will calculate the fee automatically and indicate this on the screen clearly visible to the motorist. No manual intervention shall be necessary to compute the fee. |
| EXIR.FR.010 | Once the vehicle exits a parking slot, the total parking slots available in that parking space shall automatically get updated. |
| EXIR.FR.011 | Only after completing the full cycle correctly the transaction will be considered as valid within the car park. However, audit trail of each complete, incomplete and cancelled transaction shall be available in the system. |
| EXIR.FR.012 | The solution shall be equipped with Anti-pass back technology and be able to detect and report any instance pass back. |
| EXIR.FR.013 | The solution shall allow full integration of third party devices with the Parking Management and Guidance System, and capture all transactions to generate customized reports. |
| EXIR.FR.014 | The solution shall track each and every revenue source and shall ensure noleakages due to manual intervention. |
| EXIR.FR.015 | The Pay Station shall be capable of charging handheld devices. |

**Entry and Exit Boom Barrier**

| Sr. No | Indicative Requirement Description |
|---|---|
| EEBB.FR.001 | The entrance and exit of each parking lot shall have a barrier gate system using technologies such as boom barriers, bollards etc. |
| EEBB.FR.002 | The barrier shall remain in open position for optimal period of time for the vehicle to pass at entrance and exit. |
| EEBB.FR.003 | The solution shall also include provision to capture video of vehicle of every vehicle entering and leaving any of the parking spaces and the all the information related to the same shall be stored at a central server. |
| EEBB.FR.004 | Barrier shall have capability of in built glowing direction signage |
| EEBB.FR.006 | Upon horizontal impact by a vehicle, the barrier arm shall get detached from the barrier unit with minimal damage to the vehicle and the barrier motor mechanism. An alarm shall also be raised and sent to the server and monitoring console, when the barrier is detached. |
| EEBB.FR.007 | An alert shall be sent to the console and server to ensure that the administrator is informed that the barrier is not attached or barrier breakage. |
| EEBB.FR.008 | All vehicular passages during the time that the barrier is not attached shall be recorded and displayed in the reports separately in order to audit the necessary revenue transactions during that time. |
| EEBB.FR.009 | Upon impact during closure, the arm will stop and stay in the same position. Under no circumstances shall the arm re-open upon impact. This is to prevent keeping the arm open for illegal entries or exits. |
| EEBB.FR.010 | The barrier arm shall be easy to refit with barrier unit in a short duration (withinone minute). |

| | |
|---|---|
| EEBB.FR.011 | If for any reason and external override (fire system) needs to be connected, then this shall only be possible over the Entry/exit Device and the switch shall be permanently monitored by the Parking Management System. |

**Wireless Handheld Device**

| Sr. No | Indicative Requirement Description |
|---|---|
| HHD.FR.001 | Handheld device shall be able to receive available parking information fromcontrol centre |
| HHD.FR.002 | It shall be able to allocate parking space to local users and generate tickets |
| HHD.FR.003 | It shall be able to authenticate ticket of mobile users via QR code reading from mobile devices |
| HHD.FR.004 | It shall update central web-server with parking bay allocation information |
| HHD.FR.005 | It shall be integrated with local display unit for parking status information and boom barrier operations for which logs are to be created in Parking Management System |
| HHD.FR.006 | Similar device at the exit location should work as payment collection device or same device if enter and exit are next to each other |
| HHD.FR.007 | The calculated amount will be received from parking users through integration with payment gateways |
| HHD.FR.008 | In case of failure of network, the amount should be calculated manually and same should be updated to Smart Parking System later |

**Payment Options**

| Sr. No | Indicative Requirement Description |
|---|---|
| PAY.FR.001 | The primary mode of payment for parking will be by cash at the Pay Station |
| PAY.FR.002 | For bookings through Citizen App or Smart Web portal application, payment will be made using e-Wallet, net banking, credit card, debit card etc. with appropriateintegration with payment gateways |
| PAY.FR.003 | Additionally, the SI can implement innovative and cost effective payment methods (such as e- vouchers). |

**Parking Guidance subsystem for motorists -Informative Display Panels**

| Sr. No | Indicative Requirement Description |
|---|---|
| IDP.FR.001 | The display panels units shall indicate available spaces for each parking aisle, bay/zone/level, total parking and shall be able to be customized by software. |
| IDP.FR.002 | The display panel shall be easy to understand and must have graphical directional and zone status indication (as red crosses for zone full or green directional arrows to guide drivers to zones with available spaces). |

**Real-time Monitoring and Dynamic MIS Reporting**

| Sr. No | Indicative Requirement Description |
|---|---|
| MIS.FR.001 | The system should include central reporting system establishing the connectionbetween the devices and sensors, and the centralized Command and Control Centre. |
| MIS.FR.002 | The solution should include reporting dashboards with location specific thresholds to beset for generating customized reports |

| | |
|---|---|
| MIS.FR.003 | The solution should be capable of monitoring the number of vehicles that entered or exited the parking premises during any given time |
| MIS.FR.004 | The solution should generate reports for each parking spot, in each of the parking lots capturing utilization, cost, and revenue details, and details of assets, people and etc. |

| | |
|---|---|
| MIS.FR.005 | These reports should be available in all standard acceptable formats like .csv, .pdf, .txt,etc. |

**Network Video Recorders and accessories**

| S. No | Indicative Requirement Description |
|---|---|
| NVR.FR.001 | The system shall provide real-time over the network digital video surveillance |
| NVR.FR.002 | System shall have the functionality including recording capability for period of 15 days |
| NVR.FR.003 | The system shall allow full functionality with IP cameras from major manufacturers |
| NVR.FR.004 | The system shall support various compressions, including MPEG-4, M-JPEG and H.264,H.265 manufacturer dependent |
| NVR.FR.005 | The system shall have Graphical Map feature supports realistic camera location |
| NVR.FR.006 | Multiple channel viewing/recording system allowing networking of Network Video Recorders (NVR) |
| NVR.FR.007 | The system shall allow the Device Site List or logical camera grouping |
| NVR.FR.008 | The system shall allow Individual picture quality settings per camera |
| NVR.FR.009 | The system shall allow the remote configuration of devices across the Network |
| NVR.FR.010 | The system shall have the features LAN and WAN (Internet) connectivity |
| NVR.FR.011 | The system shall have the features of Remote alarm capability |
| NVR.FR.012 | The system shall have the authorization utility for maximum system security |
| NVR.FR.013 | The system shall create macros to view/listen and record video and audio, PTZ cameras at pre-set positions, trigger relays over the network and send email or text message on alarms or on schedule |
| NVR.FR.014 | The system shall have the features of video intelligence module provides alarms with indication on video |
| NVR.FR.015 | The system shall have the provision to record up to 50 no. of camera at a time |
| NVR.FR.016 | The system shall record and view live video at different fps without additional video streams |

**Smart Parking System – Hardware Technical Specifications**
**Entry / Exit boom Barrier Gate**

| Sr. No. | Parameter | Indicative Requirement Description | Compliance Y/N |
|---|---|---|---|
| ABB.TR.001 | General Features | High Strength, Attractive Look and Fine Finish, Integration with Parking Column shall be possible | |
| ABB.TR.002 | Opening Time(sec): | 6 Sec | |
| ABB.TR.003 | Boom Length(mm): | 3000 | |
| ABB.TR.004 | Height of Boom Form Ground (mm) | 800 | |
| ABB.TR.005 | Housing Dimension | 1050x300x260 | |
| ABB.TR.006 | Boom Dimension (mm) | 100x50 | |

| | | | |
|---|---|---|---|
| ABB.TR.007 | Controller Protecting Rating | IP 55 | |

| | | | |
|---|---|---|---|
| ABB.TR.008 | Power | 100 Watt or less | |
| ABB.TR.009 | Torque(nm) | 400 or more | |
| ABB.TR.010 | Duty Use | Intensive Use | |
| ABB.TR.011 | Operating Temp & Humidity | -20 C To + 60 C, 5-95% RH | |
| ABB.TR.012 | Life Expectancy | 10 Years | |
| ABB.TR.013 | Daily Operating Cycles (recommended) | 600 | |
| ABB.TR.014 | Standard Accessories (included) | Remote, Control Board, Instruction Manual, Manual Key, Wireless Push Button | |

**Desktop**

| Sr. No. | Parameter | Indicative Requirement Description | Compliance Y / N |
|---|---|---|---|
| DSK.TR.001 | Processor | Intel Core i5, 64bit x86 Processor @ 3.2 GHz or more,4MB L3 cache, Memory support DDR3 or better specifications | |
| DSK.TR.002 | Motherboard & Chipset | OEM Motherboard | |
| DSK.TR.003 | Video | The video management software shall be installed on each desktop to access the video feed from NVR system. | |
| DSK.TR.004 | Network | Integrated 10/100/1000 Gigabit Ethernet controller | |
| DSK.TR.005 | Ports | 1 HDMI port (Preferable), 2x USB 2.0 and 2 x USB 3.0 (Preferable), | |
| DSK.TR.006 | Ports | Minimum 4 ports USB 3.0 | |
| DSK.TR.007 | Ports | Front I/O includes (2 or more) USB 2.0 ports | |
| DSK.TR.008 | Ports | Rear I/O includes (2 or more) USB 3.0 ports, (2 or more) USB 2.0 ports, serial port, Parallel port, PS/2 mouse and | |
| DSK.TR.009 | Ports | keyboard ports, RJ-45 network interface, DisplayPort 1 VGA and 3.5mm audio in/out jacks; 4 in 1 Media Card Reader(Preferable) | |
| DSK.TR.010 | HDD Controller | Integrated dual port SATA-II controller | |
| DSK.TR.011 | Memory | 16GB DDR III 1333MHz or higher | |
| DSK.TR.012 | Storage | 1TB @ HDD 7200 RPM | |
| DSK.TR.013 | Optical Drive | 22X DVD writer or higher and the corresponding software | |
| DSK.TR.014 | Monitor | 21" TFT LCD monitor minimum 1920 x 1080 resolution with 5 ms response time or better specifications, TCO 03 or higher certified | |
| DSK.TR.015 | Keyboard | 107 or more Keys Keyboard | |

| | | | |
|---|---|---|---|
| DSK.TR.016 | Mouse | 2 / 3 button USB Optical Scroll Mousewith anti- static mouse pad resolution of Optical 1000 cpi, Complying to CE and FCC norms | |

| | | | |
|---|---|---|---|
| DSK.TR.017 | Power Management and DMI | System with Power management features& Desktop Management Interface implementation | |
| DSK.TR.018 | Operating System | Windows desktop latest version | |
| DSK.TR.019 | Power input | 100 -240V AC | |
| DSK.TR.020 | Router | 3G/4G to Wi-Fi/Ethernet Router with High Power 3G Antenna shall be provided with desktops where internet is not available | |

**Parking Column with Barcode/ QR code Ticket Reader & Writer**

| Sr. No. | Parameter | Indicative Requirement Description | Compliance Y /N |
|---|---|---|---|
| PCG.TR.001 | feature | The Column Gate shall have the following features | |
| PCG.TR.002 | | Ticket Dispenser | |
| PCG.TR.003 | | Barcode / QR Code Reader | |
| PCG.TR.004 | | Ticket Printing facility | |
| PCG.TR.005 | | Display | |
| PCG.TR.006 | Design | It shall have unique design based on Aluminum and high grade synthetics | |
| PCG.TR.007 | Functionality | It shall be modular, easy to maintain and connected to the central web application server for operations management | |
| PCG.TR.008 | Display | Bright High Resolution graphic display | |
| PCG.TR.009 | Ticket Dispenser | It shall have ticket dispenser functionality with paper roll printer | |
| PCG.TR.010 | Operating Voltage | 100-240 V ±10 % / 50-60 Hz | |
| PCG.TR.011 | Operating | 0 to +50 °C | |
| PCG.TR.012 | Humidity | Max 90% | |
| PCG.TR.013 | Protection | IP65 | |

**Data Collector Unit**

| Sr. No. | Parameter | Indicative Requirement Description | Compliance Y /N |
|---|---|---|---|
| DCU.TR.001 | Feature | Shall be a microcontroller / microprocessor based system that shall integrate with PLC of the Parking Mechanization system over wired bus protocols like Modbus, Ethernet Ip , Priebuses.to collect parking availability information. | |
| DCU.TR.002 | Design | It shall have unique design based on Aluminum and high grade synthetics | |

| | | | |
|---|---|---|---|
| DCU.TR.003 | Functionality | It shall be modular, easy to maintain andconnected to the central web application server for operations management and syncing availability updates from mechanized parking system | |
| DCU.TR.004 | Display | The DCU shall connect with parking availability displays to show the parking availability information on them. | |
| DCU.TR.005 | Operating Voltage | 100-240 V ±10 % / 50-60 Hz | |
| DCU.TR.006 | Operating | 0 to +50 °C | |
| DCU.TR.007 | Humidity | Max 90% | |
| DCU.TR.008 | Protection | IP65 | |

**Point of Sale Device**

| Sr. No. | Item | Indicative Requirement Description | Compliance Y /N |
|---|---|---|---|
| POS.TR.001 | Functions | EMV / PBOC Chip Card Reader | |
| POS.TR.002 | Functions | Triple track magnetic stripe card reader | |
| POS.TR.003 | Functions | NFC | |
| POS.TR.004 | Functions | Over-the-air firmware update | |
| POS.TR.006 | Functions | Secure PIN pad | |
| POS.TR.007 | Functions | Thermal printer | |
| POS.TR.008 | Display | Backlit dot-matrix LCD display | |
| POS.TR.009 | Buttons | Numerical buttons, ENTER, CANCEL & CLEAR buttons, power on/ setting button, Up/Feed Paper buttons, Down/ Reprint button | |
| POS.TR.010 | Communication Interface Thermal Printer | Bluetooth v4.0, USB, WIFI, GPRS | |
| POS.TR.011 | Paper Width | 58mm/2.28 inch | |
| POS.TR.012 | Paper Roll Diameter | Max 30 mm/ 1.18 inch (shall print min 60 receipts with printing length 10mm per receipt) | |
| POS.TR.013 | Resolution | 8 dots/mm, 384 dots / line | |
| POS.TR.014 | Power Battery | Lithium rechargeable battery 1400 MAH, 3.7Vor above | |
| POS.TR.015 | Charging | via micro USB or cradle | |
| POS.TR.016 | Key Management | DUKPT, MK/SK | |
| POS.TR.017 | Encryption | TDES, AES | |
| POS.TR.018 | Support operating Systems | Android 2.1 or above | |
| | | iOS 6.0 or above | |
| | | Windows Phone 8 | |
| | | MS Windows | |
| POS.TR.019 | MCU | ARM Secure MCU with M4 core, speed up to 120MHz | |
| POS.TR.020 | Memory | 1 MB Flash Memory | |
| POS.TR.021 | Operating Temperature | 0 to 60 Degree Celsius | |
| POS.TR.022 | Humidity | 5-95 % | |

| | | | |
|---|---|---|---|
| POS.TR.022 | Functionality | The system shall provide complete ticketing solution as per functional requirements of the RFB and work in synchronization with centralized parking web application | |

**Surveillance IP Camera (Full HD, Fixed Box)**

| Sl. No. | Category | Minimum Requirement Specifications | Compliance Y /N |
|---|---|---|---|
| FSC.TR.001 | General Requirements | The camera should be manufacturer's official product line designed for commercial / industrial 24x7x365 use. The camera and camera firmware should be designed and developed by same OEM | |
| FSC.TR.002 | Image Sensor with WDR | 1/3.2" with True WDR, Progressive CMOS Sensor or better | |
| FSC.TR.003 | Lens Specs | Compatible to image sensor, Focal length 8-50 mm or better, Full HD (1080P), Auto IRIS / P IRIS, Corrected IR, CS Mount with IR cut filter | |
| FSC.TR.004 | Resolution | Active Pixels 1920(w) x 1080(h) | |
| FSC.TR.005 | Minimum | Colour: 0.3 lux or better, B/W: 0.05 lux or better | |
| FSC.TR.006 | Video Encoder | H.265, Motion JPEG | |
| FSC.TR.007 | Frame Rate | min. 25 FPS or higher | |
| FSC.TR.008 | Local Storage | 32 GB SD Card or higher | |
| FSC.TR.009 | Ethernet | 10/100/ Base-T ports | |
| FSC.TR.010 | Protocols | Minimum of the following protocols to be supported RTSP, RTP/TCP, RTP/UDP, HTTP, HTTPS, DHCP | |
| FSC.TR.011 | Industry Standards | ONVIF Compliant | |
| FSC.TR.012 | Power Supply | POE IEE 802.3af compliant | |
| FSC.TR.013 | Operating Temperature | 0° C to 50° C or better | |
| FSC.TR.014 | Operating Humidity | 0% to 90% for cameras | |
| FSC.TR.015 | Enclosure / Casing | IP 66 | |
| FSC.TR.016 | Certifications | UL, CE, C83FCC, ONVIF 2.x/S | |
| FSC.TR.017 | Support | The system should not be an end of life / end of service product. | |
| FSC.TR.018 | Streaming | The camera shall be able to setup and stream out minimum two (2) stream profiles. Each stream profile can have its own compression, resolution, frame rate and quality independently. | |
| FSC.TR.019 | White Balance | Auto / Manual | |
| FSC.TR.020 | Back Light Compensation | Auto | |
| FSC.TR.021 | Security | Security Password protection | |
| FSC.TR.022 | Security | Vandal and impact resistant housing, IK 10,IP66, NEMA 4X | |
| FSC.TR.023 | Security | Detection of camera tampering and Detection of Motion should be possible using either camera or VMS | |
| FSC.TR.024 | Functional | Self-cleaning / anti-dust / hydro-phobic coating features | |

| | | | |
|---|---|---|---|
| FSC.TR.025 | Mounting Accessories | For pole and surface mount with L/C Brackets | |
| FSC.TR.026 | IR Illuminator | External / build-in IR Illuminator with minimum 50 mtr. In case of external, "IR Illuminator" section to be referred | |

**Parking Availability LED Display**

| Sr. No. | Item | Indicative Requirement Description | Compliance Y / N |
|---|---|---|---|
| LED.4Line.TR.001 | Size | LED Display - Minimum 600x1000 mm to show complete parking availability information | |
| LED.4Line.TR.002 | Pitch | 13 mm (H) * 13 mm (V) | |
| LED.4Line.TR.003 | Colour | Amber colored LED - Day Light Readable | |
| LED.Line.TR.004 | Minimum & maximum viewing distance and angle of | Viewing distance 20-100 meters<br>Angle of viewing - Minimum 60°V – 110°H | |
| LED.4Line.TR.005 | Vibration standard AIS 12/AIS:062 - 10g | 2g | |
| LED.4Line.TR.006 | Storage capacity insidethe Display | Shall be able to store parking availability information | |
| LED.4Line.TR.007 | Communication protocol | GPRS, RF, RS485 etc. as per site requirement | |
| LED.4Line.TR.008 | Controller and antenna | Inbuilt | |
| LED.4Line.TR.009 | Environmental specifications | (a) Temperature: 0 to +55 deg C<br>(b) Thermal cycling: 5 Deg C/mt<br>(c) Humidity: 5% to 95% RH<br>(d) Sealing: IP 65 (Front), IP 54 (Rear) | |
| LED.4Line.TR.010 | Minimum life | 50,000 Hrs | |
| LED.4Line.TR.011 | Data format | Bitmap or Unicode | |
| LED.4Line.TR.012 | Power supply | 90 V to 250 V AC; 50 VA | |
| LED.4Line.TR.013 | Update of Information | Real time (configurable refresh rate) | |
| LED.4Line.TR.014 | Display Format | Multimedia content, text in Hindi, English and Punjabi/ with presentation in tables, fixed and scrolling text | |
| LED.4Line.TR.015 | Structure | Light weight structure with toughened glass fixed with UV resistant adhesive in front | |
| LED.4Line.TR.016 | Compliance | IS /IEC 60947-1:2004 in conjunction withIS/IEC 60529:2001 | |

**SPECIFICATIONS FOR OPERATION AND MAINTENANCE**

## 1. Maintenance

Three types of Maintenance to be carried out by the Contractor

i. Preventive maintenance, where equipment is maintained before break down occurs. The contractor should make every effort to maintain the equipment before break down occurs. For this purpose, the Contractor should ensure the operation of all the stand by equipment in rotation.
ii. Operational maintenance, where equipment is maintained while being used.
iii. Corrective maintenance, where equipment is maintained after break down. This maintenance willof course be an integral part of the contract and in case of break down, the contractor must see to it that the said component is Operational within maximum 6 hours from the time of its occurrence.

The Contractor must take care of Maintenance, Repair, and Operations/ Overhaul - (MRO) asexplained below:

a. MRO involves fixing any sort of mechanical, plumbing or electricaldevice should it become out of order or broken (known as repair, unscheduled, or casualty maintenance).
b. It also includes performing routine actions which keep the device in working order (known as scheduled maintenance) or prevents trouble from arising (preventive maintenance).
c. MRO may be defined as, "All actions which have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions."

## 2. Operation

a. In case, the motor or any other equipment is burnt or damaged due tonegligence of the contractor or due to faulty Operation it shall be sole responsibility of the Contractor to rewind/replace/repairit as per standards of the equipment free of cost within 72 hours.
b. In case of any fault in Operation and performance of the Facility, contractor or his staff at duty will immediately report to the BUIDCO/MCF about it.
c. The Contractor shall run the entire car parking systems after ensuring proper voltage. He shall also record all the power failures and voltage in daily log sheet. He will bring into notice of power supply agency as well as control room and Departmental Engineer about the break down/power failure. He will also get the electricity restored simultaneously and will use DG sets immediately to reduce parking / retrieval time.

## 3. Specifications for Operation and Maintenance Manual

a. The contractor shall provide three copies of revised O&M Manual, if any, to the Engineer / Employer / BUIDCO/MCF in soft as well as hard copies, at the time of the commissioning of the project.
b. The O&M Manual shall include in elaborate detail, all Operating and maintenance proceduresand policies which are required, advisable and / or necessary for the Facility to achieve full compliance with the Operational guarantees and to achieve maintenance and repair standard for the Facility which will ensure compliance with the maintenance specifications.
c. Without limiting the generality of the foregoing, the O&M Manual shall include descriptions, procedures, and shall comply with the requirements, set forth in the provisions of the Bid Documents.
d. The draft of the O&M Manual shall be subject to the review and approval of employer, which shall have the right to make any changes and revisions to the O&M Manual as it may deem appropriate. The Contractor shall revise such draft O&M Manual prior to the commencement of the O&M period.
e. The contractor shall annually fully review, revise, update and modify the draft O&M Manual as may be necessary or appropriate.
f. During the term of this Agreement, the contractor shall promptly notify employer of any revisions, additions or modifications which he, in his professional opinion, believes should be made to the O&M Manual, whether as a result of additional experience in Operating and maintaining the Facility,changes or modifications to any equipment, part, component or structure incorporated in the Facility.
g. The Maintenance and Operation Manual shall have a write up on the procedure to be followed in case of fire.
h. There has to be a description of the system used for firefighting and scheduleof maintenance and refilling if any.

i. The location of the detectors and nozzles for distribution / spraying of the fire-fighting mediashall be depicted on a proper drawing.

j. The Operation portion of the Manual will at least contain the following information:

- Block diagrams for the safety interlock
- Block diagrams for the software
- Clear description for the Macros

k. The Maintenance portion of the Manual will contain at least the following information:

- Schedule of lubrication with type of lubricants to be used
- Schedule of topping and oil changes for the gear boxes with type of oil
- Schedule of bearings replacements
- Schedule of replacement of the electrical contacts.
- General Arrangement drawing
- Drawing showing point of Lubrication for grease and oil for centralized lubrication
- Manufacturing drawing with material forthe maintenance items Block diagram for the

electrical circuit

Circuit diagram for the electrical circuit with identification of control gearsand wire end ferrulenumbering

Block diagram for the PLC with identification.

## 4. Training

The Contractor shall plan and develop the course content, and implement on-the- job and classroom- based training, for BUIDCO/MCF deputed staff of at least 15 personnel in 3 batches of 5 personnel each, during last 6 months of the Operation & Maintenance period. The Contractor shall organize training for identified managers from amongst the BUIDCO/MCF deputed staff in technical aspects of semi- automatic car parking systems to enable BUIDCO/MCF to build sufficient capacity and skills to manage the said car parking systems at a later date if required.

This training would include training in overhauling and replacement of various components of Automatic Car Parking Systems, Electrical Systems, Fire Prevention Systems, Fire Fighting Systems, and expertise in Maintenance of the entire Office block.

The contractor shall provide on job training to the staff of BUIDCO/MCF so that aftercompletion of O&M period, BUIDCO/MCF employees can easily maintain and Operate the systems on their own.

**Drawings**

The drawings provided, hereunder, are indicative only. However, since this is a design-build-Operate contract, the contractor has to develop his own drawings andsubmit the same for approval before execution.

**LIST OF DRAWINGS**

| **Sl. No.** | **Description** | **Drawing Number** | **No. of Sheets** |
|---|---|---|---|
| 1. | Site plan with existing establishment for proposed Automated Multi level Car Parking near Sabzi Mandi | AS PER RFP | |

## Annexure – G

## Schedule of Stage of payments for the Project

The General Manger of BUIDCO shall have full powers to fix interim rates within the components. In case of any deviation/alternations/modifications of methodology leading to change in components or its quantity or incorporation of new items of work, the Chief Executive Officer shall have full powers to revise the breakup components keeping the contract price same as quoted by the bidder.

a. Upon receiving a report from the Engineer in Charge certifying the achievement of the below mentioned Payment Milestones.

b. The payment shall be payable as per the Payment Milestone given below during Construction Period shall be as under:

**PART "A" DESIGN, BUILD, OPERATE AND MAINTAIN FOR 5 YEARS INCLUDING 1 YEAR DLP MECHANIZED AUTOMATIC CAR PARKING FACILITY FOR MINIMUM 150 CARS IN MAURYA LOK COMPLEX ON EPC MODE UNDER PATNA SMART CITY MISSION**

| Sl No. | Stages of Work | Percentage of "bidamount" |
|---|---|---|
| 1. | On approval of Final design (Architectural/structural Designs, Estimates,Tech Spec) | 5% |
| 2. | On Completion of Civil Foundation works. | 10% |
| 3. | On supply of steel structure up to 6 Level on prorate basis module wise. | 20% |
| 4. | On completion of erection of steel structure upto 6 level module wise on prorate basis | 10% |
| 4. | On supply & erection of drive assembly and pallets | 15% |
| 5. | on Completion of MEP works, fire- fighting, Firefighting system including OH tank, Cladding, ex1emal development, etc. | 20% |
| 6. | On completion of Testing, commissioning, clearing snags, HandingOver and training. | 10% |
| 7. | During O&M period of 5 years on prorate basis module wise. | 10% |

Provided that in case of Change of Scope, the Physical Progress shall be recalculated to account for the changed scope.

d. In case, there is a delay in achieving the Milestone, the payment shall be made on prorata basis of the particular milestone.

**PART "B" OPERATION AND MAINTENANCE OF COMPLETE MLCP (PART "A" AND "B") FOR A PERIOD OF 60 MONTHS**

Operation and Maintenance of Automated MLCP with all mechanical, electrical ICT Works under Part A" of Bid document and all project related construction complete with all required consumables, tools and plants but excluding the power charges. The operation and maintenance has strictly to be done as per O & M specifications and related manuals. During the O&M period the bidder will collect user charges from advertising and parking fees from the users.

## Annexure-1
## List of Approved Make

| S.no | Details of Materials / Equipment Approved | Make |
|---|---|---|
| 1 | Steel Structure, | Jindal/Sail/TATA/ Essar/Balaji/ Prime Steel/ Pushpak steel/or Equivalent |
| 2 | GI Sheets, | JSW/Essar/Posco/Uttam/AMNS/or Equivalent |
| 3 | Brake Geared Motors | ABB/CGL/LHP / HINDUSTAN / REMI M/ Samyang/ I- Bore/ or Equivalent |
| 4 | Roller Chain, | Ti Diamond/Reynolds/Equivalent - India, |
| 5 | Wire Ropes | Usha Martin / Tyler/or Equivalent |
| 6 | Sensor, | Omron/Autonics/Honeywell/E&H/Yokogawa/Forbes Marshall/or Equivalent |
| 7 | Wires and Cables - Harness, | Universal/Havells/RRKABEL/ Polycab/or Equivalent |
| 8 | ACB/MCCB/RCCB | ABB/L&T/Schinder//Siemens/HPL/or Equivalent |
| 9 | Anchors & Hardwares | Arrow/SYNNEX/Tech Data/Avnet/Ingram Micro/or Equivalent |
| 10 | Sprinkler Flexible Hose | Tyco / Easyflex / or Equivalent |
| 11 | Pressure Gauge | Emerald/ Fiebig/ H Guru/or Equivalent |
| 12 | Paints | Asian Paints/ Berger / Nerolac/or Equivalent |
| 13 | G.I./M.S. Pipes (IS:1239 / IS:3589) | Jindal/ Tata / SAIL / RINL/or Equivalent |
| 14 | Standard M.S. Fittings | Zenith/ Seamless Fittings/ Pipeline Products / or Equivalent |
| 15 | Grooved Fitting & Coupling (UL Listed) | Jainsons /Shurjoint /Tyco Victaulic/or Equivalent |
| 16 | DI/CI/Forged Steel Fittings | Bharat Forge /Jainsons Industries/ VS /Kejriwal Casting/or Equivalent |
| 17 | C.I. (Class L.A.) Pipes | Electro Steel / IISCO / NECO / Kapilansh/or Equivalent |
| 19 | CI/DI MH Cover & Frame | Crescent Foundry / NECO / Raj Iron Foundry/or Equivalent |
| 20 | FRP/GRP Manhole Covers | Everlast / Thermoset/or Equivalent |
| 21 | Fire Hose | Eversafe / Safeguard / Newage / Kalpex/or Equivalent |
| 22 | Cement | Ambuja/Ultratech/ACC/JK/or Equivalent |
| 23 | Reinforcement steel | Jindal/Sail/TATA/ Balaji/ Prime Steel/RINL /Pushpak steel/or Equivalent |
| 24 | Photo Luminous Signages | Autolite / Legrand / 3M/or Equivalent |
| 25 | Pump | Kirloskar/ Grundfos/Flowmore/or Equivalent |
| 26 | Lights | Philips/bajaj/havells/HPL/or Equivalent |
| 27 | Fire Extinguishers | Ceasefire/ NewAge Fire / Safex / Reliance / UTC/or Equivalent |
| 28 | Gun Metal Branch Pipe | Eversafe/ NewAge /Safeguard/ Safex /Minimax/or Equivalent |
| 29 | Non Return Valve / Check Valve | Wafer Type / Kirloskar / Leader / Zoloto / IVC / AVK/or Equivalent |

| | | |
|---|---|---|
| 30 | Fastener | Fisher/ Hilti/or Equivalent |
| 31 | Welding Rod | Advani/ Ador / Mangalam/or Equivalent |
| 32 | MCCB | ABB / Siemens / Legrand / L & T / Schnider / HPL/or Equivalent |
| 33 | Connectors | Elmex / Raychem / Connect well/or Equivalent |
| 34 | MCB (7 kA breaking capacity) | ABB / Siemens / Legrand / L & T / Schnider / HPL/or Equivalent |
| 35 | FRLS LT Wires | RR Kabel/Polycab / Havells / KEI / Universal/or Equivalent |
| 36 | Timers | Siemens / Havells / Legrand/or Equivalent |
| 37 | Switches & accessories | Legrand / Havells / HPL / Anchor/or Equivalent |
| 38 | PVC Conduit | Precision / BEC / AKG / Astral / Ashirwad / LM Industries/or Equivalent |
| 39 | PLC | Honeywell/Mitsubishi/Phoenix/Fuji/ABB/Omron/or Equivalent |
| 40 | Motor Starters / Contactors | ABB / Siemens / L&T / Alstom / Schnider / Havells / CGL/or Equivalent |
| 41 | LED Light Fittings & Lamps | Wipro/Philps/Syska / Havells / Bajaj / Halonix/or Equivalent |
| 42 | AL. AR. LT XLPE FRLS Cable | RR Kabel/Polycab / Havells / KEI / Universal / RR Kable/or Equivalent |
| 43 | Distribution Boxes & accessories | Siemens / Legrand / Hagger/or Equivalent |
| 44 | Air Circuit Braker | ABB / Siemens / Legrand / L & T / Schnider / HPL/or Equivalent |
| 45 | Panel Meter | Automatic Electric Ltd / Secure / HPL/or Equivalent |
| 46 | HRC Fuse & base | Siemens / C&S / ABB / HPL/or Equivalent |
| 47 | Gland | Raychem / 3M / Dowells/or Equivalent |
| 48 | Lugs | Dowells / RayChem/or Equivalent |
| 49 | Chemical Earthing | DHBVN approved make/or Equivalent |
| 50 | Stainless Steel | Jindal/Sail/TATA/ Balaji/RINL/ Prime Steel/ Pushpak steel/or Equivalent |
| 51 | Ceramic Tiles/vitrified Tile | Nitco /Kajaria /Somany/or Equivalent |
| 52 | Telephone Black Granite | As approved by Architect |
| 53 | ABD Paint / Texture Paint / Enamel Paint | Asian Paints / Nerolac / ICI / Burger/or Equivalent |
| 54 | Aluminium Sections For Doors, Windows & Wall | Indal/Jindal/ Hindalco/ Geeta/ Bengal/ Rolling/or Equivalent |
| 55 | Anodized aluminium fittings for doors/windows | Crown/ALANS/Classic/Bharat/ Argent/or Equivalent |
| 56 | Laminate | Formica/Greenlam/Merinolam/or Equivalent |
| 57 | Flush Doors | Duraboard /Kit ply/or Equivalent |
| 58 | Diesel Engine (D.G. set) | Sudhir/ Cummins/ Kirloskar/ Jackson/or Equivalent |

**Note: -**

1. Pre-dispatched inspection shall be carried out by BUIDCO/Third Party along with PMC.
2. In case of deviation in make and model, prior approval of BUIDCO shall have to be obtained.
3. Any item not included in the Indicative List, the agency shall get it approved from BUIDCO.